14.2 Initial Plant Test Program

14.2.1 Summary of Test Program and Objectives

14.2.1.1 Summary of the Startup Test Program

The startup test program includes testing activities that commence with the completion of construction and installation and end with the completion of the power ascension testing. Testing is performed on SSC that:

- Are used for safe shutdown and cooldown of the reactor under normal plant conditions and for maintaining the reactor in a safe condition for an extended shutdown period.
- Are used for the safe shutdown and cooldown of the reactor under infrequent or moderately frequent transient events, postulated accident conditions, and for maintaining the reactor in a safe condition for an extended shutdown period following such conditions.
- Are used for establishing conformance with safety limits or limiting conditions for operation that shall be included in the Technical Specifications.
- Are classified as engineered safety features (ESF) or used to support or establish that the operations of ESF are within design limits.
- Are assumed to function or that are credited in the accident analysis as described throughout this FSAR.
- Are used to process, store, control, measure, or limit the release of radioactive materials.
- Are used in the special low-power testing program that is conducted at power levels no greater than five percent to provide meaningful technical information in addition to that obtained in the normal startup test program required for the resolution of Three Mile Island (TMI) action plan item 1.G.1.
- Are identified as a significant risk in the facility based on a specific probabilistic risk assessment.
- Are used to mitigate severe accidents that are beyond the U.S. EPR design basis.

This test program demonstrates that SSC operate and comply with design requirements and meet the requirements of 10 CFR 50, Appendix B, Criterion XI. The startup test program results confirm that performance levels meet the functional safety requirements and verify the adequacy of SSC design and the functionality of systems over their operating ranges. The testing of SSC should include, to the extent practical, simulation of the effects of control system and equipment failures or malfunctions that could reasonably be expected to occur during the plant's lifetime. It also helps to establish baseline performance data and serves to verify that normal operating and

emergency procedures achieve their intended purposes. The data collected during the performance of testing shall be categorized as acceptance criteria or baseline data. Acceptance criteria data has clearly defined criteria (minimum or maximum allowable values) that are used to determine if the system or component is capable of meeting the design basis assumptions in the accident analyses. Baseline data is not used to determine if a component or system can meet a design basis assumption. Baseline data is collected for trending purposes and does not have established acceptance criteria, it shall be clearly denoted that the data is recorded for baseline purposes.

The startup test program begins at the end of construction activities and consists of the following phases:

- Phase I - preoperational testing program.
- Phase II - initial fuel loading and precritical testing.
- Phase III - initial criticality and low power physics testing.
- Phase IV - power ascension testing.

14.2.1.1.1 Construction Activities

Construction activities consist of tests and inspections required to confirm that construction is complete and that systems are ready for preoperational testing.

Construction activities that verify the construction quality associated with SSC are satisfactorily completed prior to turning control and responsibility over to the startup organization. Construction activities consist of functional tests and inspections which include, but are not limited to:

- Weld inspections and other types of material examinations.
- Hanger and pipe support inspections.
- Flushing and hydro lazing, excluding flushes that require operation of permanent plant equipment.
- Cleaning interior and exterior surfaces of piping and other components.
- Circuit integrity and separation checks, excluding tests that require permanent plant circuits to be energized.
- Hydrostatic pressure tests.
- Instrument calibrations, excluding portions of calibration procedures that require permanent plant circuits to be energized or plant computer conversions from field units to engineering units. Construction personnel can use temporary power sources to verify that instruments respond to calibrated input sources.

Specific construction test requirements shall be established in accordance with the site administrative procedures.

14.2.1.1.2 Phase I - Preoperational Testing

Upon the completion of construction and installation testing, preoperational tests are performed to demonstrate that SSC operate in accordance with design bases. Simulated signals or inputs are often used to demonstrate the full range of the system operation when it would be undesirable to create real system conditions. The general objectives of the preoperational test phase are:

- To demonstrate that appropriate acceptance criteria are met for SSC for safety-related SSC, including alarms and indications.
- To test all ASME Section III (Reference 1), Class 1, 2 and 3 piping systems as described in Section 3.9.2.1.
- To test high-energy piping systems inside Seismic Category I structures, or those whose failure would reduce the safety level of a Seismic Category I SSC, as described in Section 3.9.2.1.
- To provide documentation of the performance and safety of equipment and systems in all operating modes, including degraded modes (e.g., stuck open miniflow valves, open cross connects) for which the systems are designed to remain operational.
- To demonstrate equipment performance throughout the full design operating range.
- To test, as appropriate, manual operation, operation of systems and their components, automatic operation, operation in alternate or secondary modes of control, and operation and verification tests to demonstrate expected operation following a loss of power sources.
- To test the proper functioning of instrumentation and controls, permissive and prohibit interlocks, and equipment protective devices, for which malfunction or premature actuation may shut down or defeat the operation of systems or equipment.
- To provide baseline test and operating data of equipment and subsystems for future reference.
- To operate equipment for a sufficient period to demonstrate performance so that design, manufacturing, or installation defects can be detected and corrected.
- To provide the permanent plant operating staff with the maximum opportunity to obtain practical experience in the operation and maintenance of equipment and systems and their associated procedures. Maintenance activities should include,

but not be limited to, instrument calibrations, powered valve functional tests, and lubrication programs.

- To perform dynamic valve testing under maximum design differential pressure, if practical.

Phase I testing ends with hot functional testing (HFT) which is the initial opportunity to perform integrated tests at hot zero power (HZP) pressure and temperature conditions. The general objectives for HFT are:

- To make certain that plant systems operate together on an integrated basis to the extent possible prior to fuel load.
- To incorporate surveillance, normal, and emergency operating procedures into test program procedures to the extent practical. These procedures are verified to the extent practical and revised, if necessary, prior to fuel loading.
- To demonstrate that systems and safety equipment are operational and that it is possible to proceed to fuel loading and to the startup phase.
- The HFT preoperational tests shall clearly distinguish between the data that is used to verify that a design basis performance requirement is met and the test data is taken to record baseline information. The procedure shall clearly verify that data has clearly defined acceptance criteria, minimum acceptable value, and provide a method to document exceptions to the minimum acceptable value.

Abstracts for the preoperational tests are provided in Section 14.2.12.

14.2.1.1.3 Phase II - Initial Fuel Loading and Precritical Testing

Initial fuel loading starts after completion of the preoperational testing. This phase of the initial test program provides a systematic process to safely accomplish and verify the initial fuel loadings. Fuel loading is detailed in Section 14.2.10.1.

Following the completion of initial fuel loading operations and prior to initial criticality, tests are performed to provide additional confirmation that plant systems necessary for normal plant operation function as expected and to obtain performance data on core-related systems and components. As often as is practical, normal plant operating procedures are used to bring the plant from cold shutdown conditions through hot shutdown conditions. Testing normally proceeds directly to initial criticality testing and the beginning of low power physics testing. Abstracts of tests conducted during this phase are provided in Section 14.2.12.

14.2.1.1.4 Phase III - Initial Criticality and Low Power Physics Testing

The initial criticality phase of the startup test program confirms that criticality is achieved in a safe and controlled manner:

- Neutron flux levels are continuously monitored and periodically evaluated. A neutron count rate at least ½ count per second is registered on the startup channels before startup begins, and the signal-to-noise ratio is greater than two.

- Systems required for startup or protection of the plant, including the reactor protection system and emergency shutdown system, are operable and in a state of readiness.

- The control rod or poison removal sequence is accomplished using detailed procedures approved by personnel or groups designated by the COL applicant.

- The reactor achieves initial criticality by boron dilution and control rods are withdrawn before dilution begins.

- The control rod insertion limits defined in the Technical Specifications are observed and complied with.

- The reactivity addition sequence is prescribed, and the procedure will require a cautious approach in achieving criticality to prevent passing through criticality in a period shorter than approximately 30 seconds (<1 decade per minute).

A description of the procedures followed during the approach to initial criticality is included in Section 14.2.10.2. Following initial criticality, a series of low-power physics tests are performed to verify selected core design parameters. These tests serve to substantiate the following:

- Confirm the design and, to the extent practical, validate the analytical models.

- Verify the correctness or conservatism of assumptions used in the safety analyses and Technical Specifications.

- Confirm the operability of plant systems and design features that could not be completely tested during the preoperational test phase because of the lack of an adequate heat source for the reactor coolant and main steam systems.

- Demonstrate that core characteristics are within the expected limits.

- Provide data for benchmarking the design methodology used for predicting core characteristics later in life.

The initial criticality and low-power physics tests (LPPT) as a minimum consist of the following:

1. Withdrawal of the shutdown bank RCCAs.

2. Withdrawal of the control bank RCCAs in sequence and overlap until the final control bank is inserted approximately 50 to 100 pcm.

3. Reduction of the reactor coolant boron concentration (dilution) in a gradual manner until the reactor is just critical or with source range counts increasing gradually.

4. Increasing source range counts slowly to the point of adding heat (POAH) and then reducing the intermediate range indication by one-half to one decade.

5. Determination of adequate overlap of source and intermediate-range neutron instrumentation, and verification that proper operation of associated protective functions and alarms provide plant protection in the low-power range.

6. Verification that the Technical Specification SR 3.1.2.1 requirement of 1000 pcm is met. At this point the Test Coordinator should verify that initial criticality activities have been completed and transition to those activities supporting low power physics testing.

7. Establish the LPPT band and reduce flux until the reactor is approximately at the lower end of the flux band if the isothermal temperature coefficient is expected to be positive and at the upper end of the band if the isothermal temperature coefficient is expected to be negative.

8. Measurement of the all rods out boron concentration (boron endpoint) to verify calculational models and accident analysis assumptions.

9. Measurement of the isothermal coefficient which infers the boron and moderator temperature reactivity coefficients over the temperature and boron concentration ranges in which the reactor may initially be taken critical.

10. Perform a pseudo-rod-ejection test to verify calculational models and accident analysis assumptions.

11. Measurements of control rod and control rod bank reactivity worths to (1) confirm that they are in accordance with design predictions and (2) confirm by analysis that the rod insertion limits will be adequate to confirm a shutdown margin consistent with accident analysis assumptions throughout core life, with the greatest worth control rod stuck out of the core.

Abstracts of tests performed during this phase are provided in Section 14.2.12.

14.2.1.1.5 Phase IV - Power Ascension Testing

A series of power ascension tests is conducted to bring the reactor to full power. Testing is performed at various power levels and is intended to demonstrate that the facility operates in accordance with its design bases during steady state conditions and, to the extent practicable, during anticipated transients. To validate the analytical models used to predict plant responses to anticipated transients and postulated accidents, these tests should establish that measured responses are in accordance with predicted responses. The predicted responses should be developed using real or expected values of such attributes as beginning-of-life core reactivity coefficients, flow

rates, pressures, temperatures, pump coastdown characteristics, and response times of equipment, as well as the actual status of the plant (not those values or plant conditions assumed for conservative evaluations of postulated accidents).

Tests and acceptance criteria should also be prescribed to demonstrate the ability of major or principal plant control systems to automatically control process variables within design limits. Such tests are expected to provide assurance that the facility's integrated dynamic response is in accordance with design for plant events such as reactor trip, turbine trip, reactor coolant pump trip, and loss of feedwater heaters or feedwater pumps. Testing should be sufficiently comprehensive to establish that the facility can operate in all operating modes for which it has been designed; however, tests should not be conducted, or operating modes or plant configurations established, if they have not been analyzed or if they fall outside the range of assumptions used in analyzing postulated accidents described in the U.S. EPR FSAR.

Appropriate consideration should be given to testing at the extremes of possible operating modes for facility systems. Testing under simulated conditions of maximum and minimum equipment availability within systems should be accomplished if the facility is intended to be operated in these modes (e.g., testing with different reactor coolant pump configurations, single-loop reactor coolant system operation, operation with the minimum allowable number of pumps, heat exchangers, or control valves in the feedwater, condensate, circulating, and other cooling water systems).

The following items illustrate some of the types of performance demonstrations, measurements, and tests that are included in the power ascension test phase.

1. Determine steady state core performance and power coefficients are within design limits (Test Numbers 190, 191, 192, 206, and 207).

2. Check rod drop times against plant data (Test Number 222).

3. Demonstrate capability and sensitivity to detect a control rod misalignment equal to or less than the Technical Specification limits (Test Number 213).

4. Verify that plant performance is as expected for runback and following a partial trip (Test Number 221).

5. Verify the capability of plant monitoring systems (Test Numbers 193, 197, 204, and 205).

6. Demonstrate the adequacy of design by comparing design values to performance data (Test Numbers 194, 199, 203, 210, 212, 215, and 216).

7. Demonstrate the ability of the plant to withstand transient conditions (Test Numbers 196, 198, 200, 211, 214, 217, 219, and 220).

Abstracts of tests performed during power ascension are provided in Section 14.2.12.

A pseudo-rod-ejection test will be performed during initial criticality and LPPT and not during power ascension. AREVA has reviewed previous pseudo-rod-ejection tests performed during power ascension and the three-dimensional nodal models used for currently operating plants and the U.S. EPR. AREVA has determined that the data generated by this type of test would not be beneficial for modeling a rod ejection event.

14.2.2 Organization and Staffing

It is the responsibility of the COL applicant to organize and staff phases of the test program. A COL applicant that references the U.S. EPR certified design will provide site-specific information that describes the organizational units that manage, supervise, or execute any phase of the test program. This description should address the organizational authorities and responsibilities, the degree of participation of each identified organizational unit, and the principal participants. The COL applicant should also describe how, and to what extent, the plant's operating and technical staff participates in each major test phase. This description should include information pertaining to the experience and qualification of supervisory personnel and other principal participants who are responsible for managing, developing, or conducting each test phase. In addition, the COL applicant is responsible for developing a training program for each fundamental group in the organization.

14.2.3 Test Procedures

Detailed procedure guidelines and procedures provided by the appropriate design organization are utilized to develop various system test procedures. Thus, test procedures are based on the requirements of system designers and the applicable RGs.

Each test procedure is prepared using pertinent reference material provided by the appropriate design and vendor organizations, the FSAR, the Technical Specifications and the applicable RGs. A test procedure is prepared for each specific system test to be performed during the test program. Each system test procedure contains, at a minimum, the following major topic areas:

- Test objectives.
- Acceptance criteria.
- References.
- Prerequisites.
- System initial conditions.
- Environmental conditions.

- Special precautions.
- Detailed procedure (including data collection).
- Restoration.
- Documentation of test results.

Acceptance criteria will be based on generic and site-specific safety analyses. Once a safety analysis value has been identified it is necessary to decide the direction to conservatively bias the value for each test. Note that it is not uncommon to bias the safety analysis value one direction for one test and in the opposite direction for another test. The appropriate amount of bias to apply to the safety analysis value is the sum of several parameters. Some of the parameters that should be considered are as follows:

- Instrument uncertainty, including all components from the sensor to the indicator.
- Uncertainty due to sensing line. Is the fluid in the sensing line the same as the process fluid? If the effect is conservative it may be ignored but if it is non-conservative it should be considered.
- Static head correction from the point of interest. For example, from the reactor vessel flange to the instrument location. If this correction is conservative it may be ignored but if it is non-conservative is should be considered.
- Dynamic head correction. If this correction is conservative it may be ignored but if it is non-conservative is should be considered.
- Readability, round off error and instrument indicator should be considered if this correction is conservative it may be ignored but if it is non-conservative is should be considered.
- Engineering design margin is a term that is usually applied to a conservative bias applied to the acceptance criteria to account for component wear and other degradation factors.
- Atmospheric corrections is a term that is used to describe the conservative bias that is applied to the safety analysis values to account for the atmospheric condition differences between the conditions assumed in the accident analysis and present in the field during the test (fluid density, temperature, atmospheric pressure, etc.).

The explicit, measurable criteria that must be verified by testing will be entered into a database that contains the following:

- Clear description of the value, for example, maximum medium head safety injection flow into a depressurized reactor coolant system.

- Safety analysis value that must be assured.
- Instrument uncertainty.
- Process correction term (the safety analysis may have been performed at a different temperature than can be achieved during preoperational testing).
- The margin allowance between the preoperational test acceptance value and the in-service test allowable degradation limit.
- The site-specific test procedure number.
- The test abstract number.

Preoperational tests verify each alarm, permissive, interlock, automatic system response, etc. for the associated system unless specifically exempted from verification by the test review team. The preoperational test verification of an alarm, permissive, interlock, automatic system response, etc. is not a calibration and may not verify the actual setpoint value due to different fluid densities or other test conditions. If the observed value during the preoperational test is significantly different, then this should be recorded as a test deficiency and corrected prior to test review team review. The following items should be used when deciding the verification method to be used:

- Preference 1, system operation - It is recommended to operate the system in a manner to verify an alarm if it will not significantly increase the probability of equipment damage or personnel injury. An example is - CVCS letdown flow alarm is designed to prevent damage to the resin bed. This alarm could be verified prior to loading the CVCS resin.
- Preference 2, field test input - In this case the field lead to the sensor is temporally lifted by a qualified technician and a test signal is transmitted to the computer to generate the alarm, permissive, etc.

When performing a preoperational test it is common to have upstream or downstream systems that are not functional at the time that a test is performed. The preoperational test will document when upstream or downstream systems are not functional. An example of acceptable preoperational test with a non-functioning support follows:

- Normal operation of the LHSI pump requires CCW cooling of the pump seal but the pump vendor has authorized operation of the LHSI pump at temperatures ≤ 180°F. A preoperational test to verify shutoff head and verify the pump curve with a non-functional CCW cooling of the pump seal using 68°F IRWST water would be acceptable, pending review by the test review team.

In general, pump shutoff head values are obtained by verifying two or more developed head versus flow points on the vendor supplied pump curve and extrapolating the shutoff head. One of the points should be just greater than the recommended

minimum flow point. The Startup Manager shall approve the collection of any actual shutoff head test point.

Test procedures are reviewed as specified by the site-specific administrative control procedures. The originating organization incorporates any required changes into each test procedure at the completion of these reviews. Special test procedures may become necessary for investigative purposes during the Phase I through Phase IV test program. The preparation, review, and approval of these special procedures are governed by site-specific administrative control procedures. Special test procedures that deal with nuclear safety are processed under the same controls as normal startup test procedures. A COL applicant that references the U.S. EPR design certification will provide site-specific information for review and approval of test procedures.

Submittal of applicable procedures and guidelines to the NRC staff for review shall be conducted as described in Section 14.2.11.

14.2.4 Conduct of Test Program

A COL applicant that references the U.S. EPR design certification will plan, and subsequently conduct, the plant startup test program. The initial test program is conducted by the startup test group and is controlled by administrative procedures and requirements. The administrative procedures that govern the test program receive the same level of approval as other administrative procedures. The administrative procedures:

- Define format and content of startup test procedures.
- Define review and approval process for both initial issue and subsequent revisions of test procedures.
- Define review and approval process for test results as well as for the failure to meet acceptance criteria or other operational problems or design deficiencies.
- Describe the phases of the initial test program and establishes the requirements for progressing from one phase to the next, as well as identifies the requirements for moving beyond selected hold points or milestones within a given phase.
- Describe the controls used to verify that the as-tested status of each system is known and that modifications including retest requirements deemed necessary for systems undergoing or already having completed testing are tracked.
- List the qualifications and responsibilities of the positions within the startup test group.

The startup administrative procedures are intended to supplement normal plant administrative procedures by addressing issues that are specific to the startup test program.

14.2.5 Review, Evaluation, and Approval of Test Results

A COL applicant that references the U.S. EPR design certification will address the site-specific administration procedures for review and approval of test results. Completed procedures and test reports included in the ITAAC shall be routed to the NRC Resident for Commission review. Final review and approval, including ITAAC reviews of overall test phase results for selected milestones or hold-points within test phases shall be completed before beginning the next phase of startup testing.

14.2.6 Test Records

According to applicable regulatory requirements, initial test program results are compiled and maintained in compliance with administrative procedures. Retention periods for test records are based on considerations of their usefulness in documenting plant performance characteristics, and are retained in accordance with RG 1.28, Quality Assurance Program Requirements – Design and Construction, as described in Chapter 17. Startup test reports will be prepared in accordance with RG 1.16, Reporting of Operating Information – Appendix A Technical Specifications.

14.2.7 Conformance of Test Programs with Regulatory Guides

The primary regulatory guide for the startup test program is RG 1.68, Initial Test Program for Water Cooled Nuclear Power Plants, Revision 3, March 2007. The startup test program will conform to the relevant testing guidance in applicable regulatory guides. The RGs which provide specific guidance related to testing and testing programs are:

- RG 1.9 - Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants, Revision 4, March 2007.
- RG 1.20 - Comprehensive Vibration Assessment Program for Reactor Internals During Preoperation and Initial Startup Testing, Revision 3, March 2007. Exceptions to regulatory guidance are described in Section 3.9.2.4.1.
- RG 1.30 - Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment, Revision 0, August 1972.
- RG 1.37 - Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants, Revision 1, March 2007.
- RG 1.41 - Preoperational Testing of Redundant On-Site Electric Power Systems to Verify Proper Load Group Assignments, Revision 0, March 1973.
- RG 1.45 - Reactor Coolant Pressure Boundary Leakage Detection Systems, Revision 1, May 2008.

- RG 1.52 - Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered-Safety-Feature Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants, Revision 3, June 2001.
- RG 1.68.2 - Initial Startup Test Program to Demonstrate Remote Shutdown Capability for Water-Cooled Nuclear Power Plants, Revision 1 July 1978.
- RG 1.68.3 - Preoperational Testing of Instrument and Control Air Systems, Revision 0, April 1982.
- RG 1.72 - Spray Pond Piping Made from Fiberglass-Reinforced Thermosetting Resin, Revision 2, November 1978. This RG is not applicable because the U.S. EPR does not use this type of spray pond piping.
- RG 1.78 - Evaluating the Habitability of a Nuclear Power Plant Control Room during a Postulated Hazardous Chemical Release, Revision 1, December 2001.
- RG 1.79 - Preoperational Testing of Emergency Core Cooling Systems for Pressurized-Water Reactors, Revision 1, September 1975.
- RG 1.97 - Criteria For Accident Monitoring Instrumentation For Nuclear Power Plants, Revision 4, June 2006.
- RG 1.116 - Quality Assurance Requirements for Installation, Inspection, and Testing of Mechanical Equipment and Systems, Revision 0-R, May 1977.
- RG 1.118 - Periodic Testing of Electric Power and Protection Systems, Revision 3, April 1995.
- RG 1.128 - Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants, Revision 2, February 2007.
- RG 1.136 - Design Limits, Loading Combinations, Materials, Construction, and Testing of Concrete Containments, Revision 3, March 2007.
- RG 1.139 - Guidance for Residual Heat Removal. Revision 0, May 1978.
- RG 1.140 - Design, Testing, and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants, Revision 2, June 2001.

14.2.8 Utilization of Reactor Operating and Testing Experience in Development of Initial Test Program

The design of the U.S. EPR is an evolutionary design. As such, the experience gained from previous successful startups is factored into the initial test program. This information reflects both AREVA operating and test experience and industry wide experience concerning pressurized water reactors. A summary will be developed to provide conclusions from this review and the effects on the test program.

The plant operations staff reviews reactor operating and testing experiences at other facilities that are similar in design and capacity prior to the unit starting up. This review is carried out by circulating the following information to startup and operations personnel so that pertinent information can be utilized in the startup program:

- Licensee event reports or summaries.
- NRC I&E bulletins.
- NRC circulars.
- NRC information notices.
- INPO items.
- Reportable occurrences of repeatedly experienced safety concerns.
- Operating experiences that could potentially impact performance of the test program.

14.2.8.1 First-of-a-Kind Testing

First-of-a-kind design features are those identified as new, unique, or special in one or more aspects of their plant application that warrant extended or more detailed testing to verify their functional performance.

From a design standpoint, the U.S. EPR is not a first-of-a-kind plant. Specific features that may be novel in the U.S., such as the control rod drive systems or the incore neutron measurement system, have been successfully implemented in previous AREVA designs. In addition, for new EPR-specific features the U.S. EPR will be preceded by European units which are scheduled to enter commercial operation prior to any U.S. unit. Hence, extensive testing and operational data will be available prior to the first U.S. EPR beginning its Initial Plant Test Program.

Examples of features that may be novel in the U.S., but which are in service at AREVA plants in Europe include:

- Control rod drive mechanisms (CRDM).
- Control rod position indication.
- Fixed and moveable incore neutron measurement systems.

Examples of features that may be novel in the U.S., but which are expected to have been demonstrated in other EPR units prior to operation of any U.S. EPR include:

- Reactor internals (vibration measurement).

- Natural circulation of the reactor coolant system (RCS).
- Reactor coolant pump (RCP) standstill seal.
- Pressurizer surge line (thermal stratification).

14.2.9 Trial Use of Plant Operating and Emergency Procedures

The test program schedule is addressed in Section 14.2.11. The schedule for the development of the plant operating and emergency procedures shall allow sufficient time for trial use of these procedures during the initial test program as appropriate and to the extent possible. For example, the Plant Operations staff should take every available opportunity to use the plant procedures as follows:

- Normal operations procedures should be used to perform basic valve alignments for preoperational tests.
- Hot Functional testing should be performed with as many normal operations procedures as practical.
- Emergency operating procedures that require special plant conditions, such as the reactor head removed and the refueling cavity available to receive water, should be performed when those conditions have been created for preoperational testing.
- Technical specification surveillance tests should be performed and surveillance test problems corrected prior to fuel loading.

A COL applicant that references the U.S. EPR design certification will identify the specific operator training to be conducted as part of the low-power testing program related to the resolution of TMI Action Plan Item I.G.1, as described in (1) NUREG-0660 - NRC Action Plans Developed as a Result of the TMI-2 Accident, Revision 1, August 1980, (2) NUREG-0694 - TMI-Related Requirements for New Operating Licenses, June 1980, and (3) NUREG-0737 - Clarification of TMI Action Plan Requirements.

To accomplish these requirements, the following actions will be performed during Phase I:

- Emergency operating procedures will be performed on the plant simulator for procedure validation and operator training. The emergency operating procedures will be scheduled to be performed as soon as possible after the associated preoperational test so that test problems can be resolved prior to fuel load.
- Each operating shift will be provided hands-on training for plant evaluation and off-normal events, in addition to emergency procedures.
- Each operating shift will be provided training for normal operating and surveillance procedures. The normal operating and surveillance procedures will

be scheduled to be performed as soon as possible after the associated preoperational test so that test problems can be resolved prior to fuel load.

- Each operating shift will be provided hands-on training and participation in Phase I through Phase III testing. To accomplish this goal, operations procedures will control personnel that are allowed to perform the following tasks:
  - Valve alignments (i.e., local valve manipulations, remote manual operation).
  - Electrical alignments (i.e., breaker manipulations, installing or removing fuses).
  - Equipment manipulations (i.e., pump starts, refueling equipment operation).

14.2.10 Initial Fuel Loading and Initial Criticality

Initial fuel loading and initial criticality are performed in a controlled manner during the startup test program. These activities are performed in a controlled and safe manner using the test procedures addressed in Section 14.2.12. Technical Specification requirements are applicable and must be satisfied prior to these operations.

14.2.10.1 Initial Fuel Loading

Licensees should establish and follow specific safety measures, such as:

1. Establish requirements for periodic data-taking.
2. Predictions of core reactivity should be prepared in advance to aid in evaluating the measured responses to specified loading increments.
3. Establish requirements for the operability of plant systems and components, including reactivity control systems and other systems and components necessary to ensure the safety of plant personnel and the public in the event of errors or malfunctions.
4. Scram time tests should be sufficient to provide reasonable assurance that the control rods will scram within the required time under plant conditions that bound those under which the control rods might be required to function to achieve plant shutdown (testing should demonstrate control rod scram times at both hot zero power and cold temperature conditions, and with flow and no-flow conditions).

Minimum initial conditions for core load:

- The fuel loading evolution is controlled by the use of approved plant procedures, which establish plant conditions, control access, establish security, control maintenance activities, and provide instructions that pertain to the use of fuel handling equipment.

- The boron concentration and isotopic content in the coolant is verified to be equal to or greater than that required for refueling. It is not anticipated that the refueling cavity will be completely filled. However, the water level in the reactor vessel shall remain above the installed fuel assemblies at all times.

- The residual heat removal system (RHRS) provides coolant circulation that verifies adequate boron mixing and a means of controlling water temperature. The in-containment refueling water storage tank (IRWST) is in service and contains borated water at a volume and concentration that complies with the requirements. Applicable administrative controls shall be used to prevent unauthorized alteration of system lineups or change to the boron concentration in the RCS.

- The initial core loading is directly supervised by a senior licensed operator having no other concurrent duties.

- The composition, duties, and emergency procedure responsibilities of the fuel handling crew are specified.

- The status of all systems required for fuel loading is specified.

- The status of containment is specified.

- The status of the reactor vessel is specified.

- The fuel handling equipment has been verified to be operating correctly by performing preoperational tests prior to handling fuel.

- The status of protection systems, interlocks, alarms, and radiation protection equipment has been verified.

- A minimum of two permanent or temporary neutron detectors are located so that core reactivity changes can be detected and recorded. The neutron detectors shall be calibrated and operable prior to fuel movement.

- Response checks of neutron detectors are required prior to the commencement of fuel loading.

- Continuous area radiation monitoring shall be provided during fuel handling and fuel loading operations. Permanently installed radiation monitors display radiation levels in the main control room (MCR) and shall be monitored by licensed operators.

Fuel assemblies, together with inserted components, are placed in the reactor vessel, one at a time, according to previously established and approved sequences. The initial fuel loading procedure shall include detailed instructions, which prescribe successive movements of each fuel assembly. The procedures allow each fuel assembly movement to be verified prior to proceeding with the next assembly. Multiple checks are made for fuel assembly and inserted component serial numbers to guard against possible inadvertent exchanges or substitutions.

At least two fuel assemblies that contain primary neutron sources shall be placed into the core at appropriate specified points in the initial fuel loading procedure. This will provide a neutron population large enough for adequate monitoring of the core. As each fuel assembly is loaded, at least two separate inverse count-rate plots shall be maintained to verify that the extrapolated inverse count-rate ratio (ICRR) behaves as expected. The ICRR plots should also include related plant data (RHR flow, RCS temperature, etc.) that is taken on the same frequency. In addition, nuclear instrumentation shall be monitored to verify that each just-loaded fuel assembly does not excessively increase the count-rate. The results of each loading step shall be reviewed and evaluated before the next sequence fuel assembly is grappled by the refueling machine.

Criteria for the safe loading of fuel require that loading operations stop immediately if:

- The neutron count-rate from either temporary nuclear channel unexpectedly doubles during any single loading step, excluding anticipated change due to detector or source movement, or spatial effects such as a fuel assembly coupling source with a detector.
- The neutron count-rate on any individual nuclear channel increases by a pre-established maximum multiplication factor during any single loading step, excluding anticipated changes due to detector or source movement, or spatial effects such as a fuel assembly coupling source with a detector.
- There is a loss of communications between the control room and the senior licensed operator or fuel handling personnel.
- There is less than the required minimum number of operable source-range detectors.
- The extra borating system is inoperable.

A fuel assembly shall not be un-grappled from the refueling machine until stable count-rates have been obtained. In the event that an unexplained increase in count-rate is observed on any nuclear channel, the last fuel assembly loaded shall be withdrawn. Before proceeding, the procedure and loading operation shall be reviewed and evaluated to verify the safe loading of fuel.

Plant procedures shall establish criteria for the following:

- Emergency boron injection.
- Containment evacuation.
- Actions to be followed in the event of fuel damage.
- Actions to be followed or approvals to be obtained before routine loading may resume after one of the above limitations has been reached or invoked.

14.2.10.2 Initial Criticality

Initial criticality is controlled by the use of approved plant procedures which establish required plant conditions and successful completion of prerequisite tests described in Section 14.2.12. Initial criticality is obtained by a specified, controlled and orderly combination of a rod cluster control assembly (RCCA) withdrawal, and a boron concentration reduction. The approach to criticality requires that RCCA groups be withdrawn in sequence with overlap, except for the last regulating group, which shall remain far enough into the core to provide effective control when criticality is achieved. The RCS boron concentration is then reduced to achieve criticality, at which time the regulating group shall be used to maintain criticality.

Core response during RCCA group withdrawal and RCS boric acid concentration reduction shall be monitored in the MCR by observing the change in neutron count-rate as indicated by the permanent nuclear instrumentation. The U.S. EPR plans to use the rod withdrawal sequence and dilution to criticality in subsequent plant startups that require LPPT. For U.S. EPR startups not requiring LPPT, the plan is to dilute to a concentration that corresponds to an estimated critical condition with Control Bank D near the core mid-plane. The same withdrawal sequence and pattern is used with criticality being achieved during Control Bank D withdrawal.

During reactor startup, the neutron count-rate is plotted as a function of RCCA group position and RCS boron concentration during the approach to criticality. The approach to criticality shall be controlled and specific hold points shall be specified in the procedure. The results of the inverse count-rate monitoring and the indications on installed instrumentation shall be reviewed and evaluated before proceeding to the next prescribed hold point. The criteria for providing a safe and controlled approach to criticality require that the following conditions are met:

- High flux trip setpoints are reduced to a value consistent with performance of the next test plateau.
- Rod drop time tests have been performed to provide reasonable assurance that the control rods will trip within the required time under plant conditions that bound those under which the control rods might be required to function to achieve plant shutdown (rod drop testing should demonstrate control rod drop times at both hot zero power and cold temperature conditions, and with all RCPs operating and no-RCPs operating conditions).
- Technical Specifications required for entry into MODE 2 are met.
- A minimum count rate of 1/2 counts per second (cps) is met.
- A signal-to-noise ratio greater than two is met.
- A statistical reliability test on each operable source range instrument is performed.

- A sustained startup rate of one decade per minute is not exceeded.
- RCCA withdrawal or boron dilution is suspended if unexplainable changes in neutron count-rates are observed.
- A minimum of one decade of overlap is observed between the source and intermediate channels of the excore nuclear instruments.

14.2.11 Test Program Schedule

The scheduling of individual tests or test sequences is established so that systems and components that are required to prevent or mitigate the consequences of postulated accidents are tested prior to fuel loading. Tests that require a substantial core power level for proper performance are performed at the lowest power level commensurate with obtaining acceptable test data.

A COL applicant that references the U.S. EPR certified design will develop a test program that considers the following guidance components:

1. The applicant should allow at least nine months to conduct preoperational testing.
2. The applicant should allow at least three months to conduct startup testing, including fuel loading, low-power tests, and power-ascension tests.
3. Plant safety will not be dependent on the performance of untested SSC during any phase of the startup test program.
4. Surveillance test requirements will be completed in accordance with plant Technical Specification requirements for SSC operability before changing plant modes.
5. Overlapping test program schedules (for multiunit sites) should not result in significant divisions of responsibilities or dilutions of the staff provided to implement the test program.
6. The sequential schedule for individual startup tests should establish, insofar as practicable, that test requirements should be completed prior to exceeding 25 percent power for SSC that are relied on to prevent, limit, or mitigate the consequences of postulated accidents.
7. Approved test procedures should be in a form suitable for review by regulatory inspectors at least 60 days prior to their intended use or at least 60 days prior to fuel loading for fuel loading and startup test procedures.
8. Identify and cross reference each test (or portion thereof) required to be completed before initial fuel loading and that is designed to satisfy the requirements for completing ITAAC.

14.2.12 Individual Test Descriptions

The individual preoperational test abstracts identified in this section contain test descriptions that form one part of the bases for defining the minimum testing requirements.

In these abstracts:

- References to design or design requirements generally mean functional design or functional design requirements. For example, SSC may have higher design capacity than what is functionally required.
- Acceptance criteria are based on system design parameters that are used in the safety analysis and on programmatic requirements. For example, programmatic testing requirements for the pump and valve testing are described in Section 3.9.6.

Detailed U.S. EPR preoperational test procedures:

- Accomplish the testing described in the test abstracts via multiple test procedures that may be executed at different times.
- Establishes the prerequisite conditions per individual test requirements. For example, heating, ventilation, air conditioning (HVAC) testing will be done at current environmental conditions, not extremes of design-assumed temperatures.
- Include data requirements for individual tests in more detail (as necessary for verifying test objectives).

14.2.12.1 NSSS Support Systems

14.2.12.1.1 Fuel Pool Cooling and Purification System (Test #001)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the fuel pool cooling and purification system (FPCPS).

1.2 To identify any spent fuel pool leakage.

1.3 To demonstrate electrical independence and redundancy of power supplies.

1.4 To verify that the radiation sample point provides a representative sample of the FPCPS.

2.0 PREREQUISITES

2.1 Construction activities on the FPCPS have been completed.

2.1.1 Verify that construction has back filled each leak chase channel from a low pressure source and verified that each leak

chase drains the back filled water through an unobstructed leak chase pipe and valve.

2.2 FPCPS system instrumentation has been calibrated and is functional for performance of the following test.

2.3 Test instrumentation available and calibrated per site procedures.

2.4 Component cooling water system (CCWS) water is available to the fuel pool cooling heat exchanger.

2.5 Support systems required for the operation of the FPCPS are complete and functional.

2.6 The following have been filled to normal level, or shall be during the performance of this test:

2.6.1 Spent fuel pool.

2.6.2 Refueling cavity.

2.6.3 IRWST.

3.0 TEST METHOD

3.1 Measure the head versus flow curves for pumps.

3.1.1 $NPSH_a \geq NPSH_R$.

3.1.2 Discharge head.

3.1.3 Flow corresponding to head at each point.

3.1.4 Starting time (motor start time and time to reach rated flow).

3.2 Operate each FPC train when aligned for one and two pump operation and measure flow to the SFP.

3.3 Observe the operation of each FPC train isolation valve during FPC pump start and stop.

3.4 Measure each FPC heat exchanger differential pressure at design flows.

3.5 Observe operation of instrument and controls (manual and automatic), including setpoints, actuations, instrument interlocks and alarms using actual or simulated inputs over the full range of the SFP instrumentation operation.

3.6 Check the functionality of the spent fuel pool gates and quantify gate leakage.

3.7 Check to determine if the anti-siphon pipes and holes on the FPCPS lines are free of obstructions.

3.8 Quantify leakage of the spent fuel pool by checking the spent fuel pool leak detection system.

3.9 Operate the Fuel Building purification pump and then the Reactor Building purification pump and measure flow when the system is aligned to the purification ion exchanger, filtering the following:

3.9.1 Spent fuel pool.

3.9.2 Refueling cavity.

3.9.3 IRWST.

3.10 Measure differential pressure across the FPP ion exchanger, pre-filter, and post filter.

3.11 Measure the performance characteristics of power-operated valves (e.g., thrust, stroke time, fail position upon loss of motive power) as designed.

3.12 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.13 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.14 Connect and check the on-demand level indication functionality of the battery-powered SFP portable indication devices.

3.15 Verify that sample point (refer to Table 11.5-1, Radiation Measuring Point R-39) is capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Pump head versus flow and operating data for each pump.

4.2 FPC pump flows for tested alignments.

4.3 FPC isolation valve performance results.

4.4 FPC heat exchanger pressure drop results.

4.5 FPP pump flows for tested alignments.

4.6 FPP ion exchanger, pre-filter, and post filter pressure drop results.

4.7 Setpoints of alarms interlocks and controls.

4.8 Anti-siphon device inspection report.

4.9 Spent fuel pool gate leakage data.

4.10 Valve performance data.

4.11 Control valve operation and position.

5.0 ACCEPTANCE CRITERIA

5.1 The FPCPS meets design requirements (refer to Sections 9.1.2 and 9.1.3):

5.1.1 FPC pump performance within limits.

5.1.2 FPC instrument and controls, interlocks, and alarms function as designed.

5.1.3 Design flows are achieved for both one FPC pump and two FPC pump system operation.

5.1.4 FPC isolation valves operate as designed (valve open on pump start and close on pump stop).

5.1.5 The pressure drop for each heat exchanger is within design limits.

5.1.6 The FPC anti-siphon lines and holes are free of obstructions.

5.1.7 FPP pump performance within limits.

5.1.8 FPP controls, interlocks, and alarms function as designed.

5.1.9 Spent fuel pool leakage within design limits.

5.1.10 Valve performance within design limits.

5.1.11 Gate performance within design limits.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

5.3 Radiation sample point (refer to Table 11.5-1, Radiation Measuring Point R-39) is capable of collecting the required samples.

14.2.12.1.2 CVCS Volume Control Tank (Test #002)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the volume control tank (VCT) subsystem of the chemical and volume control system (CVCS).

2.0 PREREQUISITES

2.1 Construction activities on the VCT subsystem have been completed.

2.2 The VCT subsystem instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Water makeup system is available to the VCT.

2.4 Support systems required for operation of the VCT are complete and functional.

3.0 TEST METHOD

3.1 Operate motor operated valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.2 Record response of power-operated valves upon loss of motive power (refer to Section 9.3.4 for anticipated response).

3.3 Partially fill the VCT with water makeup system and pressurize the VCT using the nitrogen pressurization system. Observe alarm operation.

3.4 Vent the VCT and pressurize using the nitrogen system.

3.5 Drain and refill the VCT with water makeup system. Observe level alarms and interlocks.

3.6 Simulate a full range of VCT temperatures and observe alarms.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indication.

4.3 Position response of valves to loss of motive power.

4.4 VCT pressurization data.

4.5 VCT level program data.

4.6 Values of parameters at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The VCT subsystem meets design requirements (refer to Section 9.3.4):

5.1.1 Verify valve performance is within limits.

5.1.2 Verify alarms and interlocks function as designed.

5.1.3 Verify control system response is within design limits.

14.2.12.1.3 CVCS Charging and Seal Injection (Test #003)

1.0 OBJECTIVE

1.1 To demonstrate the proper performance of the CVCS charging subsystem.

1.2 To demonstrate the proper performance of the CVCS seal injection subsystem.

1.3 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the CVCS charging and seal injection subsystems have been completed.

2.2 The CVCS charging and seal injection subsystem instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 The water makeup system subsystem is functional to provide a reliable supply to the charging pump suction.

2.4 The VCT subsystem is functional to supply charging pump suction.

2.5 The reactor vessel is ready to receive water from the charging headers.

2.6 The pressurizer is ready to receive water from the auxiliary spray line.

2.7 RCP are ready to receive seal injection water (pumps are coupled and off the backseat) and standstill seal is open.

2.8 Support systems required for operation of the CVCS charging and seal injection subsystems are functional.

3.0 TEST METHOD

3.1 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.2 Record response of power-operated valves upon loss of motive power (refer to Section 9.3.4 for anticipated response).

3.3 Prior to starting the charging pump, simulate a high seal injection filter differential pressure and verify proper indication and alarms.

3.4 Manually start each charging pump. Observe charging pump operation including charging pump alarms and interlocks.

3.5 With a charging pump running:

3.5.1 Open the seal injection lines and observe flow.

3.5.2 Verify proper operation of the seal injection filters.

3.6 With a charging pump running, open the auxiliary spray valve, and observe flow.

3.7 Demonstrate the operation of the RCP seal injection flow control valves.

3.8 Demonstrate the flow rate of the CVCS miniflow path.

3.9 Demonstrate the operation of RCP seal injection header.

3.10 Demonstrate performance, including head and flow characteristics, of the charging pumps.

3.11 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indication.

4.3 Position response of valves to loss of motive power.

4.4 Charging pump and oil lubrication system performance.

4.5 Charging pump running data.

4.6 Setpoints at which alarms and interlocks occur.

4.7 Seal injection flow rates.

4.8 Auxiliary spray flow rates.

4.9 CVCS charging pump head versus flow.

5.0 ACCEPTANCE CRITERIA

5.1 The CVCS charging subsystem meets design requirements as described in Section 9.3.4.

5.1.1 Verify valve performance is within limits.

5.1.2 Verify alarms and interlocks function as designed.

5.1.3 Verify control system response is within design limits.

5.1.4 Verify CVCS minimum / maximum system flow rates are within design limits.

- Table 14.3-1 Item 1-4.

5.1.5 Verify charging pump head and flow.

5.1.6 Verify charging pump miniflow performance.

5.1.7 Verify various CVCS flow paths and flow rates.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.1.4 CVCS Letdown (Test #004)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the CVCS letdown subsystem for normal and emergency conditions.

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the CVCS letdown subsystem have been completed.

2.2 Letdown subsystem instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for the operation of the CVCS letdown subsystem control valves are functional.

2.4 The RCS is operated at HZP pressure and temperature.

3.0 TEST METHOD

3.1 Operate control valves remotely while:

a. Observing each valve operation and position indication, and

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.2 Record response of power-operated valves upon loss of motive power as designed (refer to Section 9.3.4).

3.3 Observe response of letdown system to simulated pressurizer level signals.

3.4 Simulate a safety injection actuation signal (SIAS) and observe system response.

3.5 Simulate a containment isolation signal (CIS) and observe system response.

3.6 Simulate an inadvertent dilution event and observe system response.

3.7 Simulate a range of letdown temperatures and observe the response of control valves. Observe alarm and interlock operation.

3.8 Measure system pressure and temperature upstream and downstream of pressure control valves and verify sub-cooled conditions exist.

3.9 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indication.

4.3 Position response of valves to loss of motive power.

4.4 Response of control valves to simulated pressurizer level changes.

4.5 Response of system and isolation valves to simulated isolation signals.

4.6 Response of control valves to simulated letdown temperature.

4.7 Delta pressure (ΔP) across letdown flow control.

4.8 Setpoints at which alarms, indications, and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The CVCS letdown subsystem meets design requirements (refer to Section 9.3.4):

5.1.1 Verify valve performance meets design requirements.

5.1.2 Verify alarms and interlocks function as designed.

5.1.3 Verify control system response is within design limits.

5.1.4 Verify that flow rates meet design requirements.

5.1.5 Verify letdown system pressure and temperature meet subcooling design requirements.

5.1.6 Verify response to simulated safety related signals.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.1.5 CVCS Chemical Addition (Test #005)

1.0 OBJECTIVE

1.1 To demonstrate that the chemical addition subsystem can inject liquid chemicals into the suction supply of the charging pumps.

1.2 To demonstrate a flow path from the chemical addition tank to the liquid waste system.

2.0 PREREQUISITES

2.1 Support systems required for operation of the chemical addition subsystem are complete and functional.

2.2 The chemical addition tank has been filled from the makeup system with a predetermined amount of water makeup system.

2.3 The CVCS charging subsystem is functional and the charging pump is operating.

2.4 The associated instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.5 A charging pump is in operation.

3.0 TEST METHOD

3.1 Start the chemical addition pump and observe the chemical addition tank level.

3.2 Drain the chemical addition tank to the nuclear island drain and vent systems (NIDVS) and observe the chemical addition tank level.

4.0 DATA REQUIRED

4.1 Chemical addition tank levels.

5.0 ACCEPTANCE CRITERIA

5.1 Verify the flow path from the chemical addition tank to charging pump suction supply line.

5.2 Verify the flow path from the chemical addition tank to the NIDVS.

5.3 The chemical addition subsystem meets design requirements (refer to Section 9.3.4).

5.3.1 Verify the ability to inject chemicals into the CVCS.

14.2.12.1.6 Coolant Supply and Storage System (Test #006)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the coolant supply and storage system (CSSS).

2.0 PREREQUISITES

2.1 Construction activities on the CSSS have been completed.

2.2 CSSS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Boric acid concentrator is ready to receive water from the CSSS.

2.4 Support systems required for operation of the CSSS are complete and functional.

3.0 TEST METHOD

3.1 Fill the coolant storage tanks and observe level indications and alarms.

3.2 Simulate a full range of coolant storage tank temperatures and observe indications and alarms.

3.3 Fill the boric acid column from the coolant storage tank using each evaporator feed pump.

3.4 Observe boric acid column level indications, alarms, interlocks, and evaporator feed pump discharge pressure.

3.5 Refill and isolate the boric acid column.

3.6 Open the boric acid column recirculation valves and start each circulation pump while observing boric acid column level changes and verify circulation pump performance.

3.7 Observe operation of the electrical heater that supplies the initial heatup of the boric acid column.

3.8 Observe transfer performance by lining up the boric acid delivery pumps to the boric acid storage tank (BAST).

3.9 Line up the vapor compressors with the seal water pumps aligned to the seals and determine if the condensate pumps can supply processed demineralized water to the reactor makeup storage tank.

3.10 Observe operation of the degasifier column and associated components.

3.11 Observe response of power-operated valves upon loss of motive power (refer to Section 9.3.4 for anticipated response).

3.12 Verify performance, including head and flow characteristics, for the coolant storage pumps.

4.0 DATA REQUIRED

4.1 Coolant storage tank level and temperature for each tank.

4.2 Coolant storage pump pressure.

4.3 Setpoints of alarms and interlocks.

4.4 Position response of valves to loss of motive power.

4.5 Pump head versus flow for system pumps.

5.0 ACCEPTANCE CRITERIA

5.1 The CSSS meets design requirement (refer to Section 9.3.4):

5.1.1 Verify that controls, interlocks, and alarms function as designed.

5.1.2 Verify that the coolant treatment components operation is within design limits.

5.1.3 Verify valve performance meets design requirements.

5.1.4 Verify that system indications function as designed.

14.2.12.1.7 Reactor Boron and Water Makeup System (Test #007)

1.0 OBJECTIVE

1.1 To demonstrate the performance of the reactor boron and water makeup system (RBWMS).

1.2 To verify that the radiation sample point provides a representative sample of the RBWMS.

2.0 PREREQUISITES

2.1 Construction activities on the RBWMS have been completed.

2.2 RBWMS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Plant demineralized water supply system is functional.

2.4 Coolant storage and supply system is available to support the operation of the RBWMS is complete and functional.

2.5 Support systems required for the operation of the RBWMS are complete and functional.

3.0 TEST METHOD

3.1 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.2 Observe response of power-operated valves upon loss of motive power as designed (refer to Section 9.3.4 for anticipated response).

3.3 Observe level indications and alarms while filling the BAST.

3.4 Simulate a range of BAST temperatures while observing indications and alarms.

3.5 Observe tank level, pump discharge pressure, alarms and controls while draining the BAST using each boric acid makeup pump.

3.6 Measure performance, including head and flow characteristics, for each boric acid makeup pump.

3.7 Measure performance, including head and flow characteristics, for each RBWMS demineralized water pump.

3.8 Demonstrate makeup to VCT, and supply to CVCS pump suction from the boric acid makeup pumps and demineralized water pumps.

3.9 Verify that sample point (refer to Table 11.5-1, Radiation Measuring Point R-45) is capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Valve position indication.

4.2 Position response of valves to loss of motive power.

4.3 BAST level, pressure and temperature.

4.4 Boric acid makeup pumps discharge pressure.

4.5 Demineralized water pumps discharge pressure.

4.6 RBWMS flow.

4.7 Setpoints of alarms and interlocks.

4.8 Pump head versus flow.

4.9 VCT levels.

5.0 ACCEPTANCE CRITERIA

5.1 The RBWMS meets design requirements (refer to Section 9.3.4):

5.1.1 Verify valve performance is within design limits.

5.1.2 Verify alarm and interlocks function as designed.

5.1.3 Verify that system controls function as designed.

5.1.4 Verify pump flow and head are within design limits.

5.1.5 Verify the ability to deliver boric acid to the VCT mixing components.

5.1.6 Verify that system indications function as designed.

5.2 Radiation sample point (refer to Table 11.5-1, Radiation Measuring Point R-45) is capable of collecting the required samples.

14.2.12.1.8 Boric Acid Mixing Tank (Test #008)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the boric acid mixing tank subsystem.

2.0 PREREQUISITES

2.1 Construction activities on the boric acid mixing tank subsystem have been completed.

2.2 Support systems required for operation of the boric acid mixing tank are complete and functional.

2.3 The BAST subsystem is functional.

3.0 TEST METHOD

3.1 Fill the boric acid mixing tank with water from the demineralized water distribution system.

3.2 Energize heaters and measure the length of time required to heat the tank.

3.3 Observe heater control setpoints.

3.4 Line up the boric acid mixing tank to the BAST.

3.5 Start a boric acid feed pump and observe the mixing tank level.

3.6 Refill the boric acid mixing tank, dissolve boric acid crystals and start the mixing tank agitator.

3.7 Take samples as the tank is drained to determine the boric acid concentration.

4.0 DATA REQUIRED

4.1 Mixing tank heater performance data.

4.2 Heatup rate.

4.3 Boric acid concentration.

5.0 ACCEPTANCE CRITERIA

5.1 The boric acid mixing tank subsystem meets design requirements (refer to Section 9.3.4):

5.1.1 Verify operation of the boric acid mixing components is within design limits.

5.1.2 Verify alarms and interlocks function as designed.

5.1.3 Verify system controls function as designed.

14.2.12.1.9 Boric Acid Storage Tank (Test #009)

1.0 OBJECTIVE

1.1 To demonstrate the proper performance of the BAST subsystem components.

2.0 PREREQUISITES

2.1 Construction activities of the BAST subsystems have been completed.

2.2 The BAST subsystem instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 The CVCS charging subsystem is complete and functional.

2.4 The VCT subsystem is complete and functional.

2.5 The boric acid batching storage tank subsystem is complete and functional.

2.6 Support systems required for operation of the BAST subsystem are complete and functional.

3.0 TEST METHOD

3.1 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.2 Determine response of power-operated valves upon loss of motive power (refer to Section 9.3.4 for anticipated response).

3.3 Observe level alarm setpoints while filling the BAST with reactor makeup water from the boric acid batching tank subsystem.

3.4 Operate each boric acid makeup pump and observe pump performance.

3.5 Line up the boric acid makeup to charging pump suction.

3.6 Observe ability of the boric acid makeup pumps to supply adequate flow to the charging pumps.

3.7 Line up the BAST to charging pump suction.

3.8 Determine if adequate flow is delivered to the charging pumps from the BAST.

3.9 Simulate high and low BAST levels and observe indications, alarms and controls.

3.10 Simulate high and low BAST temperature and observe indications, alarms and controls.

3.11 Line up the boric acid makeup pumps to the VCT and determine if the makeup system is capable of supplying boric acid makeup to the VCT

and charging pump suction at the selected rates and quantities in functional modes.

3.12 Observe alarms and interlocks associated with boric acid makeup pumps and the VCT.

3.13 Observe performance, including head and flow characteristics, for the boric acid makeup pumps.

4.0 DATA REQUIRED

4.1 Valve performance data where required.

4.2 Valve position indication.

4.3 Position response of valves to loss of motive power.

4.4 Boric acid makeup pump performance data.

4.5 Makeup system performance data.

4.6 Setpoints at which alarms, automatic actuations, and interlocks occur.

4.7 Pump head versus flow.

5.0 ACCEPTANCE CRITERIA

5.1 The BAST subsystem meets design requirements (refer to Section 9.3.4):

5.1.1 Verify that alarms and interlocks function as designed.

5.1.2 Verify that system controls function as designed.

5.1.3 Verify that valve performance is within design limits.

5.1.4 Verify that pump performance, flow and developed head, meet design limits.

5.1.5 Verify that the BAST provides adequate net positive suction head (NPSH) to the CVCS charging pumps during design conditions.

5.1.6 Verify that various system alignments function as designed.

5.1.7 Verify that system indications function as designed.

14.2.12.1.10 Coolant Degasification System (Test #010)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the coolant degasification system (CDS).

2.0 PREREQUISITES

2.1 Construction activities have been completed on the CDS.

2.2 CDS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the CDS are functional.

3.0 TEST METHOD

3.1 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.2 Observe response of power-operated valves upon loss of motive power (refer to Section 9.3.4 for anticipated response).

3.3 Simulate interlock signals from interfacing equipment and observe CDS response.

3.4 Line up the CDS to interfacing systems and, using appropriate operating functional modes.

3.5 Determine if flow paths have been established to interfacing systems.

3.6 Observe alarm and controller response.

4.0 DATA REQUIRED

4.1 Record valve diagnostic testing data (e.g., stroke time, developed thrust).

4.2 Position response of valves to loss of motive power.

4.3 Setpoints at which alarms, automatic actuations, and interlocks occur.

4.4 Flow indications.

5.0 ACCEPTANCE CRITERIA

5.1 The CDS meets design requirements (refer to Section 9.3.4):

5.1.1 Verify valve operation is within design limits.

5.1.2 Verify applicable alarms, interlocks, and controls function as designed.

5.1.3 Verify that system indications function as designed.

5.1.4 Verify that various system alignments function as designed.

14.2.12.1.11 Coolant Purification System (Test #011)

1.0 OBJECTIVE

1.1 To demonstrate flow paths between the following are available:

1.1.1 RBWMS.

1.1.2 Purification ion exchangers (demineralizers).

1.1.3 Solid waste management system.

1.2 To demonstrate flow paths between the purification and deborating ion exchanger and gaseous waste processing system (GWPS).

2.0 PREREQUISITES

2.1 Construction activities on the coolant purification system (CPS) have been completed.

2.2 CPS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Temporary test instrumentation is available and has been calibrated.

2.4 Support systems required for operation of the CPS are complete and functional.

3.0 TEST METHOD

3.1 Line up the purification system ion exchangers to complete a flow path from the water makeup system through each CPS ion exchanger to the solid waste management system.

3.2 Start a water makeup system pump and valve in each ion exchanger sequentially, so that only one ion exchanger is in use at a time.

3.3 Observe water makeup system flow indicators and changes in reactor makeup water and spent resin tank levels. Select possible flow paths to the solid waste management system.

3.4 Connect each purification ion exchanger and the deborating ion exchanger to a compressed air system (CAS) and connect a pressure gage to the ion exchanger vent.

3.5 Adjust the air supply to 15-20 psig.

3.6 Start air flow to the ion exchangers and individually open each ion exchanger vent valve and align the ion exchanger to the GWPS.

3.7 Observe the ion exchanger vent pressure, air supply pressure, and flow rate.

4.0 DATA REQUIRED

4.1 Water makeup system flow rate.

4.2 Water makeup system and spent resin tank levels.

4.3 Air supply pressure and flow rate.

4.4 Ion exchanger test pressure.

5.0 ACCEPTANCE CRITERIA

5.1 Verify flow paths between the water makeup system, the purification and deborating ion exchangers, and the solid waste management system.

5.2 Verify flow paths between the purification and deborating ion exchangers and the GWPS.

5.3 The CVCS purification subsystem meets design requirements (refer to Section 9.3.4):

5.3.1 Verify valve performance per design requirements.

5.3.2 Verify alarm and interlocks function as designed.

5.3.3 Verify that controls function as designed.

14.2.12.1.12 Reactor Coolant System (Test #012)

1.0 OBJECTIVE

1.1 To perform the initial venting of the RCPs and the RCS.

1.2 To perform the initial operation of the RCPs.

1.3 To demonstrate RCP performance.

1.4 To observe alarm functions.

1.5 To observe the operation of the RCS sample isolation valves.

1.6 To perform checkout of humidity detection system.

1.7 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the RCS, RCPs, and RCS sample isolation system have been completed.

2.2 RCP and RCS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Component cooling water (CCW) to the RCP is available.

2.4 RCP motor initial operation preoperational test has been completed.

2.5 Pre-start RCP activities have been completed, including opening the standstill seal.

2.6 Support systems required for operation of the RCPs and RCS sample isolation valves are functional.

2.7 The humidity detection system has an installed test tube to route humid air to the detection system.

2.8 The humidity detection system humidity cell has been calibrated.

3.0 TEST METHOD

3.1 Simulate temperature, pressure, and flow signals from each RCP and verify alarm setpoints.

3.2 Simulate temperature signals from each RCS RTD and observe alarm operation.

3.3 Perform initial venting of RCPs, pressurizer, and reactor vessel.

3.4 Perform initial run of RCPs.

3.5 Vent the RCS after each run is complete.

3.6 Observe power-operated valves operation upon loss of motive power (refer to Section 5.1 for anticipated response).

3.7 Verify that the humidity detection system responds to a simulated high humidity.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.9 Verify that the standstill seal can be engaged when the RCP is stopped.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms occur.

4.2 RCP cold performance data.

4.3 Position response of valves to loss of motive power.

5.0 ACCEPTANCE CRITERIA

5.1 Verify performance and alarms of the RCS and RCPs as designed (refer to Sections 3.6.3.7, 5.1, 5.2.5, and 5.4.1):

5.1.1 Verify valve performance per design requirements.

5.1.2 Verify alarm and interlocks function as designed.

5.1.3 Verify that controls function as designed.

5.1.4 Verify that RCP operation and vibration levels are within design limits.

5.1.5 Verify that the RCP ratchet pawls on idle RCPs prevent reverse rotation when RCPs are started.

5.1.6 Verify that RCP startup and operating currents are within design limits.

5.1.7 Verify that humidity instrumentation is functional.

5.1.8 Verify that RCS venting is accomplished.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.2 Front Line Safety Systems

14.2.12.2.1 Combustible Gas Control System (Test #013)

1.0 OBJECTIVE

1.1 To demonstrate operation of the combustible gas control system (CGCS) hydrogen mixing dampers.

1.2 To demonstrate that the CGCS passive autocatalytic recombiners (PARs) are properly installed and are functional prior to fuel loading.

1.3 To demonstrate that the CGCS components are installed per design requirements:

1.3.1 Convection foils (refer to Section 6.2.5).

1.3.2 Rupture foils (refer to Section 6.2.5).

1.3.3 Hydrogen mixing dampers (refer to Section 6.2.5).

1.4 Deleted.

2.0 PREREQUISITES

2.1 Construction activities on the CGCS components have either been completed or exceptions have been recorded and the impact on the system performance has been determined.

2.1.1 PARs.

2.1.2 Convection foils.

2.1.3 Rupture foils.

2.1.4 Hydrogen mixing dampers.

2.2 Test instrumentation is available and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

2.3 Factory acceptance tests on the PARs have been completed and approved.

2.3.1 The PAR inspection drawers have each been opened and a detailed inspection has revealed that there are no scratches, damage, or foreign objects in the PARs.

3.0 TEST METHOD

3.1 Operate the RCB HVAC systems in all normal configurations and verify that the foils and dampers provide the designed separation boundary between the equipment compartments and service compartments.

3.2 Observe operation of the following CGCS components over the design range:

3.2.1 Instrumentation and controls.

3.2.2 Alarms.

3.3 Simulate a high absolute RCB pressure signal and verify that the hydrogen mixing dampers reposition, as designed.

3.4 Simulate a high differential pressure signal between the service compartments and equipment compartments and verify that the hydrogen mixing dampers reposition, as designed.

3.5 Verify the response of hydrogen mixing dampers to loss of motive power.

3.6 Verify that the hydrogen mixing dampers respond to manual operator commands.

3.7 Remove bolted connection from thermolock on each convection/ rupture foil and verify the following:

3.7.1 Lower frame swings freely to open position. Record component identification number of any component that is within 12 inches of the lower frame at any time during opening.

3.7.2 No visible signs of debris or mechanical damage.

3.7.3 EDPM gasket shall be in good condition and form a seal between the upper and lower frames.

4.0 DATA REQUIRED

4.1 Pretest and post-test hydrogen mixing damper positions.

5.0 ACCEPTANCE CRITERIA

5.1 The containment passive autocatalytic recombiners meet design criteria (refer to Section 6.2.5).

5.2 The hydrogen mixing dampers perform as designed (refer to Section 6.2.5):

5.3 The containment convection foils meet design criteria (refer to Section 6.2.5).

5.4 The containment rupture foils meet design criteria (refer to Section 6.2.5).

14.2.12.2.2 Medium Head Safety Injection System (Test #014)

1.0 OBJECTIVE

1.1 To functionally test the operation and performance of each critical component within the medium head safety injection system (MHSI) in conditions that are representative of actual plant conditions or close enough to allow data to be extrapolated to actual conditions.

1.2 To observe MHSI response to an SIAS using normal, alternate, and emergency power sources.

1.3 To observe operation of the flow paths through the cold leg MHSI piping to the reactor vessel, to determine if the system is properly installed and is functional prior to fuel loading.

1.4 To confirm full flow capability of the MHSI system with minimum backpressure.

1.5 To observe operation of the MHSI sampling system isolation valves.

1.6 To observe operation of the elevation of MHSI containment isolation valves (CIV) relative to the IRWST water level to validate NPSH and loop seal design criteria.

1.7 To record data that is used to validate design basis assumptions or provide a baseline record of system performance for non-safety-related attributes.

1.8 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the MHSI system have either been completed or exceptions have been recorded and the impact on system performance has been determined.

2.2 Support systems and instrumentation required for operation of the MHSI subsystem are complete and functional or the impact on system performance has been determined.

2.3 The IRWST is filled with sufficient primary makeup water to conduct testing on the MHSI system.

2.4 The reactor vessel head and internals have been removed and the reactor vessel water level has been lowered below the vessel nozzles.

2.5 Test instrumentation to be used for pump performance has been installed and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

2.6 The MHSI system instrumentation is functional and calibrated and is operating satisfactorily prior to performing the following test.

2.7 Test instrumentation is available and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

3.0 TEST METHOD

3.1 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.2 Observe operation of power-operated valves upon loss of motive power (refer to Section 6.3 for anticipated response).

3.3 Start each MHSI pump using an SIAS signal and collect initial pump operating data:

3.3.1 MHSI pumps shall be aligned to discharge to the depressurized RCS (vessel level maintained below the vessel nozzles).

3.3.2 MHSI discharge valves throttled and calibrated instrumentation installed to compare safety injection (SI) pump flow and discharge pressure to the pump manufacturer head-flow curve.

3.3.3 Perform critical (full flow) sections of the test using normal and emergency power sources.

3.3.4 Collect valve data on valves that reposition to perform an accident mitigation function under maximum differential pressure conditions.

3.3.5 Measure suction supply (NPSH) to the MHSI pumps from the IRWST using the suction header under maximum flow conditions, minimum IRWST level, and minimum vessel level.

3.3.6 Compare the measured suction head to the MHSI pump manufacturer NPSH requirements when corrected for IRWST minimum level attainable during an SIAS and maximum IRWST fluid temperature. (Note: it is acceptable to correct available data if design conditions can not be duplicated).

3.3.7 Operate each MHSI pump available for cold leg safety injection (CLSI) through the CLSI header and collect pump operating data.

3.4 Operate each MHSI pump to document the full flow capability.

3.4.1 Discharge head.

3.4.2 Flow corresponding to head at each point.

3.4.3 Starting time (motor start time and time to reach rated flow).

3.5 Collect fluid samples from each of the MHSI system sampling points.

3.6 Measure the MHSI pump minimum flow recirculation flow rate to the IRWST. Compare the measured flow rate to the required minimum flow rate provided by the pump supplier.

3.7 Record the static head of water in pump discharge lines relative to IRWST level with the valves in the MHSI lines between the IRWST and RCS in the open position.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.9 Verify that the MHSI system meets full flow and shutoff head (by extrapolation) design requirements.

4.0 DATA REQUIRED

4.1 Valve position and position indication.

4.2 Position response of valves to loss of motive power.

4.3 Valve performance data, where required.

4.4 MHSI pump initial functional data including the following:

4.4.1 MHSI pump head versus flow.

4.4.2 MHSI pump suction pressure.

4.4.3 MHSI pumped fluid temperature.

4.4.4 Reactor vessel level.

4.4.5 IRWST level.

4.4.6 Chemistry of the water during the test.

4.4.7 Debris content of the water during the test as identified by sampling.

4.5 Response of MHSI system to SIAS when powered by normal, alternate and emergency power sources:

4.5.1 Motor current.

4.5.2 Buss voltage.

4.5.3 Time from signal to rated flow.

5.0 ACCEPTANCE CRITERIA

5.1 The MHSI system meets design requirements (refer to Section 6.3):

5.1.1 Verify that the alarms and interlocks function as designed.

5.1.2 Verify that the system controls function as designed.

5.1.3 Verify that the MHSI pump flow and developed head meet design requirements.

- Table 14.3-1 Item 1-16.
- Table 14.3-1 Item 1-17.
- Table 14.3-1 Item 1-18.
- Table 14.3-1 Item 1-19.
- Table 14.3-1 Item 1-63.

5.1.4 Verify that MHSI pump NPSH meets design requirements.

5.1.5 Verify that valve performance meets design requirements.

5.1.6 Verify that MHSI flow rate meet minimum / maximum design limitations.

5.1.7 Verify that MHSI small miniflow rate meets minimum / maximum design limitations.

5.1.8 Verify that MHSI large miniflow rate meets minimum / maximum design limitations.

5.2 Verify that MHSI system response times are less than those specified in Section 15.6.5.

5.3 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.2.3 Safety Injection Accumulator System (Test #015)

1.0 OBJECTIVE

1.1 To perform the test described in this abstract on the safety injection accumulator system in conditions that are representative of actual plant conditions or close enough to allow the data to be extrapolated to actual conditions.

1.2 To demonstrate that the safety injection accumulator system is properly installed and is functional prior to fuel loading.

1.3 To record data that is used to validate design basis assumptions or provide a baseline record of system performance for non-safety-related attributes.

1.4 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the safety injection accumulator subsystem have been completed or exceptions have been recorded and the impact on system performance has been determined.

2.2 Support systems required for the operation of the safety injection accumulator subsystem are complete and functional prior to performing the following test.

2.3 Adequate supply of makeup water from the IRWST is available.

2.4 The reactor vessel head and internals have been removed.

2.5 The reactor vessel is filled above the reactor vessel hot leg and cold leg nozzles.

2.6 Safety injection accumulator subsystem instrumentation has been checked and calibrated and is operating satisfactorily prior to performing the following test.

2.7 Test instrumentation is available and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

2.8 The combination of reactor vessel and refueling cavity are available to receive the contents of the safety injection accumulator.

2.9 The safety injection accumulator discharge path restriction is within design limits.

2.9.1 Table 14.3-1 Item 1-13.

2.10 The safety injection accumulator minimum volume is within design limits.

2.10.1 Table 14.3-1 Item 1-12.

3.0 TEST METHOD

3.1 Demonstrate that control valves can be remotely operated while observing valve operation and position indication. Where required, measure valve performance data.

3.2 Observe operation of power-operated valves upon loss of motive power (refer to Section 6.3 for anticipated response).

3.3 Observe valve interlock and alarm operation.

3.4 Observe level indication and alarm operation while filling the safety injection accumulators from the IRWST.

3.5 Observe pressure indication, control operation and alarms while pressurizing the safety injection tanks with nitrogen.

3.6 Pressurize each safety injection accumulator to its maximum operating pressure and verify each SI accumulator discharge valve open against the maximum differential pressure.

3.7 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Valve position indication during test.

4.2 Valve performance data, where required.

4.3 Position response of valves to loss of motive power.

4.4 Setpoints at which alarms and interlocks occurs.

4.5 Times required for safety injection accumulators to discharge their contents to the RCS.

4.6 Safety injection accumulator pressure when stroking valves.

5.0 ACCEPTANCE CRITERIA

5.1 The safety injection accumulator meets design requirements (refer to Section 6.3):

5.1.1 Verify alarm, interlock, and controls function as designed.

5.1.2 Verify that valves function as designed.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.2.4 Residual Heat Removal System (Test #016)

1.0 OBJECTIVE

1.1 To perform the test described in this abstract on the RHRS in conditions that are representative of actual plant conditions or close enough to allow the data to be extrapolated to actual conditions.

1.2 To demonstrate that the RHRS including the residual heat removal (RHR) pumps is properly installed and is functional prior to fuel loading.

1.3 To record data that is used to validate design basis assumptions or provide a baseline record of system performance for non-safety-related attributes.

1.4 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the RHR/low head safety injection (LHSI) system have either been completed or exceptions have been recorded and the impact on system performance has been determined.

2.2 Plant systems required to support testing are functional and temporary systems are installed and functional.

2.3 Permanently installed instrumentation is functional and calibrated and is operating satisfactorily prior to performing the following test.

2.4 Test instrumentation is available and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

2.5 All lines in the RHR/LHSI system have been filled and vented.

3.0 TEST METHOD

3.1 Observe the minimum flow rate of each LHSI pump with minimum flow established.

3.2 Measure LHSI pump performance including head and flow characteristics for design flow paths which include the normal decay heat removal flow path and:

3.2.1 RHRS flow to the CVCS for purification during shutdown.

3.2.2 RHRS transfer of refueling water from the refueling cavity to the IRWST.

3.2.3 RHRS capability to cool the IRWST.

3.3 Perform a full flow test of the LHSI system when aligned to take suction from the IRWST and discharging to the reactor vessel, with vessel level below the hot and cold leg nozzles.

3.4 Observe operation of the protective devices, controls, interlocks, indications, and alarms using actual or simulated signals.

3.5 Observe operation, stroking speed, position indication, and response to interlock of control and isolation valves.

3.6 Determine if motor operated valve (MOV) isolation valves can be opened against design differential pressure.

3.7 Measure NPSH to the LHSI pumps from suction sources at maximum design flow rates and minimum suction levels.

3.7.1 $NPSH_a \geq NPSH_R$.

3.7.2 Discharge head.

3.7.3 Flow corresponding to head at each point.

3.7.4 Starting time (motor start time and time to reach rated flow).

3.8 Measure flow capability of the RHR heat exchangers.

3.9 Measure flow through the flow limiting device, if applicable, in the LHSI discharge lines prevents runout flow when the LHSI system is at full flow.

3.10 Determine if each RHR train is capable of being powered by the electrically independent and redundant emergency power supplies.

3.11 Operate each LHSI pump available for hot and cold leg safety injection (SI) through the associated SI line and collect pump operating data.

3.12 Observe response of RHR and LHSI power-operated valves upon loss of motive power (refer to Section 6.3 for anticipated response).

3.13 Verify that the LHSI system meets full flow and shutoff head (by extrapolation) design requirements.

4.0 DATA REQUIRED

4.1 Valve position indications.

4.2 LHSI pump head versus flow.

4.3 Valve performance data, where required.

4.4 Setpoints of alarms and interlocks.

4.5 Position response of valves to loss of motive power.

5.0 ACCEPTANCE CRITERIA

5.1 The RHR/LHSI systems meets design requirements (refer to Section 6.3):

5.1.1 Verify that LHSI pump miniflow is within minimum/ maximum flow limits.

5.1.2 Verify adequate LHSI pump NPSH from all available pump suction paths.

5.1.3 Verify that the LHSI system can be aligned to take suction from the IRWST and discharge to the reactor vessel hot and cold leg within the minimum / maximum flow limits.

- Table 14.3-1 Item 1-14.

5.1.4 Verify the ability to align the LHSI pump to the hot leg and confirm that flow is within minimum/maximum limits.

5.1.5 Verify that LHSI pump flow and developed head are within minimum/maximum limits.

- Table 14.3-1 Item 1-15.
- Table 14.3-1 Item 1-63.

5.1.6 Verify that LHSI radial miniflow rate meets minimum / maximum design limitations.

5.1.7 Verify that LHSI tangential miniflow rate meets minimum / maximum design limitations.

5.1.8 Verify alarm, interlock, and controls function as designed.

5.1.9 Verify that RHR and LHSI valves function as designed.

5.1.10 Verify that RHR can be aligned to CVCS and flow rates are within minimum /maximum limits.

5.1.11 Verify the ability to align the RHR system to cool the IRWST.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.2.5 Mid-Loop Operations Verification (Test #017)

1.0 OBJECTIVE

1.1 To perform the test described in this abstract in conditions that are representative of actual plant conditions or close enough to allow the data to be extrapolated to actual conditions.

1.2 To demonstrate that the mid-loop operations system is properly installed and is functional prior to fuel loading.

1.3 To record data that is used to validate design basis assumptions or provide a baseline record of system performance for non-safety-related attributes.

1.4 To demonstrate that installed instrumentation for operations at reduced RCS inventory is accurate and reliable.

1.5 To demonstrate the RHRS pumps can be operated at reduced RCS level without cavitation or excessive pump vibration.

1.6 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the RCS mid-loop instrumentation system have been completed or exceptions have been recorded and the impact on system performance has been determined.

2.2 RCS mid-loop system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for mid-loop operations are completed and functional.

2.4 Test instrumentation is available and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

2.5 The RCS is at normal shutdown level, the pressurizer is drained and depressurized.

2.6 The RHR and mid-loop level instrumentation systems are functional.

2.7 Recommend installing an underwater camera in each RCS leg within sight of the RHR suction line but not close enough to introduce an unwanted effect.

3.0 TEST METHOD

3.1 Observe mid-loop operation of the RCS mid-loop level instrumentation, including indication, level controls, flow controls, and alarms.

3.1.1 Loop Level Control Function.

3.1.2 Max1 RCS Loop limitation Function.

3.1.3 Min1 RCS Loop Level Limitation Function.

3.1.4 Min1p RCS Loop Level Safety Functions.

3.2 Observe operation of the LHSI pump at minimum / maximum design flow conditions (e.g., motor current, pump vibration, system flow) while operating at various mid-loop levels.

3.3 Demonstrate that the LHSI pumps can operate without cavitation at the minimum mid-loop level and maximum design flow, for mid-loop conditions.

3.4 Demonstrate that the LHSI pumps can operate without excessive vibration at the minimum mid-loop level and minimum design flow, for mid-loop conditions.

3.5 Demonstrate that the RHR system can be throttled to the maximum allowable flow that prevents vortexing during mid-loop operation.

3.5.1 Take actions to prevent starting of the MHSI pumps.

3.5.2 Reduce RCS level to the Min1p RCS Loop Level.

3.5.3 Demonstrate RHR operation at the maximum allowable mid-loop flow without evidence of vortexing.

3.5.4 Remove power from the throttled valve(s) while operating at maximum flow and verify that the valve position fails as-is.

3.5.5 Gradually increase RHR flow until vortexing is observed.

3.5.6 Increase mid-loop level to normal level.

3.5.7 Restore MHSI ability to start on low mid-loop level and verify automatic start on Min1p RCS Loop Level.

3.6 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Setpoints of alarms.

4.2 Mid-loop instrumentation data.

4.3 LHSI pump flow and vibration data.

4.4 LHSI pump performance data for limiting mid-loop design conditions.

5.0 ACCEPTANCE CRITERIA

5.1 The RHR and mid-loop instrumentation systems (e.g., controls, indication, alarms, interlocks) perform as designed (refer to Section 7.7.)

5.2 Verify that LHSI pump performance meets the following design parameters (refer to Section 7.7):

5.2.1 Maximum allowable pump vibration and temperature limits.

5.2.2 Minimum / maximum flow limiting features.

5.2.3 Acceptable indications of pump cavitation.

5.3 Verify that safety-related components meet electrical independence and redundancy requirements.

5.4 Verify mid-loop performance for each division.

14.2.12.2.6 Severe Accident Heat Removal System (Test #018)

1.0 OBJECTIVE

1.1 To perform the test described in this abstract on the severe accident heat removal system (SAHRS) simulating conditions that are representative of actual plant conditions or close enough to allow the data to be extrapolated to actual conditions.

1.2 To demonstrate that the SAHRS is properly installed and is functional prior to fuel loading.

1.3 To record data that is used to validate design basis assumptions or provide a baseline record of system performance for non-safety-related attributes.

1.4 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested have either been completed or exceptions have been recorded and the impact on system performance has been determined.

2.2 Plant systems required to support testing are functional or temporary systems are installed and functional.

2.3 Permanently installed instrumentation is functional and calibrated and is operating satisfactorily prior to performing the following test.

2.4 Test instrumentation is available and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

2.5 Thermal camera is available to record thermography of SAHRS header with hot air discharged through the spray nozzles.

2.6 Temporary air compressor with more than 1500 cfm capacity (aftercooler must be bypassed) is available.

2.7 Temporary air hoses (minimum of two inch diameter) are installed between the temporary air compressor and the SAHRS header.

3.0 TEST METHOD

3.1 Record parameters associated with operation of the SAHRS pump with minimum flow established.

3.2 Record parameters associated with SAHRS pump performance including head and flow characteristics for design flow paths that can be tested by practical means.

3.3 Demonstrate valve performance data are within design limits.

3.4 Demonstrate by using the temporary air source that the SAHRS header and nozzles are free of obstructions.

3.5 Demonstrate adequate heat removal capability by the SAHRS heat exchangers, by flow measurement.

3.6 Demonstrate response of power-operated valves upon loss of motive power (refer to Section 19.0 for anticipated response).

3.7 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Valve position indications.

4.2 SAHRS pump head versus flow characteristics.

4.3 Valve performance data, where required.

4.4 Setpoints at which interlocks and alarms occur.

4.5 Position response of valves to loss of motive power.

4.6 Thermography record that spray nozzles are unobstructed. Thermography evidence shall be conclusive without need for supporting documentation.

5.0 ACCEPTANCE CRITERIA

5.1 The SAHRS meets design criteria (refer to Section 19.0):

5.1.1 Verify SAHRS pump performance is within minimum / maximum flow limits.

5.1.2 Verify that SAHRS pump performance on miniflow is within limits.

5.1.3 Verify that the SAHRS spray header nozzles are unobstructed.

5.1.4 Verify that the SAHRS heat exchangers meet flow requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.2.7 Extra Borating System (Test #019)

1.0 OBJECTIVE

1.1 To perform the test described in this abstract on the extra borating system (EBS) in conditions that are representative of actual plant conditions or close enough to allow the data to be extrapolated to actual conditions.

1.2 To demonstrate that the EBS is properly installed and is functional prior to fuel loading.

1.3 To record data that is used to validate design basis assumptions or provide a baseline record of system performance for non-safety-related attributes.

1.4 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the RCS and EBS have either been completed or exceptions have been recorded and the impact on system performance has been determined.

2.2 EBS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Test instrumentation is available and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

2.4 The EBS boron supply tank is functional to supply the extra borating pump suction.

2.5 The reactor vessel is ready to receive water from the EBS.

2.6 Support systems required for operation of the EBS are functional.

3.0 TEST METHOD

3.1 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.2 Observe response of power-operated valves upon loss of motive power (refer to Section 6.8 for anticipated response).

3.3 Start each EBS pump manually.

3.4 Observe EBS pump operation including pump alarms and interlocks.

3.5 Observe operation of EBS injection header (e.g., flow, pressure, temperature).

3.6 Measure performance, including head and flow characteristics, of the EBS pumps.

3.6.1 $NPSH_a \geq NPSH_R$.

3.6.2 Discharge head.

3.6.3 Flow corresponding to head at each point.

3.6.4 Starting time (motor start time and time to reach rated flow).

3.7 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.8 Verify that the EBS system meets full flow and shutoff head (by extrapolation) design requirements.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indication.

4.3 Position response of valves to loss of motive power.

4.4 EBS pump operating data.

4.5 Setpoints at which alarms and interlocks occur.

4.6 EBS pump head versus flow.

5.0 ACCEPTANCE CRITERIA

5.1 The EBS meets design requirements (refer to Section 6.8):

5.1.1 Verify that EBS pump relief valve discharges to the EBS storage tank to protect the EBS discharge piping.

5.1.2 Verify adequate EBS pump NPSH from all available pump suction paths.

5.1.3 Verify that the EBS can be aligned to take suction from the EBS Storage Tank and discharge to the reactor vessel cold leg within the minimum / maximum flow limits.

5.1.4 Verify that EBS pump flow and developed head are within minimum/maximum limits.

5.1.5 Verify alarm, interlock, and controls function as designed.

5.1.6 Verify that EBS valves function as designed.

5.1.7 Verify that the EBS maximum discharge pressure is greater than the maximum RCS design pressure.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.2.8 Emergency Feedwater System (Test #020)

1.0 OBJECTIVE

1.1 To perform the test described in this abstract on the emergency feedwater system (EFWS) in conditions that are representative of actual plant conditions or close enough to allow the data to be extrapolated to actual conditions.

1.2 To demonstrate that the EFWS is properly installed and is functional prior to fuel loading. This test shall demonstrate the ability of the EFWS to supply feedwater to the steam generators (SG) for design emergency conditions.

1.3 To record data that is used to validate design basis assumptions or provide a baseline record of system performance for non-safety-related attributes.

1.4 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested have either been completed or exceptions have been recorded and the impact on system performance has been determined.

2.2 Permanently installed instrumentation is functional and calibrated and is operating satisfactorily prior to performing the following test.

2.3 Test instrumentation is available and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

2.4 Plant systems required to support testing are functional, or temporary systems are installed and functional.

3.0 TEST METHOD

3.1 Test the control logic and record response.

3.2 Measure the following head and flow characteristics of emergency feedwater (EFW) pumps:

3.2.1 Pump head versus flow.

3.2.2 Starting time (motor start time and time to reach rated flow).

3.2.3 $NPSH_a \geq NPSH_R$.

3.3 Align the EFW system to all possible design flow paths and record flow.

3.4 Determine if the operation in response to signals from the plant protection system is within design limits.

3.5 Measure EFW system operation in response to signals from the hardwired controls of the safety information and controls system.

3.6 Measure response of power operated valves (e.g., stroke time, developed thrust).

3.7 Record operation of the following using actual or simulated inputs:

3.7.1 Protective devices.

3.7.2 Controls.

3.7.3 Interlocks.

3.7.4 Instrumentation response.

3.7.5 Alarms.

3.8 Record pump performance during an endurance test.

3.9 Observe response of power-operated valves upon loss of motive power (refer to Section 10.4.9 for anticipated response).

3.10 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 EFWS valve position indications.

4.2 EFWS valve performance data, where required including valve stroke time under design basis differential pressure.

4.3 EFWS pump head versus flow curves.

4.4 Flow rates through venturi.

4.5 Response of EFW pumps to safety-related signals.

4.6 Pump start times.

4.7 Position response of EFWS valves to loss of motive power.

5.0 ACCEPTANCE CRITERIA

5.1 The EFWS meets design criteria (refer to Section 10.4.9):

5.1.1 Verify that EFWS pump miniflow is within minimum/ maximum flow limits.

5.1.2 Verify adequate EFWS pump NPSH from all available pump suction paths.

5.1.3 Verify that the EFWS can be aligned to take suction from the EFW Storage Tank and discharge to the steam generator within the minimum / maximum flow limits.

- Table 14.3-1 Item 1-57.
- Table 14.3-1 Item 1-58.
- Table 14.3-1 Item 1-54.
- Table 14.3-1 Item 1-55.

5.1.4 Verify that EFW pump flow and developed head are within minimum/maximum limits.

5.1.5 Verify that EFW pump startup time from event detection to full flow meet design limits.

- Table 14.3-1 Item 1-64.

5.1.6 Verify alarm, interlock, and controls function as designed.

5.1.7 Verify that EFW valves function as designed.

5.2 Verify safety-related components meet electrical independence and redundancy requirements.

14.2.12.2.9 Emergency Feedwater Storage Pool (Test #021)

1.0 OBJECTIVE

1.1 To perform the test described in this abstract on the EFWS in conditions that are representative of actual plant conditions or close enough to allow the data to be extrapolated to actual conditions.

1.2 To record data that is used to validate design basis assumptions or provide a baseline record of system performance for non-safety-related attribute.

1.3 To demonstrate that the EFW storage pool provides a reliable source of water for the EFWS.

1.4 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITE

2.1 Construction activities on the EFW storage pool have either been completed or exceptions have been recorded and the impact on system performance has been determined.

2.2 The EFW storage pool instrumentation has been calibrated and is functional for performance of the following test.

2.3 Test instrumentation is available and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

2.4 Support system required for the operation of the EFW storage pool is complete and functional.

2.5 Verify that EFW pool capacity at minimum design level meets design volume requirements.

3.0 TEST METHOD

3.1 Observe response of associated EFW pool control logic.

3.2 Observe operation EFW pool design flow paths.

3.3 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.4 Observe response of power-operated valves upon loss of motive power a (refer to Section 10.4.9 for anticipated response).

3.5 Observe operation of protective devices, controls, interlocks, instrumentation, and alarms, using actual or simulated inputs.

3.6 Verify the EFW storage pool is maintained at acceptable dissolved oxygen concentrations.

3.7 Verify flow paths.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Pump operating data.

4.2 Valve performance data, where required.

4.3 Valve position indication.

4.4 Position response of valves to loss of motive power.

4.5 Setpoints at which alarms and interlocks occur.

4.6 Applicable chemistry results.

5.0 ACCEPTANCE CRITERIA

5.1 The EFW storage pool meets design criteria (refer to Section 10.4.9):

5.1.1 Verify operation of EFW pool controls, interlocks, and alarms.

5.1.2 Verify that EFW pool valves function as designed.

5.1.3 Verify that EFW pool capacity is within design limits.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.2.10 In-Containment Refueling Water Storage Tank System (Test #022)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the following subsystems:

1.1.1 IRWST.

1.1.2 Severe accident heat removal system (SAHRS) supply header.

1.1.3 MHSI supply header.

1.1.4 LHSI supply header.

1.1.5 CVCS supply header.

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

1.3 Identify any leakage from the IRWST liner plate.

2.0 PREREQUISITES

2.1 Construction activities on the IRWST are complete.

2.2 Plant systems required to support testing are functional or temporary systems are installed and functional.

2.3 Permanently installed instrumentation is functional and calibrated.

2.4 Test instrumentation is available and calibrated.

2.5 Refueling cavity integrity can be established.

2.6 The core spreading area can receive water from the IRWST.

2.7 Verify that the minimum IRWST capacity is within design limits.

2.7.1 Table 14.3-1 Item 1-20.

3.0 TEST METHOD

3.1 Operate control valves remotely while:

3.1.1 Observing each valve operation and position indication.

3.1.2 Measuring valve performance data (e.g., thrust, opening and closing times).

3.2 Fill the IRWST with reactor makeup water and record volume versus indicated level. Observe level indication and alarms.

3.3 Simulate the full range of IRWST temperatures and observe indications and alarms.

3.4 Check design flow path from IRWST to the SAHRS including the core spreading area (e.g., sump, strainers, and other debris retention devices).

3.5 Check design flow path from IRWST to the safety injection systems (MHSI and LHSI) including the refueling cavity (e.g., sump, strainers, and other debris retention devices).

3.6 Check design flow path from IRWST to the CVCS suction (e.g., sump, strainers, and other debris retention devices).

3.7 Verify operation of the level alarms and indication of the reactor cavity.

3.8 Demonstrate functionality and adequacy of range of the IRWST pressure instrumentation.

3.9 Demonstrate the operation and configuration of the IRWST return screens.

3.10 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.11 Quantify leakage from the IRWST liner plate.

4.0 DATA REQUIRED

4.1 Valve position indications.

4.2 Valve opening and closing time, where required.

4.3 Setpoint at which alarms occur.

4.4 IRWST leakage.

5.0 ACCEPTANCE CRITERIA

5.1 The IRWST meets design requirements (refer to Sections 6.3 and 19.2):

5.1.1 Verify that the CVCS suction path meets design requirements.

5.1.2 Verify that the safety injection suction path meets design requirements.

5.1.3 Verify that the SAHRS suction path meets design requirements

5.1.4 Verify alarm, interlock, and controls function as designed.

5.1.5 Verify that IRWST valves function as designed.

5.1.6 IRWST leakage meets design requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.2.11 Core Melt Stabilization System (Test #023)

1.0 OBJECTIVE

1.1 To demonstrate proper construction of the core melt stabilization system (CMSS).

2.0 PREREQUISITES

2.1 Construction activities on the CMSS are complete.

2.2 Plant systems required to support testing are functional or temporary systems are installed and functional.

2.3 Permanently installed instrumentation is functional and calibrated and is operating satisfactorily prior to performing the following test.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Determine acceptability by visual examination system constructed as described in design documents.

3.2 Measure the acceptability of the cooling system, as described in design documents.

4.0 DATA REQUIRED

4.1 Punch list of deficiencies at time of acceptance walkdown have been corrected.

4.2 Cooling system flow rate.

5.0 ACCEPTANCE CRITERIA

5.1 All deficiencies noted during the walkdown have been corrected.

5.2 The configuration, including the cooling system flow rate, is as designed (refer to Section 19.0).

14.2.12.3 Engineered Components

14.2.12.3.1 Containment Equipment Hatch Functional and Leak Test (Test #024)

1.0 OBJECTIVE

1.1 To verify the measured leakage through the containment equipment hatch when summed with the total of other Type B and C leak rate tests (LRT) is within the limits as required by the Technical Specifications and 10 CFR 50, Appendix J.

1.2 To demonstrate the operation of the containment equipment hatch.

2.0 PREREQUISITES

2.1 Construction activities on the equipment have been completed.

2.2 Temporary pressurization equipment is installed and instrumentation calibrated.

3.0 TEST METHOD

3.1 Demonstrate the operation of the equipment hatch from its normal closed location to its open location and back to its normally closed location.

3.2 Place the hatch in the closed position and perform a 10 CFR 50, Appendix J, Type B LRT.

3.3 Place the hatch in the closed position and perform a structural integrity test at 110 percent of design basis accident pressure.

4.0 DATA REQUIRED

4.1 Containment equipment hatch leak data.

5.0 ACCEPTANCE CRITERIA

5.1 Verify leak rate, when summed with the total of other Type B and C LRTs, does not exceed the limits as required by the Technical Specifications and 10 CFR 50, Appendix J.

5.2 The equipment hatch assembly operates in accordance with manufacturer instructions.

5.3 The equipment hatch meets design requirements (refer to Sections 3.1.5, 3.8.1, and 3.8.2).

5.3.1 Structural integrity test.

5.3.2 Appendix J LRT.

5.3.3 Verify alarms, interlocks, and system controls.

14.2.12.3.2 Containment Personnel Airlock Functional and Leak Test (Test #025)

1.0 OBJECTIVE

1.1 To verify the measured leakage, through each containment personnel airlock when summed with the total of other Type B and Type C LRTs is within the limits as required by the Technical Specifications and 10 CFR 50, Appendix J.

1.2 To verify each, containment personnel airlock, operates as designed in Sections 3.1.5, 3.8.1, and 3.8.2.

2.0 PREREQUISITES

2.1 Construction activities on the containment personnel airlocks have been completed.

2.2 Temporary pressurization equipment is installed and instrumentation is calibrated.

2.3 Electrical checks are complete on the hatches.

3.0 TEST METHOD

3.1 Operate each airlock in accordance with manufacturer instructions; verify alarms, interlocks and indications.

3.2 Place each airlock in the closed position and perform a 10 CFR 50, Appendix J, Type B LRT.

3.3 Place each airlock in the closed position and perform a structural integrity test at 110 percent of design basis accident pressure.

4.0 DATA REQUIRED

4.1 Individual airlock leak data.

5.0 ACCEPTANCE CRITERIA

5.1 Verify leak rates, when summed with the total of other Type B and C LRTs, do not exceed the limits as required by the Technical Specification and 10 CFR 50, Appendix J.

5.2 The containment personnel airlocks perform as designed (refer to Sections 3.1.5, 3.8.1, and 3.8.2):

5.2.1 Structural integrity test.

5.2.2 Appendix J LRT.

5.2.3 Verify alarms, interlocks, and system controls.

14.2.12.3.3 Containment Electrical Penetration Assemblies (Test #026)

1.0 OBJECTIVE

1.1 To verify the integrity of the electrical penetration o-ring seals, and to verify that a summation of the Type B and C LRT results does not exceed the limits as required by the Technical Specifications and 10 CFR 50, Appendix J.

2.0 PREREQUISITES

2.1 Containment electrical penetration assemblies must be complete with no identified exceptions or discrepancies which would affect the test.

3.0 TEST METHOD

3.1 Perform a 10 CFR 50, Appendix J, Type B LRT at 100 percent of design basis accident pressure for each electrical penetration identified in Table 6.2.4-1.

4.0 DATA REQUIRED

4.1 Electrical penetration leak data.

5.0 ACCEPTANCE CRITERIA

5.1 Verify the sum of the containment electrical penetration assembly LRTs, when summed with other Type B and Type C tests, does not exceed limits as required by the Technical Specifications and 10 CFR 50, Appendix J.

5.2 Containment electrical penetration assemblies perform as designed (refer to Sections 3.1.5, 3.8.1, and 3.8.2):

5.2.1 Appendix J LRT.

14.2.12.3.4 Containment Isolation Valves (Test #027)

1.0 OBJECTIVE

1.1 To demonstrate that CIVs operate as designed from a remote manual signal and in response to automatic actuation.

1.2 To verify that upon loss of actuating power, the valves fail as designed.

Note: The intent is not to perform stroke testing if already performed in individual system tests. For this test a table will be created for each CIV that includes the tested stroke time and the appropriate test reference.

1.3 To verify that valves operate in less than the time specified in the system test procedure.

1.4 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the CIVs have been completed.

2.2 Support system required to operate the CIVs are functional.

2.3 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Operate CIVs remotely while:

3.1.1 Observing each valve operation and position indication, and

3.1.2 Measuring valve performance data if not performed during individual system test (e.g., thrust, opening and closing times).

3.2 Verify CIVs fail upon loss of motive power to their position specified in the safety analysis.

3.3 Verify that CIVs reposition to the position specified by design upon initiation of these simulated activation signals.

3.3.1 Containment Stage 1 Signal due to high containment pressure.

- Verify that those components that are required to respond during an extended loss of alternating current power (ELAP) event are capable of being repositioned, as designed.

3.3.2 Containment Stage 1 Signal due to high containment radiation.

- Verify that those components that are required to respond during an ELAP event are capable of being repositioned, as designed.

3.3.3 Containment Stage 2 Signal due to high-high containment pressure.

- Verify that those components that are required to respond during an ELAP event are capable of being repositioned, as designed.

3.4 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Valve performance data under differential pressure, flow, and temperature conditions as applicable.

4.2 Valve position indications.

4.3 Position response of valves to loss of motive power.

4.4 Valve response to a simulated actuation signal.

4.5 ELAP component response to operator commands during containment isolation signals.

5.0 ACCEPTANCE CRITERIA

5.1 The CIVs operate as designed (refer to Sections 3.1.5 and 6.2.4):

5.1.1 Valve operation (i.e., thrust, failure mode upon loss of motive power, opening and closing times).

5.1.2 ELAP component response to operator commands during isolation signals.

5.2 The CIV closure times meet design requirements.

5.2.1 Table 14.3-2 Item 2-10.

5.2.2 Table 14.3-2 Item 2-14.

5.3 Verify that safety-related components meet electrical independence requirements and redundancy requirements.

14.2.12.3.5 Containment Isolation Valves Leakage Rate (Test #028)

1.0 OBJECTIVE

1.1 To verify that the measured leakage through each containment penetration isolation valve when summed with the total of other Type B and C LRTs is within the limits as required by the Technical Specifications and 10 CFR 50, Appendix J.

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested have been completed.

2.2 Temporary pressurization equipment is installed and instrumentation is calibrated.

3.0 TEST METHOD

3.1 Close the individual CIVs by the means provided for normal operation of each individual valve. The valves must be stroked to the closed position by the normal means to perform a valid leakage test.

3.2 Perform 10 CFR 50 Appendix J, Type C test, by local pressurization of each penetration.

4.0 DATA REQUIRED

4.1 Individual penetration leak data.

5.0 ACCEPTANCE CRITERIA

5.1 Verify leak rates, when summed with the total of other Type B and C LRTs, do not exceed the allowable limits as required by the Technical Specifications and 10 CFR 50, Appendix J.

5.2 The CIVs operate as designed (refer to Sections 3.1.5, 3.8.1, and 6.2.6).

14.2.12.3.6 Containment Integrated Leak Rate and Structural Integrity Tests (Test #029)

1.0 OBJECTIVE

1.1 To perform the structural integrity test (SIT) and integrated leak rate test (ILRT) for the containment.

1.2 To verify that the integrated leak rate from the containment does not exceed the maximum allowable leakage rate.

1.3 To verify that the various purge paths can control the containment depressurization.

2.0 PREREQUISITES

2.1 Containment penetration local leak rate testing has been completed.

2.2 All systems inside containment which have CIVs identified are vented and drained as required by Section 6.2.6.1.

2.3 Leakage rate determination instrumentation is available, calibrated, and is operating satisfactorily prior to performing the following test.

2.4 Containment inspection completed as required by the Technical Specifications and 10 CFR 50, Appendix J.

2.5 Systems required for the test are available, including station air and other miscellaneous systems.

2.6 Instrumentation to measure containment building movement is installed and calibrated and is operating satisfactorily prior to performing the following test.

2.7 Containment ventilation system fans are capable of running for air circulation. Note that it is necessary to create air circulation to eliminate local temperature variations that would bias the test results.

2.8 The containment purge paths are available for containment depressurization.

3.0 TEST METHOD

3.1 Close individual CIVs by the means provided for normal operation of the valves as required by 10 CFR 50, Appendix J.

3.2 Remove power from the hydrogen mixing damper solenoids.

3.3 Verify that the hydrogen mixing dampers are open prior to beginning the containment pressurization.

Note: There should be at least one opening (door or foil) into each confined area but the test should also consider adequate air mixing (to prevent local hot spots) in areas that are not instrumented during the test.

3.4 A suitable number of the following components have been placed in the open position:

3.4.1 Convection and rupture lower door frames.

3.4.2 Pressure relieving doors.

3.4.3 Radiation doors.

3.5 Increase the internal pressure in the containment building from atmospheric pressure to a minimum of 115 percent of design pressure in at least four approximately equal increments and depressurized in the same increments.

3.6 Record data at each pressure level, during pressurization and depressurization, an evaluation of the deflections shall be made to

determine if the response deviates significantly from the expected response.

3.7 Perform a visual inspection of the containment hatches, penetrations, and flanged joints.

3.8 Determine the containment leak rate at calculated peak accident pressure and at one-half calculated peak accident pressure.

3.9 Verify leakage by reference vessel method, absolute pressure method, or both.

3.10 Verify the test accuracy by supplementary means.

3.11 Verify that the containment can be depressurized.

3.11.1 Initially using the deflation line, verify that the control valve adequately controls the depressurization.

3.11.2 Terminate the deflation and verify that the system responds as desired.

3.11.3 When containment pressure has been depressurized to approximately 35 psig, place the normal low flow purge valve into service and verify that the system adequately controls the depressurization.

3.11.4 Terminate the deflation and verify that the system responds as desired.

3.11.5 When containment pressure has been depressurized to approximately 30 psig, place the ELAP bypass small purge path into service and verify that the system adequately controls the depressurization.

3.11.6 Terminate the deflation and verify that the system responds as desired.

4.0 DATA REQUIRED

4.1 Structural integrity data.

4.1.1 The readings of instrumentation to measure containment building movement shall be recorded at selected pressure levels.

4.1.2 Displacements shall be measured at several points along locations spaced evenly around the containment. The locations shall include the following:

- Springline.
- Top of dome (the top of the concrete).
- Locations with varying stiffness characteristics such as major penetrations.
- Radial and vertical defections of the containment wall adjacent to the equipment hatch opening shall be measured at twelve points around the hatch penetration. The twelve points shall be three locations each at the

three, six, nine and twelve o'clock positions around the penetration.

4.2 Integrated leak rate data.

4.2.1 Containment temperature, pressure, and humidity.

4.2.2 Reference vessel temperature and pressure.

4.2.3 Atmospheric pressure and temperature.

4.2.4 Known leakage air flow.

4.3 Record the following data in the equipment space and the service area.

4.3.1 Differential pressure data.

4.3.2 Temperature data in the equipment space.

4.3.3 Temperature data in the service area.

5.0 ACCEPTANCE CRITERIA

5.1 SIT results are satisfactory, in accordance with ASME Code, Article CC-6000 (Reference 2) and RG 1.136, as detailed in Section 3.8.1.7.1.

5.2 Containment vessel shows no signs of structural degradation following the SIT as designed (refer to Section 3.8.1).

5.3 The ILRT results are satisfactory as specified in Section 6.2.6.

5.3.1 Table 14.3-1 Item 1-10.

5.3.2 Table 14.3-2 Item 2-2.

5.4 Containment meets design requirements (refer to Sections 3.1.5, 3.8.1, and 6.2.6).

5.5 The various alignments that can be used to depressurize containment function as designed.

5.5.1 Damage to flow path is not experienced.

14.2.12.3.7 Reactor Coolant System Hydrostatic (Test #030)

1.0 OBJECTIVE

1.1 To verify the integrity of the RCS pressure boundary and associated Safety Class I piping.

2.0 PREREQUISITES

2.1 The RCS is filled, vented, and above the minimum required temperature. Note that it is necessary to heat the RCS by running the RCPs so that the system shall remain above the minimum temperature during the soak period and the subsequent examination period.

2.2 All RCPs are functional.

2.3 A high head pump (1.25 times the RCS design pressure) is available for the hydrostatic test.

2.4 Primary safety valves are removed or gags are available for installation, after RCPs are secured.

2.5 Permanently installed instrumentation necessary for testing is functional and calibrated.

2.6 Relief valve with sufficient capacity to protect the RCS pressure boundary is installed.

2.7 Test instrumentation is available and calibrated. Note that it is necessary to add the additional pressure that is equivalent to the instrument uncertainty to the test pressure.

3.0 TEST METHOD

3.1 Operate RCPs to sweep gases from the SG tubes.

3.2 Vent the RCS and the reactor vessel head.

3.3 Operate the RCPs to increase the RCS temperature to greater than that required for pressurization of RCS to test pressure. Note that temperature will decline during the test and the test must be completed prior to reaching the nil ductility temperature for the limiting component.

3.4 Perform the test in accordance with the ASME Section III Code requirements.

4.0 DATA REQUIRED

4.1 RCS temperature.

4.2 RCS pressure.

4.3 Chronological sequence of events.

5.0 ACCEPTANCE CRITERIA

5.1 The RCS hydrostatic test meets the requirements of ASME Code, Section III.

14.2.12.3.8 Reactor Coolant Pump Motor Initial Operation (Test #031)

1.0 OBJECTIVE

1.1 To verify the proper operation of each RCP motor.

1.2 To collect baseline data for each RCP motor.

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 The RCP motor instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.2 Each RCP motor and its respective pump are uncoupled.

2.3 Support systems required for operation of each RCP motor are functional.

3.0 TEST METHOD

3.1 Determine oil level setpoints of oil reservoirs by draining oil from motor reservoirs and subsequently refilling.

3.2 Simulate oil lift pumps and CCW system starting interlocks preventing RCP motor operation and observe effects.

3.3 Manually start the RCP oil lift system, and verify satisfactory oil levels in reservoirs, and operation of the oil lift system.

3.4 Start CCW flow to the RCP motor and observe indicating lights and alarms.

3.5 Rotate the RCP motor and verify that the wiring of motor leads and torque required to rotate the motor is correct using a torque wrench and phase rotation meter.

3.6 Verify that RCP will not rotate in reverse direction using a torque wrench.

3.7 Verify the condition and the operation of the anti-rotation ratchet pawls.

3.8 Verify the condition and freedom of movement of the RCP flywheel.

3.9 Jog the RCP motor and verify correct rotation by independent means.

3.10 Start each RCP motor and verify that operation is within design limits.

3.11 Record the motor operating data.

3.12 Verify proper operation of the RCP oil lift system.

3.13 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Motor operating data.

4.2 Torque needed to rotate the RCP motors.

4.3 Setpoints at which indications, alarms, and interlocks occur.

4.4 RCP oil lift system pressure.

4.5 RCP motor operating data.

5.0 ACCEPTANCE CRITERIA

5.1 The RCP motors, support systems, alarms, indications, and interlocks perform as designed (refer to Section 5.4.1):

5.1.1 CCW flow and indication to the RCP.

5.1.2 RCP instrumentation.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

5.3 Verify that the RCP anti-reverse rotation device does not allow reverse rotation when other RCPs are in operation.

14.2.12.3.9 Steam Generator Hydrostatic (Test #032)

1.0 OBJECTIVE

1.1 To hydrostatically test the secondary side of the SG and portions of the following systems that can not be isolated from the SG:

1.1.1 Main steam.

1.1.2 Feedwater.

1.1.3 SG blowdown.

1.1.4 EFWS.

2.0 PREREQUISITES

2.1 Construction activities on the SG secondary side are complete.

2.2 The RCS is available to be pressurized and the RCPs are functional.

2.3 The main steam safety valves are removed and blind flanges are installed.

2.4 Temporary hydrostatic test pump and relief valves are installed.

2.5 Temporary instrumentation (temperature and pressure) calibrated and installed.

2.6 Systems required to support the operation the RCS and RCPs are available.

2.7 Any permanent plant instrumentation not able to withstand hydrostatic pressure is removed from service.

2.8 Main steam piping has been determined to be capable of supporting water filled lines or temporary supports have been installed.

3.0 TEST METHOD

3.1 Fill and vent the SGs and chemically treat the water, as required.

3.2 Operate the RCS and associated systems as needed to operate the RCPs. Heat the RCS and SGs to the required temperature. The SGs must be sufficiently heated so that the temperature shall not fall below the minimum nil-ductility temperature during the required system hold or examination period.

3.3 Pressurize the primary side as required to maintain less than maximum secondary to primary differential pressure.

3.4 Pressurize the SG to the pressure required by the technical manual.

3.5 Perform an inspection of designated items and record any discrepancies.

4.0 DATA REQUIRED

4.1 Record SG pressure and temperatures during performance of the test.

4.2 Record the location of any observed leakage.

5.0 ACCEPTANCE CRITERIA

5.1 The SGs hydrostatic test meets the requirements as stated in the SG technical manual and the ASME, "Boiler and Pressure Vessel Code," Section III.

14.2.12.3.10 Steam Generator Downcomer Feedwater System Water Hammer (Test #033)

1.0 OBJECTIVE

1.1 To demonstrate the absence of any significant water hammer during SG water level recovery following the exposure of the downcomer feedwater sparger to a steam environment and to inspect the feedwater line welds in accordance with NRC Bulletin 79-13.

2.0 PREREQUISITES

2.1 Construction activities on the EFWS and those sections of the feedwater system (MFWS) that are affected have been completed.

2.2 The feedwater control instrumentation and other appropriate permanently installed instrumentation have been calibrated and are functioning satisfactorily.

2.3 Main steam system (MSS) is available.

2.4 Appropriate AC and DC power sources are available.

2.5 RCS operating at nominal HZP (pressure and temperature) conditions.

3.0 TEST METHOD

3.1 Lower the SG water level below the feedwater and emergency feedwater headers but within the narrow range (NR) level indication band for a period of 30 minutes (no feedwater shall be introduced into the generator through the feedwater header during this period).

3.2 Monitor for noise or vibration by stationing personnel as appropriate.

3.3 Initiate feedwater flow to restore SG level in a manner that simulates automatic EFWS actuation.

3.4 Repeat the test using the startup, standby pump to restore SG level in a manner that simulates automatic actuation.

4.0 DATA REQUIRED

4.1 Visually inspect the accessible portions of feedwater piping and piping supports following the performance of the test to verify operability and conformance to design.

4.2 Visual inspection of SG sparger shall be performed prior to core load.

4.3 Perform radiographic examination, supplemented by ultrasonic examination as necessary to evaluate indications, of all feedwater nozzle-to-pipe welds and of adjacent pipe and nozzle areas (a distance equal to at least two wall thicknesses).

5.0 ACCEPTANCE CRITERIA

5.1 Perform a visual inspection consisting of both a quantitative and qualitative evaluation of feedwater piping, supports, and sparger and determine if the integrity of components has not been violated with performance of EFWS initiation testing.

5.1.1 The quantitative component of the evaluation is a post-test evaluation of the SG sparger for visual damage. The inspection will look for cracked welds and inspect the sparger by comparing as-built dimensions to post-test dimensions. Any dimensional differences will be evaluated. The specific allowable dimensional differences are not typically specified in the SG design package and are evaluated on a case-by-case basis if differences are noted.

5.1.2 The qualitative component evaluation consists of noise and vibration analysis. The source of noise and vibration may be indicative of EFW line voiding or two phase flow and can lead to future sparger degradation if not corrected.

5.2 Evaluation shall be in accordance with ASME Section III, Subsection NC, Article NC-5000. Radiography shall be performed to the 2T penetrameter sensitivity level, in lieu of Table NC-5111-1, with systems void of water.

5.2.1 In the event cracking is identified during examination of the nozzle-to-pipe weld, all feedwater line welds up to the first piping support or snubber outboard of the nozzle shall be volumetrically examined in accordance with the requirements of Sections 4.3 and 5.2 of this test.

14.2.12.3.11 Balance of Plant Piping Thermal Expansion Measurement (Test #034)

1.0 OBJECTIVE

1.1 To demonstrate that the balance of plant (BOP) components are free to expand thermally as designed during initial plant heatup and return to their baseline cold position after the initial cooldown to ambient temperatures.

2.0 PREREQUISITES

2.1 This test is carried out in conjunction with the initial RCS heatup; prerequisite conditions for initial heatup of the RCS must be established.

2.2 Construction activities are complete on the pipes to be measured.

2.3 Adjustment, setting and marking of initial positions of spring hangers, hydraulic restraints, and special devices of the systems have been completed.

2.4 Temporary scaffolding and ladders are installed as required to make observations and record data.

3.0 TEST METHOD

3.1 Perform a visual inspection during HFT and precritical heatup for power escalation to verify that spring supports are within design range (i.e., indicator within spring scale) and recorded.

3.2 Perform a visual inspection of snubbers to verify they have not contacted either stop and are within expected travel range.

3.3 Perform a visual inspection of snubber piston scales to verify acceptance criteria for piston to stop gap is met. Hot displacement measurements of snubbers shall be obtained and motion shall be compared with predicted values.

3.4 Perform system walkthroughs during HFT to visually verify that piping and components are unrestricted from moving within their range.

3.5 Verify by observation or calculation (or both) that the snubbers shall accommodate the predicted thermal movement for systems that do not attain design operating temperature.

3.6 Inspect small pipe in the vicinity of connections to large pipe to verify that sufficient clearance and flexibility exists to accommodate thermal movements of the large pipe.

3.7 Obtain hot displacement measurements of the main feedwater system (MFWS) and EFWS during Phase IV Power Ascension Testing.

3.8 Re-inspect snubbers and spring supports, which required adjustments during the test in a subsequent hot condition to verify that adjustments are within design limits.

4.0 DATA REQUIRED

4.1 Tabulate position measurements for designated piping, spring supports, and snubbers at various temperature plateaus and the following reference points:

4.1.1 Cold (ambient conditions).

4.1.2 During heatup (transition from Mode 4 to Mode 3).

4.1.3 Steady state HZP (pressure and temperature) conditions.

4.1.4 During cooldown.

4.1.5 After returning to ambient conditions.

5.0 ACCEPTANCE CRITERIA

5.1 Piping moves freely as designed (refer to Section 3.9.2).

5.2 Thermal movement of piping at the locations of spring hangers and snubbers are within allowable travel range as designed (refer to Section 3.9.2).

5.3 Thermal movement of the piping at restricted measurement locations are within the acceptable limits or discrepant response is reconciled using acceptable reconciliation methods as designed (refer to Section 3.9.2).

14.2.12.3.12 BOP Piping Vibration Measurement (Test #035)

1.0 OBJECTIVE

1.1 To verify that piping layout and support or restraints (or both) are adequate to withstand normal transients without damage in the designated piping systems.

1.2 To demonstrate that flow induced vibration is sufficiently small to cause no fatigue or stress failures in the designated piping systems.

2.0 PREREQUISITES

2.1 System components and piping supports have been installed in accordance with design drawings for system to be tested.

2.2 System piping has been installed in accordance with design drawings for system to be tested.

2.3 HFT or precritical heatup (or both) for power escalation are underway.

2.4 System piping has been filled and vented for normal operation.

3.0 TEST METHOD

3.1 Perform an assessment of piping system vibration observed during system operation.

4.0 DATA REQUIRED

4.1 Pipe response data to include piping drawings, vibration measurements and operating conditions.

5.0 ACCEPTANCE CRITERIA

5.1 Steady state vibration testing based on limits established by the piping designers.

5.1.1 Acceptance criteria are based on conservatively estimated stresses which are derived from measured velocities and conservatively assumed mode shapes.

5.2 Transient vibration testing based on limits established by the piping designers.

5.2.1 No permanent deformation or damage in any safety-related system, structure or component is observed.

5.2.2 All suppressors and restraints respond within their allowable ranges, between stops or with indicators on scale.

14.2.12.3.13 Control Rod Drive Mechanism Control (Test #036)

1.0 OBJECTIVE

1.1 To demonstrate proper input signals and proper sequencing of input signals to CRDM coils.

1.2 To demonstrate proper operation of the CRDM control system in functional modes.

1.3 To verify proper operation of the CRDM control system interlocks and alarms.

1.4 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the CRDM control system have been completed and system software is installed.

2.2 Cable continuity tests have been completed.

2.3 Special test instrumentation has been calibrated and is functional.

2.4 Special test equipment is functional.

2.5 RCCAs are installed in dummy or actual fuel assemblies, to allow movement of the RCCAs.

2.6 RCCAs are latched by lifting the drive shaft and observing the weight corresponding to a latched RCCA, prior to installing the reactor head.

2.7 Support systems required for operation of the CRDM control system are functional.

2.8 Reactor head installed, filled and vented to cool the CRDMs or an analysis has been performed to demonstrate that filling the CRDMs is not necessary.

3.0 TEST METHOD

3.1 Energize and latch CRDMs by closing the reactor trip breaker.

3.2 Observe the sequence in which withdraw and insert signals are passed to the appropriate CRDM coil using special test instrumentation.

3.3 Observe operation of the RCCA position indicators.

3.4 Operate the CRDM control system in functional modes.

3.5 Simulate input signals and observe operation of the following:

3.5.1 CRDM withdrawal inhibit interlocks.

3.5.2 CRDM withdrawal sequence and overlap controls (control banks only).

3.5.3 Partial reactor trip.

3.5.4 Realignment in proper overlap and sequence following a partial reactor trip.

3.5.5 Park position.

3.5.6 Bite position.

3.5.7 Alarms.

3.6 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 CRDM coil current traces.

4.2 CRDM control system rod step indications.

4.3 CRDM control system operating data.

4.4 Interlock and alarm actuation points.

5.0 ACCEPTANCE CRITERIA

5.1 The CRDM control system meets design requirements (refer to Section 7.1.1.5.1):

5.1.1 CRDM interlocks, controls, and alarms.

5.1.2 CRDM latch operation.

5.2 The RCCA bank withdrawal rate is within design limits.

5.2.1 Table 14.3-1 Item 1-2.

5.3 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.3.14 Pressurizer Safety Relief Valves (Test #037)

1.0 OBJECTIVE

1.1 To verify the power operation setpoint of the pressurizer safety relief valves.

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

1.3 To verify remote manual operation of the pressurizer safety relief valves (PSRVs).

1.4 To verify vibration response of the PSRV and its relief piping is acceptable.

1.5 To verify piping displacements are acceptable.

2.0 PREREQUISITES

2.1 Construction activities on the pressurizer have been completed and associated instrumentation has been calibrated and is operating satisfactorily.

2.2 The RCS is at HZP (temperature and pressure).

2.3 Spring-operated pilot valve device with associated support equipment and calibration data is available.

2.4 The PSRVs have been capacity and stroke time tested at a offsite test facility.

3.0 TEST METHOD

3.1 Increase the lifting force on each spring-operated pilot valve, using a special pilot valve actuator test device, until the main relief disk just starts to lift.

3.2 Determine setpoint pressure from the lifting device correlation data.

3.3 Adjust valve setpoint pressure if necessary and retest.

3.4 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.5 Verify remote manual operation of each PSRV.

3.6 Verify that piping displacement and vibration data have been acquired.

4.0 DATA REQUIRED

4.1 Pressurizer pressure and temperature at time of test.

4.2 Pressure applied to the actuating device to lift the main relief disk off its seat.

4.3 Piping displacement and vibration data during each valve lift sequence.

5.0 ACCEPTANCE CRITERIA

5.1 The PSRVs respond to test overpressure conditions. Refer to the description in Sections 5.4.13 and 5.2.2.

5.2 The PSRVs respond to manually initiated signals. Refer to the description in Sections 5.4.13 and 5.2.2.

5.3 Verify that safety-related components meet electrical independence requirements and redundancy requirements.

5.4 Piping displacement and vibration data is collected and reviewed.

5.5 PSRV capacity meets design requirements.

5.5.1 Table 14.3-1 Item 1-8.

5.6 PSRV measured stroke times meet design requirements.

5.6.1 Table 14.3-1 Item 1-9.

5.7 PSRV setpoint meets design requirements.

5.7.1 Table 14.3-1 Item 1-65.

14.2.12.3.15 Fuel Handling System (Test #038)

1.0 OBJECTIVE

1.1 To verify the proper operation of the fuel handling system (FHS).

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested are complete.

2.2 Permanently installed instrumentation is functional and calibrated and is operating satisfactorily prior to performing the following test.

2.3 Plant systems required to support testing are functional or temporary systems are installed and functional.

2.4 Special test instrumentation is available and calibrated.

2.5 The reactor vessel head and upper internals are removed.

2.6 The lower core barrel is installed and aligned.

2.7 Dummy fuel assemblies, dummy RCCAs and test weights are available.

3.0 TEST METHOD

3.1 Verify that the operation of the new fuel elevator and the associated interlocks is within design limits.

3.1.1 Verify each usable new fuel storage rack position is capable of storing a fuel assembly by performing a trial fit of the dummy fuel assembly (drag test) using the appropriate crane.

3.2 Verify operation of the spent fuel handling refueling machine as follows:

3.2.1 Check bridge trolley function is within design limits.

3.2.2 Check that hoist speeds are within design limits.

3.2.3 Load limits setpoints are within design limits.

3.2.4 Interlocks function as designed.

3.2.5 Limit switches function as designed.

3.3 Verify each usable spent fuel storage rack position is capable of storing a fuel assembly by performing a trial fit of the dummy fuel assembly (drag test) using the spent fuel handling machine.

3.4 Verify that operation of the following transfer subsystems remotely is within design limits.

3.4.1 Upender operation in the Fuel Building.

3.4.2 Upender operation in the Reactor Building.

3.5 Verify that operation of the reactor containment refueling machine as follows:

3.5.1 Check bridge trolley function is within design limits.

3.5.2 Check hoist speeds are within design limits.

3.5.3 Load limits are within design limits.

3.5.4 Interlocks function as designed.

3.5.5 Limit switches function as designed.

3.6 Verify each core location is capable of accepting a fuel assembly by placing a dummy fuel assembly in each location (drag test) using the reactor containment refueling machine.

3.7 Verify that operation of the refueling machine with the fuel assembly insert (FAI) guide tube installed is as follows:

3.7.1 Check hoist speeds are within design limits.

3.7.2 Load limits are within design limits.

3.7.3 Interlocks function as designed.

3.7.4 Limit switches function as designed.

3.8 Verify the following:

3.8.1 Using the full sequence of focusing, camera tilt, and camera rotation verify the operation of the underwater television camera system is within design limits.

3.8.2 Utilizing the complete fuel handling equipment, transfer a dummy fuel assembly from the new fuel elevator through a total fuel loading cycle in the reactor core and a total spent fuel cycle from the core to the spent fuel storage area both in automatic and manual modes of operation.

3.8.3 Demonstrate the capabilities of the special fuel handling tools by verifying that operation with dummy fuel assembly and dummy RCCA meets design requirements.

4.0 DATA REQUIRED

4.1 Applicable indexing coordinates.

4.2 Monitoring instrumentation responses.

5.0 ACCEPTANCE CRITERIA

5.1 The FHS meets design requirements (refer to Section 9.1.4):

5.1.1 Bridge trolley function is within design limits.

5.1.2 Hoist speeds are within design limits.

5.1.3 Load limits setpoints are within design limits.

5.1.4 Interlocks function as designed.

5.1.5 Limit switches function as designed.

5.1.6 Spent fuel rack storage cells are accessible or controls have been implemented to prevent attempted storage of fuel assemblies in these locations.

5.1.7 New fuel rack storage cells are accessible or controls have been implemented to prevent attempted storage of fuel assemblies in these locations.

5.1.8 Fuel handling tools function as designed.

5.1.9 Fuel transfer devices function as designed.

14.2.12.3.16 Fuel Transfer System Operation and Leak Test (Test #039)

1.0 OBJECTIVE

1.1 To verify the measured leakage through the fuel transfer tube when summed with the total of other Type B and Type C LRTs is within the limits as required by the Technical Specifications and 10 CFR 50, Appendix J and meets the requirements of the SIT.

1.2 To demonstrate the operation of the fuel transfer tube blind flange closure.

1.3 To verify a leak tight seal between the spent fuel transfer penetration and the cask handling area, including the flange into loading pit and upper cover.

2.0 PREREQUISITES

2.1 Construction activities on the fuel transfer tube have been completed.

2.2 Construction activities on the spent fuel transfer penetration have been completed.

2.3 Temporary pressurization equipment is installed and instrumentation calibrated.

3.0 TEST METHOD

3.1 Operate the fuel transfer tube blind flange in accordance with manufacturer instructions.

3.2 Verify the blind flange can be opened and closed within the stated amount of time.

3.3 Place the blind flange in the closed position and perform a 10 CFR 50, Appendix J Type B LRT on the fuel transfer tube seal integrity at 110 percent design basis accident pressure.

3.4 Verify that the flange into loading pit and the upper cover provide a leak tight seal.

4.0 DATA REQUIRED

4.1 Fuel transfer tube assembly leak data.

4.2 Time to operate the fuel transfer blind flange.

4.3 Spent fuel penetration assembly leak data.

5.0 ACCEPTANCE CRITERIA

5.1 The leak rate when summed with the total of other Type B and C LRTs does not exceed the limits as required by the Technical Specifications and 10 CFR 50, Appendix J.

5.2 The fuel transfer tube meets SIT acceptance criteria per ASME Code, Section III, Division 1, Subsection NE.

5.3 The fuel transfer tube blind flange operates in accordance with manufacturer instructions.

5.4 The fuel transfer tube penetration and blind flange perform as designed (refer to Sections 3.8.1 and 9.1.4).

5.5 The spent fuel penetration provides a leak tight seal in the floor of the loading pit.

14.2.12.3.17 Spent Fuel Cask Transfer Facility (Test #047)

1.0 OBJECTIVE

1.1 To verify the proper operation of the spent fuel cask transfer facility (SFCTF).

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested are complete.

2.2 Permanently installed instrumentation is functional and calibrated, and is operating satisfactorily prior to performing the following test.

2.3 Plant systems required to support testing are functional, or temporary systems are installed and functional.

2.4 Special test instrumentation is available and calibrated.

2.5 Dummy fuel assemblies, dummy cask and test weights are available.

3.0 TEST METHOD

3.1 Perform the following tests to verify operation of the SFCTF:

3.1.1 Verify that geometrical dimensions, gaps and tolerances are within design limits.

3.1.2 Verify cabling controls are as designed.

- Power cabling and I&C, including adjustments to external interlocking, sensors, and limit switches.
- Grounding.

3.1.3 Verify that security devices are ready to be correctly operated.

3.1.4 Verify the operation of the spent fuel cask transfer machine (SFCTM) inside and outside the FB, with and without its coupling (when it is self-propelled or towed by the tractor).

3.1.5 Verify operation of each mechanism and of each operational sub-assembly.

3.1.6 Verify leak tightness of lower cover of the penetration under the water column pressure.

3.1.7 Verify leak tightness and perform hydrostatic test of the fluid circuits.

3.1.8 Verify penetration leak tightness with loading pit filled.

3.1.9 Verify opening/closing of the upper cover with loading pit filled.

3.1.10 Verify leak tightness of the upper cover with loading pit filled.

3.1.11 Load test of biological lid handling station and penetration upper cover hoist.

3.1.12 Verify the external interlock with the spent fuel machine, loading pit gate, and loading hall door.

3.1.13 Check the installation of adapter parts (such as leaktightness flange, centering ring).

3.1.14 Verify the operation sequence and sequential interlocking without water.

3.1.15 Verify the operation sequence and sequential interlocking with dummy cask and dummy fuel assembly under water.

3.1.16 Verify the operational reversibility, i.e., return from the biological lid handling station to the loading penetration for re-docking, unloading of fuel assembly, and undocking, up to exit of the FB.

3.1.17 Verify operation of SFCTM when it is connected to the tractor.

4.0 DATA REQUIRED

4.1 Applicable coordinates of three workstations including the vertical coordinates.

4.2 Applicable coordinates providing location of loading hall walls including rails and door.

4.3 Monitoring instrumentation responses.

5.0 ACCEPTANCE CRITERIA

5.1 The SFCTF meets design requirements (refer to Table 9.1.4-1):

5.1.1 Valves, brakes and screws function as designed.

5.1.2 Sensors operate in their electrical range.

5.1.3 Biological lid handling station functions as designed.

5.1.4 Docking mechanism functions as designed.

5.1.5 Upper cover maneuvering device and hoist function as designed.

5.1.6 Process systems for filling, draining and drying of the cask function as designed.

5.1.7 Leak tightness of double wall bellow, lower cover of penetration, upper cover of penetration, valve tools and penetration/cask interface is acceptable.

5.1.8 Hydrostatic tests of the fluid circuits are acceptable.

5.1.9 Load limits setpoints are within design limits.

5.1.10 Interlocks function as designed.

5.1.11 Limit switches function as designed.

5.1.12 SFCTM functions as designed when connected to tractor.

14.2.12.4 Civil Components and Systems

14.2.12.4.1 Containment Polar Crane (Test #040)

1.0 OBJECTIVE

1.1 To demonstrate the functional performance of the containment polar crane.

2.0 PREREQUISITES

2.1 Electric power available.

2.2 Containment polar crane instrumentation has been calibrated and is functional for performance of the following test.

2.3 Construction activities on the crane and associated equipment have been completed.

3.0 TEST METHOD

3.1 Verify functionality of trolley, bridge, and hoist.

3.2 Check hoist and trolley speeds.

3.3 Check capability of crane to position over required containment building equipment.

3.4 Perform a functional test of the polar crane at 100 percent of rated load.

3.5 Perform 125 percent static load capacity test.

3.6 Verify the operation of protective and safety devices.

3.7 Perform tests to demonstrate the following:

3.7.1 Redundant reeving.

3.7.2 Holding brakes.

3.7.3 Ability to handle load hang-ups.

3.7.4 Mis-spooling.

3.7.5 Two-block test or substitute test.

4.0 DATA REQUIRED

4.1 Hoist and trolley speeds.

4.2 Verification of that operation of interlocks is within design limits.

4.3 Load capacity data.

5.0 ACCEPTANCE CRITERIA

5.1 The containment polar crane meets design requirements (refer to Sections 3.8.3 and 9.1.5):

5.1.1 Trolley, bridge, and hoist function as designed.

5.1.2 Hoist and trolley speeds are within design limits.

5.1.3 Polar crane is capable of being positioned over required containment building equipment.

5.1.4 Polar crane protective and safety devices function as designed.

5.1.5 Polar crane load tests are completed satisfactorily.

5.1.6 Verify that the crane meets the test requirements of ASME NOG-1 (Reference 7) and NUREG-0554.

14.2.12.4.2 Fuel Building Cranes (Test #041)

1.0 OBJECTIVE

1.1 To demonstrate the functional performance of the fuel handling cranes.

2.0 PREREQUISITES

2.1 Electric power available.

2.2 Fuel building cranes instrumentation has been calibrated and is functional for performance of the following test.

2.3 Construction activities on the crane and associated equipment have been completed.

3.0 TEST METHOD

3.1 Verify functionality of trolley, bridge, and hoist for each crane.

3.2 Check hoist and trolley speeds.

3.3 Check capability of cask handling and fuel handling crane to position over required fuel building equipment.

3.4 Perform a functional test of the cranes at 100 percent of rated load.

3.5 Perform 125 +/- 5 percent static load capacity test of the cask handling crane and the fuel handling crane.

3.6 Verify the operation of protective and safety devices.

3.7 Perform tests to demonstrate the following:

3.7.1 Redundant reeving.

3.7.2 Holding brakes.

3.7.3 Ability to handle load hang-ups.

3.7.4 Mis-spooling

3.7.5 Two-block test or substitute test.

4.0 DATA REQUIRED

4.1 Hoist and trolley speeds.

4.2 Verification of that operation of interlocks is within design limits.

4.3 Load capacity data.

5.0 ACCEPTANCE CRITERIA

5.1 The fuel handling cranes perform as designed (refer to Section 9.1.5):

5.1.1 Trolley, bridge, and hoist function as designed.

5.1.2 Hoist and trolley speeds are within design limits.

5.1.3 Crane is capable of being positioned over required building equipment.

5.1.4 Crane protective and safety devices function as designed.

5.1.5 Crane load tests are completed satisfactorily.

5.1.6 Verify that the crane meets the test requirements of ASME NOG-1 (Reference 7) and NUREG-0554.

14.2.12.4.3 Turbine Building Crane (Test #042)

1.0 OBJECTIVE

1.1 To demonstrate the functional performance of the turbine building crane.

2.0 PREREQUISITES

2.1 Electric power available.

2.2 Turbine building crane instrumentation has been calibrated and is functional for performance of the following test.

2.3 Construction activities on the crane and associated equipment have been completed.

3.0 TEST METHOD

3.1 Verify functionality of trolley, bridge, and hoist.

3.2 Check hoist and trolley speeds.

3.3 Check capability of crane to position over required turbine building equipment.

3.4 Perform 125 percent load capacity test.

4.0 DATA REQUIRED

4.1 Hoist and trolley speeds.

4.2 Verification of that operation of interlocks is within design limits.

4.3 Load capacity data.

5.0 ACCEPTANCE CRITERIA

5.1 The turbine building crane meets manufacturers design specification.

5.1.1 Trolley, bridge, and hoist function as designed.

5.1.2 Hoist and trolley speeds are within design limits.

5.1.3 Crane is capable of being positioned over required building equipment.

5.1.4 Crane protective and safety devices function as designed.

5.1.5 Crane load tests are completed satisfactorily.

5.1.6 The turbine building crane is capable of handling the heaviest turbine building component (e.g., low pressure turbine, main generator stator).

14.2.12.5 Distributed Utilities

14.2.12.5.1 Raw Water Supply System (Test #043)

A COL applicant that references the U.S. EPR design certification will provide site-specific test abstract information for the raw water supply system. The following is a typical COLA test; if a site-specific test will be used, the COL applicant will provide the test.

1.0 OBJECTIVE

1.1 To demonstrate the ability of raw water supply system (RWSS) to supply filtered water to downstream systems (e.g., potable and sanitary water, demineralized water distribution system).

2.0 PREREQUISITES

2.1 Construction activities on the RWSS have been completed.

2.2 RWSS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support system required for operation of the RWSS is complete and functional.

2.4 Test instrumentation available and calibrated.

2.5 The RWSS intake is being maintained at the water level specified in the design documents.

2.6 The RWSS flow balance has been performed.

3.0 TEST METHOD

3.1 Verify that the RWSS pump and system flow meet design requirement (refer to Section 9.2.9).

3.2 Verify standby RWSS pump starts on low discharge pressure or a trip of the running pump.

4.0 DATA REQUIRED

4.1 Pump operating data.

4.2 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The RWSS operates as designed (refer to Section 9.2.9):

5.1.1 RWSS flow meets design requirements.

5.1.2 RWSS alarms, interlocks, and controls (manual and automatic) function as designed.

5.1.3 The RWSS pumps meet design requirements.

14.2.12.5.2 Reactor Containment Building Doors (Test #044)

1.0 OBJECTIVE

1.1 To perform testing to ensure that reactor containment building (RCB) radiation doors are capable of meeting design requirements.

1.1.1 Door locks, local and remote alarms, and video surveillance, in compliance with 10 CFR 20.1601 and 10 CFR 20.1602

requirements, have been installed on doors that restrict access to HRA or VHRA areas (refer to Section 12.3.1.8.1).

1.1.2 Pressure relieving function (refer to Section 3.8.3.1.13 and Table 3.8-18.

1.1.3 Seal between the equipment compartment and the service compartment.

1.1.4 Radiation barrier between the radiation sources in the equipment compartment and the service compartment areas (refer to Section 12.3.1.8.1).

1.2 To perform testing to ensure that RCB doors with pressure relieving panels are capable of meeting design requirements.

1.2.1 Pressure relieving function.

1.2.2 Seal between the equipment compartment and the service compartment.

1.2.3 RCB doors lockset design meets 10 CFR 20.1601 and 10 CFR 20.1602 requirements to control access as described in Section 12.3.1.8.1.

1.3 To perform testing to ensure that RCB watertight doors are capable of meeting design requirements.

Note: For preoperational testing it is not necessary to implement the radiation controls described in Technical Specifications 5.7.1 and 5.7.2 but it is necessary to determine the details of how the doors will be classified and controlled when the program is implemented.

1.4 To verify that the applicable radiation door access requirements of Technical Specifications 5.7.1 and 5.7.2 have been implemented.

1.4.1 Signage.

1.4.2 Lock Requirements.

2.0 PREREQUISITES

2.1 Construction activities on the following have either been completed or exceptions have been recorded and the impact on the system performance has been determined.

2.1.1 RCB radiation doors.

2.1.2 RCB doors with pressure relieving panels.

2.1.3 RCB watertight doors.

2.2 Test instrumentation is available and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

2.3 The following instrumentation, as applicable, has been calibrated and is operating satisfactorily:

2.3.1 Video surveillance.

2.3.2 Local and remote alarms.

2.4 Verify that RCB ventilation systems are capable of operating in various normal configurations.

2.5 The motorized RCB radiation doors, that are listed in Table 3.8-18 as motor operated rolling doors, are functional including the motor operators and associated key controlled switches located in the accessible (low dose) side and the emergency switch located in the non-accessible (high dose) side.

3.0 TEST METHOD

3.1 Observe RCB radiation door remote position indication including local and remote alarms, as applicable.

3.2 Observe force required to open RCB radiation doors, that are described in Table 3.8-18 as swing doors, with shear pins disengaged:

3.2.1 Breakaway torque.

3.2.2 Required torque to continue opening each RCB radiation door.

3.3 Observe that for each RCB radiation door described in Table 3.8-18 as a swing door, that the shear pin engages and the locking mechanism prevents unauthorized entry. This satisfies the access control requirements of 10 CFR 20.1601 and 10 CFR 20.1602, which are described in Section 12.3.1.8.1.

3.3.1 The radiation door opens and closes as designed.

3.3.2 The shear pin engages when the closure mechanism is activated.

3.3.3 The shear pin is locked in the engaged position when the lockset is activated.

3.3.4 The radiation swing doors cannot be opened, from the accessible area, when the lockset is locked either by pulling on the door (normal force) or by attempting to disengage the closure mechanism.

3.3.5 The radiation door closure mechanism, for doors that are described in Table 3.8-18 as swing doors, can be opened when the lockset is deactivated from the non-accessible (high dose) side area using the emergency escape feature.

3.4 Observe that each RCB radiation door opens freely without obstruction.

3.5 Observe width of opening of each RCB radiation door when fully open.

3.6 Observe seal of each RCB radiation door when the door is shut.

3.7 Observe that each RCB door with pressure relieving aperture latch engages and the locking mechanism prevents unauthorized entry from the accessible (low dose) area.

3.8 Observe seal of each RCB door with pressure relieving aperture when the door is shut.

3.9 Observe that each RCB door with pressure relieving panel is free to open without obstruction.

3.10 Observe that each RCB door with pressure relieving aperture latch engages and the locking mechanism allows entry from the non-accessible (high dose) area when the emergency escape feature is activated, as described in U.S. EPR FSAR Tier 2, Section 3.8.3.1.13.

3.11 Observe the force required to open RCB radiation doors described in Table 3.8-18 as motor operated rolling doors.

3.11.1 Breakaway torque.

3.11.2 Required torque to continue opening each RCB radiation door.

3.12 Observe that each RCB radiation door, that is described in Table 3.8-18 as a motor operated rolling door, locking mechanism prevents unauthorized entry that meets the requirements of 10 CFR 20.1601 and 10 CFR 20.1602 control access described in Section 12.3.1.8.1.

3.12.1 The radiation motor operated rolling door opens and closes as designed.

3.12.2 The radiation motor operated rolling door cannot be opened, from the accessible area, when the motor control lockset is locked either by pulling on the door (normal force) or by attempting to operate the controls when the control switch has been locked.

3.12.3 The radiation door closure mechanism, for doors that are described in Table 3.8-18 as motor operated rolling doors, can be opened when the emergency escape feature is activated from the non-accessible (high dose) side area, as described in U.S. EPR FSAR Tier 2, Section 3.8.3.1.13.

3.12.4 The radiation doors access controls meet the requirements described in Technical Specifications 5.7.1 and 5.7.2.

- Each entryway to such an area shall be barricaded and conspicuously posted as a high radiation area. This is applicable for High Radiation Areas with Dose Rates Not Exceeding 1.0 rem/hour at 30 Centimeters from the Radiation Source or from any Surface Penetrated by the Radiation.
- Each entryway to such an area shall be conspicuously posted as a high radiation area and shall be provided with a locked door barrier that prevents unauthorized entry. This is applicable for High Radiation Areas with Dose Rates Greater than 1.0 rem/hour at 30 Centimeters from the Radiation Source of any Surface Penetrated by the Radiation, but less than 500 rads/hour at 1 Meter from the Radiation Source or from any Surface Penetrated by the Radiation.

3.13 Observe RCB watertight door features.

3.14 Observe that each RCB watertight door latch engages and the locking mechanism prevents unauthorized entry.

3.15 Observe that each RCB watertight door opens freely without obstruction.

3.16 Observe seal of each RCB watertight door when the door is shut.

3.17 Operate the RCB ventilation system in various configurations while positioning the doors and verify no adverse effects.

4.0 DATA REQUIRED

4.1 RCB door instrumentation response, as applicable.

4.2 Breakaway torque to open each RCB radiation swing door.

4.3 Performance data for radiation door closure device and the lockset.

4.4 Required torque to continue to open each RCB radiation swing door.

4.5 Record width of opening for each RCB radiation swing door with door fully open.

4.6 Seal condition of the following:

4.6.1 RCB radiation swing doors.

4.6.2 RCB doors with pressure relieving panels.

4.6.3 RCB radiation door, described in Table 3.8-18, as a motor-operated rolling door.

4.6.4 RCB watertight doors.

5.0 ACCEPTANCE CRITERIA

5.1 Safety-related RCB radiation doors that are described in Table 3.8-18 as swing doors function as designed (see Section 3.8.3.1.13 and Section 12.3.1.8.1).

5.1.1 The opening torque is less than the maximum limit specified in Technical Specification Surveillance 3.6.10.2 (see Technical Specification Table 3.6.10-1).

5.1.2 The opening torque is less than the maximum limit specified in Section 3.8.3.1.13.

5.1.3 Access control requirements of the radiation doors meet the applicable programmatic requirements described in the following Technical Specification sections:

- 5.7.1 High Radiation areas ≤ 1.0 rem/hour at 30 cm from the Radiation Source or surface penetrated by radiation.
- 5.7.2 High Radiation areas > 1.0rem/hour at 30 cm from the Radiation Source or surface penetrated, but less than 500 rad/hr at 1 meter from the Radiation Source or surface penetrated by radiation.

5.2 Non-safety-related RCB radiation doors that are described in Table 3.8-18 as swing doors function as designed (see Section 3.8.3.1.13 and Section 12.3.1.8.1).

5.2.1 The opening torque is less than the maximum limit specified in Section 3.8.3.1.13.

5.2.2 Access control requirements of the radiation doors meeting the applicable programmatic requirements described in the following Technical Specifications sections:

- 5.7.1 High Radiation areas ≤ 1.0 rem/hour at 30 cm from the Radiation Source or surface penetrated by radiation.
- 5.7.2 High Radiation areas > 1.0 rem/hour at 30 cm from the Radiation Source or surface penetrated, but less than 500 rad/hr at 1 meter from the Radiation Source or surface penetrated by radiation.

5.3 Safety-related RCB doors with pressure relieving apertures function as designed and described in Section 3.8.3.1.13.

5.4 Non-safety RCB doors with pressure relieving apertures function as designed and described in Section 3.8.3.1.13.

5.5 RCB watertight doors function as designed and described in Section 3.8.3.1.13.

5.6 Non-safety RCB radiation doors, that are described in Table 3.8-18 as motor operated rolling doors, function as designed (see Section 3.8.3.1.13 and Section 12.3.1.8.1).

5.6.1 The opening torque is less than the maximum limit specified in Section 3.8.3.1.13.

5.6.2 Access control requirements of the radiation doors meet the programmatic requirements described in Technical Specifications 5.7.1 and 5.7.2.

- High Radiation areas ≤ 1.0 rem/hour at 30 cm from the Radiation Source or surface penetrated by radiation.
- High Radiation areas > 1.0 rem/hour at 30 cm from the Radiation Source or surface penetrated, but less than 500 rad/hr at 1 meter from the Radiation Source or surface penetrated by radiation.

14.2.12.5.3 Seal Water Supply System (Test #045)

1.0 OBJECTIVE

1.1 To demonstrate the ability of seal water supply system to supply filtered seal water under normal plant operations.

1.2 To verify that the seal water supply system provides adequate sealing water to systems containing radioactive fluids.

1.3 To verify that the seal water supply system provides adequate sealing water to the gaseous waste processing and operational chilled water system.

2.0 PREREQUISITES

2.1 Construction activities on the seal water supply system have been completed.

2.2 The seal water supply system instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support system required for operation of the seal water supply system is complete and functional.

2.4 Test instrumentation available and calibrated.

2.5 The seal water supply system suction supply is being maintained at the water level (pressure) specified in the design documents.

2.6 The seal water supply system flow balance has been performed.

3.0 TEST METHOD

3.1 Verify seal water supply system pump and system flow meet design specifications.

3.2 Verify standby seal water supply system pump starts on low discharge pressure or a trip of the running pump.

3.3 Verify that the seal water supply system provides designed rated flow to systems that are supplied by the seal water header.

3.4 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.5 Observe response of power-operated valves upon loss of motive power (refer to Section 9.2.7 for anticipated response).

3.6 Verify that operation of protective devices, controls, interlocks, instrumentation, and alarms meets design requirements.

3.7 Verify that the seal water supply system can meet the following maximum design requirements:

a. The seal water supply system pressure.

b. The seal water supply system temperature.

3.8 Verify proper operation of the seal water supply system buffer tank upon a simulated loss of offsite power (LOOP).

4.0 DATA REQUIRED

4.1 Pump operating data.

4.2 Setpoints at which alarms and interlocks occur.

4.3 Valve performance data, where required.

4.4 Valve position indication.

4.5 Position response of valves to loss of motive power.

5.0 ACCEPTANCE CRITERIA

5.1 The seal water supply system meets design requirements (refer to Section 9.2.7):

5.1.1 Seal water supply system pump and system flow meet design specifications.

5.1.2 Standby seal water supply system pump starts on low discharge pressure or a trip of the running pump.

5.1.3 Seal water supply system provides designed rated flow to systems that are supplied by the seal water header.

5.1.4 System valves perform within design limits.

14.2.12.5.4 Potable and Sanitary Water Systems (Test #225)

1.0 OBJECTIVE

1.1 To demonstrate the ability of potable water system to supply potable water under normal plant operations.

1.2 To demonstrate the ability of sanitary water system to supply sanitary water under normal plant operations.

1.3 To demonstrate the ability of backflow preventers to block contamination from potable water users.

2.0 PREREQUISITES

2.1 Construction activities on the potable and sanitary water systems have been completed.

2.2 Potable and sanitary water systems instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support system required for operation of the potable and sanitary water systems are complete and functional.

2.4 Test instrumentation available and calibrated.

2.5 The potable and sanitary water systems suction supplies are being maintained at the water level (pressure) specified in the design documents.

2.6 Potable water end user sites have available temporary pressure sources and connections that can be used to test backflow preventers.

3.0 TEST METHOD

3.1 Verify potable and sanitary water systems measured pump and system flow meet design specifications.

3.2 Verify that potable and sanitary water systems interlocks and protective features perform as designed.

3.3 Verify that backflow preventers function as designed:

3.3.1 Depressurize the supply header.

3.3.2 Pressurize the supply line downstream of each backflow preventer and verify the absence of pressure/flow into the depressurized supply header.

4.0 DATA REQUIRED

4.1 Pump operating data.

4.2 Setpoints at which alarms and interlocks occur.

4.3 Backflow preventer leakage data.

5.0 ACCEPTANCE CRITERIA

5.1 The potable and sanitary water systems meet design requirements (refer to Section 9.2.4):

5.1.1 System flow is within design limits.

5.1.2 Supplied water meets design requirements.

5.1.3 Backflow preventers block cross contamination of the supply headers.

14.2.12.5.5 Component Cooling Water System (Test #046)

1.0 OBJECTIVE

1.1 To demonstrate the capability of the CCWS to provide treated cooling water under the following conditions:

1.1.1 Normal unit operation.

1.1.2 During unit cooldown.

- Simulate a significant heat load on the CCW system and downstream systems (essential service water and ultimate heat sink) during hot functional testing.

1.1.3 During refueling.

1.1.4 During an emergency situation.

1.2 To demonstrate the capability of the dedicated CCWS to provide treated cooling water.

1.3 To demonstrate that system response to a simulated ESF actuation signal is as designed.

1.4 To demonstrate electrical independence and redundancy of safety-related power supplies.

1.5 To demonstrate the ability of the CCWS in conjunction with the RHR system, ESW system, and the UHS to perform a plant cooldown during hot functional testing. Testing will be performed on each safety-related cooling chain train.

1.6 To demonstrate the CCWS is adequately designed and constructed to prevent water hammer.

1.7 To verify that radiation monitors respond as designed to check sources.

1.8 To verify that radiation monitors initiate automatic control functions upon detecting high activity levels.

1.9 To verify that the response time from when radiation monitors detect a high radiation condition until each actuated component travels to the required position meets design requirements.

2.0 PREREQUISITES

2.1 Construction activities on the CCWS have been completed.

2.2 CCWS instrumentation, including radiation monitors, has been calibrated and is functional for performance of the following test.

2.3 Test instrumentation is available and calibrated.

2.4 Plant systems required to support testing are functional, or temporary systems are installed and functional.

2.5 Hot functional testing is in process for those sections that measure thermal-hydraulic performance.

2.6 Performance curves are available for the following components:

2.6.1 RHR heat exchanger.

2.6.2 CCW heat exchanger.

2.6.3 Ultimate heat sink tower.

2.7 A thermal hydraulic model of the safety-related cooling chain (RHR, CCW, ESW, and UHS) is available to analyze data from the cooldown. The data will have to be extrapolated to design conditions in order to determine system performance.

2.8 CCW system has been properly filled and vented.

2.9 LHSI system has been properly filled and vented.

2.10 ESW system has been properly filled and vented.

2.11 UHS basin is at normal level.

2.12 Outside weather conditions are suitable for performing this test.

3.0 TEST METHOD

3.1 Demonstrate that operation of the surge tanks and their controls is within design limits.

3.2 Demonstrate that system and component flow paths, flow rates, and pressure drops including head versus flow verification for the CCW and dedicated CCW pumps is within design limits.

3.2.1 Verify that pump starts/stops, valve realignments resulting from automatic switchover, RCP thermal barrier transfer, automatic valve closures and pump trips occur without introducing the following water hammer indications:

- Noise.
- Pipe movement.
- Pipe support or restraint damage.
- Leakage.
- Damaged valves or equipment.
- Pressure spikes or waves.

3.3 Perform a pump head versus flow verification for CCW and dedicated CCW pumps.

3.3.1 $NPSH_a \geq NPSH_R$.

3.3.2 Starting time (motor start time and time to reach rated flow).

3.4 Verify the stroke closure time of the CCWS switchover valves.

3.5 Verify that the start of a CCWS pump generates a starting of the corresponding ESWS train.

3.6 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.7 Observe response of power-operated valves upon loss of motive power (refer to Section 9.2.2 for anticipated response).

3.8 Verify alarms, interlocks, indicating instruments, and status lights are functional.

3.9 Verify pump control from the PICS.

3.10 Demonstrate the ability of the CCWS in conjunction with the RHRS and essential service water system to perform a plant cooldown during HFT.

3.11 Verify that the RCP thermal barriers can be supplied by either the 1.b or 2.b common header. Demonstrate that the supply can be realigned with the RCPs operating during HFT.

3.12 Verify that the fire protection makeup to the CCW surge tank meets design flow rates.

3.13 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.14 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS common 1.b Automatic Backup Switchover function.

3.14.1 Initiate a failure of CCWS Train 1 by simulating a signal for CCWS Train 1 discharge pressure less than or equal to MIN1. Verify the following actions occur:

- CCWS Train 1 common 1.b supply and return switchover valves close.
- CCWS Train 1 LHSI heat exchanger isolation valve opens.
- CCWS Train 2 common 1.b supply and return switchover valves open.
- CCWS Train 2 pump starts.
- RCP thermal barrier flow returns to normal.

3.14.2 Initiate a failure of CCWS Train 1 by simulating a signal for loss of ESWS Train 1. Verify the following actions occur:

- CCWS Train 1 common 1.b supply and return switchover valves close.
- CCWS Train 1 LHSI heat exchanger isolation valve opens.
- CCWS Train 2 common 1.b supply and return switchover valves open.
- CCWS Train 2 pump starts.
- RCP thermal barrier flow returns to normal.

3.14.3 Initiate a failure of CCWS Train 1 by simulating a signal for main train (flow through CCW pump and heat exchanger, with or without flow through common headers) flow rate less than or equal to MIN1. Verify the following actions occur:

- CCWS Train 1 common 1.b supply and return switchover valves close.
- CCWS Train 1 LHSI heat exchanger isolation valve opens.
- CCWS Train 2 common 1.b supply and return switchover valves open.
- CCWS Train 2 pump starts.
- RCP thermal barrier flow returns to normal.

3.15 Perform step 3.14 for CCWS Trains 2, 3, and 4 to verify appropriate responses.

3.16 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Emergency Temperature Control function by simulating two out of three Train 1 temperature sensors greater than MAX1. Verify the following action occurs:

- CCWS Train 1 heat exchanger bypass valve closes until MAX1 is cleared (or the valve is fully closed).

3.17 Perform step 3.16 for CCWS Trains 2, 3, and 4 to verify appropriate responses.

3.18 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Emergency Leak Detection function.

3.18.1 Simulate a CCWS Train 1 surge tank level signal less than or equal to MIN2 and simulate a flow mismatch between the inlet and outlet of the common 1.b header (non-safety related branches). Verify the following actions occur:

- KAB80 AA015/016/019 valves close.
- Normal and Automatic Switchover functions are inhibited.

3.18.2 Simulate a CCWS Train 1 surge tank level signal less than or equal to MIN3. Verify the following actions occur:

- CCWS Train 1 common 1.a supply and return switchover valves close.
- CCWS Train 1 common 1.b supply and return switchover valves close.

3.18.3 Simulate a CCWS Train 1 surge tank level signal less than or equal to MIN4. Verify the following actions occur:

- DWDS supply isolation valve closes.
- CCWS common 1.b Automatic Backup Switchover function is enabled.
- CCWS Train 1 pump trips and CCWS Train 2 pump automatically starts.

3.19 Perform step 3.18 for CCWS Trains 2, 3, and 4 to verify appropriate responses. For common 2.b testing with Trains 3 and 4 valves KAB50 AA001/004/006 close.

3.20 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Actuation from Safety Injection function by simulating a safety injection signal to CCWS. Verify the following actions occur:

- CCWS Train 1/2/3/4 pumps start automatically (if not previously running).
- CCWS Train 1/2/3/4 LHSI heat exchanger isolation valves KAA12/22/32/42 AA005 open.
- Isolation valves for non-safety-related users outside the Reactor Building (KAB50 AA001/004/006 and KAB80 AA015/016/019) close.
- LHSI pump seal cooler isolation valves (KAA22/32 AA013) open.

3.21 Perform step 3.20 for CCWS Trains 2, 3 and 4 to verify appropriate responses.

3.22 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Operation from Stage 1 Containment Isolation signal and CCWS Operation from Stage 2 Containment Isolation signal functions.

3.22.1 Simulate a containment stage 1 isolation signal to CCWS. Verify the following actions occur:

- CCWS containment isolation valves KAB40 AA001/006/012 close

3.22.2 Simulate a containment stage 2 isolation signal to CCWS. Verify the following actions occur:

- CCWS containment isolation valves KAB60/70 AA013/018/019 close.

3.23 Perform step 3.22 for CCWS Trains 2, 3, and 4 to verify appropriate responses.

3.24 Verify that CCWS Train 1 is supplying the common 1.a header (fuel pool cooling and safety injection loads) and the common 1.b header (main common user group) then perform test of CCWS Response to a LOOP function by simulating a loss of offsite power to CCWS. Verify the following actions occur:

- CCWS Train 1 starts upon receipt of a Protection System signal.

3.25 Perform step 3.24 for CCWS Trains 2, 3, and 4 to verify appropriate responses.

3.26 Verify that CCWS Train 1 is supplying the common 1.a header (fuel pool cooling and safety injection loads) and the common 1.b header (main common user group) then perform test of CCWS Switchover Valve Interlock function. Verify the following groupings of valves cannot be simultaneously opened to prohibit more than one train from being connected to a common header:

- KAA10 AA033/032 with KAA20 AA033/32.
- KAA30 AA033/032 with KAA40 AA033/32.
- KAA10 AA006/010 with KAA20 AA006/010.
- KAA30 AA006/010 with KAA40 AA006/010.

3.27 Verify that CCWS Train 1 or 2 is supplying the common 1.b header (main common user group), then perform test of CCWS RCP Thermal Barrier Containment Isolation Valve Interlock function. Verify the following action occurs:

- One of the two supply valves (KAB30 AA049/050) and one of the two return valves (KAB30 AA051/052) must be closed prior to opening KAB30 AA053/054/055/056 and vice versa.

3.28 Perform step 3.27 for CCWS Train 3 or 4 supplying common 2.b header to verify appropriate responses.

3.29 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Switchover Valve

Leakage or Failure function by simulating CCWS Train 1 surge tank level less than MIN3 and CCWS surge tank 2 level greater than MAX2. Verify the following actions occur:

- CCWS Train 1 common 1.a supply and return switchover valves close.
- CCWS Train 1 common 1.b supply and return switchover valves close.

3.30 Perform step 3.29 for CCWS Train 2 supplying common 2.b header to verify appropriate responses.

3.31 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Surge Tank Makeup function. Verify the following action occurs:

- DWDS supply isolation valve responds to CCWS surge tank level changes.

3.32 Perform step 3.31 for CCWS Trains 2, 3, and 4 to verify appropriate responses.

3.33 Verify that CCWS Train 1 is supplying the common 1.b header (main common user group), then perform test of CCWS Temperature Control function.

3.33.1 Simulate two of three CCWS Train 1 temperature sensors less than MIN1. Verify that the Train 1 heat exchanger bypass valve opens by 10 percent of its 0-100 percent range at 1 minute intervals until 2 of 3 temperature measurements are greater than MIN1, or the valve is fully open.

3.33.2 Simulate two out of three CCWS Train 1 temperature sensors greater than MAX1. Verify that the Train 1 heat exchanger bypass valve closes by 10 percent of its 0-100 percent range at 1 minute intervals until 2 of 3 temperature measurements are less than MAX1, or the valve is fully closed.

3.34 Perform step 3.33 for CCWS Trains 2, 3, and 4 to verify appropriate responses.

3.35 Verify that CCWS common 1.b header is supplying RCP thermal barrier cooling, then perform test of RCP thermal barrier isolation function.

3.35.1 Simulate high flow above threshold value on the return of RCP1 thermal barrier. Verify that RCP1 thermal barrier isolation valves close.

3.35.2 Simulate high pressure above threshold value on the return of RCP1 thermal barrier. Verify that RCP1 thermal barrier isolation valves close.

3.35.3 Perform steps 3.35.1 and 3.35.2 for RCP 2, 3, and 4 thermal barriers.

3.36 Perform step 3.35 for common 2.b header supplying RCP thermal barrier cooling to verify appropriate responses.

3.37 Verify that CCWS common 1.b header is supplying RCP thermal barrier cooling, then perform test of thermal barrier transfer revert back feature.

3.37.1 Simulate closure of common 1.b RCP thermal barrier CIVs and failure of one or more common 2.b RCP thermal barrier CIVs to open. Verify that RCP thermal barrier transfer reverts back to common 1.b supplying cooling flow to each of the four RCP thermal barriers.

3.38 Verify that CCWS common 2.b header is supplying RCP thermal barrier cooling, then perform test of thermal barrier transfer revert back feature.

3.38.1 Simulate closure of common 2.b RCP thermal barrier CIVs and failure of one or more common 1.b RCP thermal barrier CIVs to open. Verify that RCP thermal barrier transfer reverts back to common 2.b supplying cooling flow to each of the four RCP thermal barriers.

3.39 Make sure that all available loads are placed on the safety-related cooling chain train that is to be tested.

3.40 Perform a cooldown test of the safety-related cooling chain by placing the RHR system into service at the upper limit of operation.

3.41 Perform a cooldown test while operating all four RCPs and minimizing steam generator cooling.

3.42 Make sure UHS makeup water flow and blowdown flows are isolated.

3.43 Collect the following cooldown data:

3.43.1 RHR heat exchanger.

- RHR flow through the heat exchanger.
- CCW flow through the heat exchanger.
- Inlet and outlet RHR temperature.
- Inlet and outlet CCW temperature on the RHR heat exchanger.
- RHR pressure.
- CCW pressure.

3.43.2 CCW heat exchanger.

- CCW flow through the heat exchanger.
- ESW flow through the heat exchanger.
- Inlet and outlet CCW temperature.
- Inlet and outlet ESW temperature on the CCW heat exchanger.
- CCW pressure.
- ESW pressure.

3.43.3 UHS performance data.

3.44 Analyze the cooldown data using the thermal-hydraulic model at multiple operating points.

3.45 Perform steps 3.39 through 3.44 for each cooling train.

3.46 Perform system testing of dedicated CCWS controls and interlocks.

Note: Response time of actuated components is to be determined from a single test using the check source specified in Table 11.5-1 that is specified for each radiation monitor until travel is completed for each actuated component impacted by the radiation monitor signal.

3.47 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Points R-35 through R-38, R-51 through R-54, R-64) and external test equipment, as necessary:

3.47.1 Check the self-testing features of radiation monitors.

3.47.2 Record the response of radiation monitors to check sources.

3.47.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.47.4 Record alarm actuations at local and remote locations, as appropriate.

3.47.5 Initiate a high radiation signal to each radiation monitor to measure the response time for each actuated component from the time that the radiation monitor reaches the control setpoint until the actuated component has traveled to the designated position.

3.48 Confirm that Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Points R-35 through R-38, R-51 through R-54) initiate upon detecting high activity levels.

3.49 Verify that sample points (refer to Table 11.5-1, Radiation Measuring Points R-35 through R-38, and R-64) are capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Record pump head versus flow and operating data for each pump.

4.2 Flow balancing data including flow to each component and throttle valve positions.

4.3 Setpoints of alarms interlocks and controls.

4.4 Valve performance data, where required.

4.5 Valve position indication.

4.6 Position response of valves to loss of motive power.

4.7 Thermal hydraulic performance data during cooldown.

4.8 Response of CCW System to SIAS, CIAS, surge tank level signal, and CCW header differential flow signal.

4.9 RHR, CCW, ESW, and UHS thermal-hydraulic performance data.

4.10 Radiation monitor response to check source.

4.11 Technical data associated with check source.

4.12 Signal levels necessary to initiate alarm actuation.

4.13 Signal levels necessary to initiate Automatic Control Functions.

4.14 Response time of each actuated component.

5.0 ACCEPTANCE CRITERIA

5.1 The CCWS and dedicated CCWS meet design requirements (refer to Section 9.2.2):

5.1.1 Operation of the surge tanks and their controls is within design limits.

5.1.2 System and component flow paths, flow rates, and pressure drops including head versus flow verification for the CCW pumps is within design limits.

5.1.3 Pump head versus flow verification for CCW pumps is within design limits.

5.1.4 Response to safety-related simulated signals meets design requirements.

5.1.5 Non-safety-related headers and RCP headers are isolated on simulated signals.

5.1.6 System valves meet design requirements.

5.1.7 Alarms, interlocks, indicating instruments, and status lights meet design requirements.

5.1.8 Verify pump control from the PICS.

5.1.9 Verify the ability of the CCWS in conjunction with the RHRS, ESWS, and UHS to perform a plant cooldown during hot functional testing.

- Using performance data from the cooldown, determine that the RHR heat exchanger meets design requirements.
- Using performance data from the cooldown, determine that the CCW heat exchanger meets design requirements.
- A report exists and concludes that the ESWS-UHS has the capacity to remove the total Max Heat Load from the CCWS, EDG heat exchangers, the ESWPBVS room cooler, and the ESW pump mechanical work.

5.1.10 Verify the ability of the CCWS in conjunction with the RHRS, essential service water system (ESWS), and ultimate heat sink (UHS) to perform a plant cooldown during HFT.

5.1.11 Verify none of the following water hammer indications are present for all operational tests (3.14 through 3.36):

- Noise.
- Pipe movement.
- Pipe support or restraint damage.
- Leakage.
- Damaged valves or equipment.
- Pressure spikes or waves.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

5.3 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Points R-35 through R-38, R-51 through R-54, R-64). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.3.1 Range.

5.3.2 Response time.

5.3.3 Sensitivity.

5.4 Radiation monitoring instrumentation meets design requirements to monitor radiation and initiate Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Points R-35 through R-38, R-51 through R-54) upon detection of high activity levels.

5.4.1 For each applicable radiation monitor, the response time from the radiation monitor reaching the level to initiate the automated control function until each actuated component has reached the required position meets the design requirement.

5.5 Radiation sample points (refer to Table 11.5-1, Radiation Measuring Points R-35 through R-38, R-64) are capable of collecting the required samples.

14.2.12.5.6 Reserved (Test #047)

14.2.12.5.7 Essential Service Water System (Test #048)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the ESWS to supply cooling water as designed under normal and emergency conditions, where the emergency includes postaccident system realignments, if applicable.

1.2 To demonstrate the ability of the ESWS to provide cooling water to the dedicated CCWS heat exchanger in beyond design basis conditions.

1.3 To demonstrate the ability of the ESWS to provide cooling water to the essential service water pump building ventilation system (ESWPBVS).

1.4 To demonstrate electrical independence and redundancy of power supplies.

1.5 To verify that radiation monitors respond as designed to check sources.

1.6 To verify that radiation monitors initiate automatic control functions upon detecting high activity levels.

1.7 To verify that the response time from when radiation monitors detect a high radiation condition until each actuated component travels to the required position meets design requirements.

2.0 PREREQUISITES

2.1 Construction activities on the ESWS are complete and the system is functional.

2.2 ESWS instrumentation, including radiation monitors, has been calibrated and is functional for performance of the following test.

2.3 Test instrumentation available and calibrated per applicable procedures.

2.4 CCWS available to provide a heat load.

2.5 Appropriate AC and DC power sources are available.

2.6 Support systems required for operation of the ESWS are complete and functional.

2.7 The Ultimate Heat Sink (UHS) is available and functional.

2.8 The UHS basin is filled to normal level.

2.9 The UHS basin support systems required for operation of the ESWS and UHS are available, as required.

3.0 TEST METHOD

3.1 Demonstrate that the ESWS can be operated from the PICS.

3.2 Demonstrate that the ESWS starts automatically in response to a Protection signal and applicable realignments are performed in a satisfactory manner.

3.3 Verify that the ESWS pumps supply cooling water at the rated flow and design conditions.

3.4 Verify ESWS water flow is supplied to components at required flow rates, developed head, and maximum particle size.

3.5 Verify alarms, interlocks, indicating instruments, and status lights are functional.

3.6 Verify head versus flow characteristics for the ESWS water pump.

3.6.1 $NPSH_a \geq NPSH_R$.

3.6.2 Discharge head.

3.6.3 Flow corresponding to head at each point.

3.6.4 Starting time (motor start time and time to reach rated flow.

3.7 Record valve performance data, where required.

3.8 Verify and record valve position indication.

3.9 Record position response of valves to loss of motive power.

3.10 Verify system baseline performance during HFT (with RHRS in service).

3.11 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.12 Verify filter backwash operation at simulated or actual high filter differential pressure.

3.13 Verify adequate $NPSH_a$ for the ESW pump ($NPSH_a > NPSH_R$.

3.14 Verify ESW/CCW response (simulated or actual) to inadvertent isolation of the operating ESW pump's discharge valve meets design requirements.

3.15 The normal and emergency ESW system realignments (valve realignments, pump starts/stops, filter backwashes, operation of vacuum breaker valves, etc.) occur and do not indicate evidence of a water hammer under the most limiting conditions.

3.16 Verify operation of the CCWS switchover sequence meets design requirements.

Note: Response time of actuated components is to be determined from a single test using the check source specified in Table 11.5-1 that is specified for each radiation monitor until travel is completed for each actuated component impacted by the radiation monitor signal.

3.17 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Points R-66 through R-70) and external test equipment, as necessary:

3.17.1 Check the self-testing features of radiation monitors.

3.17.2 Record the response of radiation monitors to check sources.

3.17.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.17.4 Record alarm actuations at local and remote locations, as appropriate.

3.17.5 Initiate a high radiation signal to each radiation monitor to measure the response time for each actuated component from the time that the radiation monitor reaches the control setpoint until the actuated component has traveled to the designated position.

3.18 Confirm that Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Points R-66 through R-70) initiate upon detecting high activity levels.

3.19 Verify that sample points (refer to Table 11.5-1, Radiation Measuring Points R-66 through R-70) are capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Record flows as required to components and throttle valve positions.

4.2 Record alarm, interlocks, and control setpoints.

4.3 Record pump head versus flow and operating data.

4.4 System operating parameters during HFT.

4.5 Verify flow to the CCW heat exchangers using the ESW pump in the normal system alignment.

4.6 Verify flow to the dedicated CCWS heat exchanger using the dedicated ESW pump.

4.7 Valve position upon loss of motive power and valve position indication data.

4.8 Verify flow to the EDG heat exchangers using the ESW pump in the normal system alignment.

4.9 Verify flow to the ESW/PBVS room cooler using the ESW pump in the normal system alignment.

4.10 Radiation monitor response to check source.

4.11 Technical data associated with check source.

4.12 Signal levels necessary to initiate alarm actuation.

4.13 Signal levels necessary to initiate Automatic Control Functions.

4.14 Response time of each actuated component.

5.0 ACCEPTANCE CRITERIA

5.1 The ESWS meets design requirements (refer to Section 9.2.1):

5.1.1 Verify that each ESWS can be operated from the PICS.

5.1.2 Verify that each ESWS starts automatically in response to a Protection signal.

5.1.3 Verify that the ESWS pumps supply cooling water at the rated flow and design conditions.

5.1.4 Verify ESWS water flow supplied to components.

5.1.5 Verify alarms, interlocks, indicating instruments, and status lights perform as designed.

5.1.6 Verify head versus flow characteristics for the ESWS water pumps meets design requirements.

5.1.7 Verify that system valves meet design requirements (i.e., thrust, ability to initiate and terminate ESW system flow and do not indicate evidence of a water hammer).

5.1.8 Verify system baseline performance during HFT (with RHRS in service).

5.1.9 Verify filter backwash operation in response to high filter differential pressure.

5.1.10 Verify that ESW system vacuum breaker/air release devices perform as designed and do not indicate evidence of a water hammer in the ESW system.

5.1.11 Verify that ESW system pumps perform as designed (reach rated flow within the allotted time and do not indicate evidence of a water hammer when flow is initiated or terminated).

5.1.12 Verify that the ESW system debris filters function as designed (perform manual and automatic backwash, filter alarms and automatic actions, particle size acceptance criteria, etc.).

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

5.3 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Points R-66 through R-70). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.3.1 Range.

5.3.2 Response time.

5.3.3 Sensitivity.

5.4 Radiation monitoring instrumentation meets design requirements to monitor radiation and initiate Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Points R-66 through R-70) upon detection of high activity levels.

5.4.1 For each applicable radiation monitor, the response time from the radiation monitor reaching the level to initiate the automated control function until each actuated component has reached the required position meets the design requirement.

5.5 Radiation sample points (refer to Table 11.5-1, Radiation Measuring Points R-66 through R-70) are capable of collecting the required samples.

14.2.12.5.8 Ultimate Heat Sink (Test #049)

1.0 OBJECTIVE

1.1 To demonstrate that the UHS is maintained by its associated support systems.

1.2 To demonstrate electrical independence and redundancy of power supplies.

1.3 Demonstrate proper operation of the UHS, excluding heat removal capacity.

2.0 PREREQUISITES

2.1 Construction activities on the UHS have been completed and the UHS is available and functional.

2.2 UHS makeup source available, as required.

2.3 UHS blowdown path available, as required.

2.4 The UHS system instrumentation has been calibrated and is functional for performance of the following test.

2.5 Test instrumentation available and calibrated per applicable procedures.

2.6 Appropriate AC and DC power sources are available.

2.7 UHS basin support systems required for operation of the UHS and ESWS are available, as required.

2.8 The UHS basin is filled to normal operating levels.

3.0 TEST METHOD

3.1 Demonstrate operation of the UHS tower over the design range of operation.

3.1.1 Simulate a UHS operating temperature that corresponds to the lower range of operation.

3.1.2 Demonstrate that fans operate in each speed setting and direction, including reverse.

3.1.3 Demonstrate that tower bypass paths realign to mitigate ice formation.

3.1.4 Simulate a gradual increase in ambient UHS temperature and terminate the ambient temperature increase at the upper end of the design operation band.

3.1.5 Record changes to tower fans and critical component operation during temperature increase.

3.1.6 Verify that the UHS tower is operating with cooling load.

3.1.7 Verify that each UHS fan is operating in high speed (forward direction) and record performance data in the following sequence:

- Corresponding UHS inlet and outlet temperatures (°F).
- Essential service water flow rates (gpm).
- UHS air flow rates (cfm).
- Duration of described event (seconds).

3.1.8 Record data from initiation of deicing sequence until fan coasts to stop.

3.1.9 Record data from fan coasting until fan starts moving in reverse direction.

3.1.10 Record data from fan starting in reverse direction until fan is operating at normal speed in reverse direction.

3.1.11 Record data from fan speed stabilizing in reverse direction until fan can be returned to normal forward direction. Observe all applicable starting duty restrictions before returning fan to forward direction.

3.1.12 Record data from terminating deicing sequence until fan coasts to a stop.

3.1.13 Record data from fan stop until fan starts moving in forward direction.

3.1.14 Record data from fan starting in forward direction until fan is operating at high speed in the forward direction.

3.2 Perform valve performance tests (e.g., valve position response of valves to loss of motive power, thrust, stroke time).

3.3 Demonstrate that UHS makeup flow rate meets design flow requirements.

3.3.1 During normal operation.

3.3.2 During emergency operation.

3.4 Demonstrate that UHS blowdown flow rate meets design flow requirements.

3.4.1 During normal operation.

3.4.2 During emergency operation.

3.5 Demonstrate the operation of UHS level and temperature instruments and alarms.

3.6 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.7 Demonstrate that the chemical treatment system functions as designed.

3.7.1 Injection flow rate to UHS.

3.7.2 Interlocks with UHS blowdown.

3.8 Demonstrates that the UHS starts automatically in response to a protection signal and applicable realignments are performed in a satisfactory manner.

4.0 DATA REQUIRED

4.1 UHS makeup and blowdown flow rates.

4.2 Valve performance data, where required.

4.3 Valve position indication.

4.4 Temperature and relative humidity trend data.

4.5 Setpoints at which alarms and interlocks occur.

4.6 Cooling fan air flow rates.

5.0 ACCEPTANCE CRITERIA

5.1 The UHS meets design requirements (refer to Section 9.2.5):

5.1.1 Verify that control logic starts forced draft fans and aligns critical components for UHS operation for the entire design range.

5.1.2 Verify that valve performance tests (e.g., valve position response of valves to loss of motive power, thrust, stroke time) meet design requirements.

5.1.3 Verify that UHS makeup flow rate meets design flow requirements.

5.1.4 Verify that UHS blowdown flow rate meets design flow requirements.

5.1.5 Verify that the operation of UHS level and temperature instruments and alarms meet design requirements.

5.1.6 Verify that the UHS tower bypass function meets design requirements.

5.1.7 Verify that the chemical treatment system meets design requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.5.9 Fuel Pool Fill and Spray (ELAP) (Test #050)

1.0 OBJECTIVE

1.1 To functionally test the operation and performance of the fuel pool spray system in conditions that are representative of actual plant conditions or close enough to allow data to be extrapolated to actual conditions following an ELAP event.

1.1.1 The two independent spray systems.

1.1.2 The two independent fill systems.

1.2 To observe operation of the flow paths through the fuel pool spray system piping to the spent fuel pool, to determine if the system is properly installed and is functional.

1.3 To record data that is used to validate design basis assumptions or provide a baseline record of system performance for non-safety-related attributes.

1.4 To demonstrate fuel pool spray system remote manual and manual controls.

2.0 PREREQUISITES

2.1 Construction activities on the fuel pool spray system have either been completed or exceptions have been recorded and the impact on system performance has been determined.

2.2 Perform the following spent fuel pool sump activities:

2.2.1 Clean to spent fuel cleanliness requirements.

2.2.2 Install temporary pump in the spent fuel pool to deliver greater than 300 gpm water to the sump, with throttle valve.

2.3 Support systems and instrumentation required for operation of the fuel pool spray system are complete and functional or the impact on system performance has been determined.

2.3.1 Permanently installed support systems (fire protection, etc.).

2.3.2 Portable pump is connected to the appropriate connection, if available for testing.

2.4 Test instrumentation to be used for pump performance and other performance measurements has been installed and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

2.5 The spent fuel pool and nuclear island drain/vent systems instrumentation (level, temperature, flow, etc.) is functional and calibrated and is operating satisfactorily prior to performing the following test.

3.0 TEST METHOD

3.1 Operate system valves while:

3.1.1 Observing each valve operation and position indication.

3.2 Start the fuel pool spray system and collect initial operating data:

3.2.1 Establish flow from the spent fuel pump to the sump and throttle as necessary to maintain acceptable sump level.

3.2.2 Perform critical (full flow) sections of the test using all fuel pool spray sources.

- Verify 100% coverage of all spent fuel pool locations from permanently installed supplies.
- Verify 100% coverage of all spent fuel pool locations from temporarily installed supplies, if available.

3.2.3 Verify spray pattern meets design requirements.

3.2.4 Verify that spray pattern does not adversely impact other components in the area.

3.2.5 Verify that all spray and fill lines can be drained.

4.0 DATA REQUIRED

4.1 Fuel pool spray system initial functional data including the following:

4.1.1 Spray flow.

4.1.2 Spent fuel pool fill flow.

4.1.3 Fluid temperature.

4.1.4 Fuel pool level changes during design conditions.

- Spent fuel pool fill operation.
- Spent fuel pool spray operation.

4.2 Record spray patterns (pictures, marked up drawings, etc.).

5.0 ACCEPTANCE CRITERIA

5.1 The fuel pool fill/spray system meets design requirements:

5.1.1 Verify that valve performance meets design requirements.

5.1.2 Verify that the spray flow rate meets minimum/maximum design limitations.

5.2 Verify that the fuel pool fill/spray system does not indicate evidence of water hammer when flow is initiated or terminated.

14.2.12.6 General Supply Systems

14.2.12.6.1 Boron Recovery (Test #051)

1.0 OBJECTIVE

1.1 To perform testing to demonstrate that the coolant supply and storage system can be operated as designed, to recover enriched boric acid and to makeup to the boric acid storage tank (BAST).

2.0 PREREQUISITES

2.1 Construction activities on the following systems have either been completed or exceptions have been recorded and the impact on the system performance has been determined.

2.1.1 Coolant Supply and Storage System.

2.1.2 Reactor Boron and Water Makeup System.

2.2 Test instrumentation is available and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

Note: It is important not to perform this test too early due to the potential of having to waste the contents of the BAST if the tank becomes contaminated with material that exceeds the

reactor coolant chemistry limits. During hot functional testing (HFT), it is desirable to borate the RCS in order to create a passivation layer on internal surfaces but it is not necessary to use enriched boron. If the boric acid in the RCS meets chemistry requirements, it is possible to use the coolant supply and storage system (CSSS) to concentrate the boric acid and add enriched boric acid using the reactor boron and water makeup system (RBWMS) to reach the target BAST boron-10 isotopic enrichment of 40 percent.

2.3 The following preoperational tests have been completed and the overall schedule supports maintaining enriched boric acid in the BAST.

2.3.1 Coolant Supply and Storage System (Test #006).

2.3.2 Reactor Boron and Water Makeup System (Test #007).

Note: When determining if the reactor coolant is suitable for recycling, it is essential to realize that some trace contaminants will concentrate in a ratio similar to the initial/final boron concentration.

2.4 Verify that HFT is complete and the reactor coolant meets the chemistry requirements for recycling the boric acid.

3.0 TEST METHOD

3.1 Operate the CSSS using the evaporators until the concentrated boric acid is between 7000 ppm and 7300 ppm.

3.2 Confirm that the CSSS tank fluid that is to be transferred to the BAST meets RCS chemistry requirements.

3.3 Determine the boron-10 isotopic enrichment of the CSSS tank fluid that is to be transferred to the BAST.

3.4 Determine the amount of high enriched boric acid that has to be added to the BAST to bring the contents of the BAST plus the CSSS tank volume that is to be transferred to the BAST to a boron-10 isotopic enrichment of 40 ± 1.0 percent.

3.5 Add the contents of the CSSS tank volume that is to be transferred to the BAST to the BAST and verify that the contents are adequately mixed.

3.6 Add the amount of high enriched boric acid that has to be added to the BAST that was previously calculated and verify the contents are adequately mixed.

3.7 Measure the BAST boron-10 isotopic enrichment.

3.8 Determine the amount of high enriched boric acid that has to be added to the BAST to bring the BAST to a boron-10 isotopic enrichment of 40 ± 1.0 percent.

3.9 If the BAST boron-10 isotopic enrichment is greater than 39 percent, determine the amount of high enriched boric acid that has to be added to the BAST to bring the BAST to a boron-10 isotopic enrichment of 40 ± 1.0 percent; add the calculated amount to the BAST without verifying the final enrichment.

3.10 If the BAST boron-10 isotopic enrichment is less than or equal to 39 percent, determine the amount of high enriched boric acid that has to be added to the BAST to bring the BAST to a boron-10 isotopic enrichment of 40 ± 1.0 percent, then add the calculated amount to the BAST and measure the final enrichment.

4.0 DATA REQUIRED

4.1 Boron concentration of the CSSS.

4.2 Boron-10 isotopic enrichment of the CSSS.

4.3 Initial boron concentration of the BAST.

4.4 Initial boron-10 isotopic enrichment of the BAST.

4.5 Number of gallons of highly enriched boric acid that must be added to the BAST.

4.6 Final boron concentration of the BAST.

4.7 Final boron-10 isotopic enrichment of the BAST.

5.0 ACCEPTANCE CRITERIA

5.1 BAST boron concentration is between 7000 ppm and 7300 ppm.

5.2 BAST boron-10 isotopic enrichment is 40 ± 1.0 percent.

14.2.12.6.2 Safety Chilled Water System (Test #052)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the safety chilled water system (SCWS).

1.2 To demonstrate electrical independence and redundancy of power supplies.

1.3 To demonstrate proper operation of safety chilled water pumps in single and parallel operation.

1.4 To verify that radiation monitors respond as designed to check sources.

1.5 To verify that the Division 1 and 4 chillers responds to a load limiting signal during a SBO. It is acceptable to simulate SBO bus loading using offsite power and a PICS signal from a simulated SBO event.

2.0 PREREQUISITES

2.1 Construction activities on the SCWS have been completed.

2.2 SCWS instrumentation, including radiation monitors, has been calibrated and is functional for performance of the following test.

2.3 Test instrumentation available and calibrated per applicable procedures.

2.4 The flow instrumentation downstream of each SCWS pump is functional.

2.5 The CCWS is available for chiller operation, where necessary.

2.6 Appropriate AC and DC power sources are available.

2.7 Interfacing system loads are connected and available.

2.8 SCWS support systems (makeup, nitrogen) are available.

2.9 SCWS has been filled and pressurized.

3.0 TEST METHOD

3.1 Verify pump performance characteristics (e.g., head versus flow, motor current) for the SCWS pumps.

3.1.1 $NPSH_a \geq NPSH_R$.

3.1.2 Discharge head.

3.1.3 Flow corresponding to head at each point.

3.1.4 Starting time (motor start time and time to reach flow).

3.2 Demonstrate that each SCWS division can be operated from its local and remote manual control station.

3.3 Demonstrate that each SCWS division starts automatically in response to each appropriate signal.

3.3.1 Verify that the normal automatic start initially loads the SCWS to 100 percent capacity but as Division 1 through 4 chiller load is reduced the chiller output reduces to match actual load.

3.3.2 Verify that the manual start on Divisions 1 and 4 when connected to the SBO initially loads the SCWS to no more than 50 percent capacity but as chiller load is reduced the chiller output reduces to match actual load.

3.4 Verify that the chillers supply chilled water at the rated flow and design conditions.

3.5 Verify chilled water flow to each supplied component.

3.6 Verify alarms, interlocks, indicating instruments, and status lights are functional.

3.7 Verify system baseline performance during HFT.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.9 Operate the SCWS pumps in each division in parallel and throttle system flow over the entire design range using a single common throttle valve while recording individual pump flow data.

3.10 Verify that pump starts/stops, valve realignments, closing of the cross-connects occur without introducing water hammer.

3.11 Verify expansion tank operating parameters and performance.

3.11.1 Operating pressure retained in the normal band with temperature changes from high to low.

3.11.2 Alarm setpoints.

3.11.3 SCWS pressure leak rate.

3.11.4 Operating train auto trips on expansion tank Min-3 pressure.

3.12 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Points R-59 and R-60) and external test equipment, as necessary:

3.12.1 Check the self-testing features of radiation monitors.

3.12.2 Record the response of radiation monitors to check sources.

3.12.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.12.4 Record alarm actuations at local and remote locations, as appropriate.

4.0 DATA REQUIRED

4.1 Record flows as required to components and throttle valve positions.

4.2 Record alarm, interlocks, and control setpoints.

4.3 Record chiller normal operating parameters.

4.4 Record pump head versus flow and operating data for single and parallel pump operation.

4.5 System operating parameters during HFT.

4.6 Record pressure transients for system evolutions such as valve closure and pump starts and stops.

4.7 Record chiller electrical load data during starts and normal operation.

4.7.1 Division 1 normal start.

4.7.2 Division 1 manual start when loaded on SBO diesel.

4.7.3 Division 2 normal start.

4.7.4 Division 3 normal start.

4.7.5 Division 4 normal start.

4.7.6 Division 4 manual start when loaded on SBO diesel.

4.8 Radiation monitor response to check source.

4.9 Technical data associated with check source.

4.10 Signal levels necessary to initiate alarm actuation.

5.0 ACCEPTANCE CRITERIA

5.1 The SCWS operates as described in Section 9.2.8.

5.1.1 Verify pump performance characteristics for the SCWS pumps meets design requirements for single and parallel pump operation.

5.1.2 Verify that each SCWS division controls meet design requirements.

5.1.3 Verify that each SCWS division starts automatically in response to each appropriate signal.

5.1.4 Verify that the chillers supply chilled water at the rated flow and design conditions.

5.1.5 Verify chilled water flow to each supplied component.

5.1.6 Verify alarms, interlocks, indicating instruments, and status lights meet design requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

5.3 Verify that SCWS pumps do not indicate evidence of water hammer when flow is initiated or terminated.

5.4 Verify that closing of the cross-connect valves during pump operation does not indicate evidence of water hammer.

5.5 Verify that closing of the electrical division of safeguard building ventilation system and main control room air conditioning system flow control valves during pump operation do not indicate evidence of water hammer.

5.6 Verify that auto train swap to standby train due to pump/chiller failure does not indicate evidence of water hammer.

5.7 Verify that Safety Chiller operating data meets design load limits during starts and normal operation.

5.7.1 Division 1 normal start.

5.7.2 Division 1 manual start when loaded on SBO diesel.

5.7.3 Division 2 normal start.

5.7.4 Division 3 normal start.

5.7.5 Division 4 normal start.

5.7.6 Division 4 manual start when loaded on SBO diesel.

5.8 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Points R-59 and R-60). This

includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.8.1 Range.

5.8.2 Response time.

5.8.3 Sensitivity.

14.2.12.6.3 Secondary Feed and Bleed (ELAP) (Test #053)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the fire water distribution system (FWDS) feed to EFW (secondary feed and bleed) system following an ELAP event.

1.2 To demonstrate electrical independence and redundancy of power supplies to the following:

1.2.1 Diesel driven fire pumps.

1.2.2 MSRT controllers (Trains 1& 2 or Trains 3 & 4) powered from the 2 hour batteries.

2.0 PREREQUISITES

2.1 Construction activities on the FWDS to EFW (secondary feed and bleed) piping (from FWDS header to EFW cross connect discharge header) have been completed.

2.2 FWDS header feed to EFW (secondary feed and bleed) instrumentation has been calibrated and is functional for performance of the following test.

2.3 Special test instrumentation available and calibrated per applicable procedures.

2.4 The following instrumentation downstream of the diesel driven fire water pump is functional:

2.4.1 EFW flow (all divisions).

2.4.2 Steam generator level (all divisions).

2.4.3 Steam generator pressure (all divisions).

2.5 The MSRT valves are available for MSRT operation, where necessary.

2.6 Appropriate AC and DC power sources are available.

2.7 The following fluid systems have been cleaned to steam generator cleanliness requirements and filled with secondary grade water:

2.7.1 Fire water storage tanks.

2.7.2 Diesel driven fire pumps.

2.7.3 FWDS header.

2.7.4 Piping from FWDS header to EFW cross connect discharge header.

2.8 The steam generators (all divisions) are available for receiving flow from the EFW cross connect discharge header.

3.0 TEST METHOD

3.1 Verify pump performance characteristics (e.g., head versus flow, diesel motor RPM) for the diesel driven fire pumps.

3.1.1 $NPSH_a \geq NPSH_R$.

3.1.2 Discharge head.

3.1.3 Flow corresponding to head at each point.

3.1.4 Starting time (motor start time and time to reach flow).

3.1.5 Connections to diesel tank to allow fuel and lube oil refill by mobile means are available and meet connection standards.

3.2 Verify MOV performance (torque switch settings, limit switch settings, opening thrust, etc.) requirements for each MOV.

3.3 Verify manual and check valve operation for all valves.

3.4 Demonstrate that each MSRT division can be operated from its 2 hour battery supply.

3.5 Demonstrate that each diesel driven fire pump starts automatically in response to each appropriate signal.

3.6 Verify that the FWDS feed to EFW (secondary feed and bleed) supplies water to the SG at the rated flow and design conditions.

3.7 Verify alarms, interlocks, indicating instruments, and status lights are functional.

3.8 Verify system baseline performance during hot functional testing (HFT) with SGs pressurized at the design pressure for secondary side feed and bleed cooling injection.

3.9 Check electrical independence and redundancy of power supplies for described functions by selectively removing power and determining loss of function.

3.10 Verify that diesel driven fire pump starts/stops, valve realignments, of the cross-connects occur without introducing water hammer.

Note: It is not necessary to actually connect the portable pump.

3.11 Verify that the two connections for attaching a portable self-powered pump are functional and meet the established standard connection requirements.

4.0 DATA REQUIRED

4.1 Record flows as required to each steam generator and throttle valve position.

4.2 Record alarm, interlocks, and control setpoints.

4.3 Record FWDS header feed to EFW (secondary feed and bleed) normal operating parameters.

4.4 Record pump head versus flow and operating data for single and parallel diesel driven fire pump operation.

4.4.1 Fuel oil consumption.

4.4.2 Lube oil consumption.

4.4.3 Delivered flow.

4.4.4 Delivered head.

4.4.5 Pump speed (rpm).

4.4.6 Available NPSH.

4.5 System operating parameters during hot functional testing (HFT).

4.6 Record pressure transients for system evolutions such as valve closure and pump starts and stops.

4.7 Signal levels necessary to initiate alarm actuation.

4.8 Tank and steam generator levels as a function of time during the test.

5.0 ACCEPTANCE CRITERIA

5.1 The FWDS feed to EFW (secondary feed and bleed) operates as described in Section 19.2.8.

5.1.1 Verify pump performance characteristics for the diesel driven fire pumps meet design requirements.

5.1.2 Verify that each SG division control meets design requirements.

5.1.3 Verify that each MSRT division controls as designed in response to each appropriate signal.

5.1.4 Verify that the system supplies water to the steam generators at the rated flow and design conditions.

5.1.5 Verify alarms, interlocks, indicating instruments, and status lights meet design requirements.

5.2 Verify that components meet electrical independence and redundancy requirements.

5.3 Verify that diesel driven fire pumps do not indicate evidence of water hammer when flow is initiated or terminated.

5.4 Verify that closing of the cross-connect valves during pump operation does not indicate evidence of water hammer.

14.2.12.6.4 Fire Water Distribution System (Test #054)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the fire water distribution system (FWDS) to provide water at acceptable flows and pressures to protected areas.

2.0 PREREQUISITES

2.1 Construction activities on the FWDS have been completed.

2.2 FWDS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the FWDS are complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Verify that the fire water distribution system has two separate fresh water storage tanks that meet design requirements.

2.5.1 Table 14.3-3 Item 3-7.

3.0 TEST METHOD

3.1 Demonstrate the head and flow characteristics of the fire water pumps and the operation of auxiliaries.

3.2 Verify control logic.

3.3 Measure developed head and flow rates in the various flow paths of the underground FWDS by measuring flow at appropriate discharge points.

3.3.1 $NPSH_a \geq NPSH_R$.

3.3.2 Discharge head.

3.3.3 Flow corresponding to head at each point.

3.3.4 Starting time (motor start time and time to reach flow).

3.4 Verify alarms, indicating instruments, and status lights are functional.

3.5 Verify that the fire water pumps can be manually actuated, refer to Section 9.5.1.2.1.

3.6 Verify as-built FWDS drawings for above ground piping and equipment.

3.7 Verify that FWDS $NPSH_a$ is greater than the $NPSH_R$.

3.8 Verify the failed position of FWDS valves to loss of motive power.

4.0 DATA REQUIRED

4.1 Setpoints under which alarms and interlocks occur.

4.2 Pump head versus flow and operating data.

4.3 As-built FWDS drawings.

5.0 ACCEPTANCE CRITERIA

5.1 The FWDS operates as designed (refer to Section 9.5.1, including manual features):

5.1.1 Verify the head and flow characteristics of the fire water pumps and the operation of auxiliaries.

5.1.2 Verify FWDS control logic meets design requirements.

5.1.3 Verify flow rates in the various flow paths of the FWDS are installed per design.

5.1.4 Verify alarms, indicating instruments, and status lights meet design requirements.

5.1.5 Verify that the FWDS can be manually actuated (refer to Section 9.5.1.2.1).

5.1.6 Verify that the fresh water storage tanks minimum level alarms meet design requirements.

14.2.12.6.5 Spray Deluge System (Test #055)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the spray deluge system to provide effective spray pattern to protected areas.

2.0 PREREQUISITES

2.1 Construction activities on the spray deluge system have been completed.

2.2 Support systems required for operation of the spray deluge system are complete and functional.

2.3 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify sprinkler deluge spray patterns are not obstructed.

3.2 Verify as-built spray deluge system drawings.

4.0 DATA REQUIRED

4.1 Pictures of deluge spray patterns.

4.2 As-built spray deluge system drawings.

5.0 ACCEPTANCE CRITERIA

5.1 The spray deluge system operates as designed (refer to Section 9.5.1):

5.1.1 Verify that spray patterns meet design requirements.

5.1.2 Activation devices (manual and automatic) meet design requirements.

5.1.3 Verify alarms and indicating instruments meet design requirements.

5.1.4 Piping and equipment are installed per as-built drawings.

14.2.12.6.6 Sprinkler System (Test #056)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the sprinkler system to provide coverage of designated areas.

2.0 PREREQUISITES

2.1 Construction activities on the sprinkler system have been completed.

2.2 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify sprinkler system as-built drawings showing the location of installed sprinklers.

3.2 Verify sprinkler patterns are not obstructed.

3.3 Verify alarms and indicating instruments are functional.

3.4 Verify that the sprinkler systems are functional (refer to Section 9.5.1.2.1).

4.0 DATA REQUIRED

4.1 Spray nozzles meet NFPA 13 (Reference 8) requirements for locating sprinkler heads.

4.2 As-built drawings of installed sprinklers.

5.0 ACCEPTANCE CRITERIA

5.1 The sprinkler system operates as designed (refer to Section 9.5.1):

5.1.1 Verify that piping and components meet sprinkler system design requirements.

5.1.2 Activation devices (manual and automatic) meet design requirements, where applicable.

14.2.12.6.7 Gaseous Fire Extinguishing System (Test #057)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the gaseous fire extinguishing system (GFES) to provide coverage of designated areas per design.

2.0 PREREQUISITES

2.1 Construction activities on the GFES have been completed.

2.2 Support systems required for operation of the GFES are complete and functional.

2.3 Test instrumentation is available and calibrated.

2.4 Construction activities for the area being protected are complete and the structure is properly sealed.

3.0 TEST METHOD

3.1 Verify as-built drawings showing the location of areas protected by the GFES.

3.2 Verify alarms, indicating instruments, and status lights are functional.

3.3 Verify that the gaseous fire extinguishing systems can be manually actuated (refer to Section 9.5.1.2.1).

3.4 Verify as-built GFES drawings.

4.0 DATA REQUIRED

4.1 As-built drawings showing the location of areas protected by GFES equipment.

4.2 As-built GFES drawings.

5.0 ACCEPTANCE CRITERIA

5.1 The GFES operates as designed (refer to Section 9.5.1, including manual features):

5.1.1 Verify that the GFES can provide coverage of designated areas to meet design requirements. System must achieve a design concentration in a specified time and hold that concentration for a specified time.

5.1.2 Manual activation devices meet design requirements.

5.1.3 Alarms and indicating instruments meet design requirements.

5.1.4 Piping and equipment installed per as-built system drawing meet design requirements.

14.2.12.6.8 Primary Coolant Injection Subsystem (ELAP) (Test #058)

1.0 OBJECTIVE

1.1 To functionally test the operation and performance of the primary coolant injection subsystem in conditions that are representative of actual plant conditions or close enough to allow data to be extrapolated to actual conditions following an ELAP event.

1.2 To observe the core cooling pump response to the normal power supply and the independent diesel generator power supply.

1.3 To observe operation of the flow paths through the cold leg safety injection piping to the reactor vessel, to determine if the system is properly installed and is functional.

1.4 To confirm full flow capability of the primary coolant injection subsystem with minimum backpressure.

1.5 To observe operation of the primary coolant injection isolation valves relative to the IRWST water level to validate pump NPSH.

1.6 To record data that is used to validate design basis assumptions or provide a baseline record of system performance for non-safety-related attributes.

1.7 To demonstrate electrical independence and redundancy of power supplies.

1.8 To demonstrate the ability of the safety injection accumulators to deliver core cooling makeup water and control the delivery rate by controlling accumulator pressure and accumulator isolation valve position.

2.0 PREREQUISITES

2.1 Construction activities on the primary coolant injection subsystem have either been completed or exceptions have been recorded and the impact on system performance has been determined.

2.2 Support systems and instrumentation required for operation of the primary coolant injection subsystem are complete and functional or the impact on system performance has been determined.

2.2.1 Instrumentation includes all normal safety injection accumulator instrumentation and a wide range accumulator level indicator that can be sequenced with the other test instrumentation.

2.3 The IRWST is filled with sufficient primary makeup water to conduct testing on the primary coolant injection subsystem.

2.4 The safety injection accumulators have been filled and pressurized to support subsequent testing.

2.5 The reactor vessel head and internals have been removed and the reactor vessel water level has been lowered below the vessel nozzles (simulates minimum backpressure "run out" conditions).

2.6 Test instrumentation to be used for pump performance has been installed and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

2.7 The primary coolant injection subsystem instrumentation is functional and calibrated and is operating satisfactorily prior to performing the following test.

3.0 TEST METHOD

3.1 Operate system valves while:

3.1.1 Observing each valve operation and position indication.

3.1.2 Measuring MOV valve performance data (e.g., thrust, opening and closing times, and ability to control injection flow).

3.2 Observe operation of power-operated valves upon loss of motive power.

3.3 Start the primary coolant injection pump and collect initial pump operating data:

3.3.1 The primary coolant injection pump shall be aligned to discharge to the depressurized RCS (vessel level maintained below the vessel nozzles).

3.3.2 The primary coolant injection isolation valve throttled and calibrated instrumentation installed to compare pump flow and discharge pressure to the pump manufacturer head-flow curve.

3.3.3 Perform critical (full flow) sections of the test using the normal power supply to the bus and then using the pre-staged ELAP diesel generator power source.

3.3.4 Collect valve data on valves that reposition to perform an accident mitigation function under maximum differential pressure conditions.

3.3.5 Measure suction supply (NPSH) to the primary coolant injection pump from the IRWST using the suction header under maximum flow conditions, minimum IRWST level, and minimum vessel level.

3.3.6 Compare the measured suction head to the primary coolant injection pump manufacturer NPSH requirements when corrected for IRWST minimum level attainable during maximum IRWST fluid temperature. (Note: it is acceptable to correct available data if design conditions cannot be duplicated).

3.4 Check electrical independence and redundancy of power supplies for subsystem functions by selectively removing power and determining loss of function.

3.5 Test the safety injection accumulator delivery rate to depressurized reactor coolant system as follows:

3.5.1 Establish the overpressure in one or more accumulators at 65 psig while maintaining the water level within the normal technical specification required level.

3.5.2 Open the accumulator isolation valve to 15% open and record accumulator parameters as a function of time until the conditions are stable.

3.5.3 Repeat the 65 psig test as necessary to resolve discrepancies and to verify that the process is repeatable. To produce the required design flow rate, throttle the accumulator isolation valve as necessary to maintain the flow rate within the design limits.

3.5.4 Determine a safety injection accumulator isolation target valve position that is partially open that will provide significant system resistance.

3.5.5 Establish the overpressure in one or more accumulators at 50 psig while maintaining the water level within the normal technical specification required level.

3.5.6 Open the accumulator isolation valve to the previously established target position and record accumulator parameters as a function of time until the conditions are stable. To produce the required design flow rate, throttle the accumulator isolation valve as necessary to maintain the flow rate within the design limits.

3.5.7 Repeat the 50 psig test as necessary to resolve discrepancies and to verify that the process is repeatable.

3.5.8 Establish the overpressure in one or more accumulators at 40 psig while maintaining the water level within the normal technical specification required level.

3.5.9 Open the accumulator isolation valve to the previously established throttle position and record accumulator parameters as a function of time until the conditions are stable.

3.5.10 Repeat the 40 psig test as necessary to resolve discrepancies and to verify that the process is repeatable. To produce the required design flow rate, throttle as necessary to maintain the flow rate within the design limits.

3.5.11 Establish the overpressure in one or more accumulators at 30 psig while maintaining the water level within the normal technical specification required level.

3.5.12 Open the accumulator isolation valve to the previously established target position and record accumulator parameters as a function of time until the conditions are stable.

3.5.13 Repeat the 30 psig test as necessary to resolve discrepancies and to verify that the process is repeatable.

3.5.14 Establish a new target valve position and target accumulator pressure to produce the required design flow rate.

3.5.15 Establish the overpressure in one or more accumulators at the target pressure while maintaining the water level within the normal technical specification required level.

3.5.16 Open the accumulator isolation valve to the new target valve position and record accumulator parameters as a function of time until the conditions are stable.

3.5.17 Repeat the test as necessary to resolve discrepancies and to verify that the process is repeatable.

4.0 DATA REQUIRED

4.1 Valve position and position indication.

4.2 Position response of valves to loss of motive power.

4.3 Valve performance data, where required.

4.4 Primary coolant injection pump initial functional data including the following:

4.4.1 Pump head versus flow.

4.4.2 Pump suction pressure.

4.4.3 Pumped fluid temperature.

4.4.4 Reactor vessel level.

4.4.5 IRWST level.

4.4.6 Normal power supply to the bus and then using the pre-staged ELAP diesel generator power source.

4.5 Response of the primary coolant injection subsystem when powered by normal power supply to the bus and then using the pre-staged ELAP diesel generator power source:

4.5.1 Motor current.

4.5.2 Bus voltage.

4.5.3 Time from start signal to rated flow.

4.6 Safety Injection Accumulator performance data for each test pressure as a function of time.

4.6.1 Accumulator pressure.

4.6.2 Accumulator isolation valve position.

4.6.3 Accumulator wide range level.

4.6.4 Flow delivered to the RCS.

5.0 ACCEPTANCE CRITERIA

5.1 The primary coolant injection subsystem meets design requirements:

5.1.1 Verify that the alarms and interlocks function as designed.

5.1.2 Verify that the system controls function as designed.

5.1.3 Verify that the primary coolant injection pump flow and developed head meet design requirements.

5.1.4 Verify that the primary coolant injection pump NPSH meets design requirements.

5.1.5 Verify that valve performance meets design requirements.

5.1.6 Verify that the primary coolant injection flow rate meets minimum/maximum design limitations.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

5.3 Verify that the primary coolant injection subsystem does not indicate evidence of water hammer when flow is initiated or terminated.

5.4 Verify that the Safety Injection Accumulator delivers makeup flow to the depressurized RCS in a predictable manner for multiple accumulator over pressure values and that the final overpressure and throttling settings meet the minimum acceptance standards for accumulator delivery.

14.2.12.7 Power Conversion Systems

14.2.12.7.1 Feedwater System (Test #059)

1.0 OBJECTIVE

1.1 To demonstrate that the FWS, including startup feedwater pump, is capable of supplying feedwater to the SGs for normal operation.

1.2 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the FWS have been completed.

2.2 FWS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the FWS are complete and functional.

2.4 Test instrumentation available and calibrated.

2.5 Condensate system functional.

2.6 Main condenser functional.

2.7 Appropriate AC and DC power available.

3.0 TEST METHOD

3.1 Demonstrate design flow paths including economizer, downcomer, and cleanup recirculation (during HFT or power ascension tests).

3.2 Demonstrate that startup feedwater valve alignments and flow paths function as designed.

3.3 Verify the starting, head, and flow characteristics of the motor-driven startup feedwater pump.

3.4 Demonstrate minimum flow recirculation protection using simulated inputs.

3.5 Verify operation of protective devices, controls, interlocks, instrumentation, and alarms using actual or simulated inputs function as designed.

3.6 Verify the starting, head, and flow characteristics of motor-driven feedwater pumps.

3.7 Operate feedwater isolation valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, stroke times).

3.8 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.9 Observe response of the feedwater isolation valves upon loss of motive power (refer to Section 10.4.7 for anticipated response).

3.10 Verify the feedwater isolation valves close in response to protective signals.

3.11 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.12 Demonstrate standby feedwater pumps response to loss of operating pumps.

3.13 Depressurize the feedwater supply header and verify that the feedwater check valves prevent pressurization of the feedwater system at the feedwater pump discharge.

4.0 DATA REQUIRED

4.1 Motor-driven startup feedwater pump head versus flow data.

4.2 Motor-driven feedwater pump head versus flow data.

4.3 Valve performance data, where required.

4.4 Valve position indication.

4.5 Position response of valves to loss of motive power.

4.6 Setpoints at which alarms and interlocks occur.

4.7 Feedwater isolation valve data.

5.0 ACCEPTANCE CRITERIA

5.1 The FWS (including startup feedwater) operates as designed (refer to Section 10.4.7):

5.1.1 Verify design flow paths including economizer, downcomer, and cleanup recirculation meet design requirements.

5.1.2 Verify that startup feedwater valve alignments and flow paths function as designed.

5.1.3 Verify the starting, head, and flow characteristics of the motor-driven startup feedwater pump meet design requirements.

5.1.4 Verify that minimum flow recirculation protection meets design requirements.

5.1.5 Verify operation of protective devices, controls, interlocks, instrumentation, and alarms function as designed.

5.1.6 Verify the starting, head, and flow characteristics of motor-driven feedwater pumps meets design requirements.

5.1.7 Verify that control valves control feedwater flow and system pressures as designed.

5.1.8 Verify that standby feedwater pumps respond as designed to loss of operating pumps.

5.2 The feedwater isolation valves meet the test acceptance criteria (refer to Section 10.4.7):

5.2.1 Verify that isolation valves meet design requirements (e.g., response to signals, stroke speed).

5.3 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.7.2 Feedwater Heating System (Test #060)

1.0 OBJECTIVE

1.1 To demonstrate that the feedwater heating system (FWHS) is capable of heating the FWS to the design temperature for normal plant operation. This test can only be performed during HFT or similar plant conditions.

1.2 To demonstrate the FWHS alarms and controls operate as designed.

1.3 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the feedwater heater drain and vent system have been completed.

2.2 Construction activities on the feedwater heater drains system have been completed.

2.3 FWHS instrumentation has been calibrated and is functional for performance of the following test.

2.4 Feedwater heater drains system instrumentation has been calibrated and is functional for performance of the following test.

2.5 Individual feedwater and main steam component testing is complete.

2.6 The power conversions systems are operating as required to support the test.

3.0 TEST METHOD

3.1 Verify the setpoints of alarms and interlock.

3.2 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.3 Observe response of power-operated valves upon loss of motive power (refer to Section 10.4.7 for anticipated response).

3.4 Record the feedwater temperature to the SGs at maximum attainable feedwater flow and compare the readings to those predicted by the secondary model for similar conditions.

3.5 Demonstrate that the high pressure feedwater heating system level controls maintain level as designed and drain to the deaerator.

3.6 Demonstrate that the low pressure feedwater heaters level controls maintain level as designed and drain to the main condenser.

3.7 Demonstrate operation of the high level drain valves (valves divert shell side flow upon actual or simulated high level.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indication.

4.3 Position response of valves to loss of motive power.

4.4 Setpoints at which alarms and interlocks occur.

4.5 Feedwater temperature and feedwater flow rate for each heater group.

4.6 Level controllers trend data.

5.0 ACCEPTANCE CRITERIA

5.1 The FWHS meets design requirements (refer to Section 10.4.7):

5.1.1 Verify that alarms and interlocks function as designed.

5.1.2 Verify that system control bypass and isolation valves meet design requirements.

5.1.3 Verify that feed water temperatures at the feedwater exit meet design requirements.

14.2.12.7.3 Main Steam – Turbine Bypass Systems (Test #061)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the main steam system (MSS).

1.2 To demonstrate the operation of the turbine bypass system (TBS).

1.3 To demonstrate electrical independence and redundancy of power supplies.

1.4 To verify that radiation monitors respond as designed to check sources.

2.0 PREREQUISITES

2.1 Construction activities on the MSS have been completed.

2.2 Construction activities on the TBS have been completed.

2.3 MSS and TBS instrumentation, including radiation monitors, has been calibrated and is functional for performance of the following test.

2.4 Support systems required for operation of the MSS and TBS are complete and functional.

2.5 Test equipment is available and test instrumentation is calibrated.

3.0 TEST METHOD

3.1 Demonstrate automatic drain valve operation.

3.2 Demonstrate flow paths.

3.3 Verify opening of the turbine bypass valves in response to a signal simulating turbine trip and simulated steam pressure above setpoint. Record response time and steam pressure setpoints when valve travel occurs.

3.4 Verify the functionality of the main steam relief train (MSRT) valves at HZP steam pressure during HFT.

3.5 Verify the functionality of the turbine bypass valves at no-load steam pressure during HFT.

3.6 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.7 Observe response of the turbine bypass valves upon loss of motive power (refer to Section 10.4.4 for anticipated response).

3.8 Verify that operation of designated components such as protective devices, controls, interlocks, instrumentation, and alarms using actual or simulated inputs function as designed.

3.9 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.10 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Points R-55 through R-58) and external test equipment, as necessary:

3.10.1 Check the self-testing features of radiation monitors.

3.10.2 Record the response of radiation monitors to check sources.

3.10.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.10.4 Record alarm actuations at local and remote locations, as appropriate.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indication.

4.3 Position response of valves to loss of motive power.

4.4 Setpoints at which valve openings, alarms, and interlocks occur.

4.5 Flow path data.

4.6 Turbine bypass valve response time (fully shut to fully open).

4.7 Radiation monitor response to check source.

4.8 Technical data associated with check source.

4.9 Signal levels necessary to initiate alarm actuation.

5.0 ACCEPTANCE CRITERIA

5.1 The MSS performance as designed (refer to Section 10.4.4).

5.2 Turbine bypass valves open in response to a signal simulating turbine trip and controls steam pressure, as designed (refer to Section 10.4.4).

5.3 Turbine bypass valves fail upon loss of motive power as designed (refer to Section 10.4.4).

5.4 Verify that safety-related components meet electrical independence and redundancy requirements.

5.5 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Points R-55 through R-58). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.5.1 Range.

5.5.2 Response time.

5.5.3 Sensitivity.

5.6 The radiation monitoring system (main steam line activity) generates a steam line activity measurement signal as an input to the protection system (refer to Table 11.5-1, Radiation Measuring Points R-55 through R-58).

5.7 The radiation monitoring system (containment high range activity) generates a containment activity measurement signal as an input to the protection system (refer to Section 11.5.4.1 and Table 11.5-1, Radiation Measuring Points R-55 through 5-58).

14.2.12.7.4 Main Steam Safety Valve (Test #062)

1.0 OBJECTIVE

1.1 To verify the popping pressure of the MSS safety valves during HFT.

1.2 To verify an acceptable alternative method is to perform the setpoint verification at a certified testing facility.

1.3 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the main steam safety valves have been completed.

2.2 MSS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the main steam safety valves are complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 MSS is at HZP (pressure and temperature), which is a suitable temperature and pressure for valve testing.

2.6 Lifting device with associated support equipment and calibration data is available.

3.0 TEST METHOD

3.1 Increase the lifting force on the safety valve, using the lifting device until the safety valve starts to simmer.

3.2 Determine popping set pressure.

3.3 Adjust valve popping set pressure if necessary and retest.

3.4 Repeat until three consecutive pops within the required range are obtained.

3.5 Verify safety valves have no seat leakage.

3.6 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 MSS pressure and temperature.

4.2 Pressure applied to the lifting device to lift the safety valve off its seat.

4.3 Popping pressure of each main steam safety valve.

5.0 ACCEPTANCE CRITERIA

5.1 The main steam safety valves perform as designed (refer to Section 10.3).

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.7.5 Main Steam Isolation Valves and MSIV Bypass Valves (Test #063)

1.0 OBJECTIVE

1.1 To demonstrate the functional performance of the main steam isolation valves (MSIV) and MSIV bypass valve controls.

1.2 To demonstrate the proper operation of the MSIVs at normal operating temperatures, during HFT.

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the MSIVs have been completed.

2.2 MSS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the MSIVs are complete and functional.

2.4 Test equipment is available and test instrumentation is calibrated.

3.0 TEST METHOD

3.1 Operate MSIV and MSIV bypass valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, stroke times) at ambient and HFT conditions. Note that the MSIV has two operating scenarios, fast acting for MSIV and slow acting for open/close for normal operation. The intent is to measure response to normal operation.

3.2 Observe response of the MSIVs and MSIV bypass valves upon loss of motive power (refer to Section 10.3 for anticipated response).

3.3 Verify MSIV and MSIV bypass valve controls, alarms, and interlocks.

3.4 Verify MSIV and MSIV bypass valve response (e.g., thrust, stroke times) to main steam isolation signal.

3.5 Verify MSIV and MSIV bypass valve seat leakage.

3.6 Perform MSIV drift test.

3.7 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.8 Verify that the MSIV and MSIV bypass valves meet design requirements.

4.0 DATA REQUIRED

4.1 MSIV and MSIV bypass valve performance data at ambient and HFT conditions.

4.2 Valve position indication.

4.3 Position response of valves to a loss of motive power.

4.4 Setpoints at which alarms and interlocks occur.

4.5 MSIV and MSIV bypass valve seat leakage.

4.6 MSIV and MSIV bypass valve response to main steam isolation signal.

4.7 MSIV drift data.

5.0 ACCEPTANCE CRITERIA

5.1 The MSIVs and MSIV bypass valves operate as designed (refer to Section 10.3):

5.1.1 Verify that valve meet design requirements (e.g., stroke time, thrust, seat leakage, loss of motive power).

- Table 14.3-1, Item 1-62.

5.1.2 Verify that system controls, alarms, and interlocks function as designed.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.7.6 Turbine Gland Sealing System (Test #064)

1.0 OBJECTIVE

1.1 To verify that the turbine gland sealing system (TGSS) provides adequate sealing to the turbine shaft against leakage of air to the turbine casings and escape of steam to the Turbine Building.

2.0 PREREQUISITES

2.1 Construction activities on the TGSS have been completed.

2.2 TGSS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Test instrumentation is available and calibrated.

2.4 Plant systems required to support the test including auxiliary steam, the condenser, and turbine cooling water system are functional.

2.5 Plant conditions for the following subsystems allow operation of the sealing steam system.

2.5.1 Main turbine.

2.5.2 Main feed pumps.

2.5.3 Turbine control valves.

2.5.4 Main condensate flow through the gland steam condenser.

Note: The gland steam seal minimizes air in-leakage at the turbine shaft and allows the vent system radiation monitor to more accurately detect radioactive non-condensable gases that accumulate in the condenser and are vented from the condenser.

2.6 Verify preoperational Test #065 has been satisfactorily completed for radiation monitoring instrumentation.

3.0 TEST METHOD

3.1 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.2 Observe response of power-operated valves upon loss of motive power (refer to Section 10.4.3 for anticipated response).

3.3 Place the TGSS in operation using auxiliary steam during turbine startup.

3.3.1 Verify that with the gland steam seal in operation that air in-leakage is minimized. This is typically performed by

injecting helium or SF_6 in the area adjacent to the turbine seal and monitoring the vacuum pump exhaust.

3.4 Verify that operation of the TGSS as turbine load is increased functions as designed.

3.5 Verify that performance of the sealing steam exhauster blowers and the sealing steam condenser function as designed.

3.6 Verify that operation of the high pressure turbine gland spillover valve for dumping excess gland seal leakage functions as designed.

3.7 Verify that operation of protective devices, controls, interlocks, instrumentation, and alarms function as designed.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indication.

4.3 Position response of valves to loss of motive power.

4.4 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The TGSS meets design requirements (refer to Section 10.4.3):

5.1.1 TGSS provides adequate sealing of the turbine shaft.

5.1.2 TGSS valves thrust, opening times, closing times, and controls (manual and automatic) meet design requirements.

5.1.3 TGSS alarms, interlocks, and system controls meet design requirements.

14.2.12.7.7 Main Condenser and Main Condenser Evacuation System (Test #065)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the main condenser and main condenser evacuation system (MCES) to provide a continuous heat sink for normal operation.

1.2 To demonstrate the ability of the main condenser and MCES to provide a sink for the turbine bypass system.

1.3 To verify that radiation monitors respond as designed to check sources.

1.4 To verify that radiation sample points provide representative samples of the MCES.

2.0 PREREQUISITES

2.1 Construction activities on the main condenser and MCES have been complete.

2.2 Main condenser and MCES instrumentation, including radiation monitors, has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the main condenser and MCES are complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Steam seals and lagging are available.

2.6 Turbine is on turning gear.

2.7 All electrical testing is complete on the vacuum pumps and condenser valves.

3.0 TEST METHOD

3.1 Verify the vacuum integrity of the condenser by performing the following tests:

3.1.1 Hydrostatic test of the condenser with the water boxes clean and dry.

3.1.2 Establish a vacuum and determine sources of in-leakage with helium, sulfur hexafluoride or equivalent tracer gas. (Look for leaks at each valve bonnet).

3.2 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.3 Observe response of power-operated valves upon loss of motive power.

3.4 Demonstrate that operation of the vacuum pumps with design operating modes and flow paths function as designed.

3.5 Verify operation of protective devices, controls, interlocks, instrumentation, and alarms using actual or simulated inputs function as designed.

3.6 Demonstrate the operation of the condenser makeup and reject to the feedwater tank deaerator controls.

3.7 Demonstrate the operation of the automatic condenser cleaning system.

3.8 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Point R-3) and external test equipment, as necessary:

3.8.1 Check the self-testing features of radiation monitors.

3.8.2 Record the response of radiation monitors to check sources.

3.8.3 Initiate a high radiation signal to the radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.8.4 Record alarm actuations at local and remote locations, as appropriate.

3.9 Verify that sample points (refer to Table 11.5-1, Radiation Measuring Point R-65) is capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indication.

4.3 Position response of valves to loss of motive power.

4.4 Setpoints at which alarms and interlocks occur.

4.5 Vacuum pump running data.

4.6 Radiation monitor response to check source.

4.7 Technical data associated with check source.

4.8 Signal levels necessary to initiate alarm actuation.

5.0 ACCEPTANCE CRITERIA

5.1 The main condenser and MCES perform as designed (refer to Section 10.4.2):

5.1.1 Condenser vacuum is established within design limits.

5.1.2 Condenser air leakage is within established limits.

5.1.3 Condenser valves thrust, opening times, closing times, failure mode upon loss of motive power, and controls (manual and automatic) function as designed.

5.1.4 Condenser alarms, interlocks, instrumentation, and controls (automatic and manual) function as designed.

5.2 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Point R-3). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.2.1 Range.

5.2.2 Response time.

5.2.3 Sensitivity.

5.3 Radiation sample point (refer to Table 11.5-1, Radiation Measuring Point R-65) is capable of collecting the required samples.

14.2.12.7.8 Condensate System (Test #066)

1.0 OBJECTIVE

1.1 To demonstrate that the condensate system (CS) is capable of supplying an adequate flow of water at the design pressure to support the remainder of the power conversion system.

2.0 PREREQUISITES

2.1 Construction activities on the CS have been completed.

2.2 The CS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the CS are complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Plant conditions are such to provide a flow path from the condensate pumps to the feedwater tank.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify head versus flow characteristics for the condensate pumps.

3.3 Demonstrate that operation of the feedwater tank deaerator meets design requirements.

3.4 Demonstrate that operation of design flow paths including system cleanup operation function as designed.

3.5 Demonstrate that operation of minimum flow recirculation protections meet design requirements.

3.6 Demonstrate that operation of the hotwell level control system meet design requirements.

3.7 Verify that operation of designated components, such as protective devices, controls, interlocks, instrumentation, and alarms using actual or simulated inputs function as designed.

3.8 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.9 Observe response of power-operated valves upon loss of motive power (refer to Section 10.4.7 for anticipated response).

3.10 Verify that vibration levels during normal system operation and transients meet design requirements.

4.0 DATA REQUIRED

4.1 Head versus flow performance and pump operating data.

4.2 Valve performance data, where required.

4.3 Valve position indication.

4.4 Position response of valves to loss of motive power.

4.5 Setpoints at which alarms and interlocks occur.

4.6 Setpoints of the hotwell level controls.

4.7 Setpoints of the pumps minimum flow recirculation protection.

5.0 ACCEPTANCE CRITERIA

5.1 The CS operates as designed (refer to Section 10.4.7):

5.1.1 CS pumps, including pump seals, perform as designed.

5.1.2 The CS alarms, interlocks, protective devices, and controls (automatic and manual) function as designed.

5.1.3 CS valves perform as designed (e.g., thrust, seat leakage, opening time, closing time, bonnet air in-leakage, failure mode upon loss of motive power).

5.2 Vibration levels meet the requirements described in Section 3.9.2.4.

14.2.12.7.9 Steam Generator Blowdown System (Test #067)

1.0 OBJECTIVE

1.1 To verify the proper operation of the SG blowdown system (SGBS).

1.2 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the SGBS have been completed.

2.2 The SGBS instruments have been calibrated and are functional for performance of the following test.

2.3 Support systems required for operation of the SGBS are complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Verify that the blowdown system's demineralizers and filtration units are loaded with the proper types and amounts of ion exchange resins and filtration media.

2.6 Verify preoperational Test #071 has been satisfactorily completed for radiation monitoring instrumentation.

3.0 TEST METHOD

3.1 Verify the flow paths for generator blowdown and subsequent condensate recycle during HFT.

3.2 Verify blowdown flow path flow rates during HFT.

3.3 Remotely operate power-operated valves while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.4 Observe response of power-operated valves upon loss of motive power (refer to Section 10.4.8 for anticipated response).

3.5 Verify that operation of the flash tank, valves, and heat exchanger in operational modes and flow paths function as designed.

3.6 Verify that the operation of protective devices, controls, interlocks, and alarms using actual or simulated inputs meet design requirements.

3.7 Verify system response to the following:

3.7.1 The blowdown system meets design requirements in response to CIS.

3.7.2 The blowdown system meets design requirements in response to signals described in Section 10.4.8.2.2.

3.7.3 The blowdown system meets design requirements in response to a main steam isolation signal caused by low SG pressure or high SG pressure drop.

3.7.4 The blowdown system meets design requirements in response to a partial cooldown signal coupled with either high secondary activity (refer to Table 11.5-1, Monitors R-46 through R-49) or high SG level.

3.7.5 The blowdown system meets design requirements in response to a safety injection signal plus loss of offsite power.

3.8 Verify SG wet layup system operations.

3.9 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indication.

4.3 Position response of valves to loss of motive power.

4.4 Setpoints at which alarms and interlocks occur.

4.5 Response of CIVs to CIS and signals described in Section 10.4.8.2.2.

4.6 SG blowdown flow path flow rates.

5.0 ACCEPTANCE CRITERIA

5.1 The SGBS operates as designed (refer to Section 10.4.8):

5.1.1 SGBS alarms, interlocks, protective devices, and controls (manual and automatic) respond as required.

5.1.2 SGBS instrumentation performs as designed.

5.1.3 SGBS valves perform as designed (i.e., thrust, opening times, closing times, ability to initiate and terminate SGBS flow without introducing water hammers).

5.1.4 SGBS responds as designed to isolation signals.

5.1.5 SGBS flow rates meet design requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

5.3 The SGBS meet design requirements to monitor radiation (refer to Table 11.5-1, Monitors R-46 through R-49).

14.2.12.7.10 Steam Turbine (Test #068)

1.0 OBJECTIVE

1.1 To demonstrate functional performance of the steam turbine controls.

1.2 To demonstrate functional performance of the steam turbine support system.

1.3 To perform initial operation of the steam turbine system (HFT and power ascension tests).

1.4 To verify the steam turbine generator trips in response to the following:

1.4.1 Simulated reactor trip signal.

1.4.2 Simulated loss of condenser vacuum signal.

1.4.3 Manual trip from the main control room.

2.0 PREREQUISITES

2.1 Construction activities on the steam turbine system are complete.

2.2 Steam turbine system instrumentation has been calibrated and is functional for the performance of the following test.

2.3 Appropriate test equipment is available and has been calibrated.

2.4 Fluid levels throughout the system meet design limits. Personnel safety shall limit proximity to lubricating and hydraulic oils.

2.5 Schedule visual inspection of the steam turbine following testing.

2.6 Appropriate AC and DC power sources are available and functional.

2.7 Support systems required for the steam turbine system are complete and functional.

2.8 MSS is available.

2.9 Main condenser is available.

2.10 Turbine overspeed protection systems are available and functioning properly.

2.11 Manual trip circuits in the main control room and at the turbine are functioning properly and are manned during test evolutions.

3.0 TEST METHODS

3.1 Demonstrate the electro hydraulic control (EHC) system performs the following:

3.1.1 That turbine turning gear engages and disengages as designed.

3.1.2 That automatic control of turbine speed and acceleration functions through the entire speed range.

3.1.3 That automatic control of load and loading rate from auxiliary to full load, with continuous load adjustment and discrete loading rates.

3.1.4 Standby manual control of speed and load is functional when it becomes necessary to take the primary automatic control out of service.

3.1.5 Limiting of load in response to preset limits on operating parameters.

3.2 Verify that detection of undesirable operating conditions (e.g., resonance frequencies, maximum exhaust hood temperature, condenser vacuum limits, turbine vibration limits), annunciation of detected conditions, and initiation of control response to such conditions meets design requirements, as follows:

3.2.1 Monitoring the status of the control systems including the power supplies and redundant control circuits as designed and described in Section 10.2.

3.2.2 Testing of valves and controls including response to a simulated reactor trip signal and simulated loss of condenser vacuum signal and manual trip.

- Verify response time from initiation of a turbine trip signal to closure of the main steam stop valve.
- Verify response time from initiation of a turbine trip signal to closure of the reheat steam intercept valve.
- Verify response time from initiation of a turbine trip signal to closure of the main steam control valve.
- Verify response time from initiation of a turbine trip signal to closure of the reheat steam stop valve.
- Verify response time from initiation of a turbine trip signal to closure of the extraction steam non-return valve.

3.2.3 Pre-warming of valve chest and turbine rotor.

3.2.4 Monitoring the status of the turbine auxiliary systems as designed and described in Section 10.2.

3.3 Perform steam turbine performance test per latest edition of ASME PTC-6 (Reference 3).

3.4 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.5 Observe response of the following power-operated valves upon loss of motive power (refer to Section 10.2 for anticipated response).

3.5.1 Main steam stop.

3.5.2 Reheat steam intercept.

3.5.3 Main steam control.

3.5.4 Reheat steam stop.

3.5.5 Extraction steam non-return.

3.6 Demonstrate turbine lube oil system operation.

3.7 Demonstrate hydrogen oil-sealed cooling system for rotor cooling operation.

3.8 Demonstrate stator water cooling system operation.

3.9 Demonstrate moisture separators, reheaters, and extraction steam systems operation, including actuation of the extraction steam non-return valves upon a turbine trip signal.

4.0 DATA REQUIRED

4.1 Setpoint at which alarms and interlocks occur.

4.2 Plant Data for time period corresponding to automatic trip, if applicable.

4.3 Plant Data during time period corresponding to manual trip.

4.4 Turbine control logic checklist (functions verified during preoperational test).

4.5 EHC operation of each component in normal and trip mode.

4.6 Valve performance data, where required:

4.6.1 Stroke Time (full open to fully closed upon receipt of turbine trip signal).

4.6.2 Stroke Time (full closed to fully open using control signal).

4.6.3 Stroke Time (full open to fully closed using control signal).

4.7 Valve position indication.

4.8 Position response of valves to loss of motive power.

4.9 Operating data and function verification of associated turbine support systems.

5.0 ACCEPTANCE CRITERIA

5.1 The steam turbine system and support systems perform as designed (refer to Section 10.2):

5.1.1 Turbine turning gear engages and disengages as designed.

5.1.2 Turbine alarms, interlocks, protective devices, and controls (manual and automatic) meet design requirements.

5.1.3 Turbine valves (e.g., stroke speed, failure mode upon loss of motive power, ability to control turbine speed) meet design requirements.

5.1.4 Turbine performance meets design requirements.

- Turbine speed and acceleration function through the entire range.
- Automatic loading and loading rate.
- Manual turbine controls.
- Response to preset limits.

5.1.5 Turbine lube oil system operates as designed.

5.1.6 Turbine cooling systems operate as designed.

- Hydrogen oil-sealed rotor cooling.
- Stator water cooling.

5.1.7 Moisture separators, reheaters, and extraction steam systems.

5.2 Steam turbine performance is as required by vendor ratings.

5.3 Steam turbine generator trip signal is generated in response to a simulated reactor trip signal as designed (refer to Section 10.2.2.10).

5.4 Steam turbine generator trip is generated in response to a simulated loss of condenser vacuum signal as designed (refer to Section 10.2.2.10).

5.5 Steam turbine-generator trip is generated in response to a manual trip from the main control room.

14.2.12.7.11 Circulating Water Supply System (Test #069)

A COL applicant that references the U.S. EPR design certification will provide site-specific test abstract information for the circulating water supply system. The following is a typical COLA test; if a site-specific test will be used, the COL applicant will provide the test.

1.0 OBJECTIVE

1.1 To demonstrate the ability of the circulating water supply system (CWS) to provide a continuous supply of cooling water to the main

condensers and return the water to the cooling tower for heat dissipation.

2.0 PREREQUISITES

2.1 Construction activities on the CWS have been completed.

2.2 The CWS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the CWS are complete and functional.

2.4 Intake structure at the required level and water quality within limits.

2.5 Temporary test instruments installed and calibrated.

3.0 TEST METHOD

3.1 Verify head versus flow and functional characteristics for the circulating water supply pumps.

3.2 Verify required alarms and verify the corresponding actions.

3.3 Verify manual and automatic systems controls function as designed.

3.4 Verify that the cooling tower makeup pumps are capable of maintaining cooling tower level and blowdown during maximum design conditions.

4.0 DATA REQUIRED

4.1 Verification of trips and alarms.

4.2 Record pump head versus flow and operating data.

4.3 Flow data to upper and lower basins of the cooling tower.

5.0 ACCEPTANCE CRITERIA

5.1 The CWS meets design requirements (refer to Section 10.4.5):

5.1.1 CWS alarms, interlocks, and controls (manual and automatic) function as designed.

5.1.2 CWS pump performance meets design requirements.

5.1.3 CWS pumps are capable of maintaining basin levels, as designed.

14.2.12.7.12 Reheater Drains System (Test #070)

1.0 OBJECTIVE

1.1 To verify that the reheater drains system (RHDS) level controls and associated valves are capable of controlling level in feedwater heaters and drain tanks.

2.0 PREREQUISITES

2.1 Construction activities on the RHDS have been completed.

2.2 RHDS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Test instrumentation is available and calibrated.

2.4 Plant systems required to support the RHDS are functional.

2.5 Plant conditions that allow operation of the RHDS exist or actual feedwater level changes can be simulated.

3.0 TEST METHOD

3.1 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.2 Verify power-operated valves fail upon loss of motive power to the required position.

3.3 Verify that operation of protective devices, controls, interlocks, instrumentation, and alarms meet design requirements.

3.4 Verify that the RHDS can meet the following design requirements:

a. Diversion valves to the condenser open at the established setpoint.

b. Modulation valves reposition to control feedwater heater and drain tank levels at established setpoints.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indication.

4.3 Position response of valves to loss of motive power.

4.4 Setpoints at which alarms and interlocks occur.

4.5 Level indication of various components.

5.0 ACCEPTANCE CRITERIA

5.1 The RHDS meets design requirements (refer to Section 10.4.7):

5.1.1 RHDS alarms, interlocks, and controls (manual and automatic) function as designed.

5.1.2 RHDS valves perform as designed (i.e., opening times, closing times, and ability to control feedwater heater levels).

5.1.3 RHDS pumps perform as designed.

5.1.4 RHDS feedwater levels control feedwater heater levels as designed.

14.2.12.7.13 Secondary Sampling System (Test #071)

1.0 OBJECTIVE

1.1 To verify the ability of secondary sampling system (SECSS) to collect and deliver representative secondary samples to sample stations for chemical and radiological analysis during power, cooldown, and standby operation.

1.2 To demonstrate electrical independence and redundancy of power supplies to steam generator blowdown sampling system containment isolation valves.

1.3 To verify that radiation monitors respond as designed to check sources.

1.4 To verify that radiation sample points provide representative samples of the SECSS.

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested have been completed.

2.2 The secondary sampling system has been flushed with demineralized water to remove residues of chemical agents used during construction cleaning phases.

2.3 Systems being sampled are at or near normal operating pressure and temperature.

2.4 Calibrating gases and solutions are available for radioactive and non-radioactive analyses as referenced in Table 9.3.2-2 and Table 11.5-1, Monitors R-46 through R-49 and R-50.

2.5 Test instrumentation is available and calibrated.

2.6 SECSS instrumentation, including radiation monitors, has been calibrated and is functional for performance of the following test.

3.0 TEST METHOD

3.1 Withdraw fluid at each sample point, verifying adequate sample flow.

3.2 Verify that operation of alarms and interlocks meets design requirements.

3.3 Verify that operation of pump and heat exchangers in normal operation using normal flow paths meets design requirements.

3.4 Verify the analytical instrumentation provides indication and response that meet the design requirements.

3.5 Activate power-operated valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.6 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 9.3.2).

3.7 Verify that continuous monitors and sample flow rate meets design requirements.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.9 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Points R-46 through R-49) and external test equipment, as necessary:

3.9.1 Check the self-testing features of radiation monitors.

3.9.2 Record the response of radiation monitors to check sources.

3.9.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.9.4 Record alarm actuations at local and remote locations, as appropriate.

3.10 Verify that sample points (refer to Table 11.5-1, Radiation Measuring Points R-46 through R-49) are capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms and interlocks occur.

4.2 Sampling flow rate from each sample point.

4.3 Analytical instrument data.

4.4 Valve performance data, where required.

4.5 Valve position indication.

4.6 Position response of valves to loss of motive power.

4.7 Radiation monitor response to check source.

4.8 Technical data associated with check source.

4.9 Signal levels necessary to initiate alarm actuation.

5.0 ACCEPTANCE CRITERIA

5.1 The SECSS meets design requirements (refer to Section 9.3.2):

5.1.1 SECSS alarms, interlocks, and controls (manual and automatic) function as designed.

5.1.2 SECSS valves perform as designed (i.e., opening times, closing times, and pressure/temperature controls).

5.1.3 SECSS meet design requirements for representative samples.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

5.3 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Points R-46 through R-49). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.3.1 Range.

5.3.2 Response time.

5.3.3 Sensitivity.

5.4 Radiation sample points (refer to Table 11.5-1, Radiation Measuring Points R-46 through R-49) are capable of collecting the required samples.

14.2.12.7.14 Steam Generator Blowdown Demineralizing System (Test #072)

1.0 OBJECTIVE

1.1 To verify the ability of the steam generator blowdown (SGB) demineralizing system to clean the SG blowdown by a combination of filtration and ion exchange.

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested have been completed.

2.2 Systems being sampled are at or near normal operating pressure and temperature.

2.3 Calibrating gases and solutions are available for radioactive and non-radioactive analyses as referenced in Table 9.3.2-2.

2.4 Test instrumentation is available and calibrated.

2.5 Secondary sampling system instrumentation has been calibrated and is functional for performance of the following test.

2.6 Verify that steam generator blowdown system demineralizers are loaded with the proper type and amount of ion exchange resins.

2.7 Verify that steam generator blowdown system filters are loaded with the proper filter media.

3.0 TEST METHOD

3.1 Verify by physical inspection that the filter housing is constructed and assembled in a manner that doesn't permit bypass flow paths.

3.2 Verify that operation of alarms and interlocks meet design requirements.

3.3 Verify the analytical instrumentation provides indication and response that meets design requirements of ion exchanger outlet chemistry.

3.4 Activate power-operated valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.5 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 10.4.8).

4.0 DATA REQUIRED

4.1 Setpoints at which alarms and interlocks occur.

4.2 Valve performance data, where required.

4.3 Valve position indication.

4.4 Position response of valves to loss of motive power.

5.0 ACCEPTANCE CRITERIA

5.1 The SGB demineralizing system meets design requirements (refer to Section 10.4.8, 11.2, and 11.5.4.3):

5.1.1 SGB demineralizing system alarms, interlocks, and controls (manual and automatic) function as designed.

5.1.2 SGB demineralizing system valves perform as designed (i.e., opening times, closing times).

14.2.12.8 Heating Ventilation and Air Conditioning (HVAC) Systems

14.2.12.8.1 Containment Building Cooling (Test #073)

1.0 OBJECTIVE

1.1 To demonstrate the capability of the containment building ventilation system (CBVS) to maintain acceptable temperature limits and air quality in the containment during normal operations and normal shutdown.

2.0 PREREQUISITES

2.1 Major construction activities inside the containment building have been completed.

2.2 Construction activities on the CBVS have been completed.

2.3 CBVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the CBVS are complete and functional.

2.5 Test instrumentation is available and calibrated.

2.6 The RCS is at normal operating temperature and pressure during HFT.

3.0 TEST METHOD

3.1 Verify the operation of the containment recirculation cooling units.

3.2 Verify the operation of the reactor pit cooling fans.

3.3 Verify operation of the containment purge fans (both full flow and low flow).

3.4 Perform air balance as appropriate for each subsystem.

3.5 Verify that duct/housing total leakage requirements are met.

4.0 DATA REQUIRED

4.1 Operation of interlocks and set points.

4.2 Air balancing report, including fan operating data.

4.3 Containment building temperature data.

4.4 Prefilter, high efficiency particulate air (HEPA) filter, and carbon adsorber data for containment air clean up filtration units.

5.0 ACCEPTANCE CRITERIA

5.1 The CBVS perform as designed (refer to Section 9.4.7):

5.1.1 Containment Building cooling alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 Containment Building cooling fan performance meets design requirements.

5.1.3 Containment Building cooling dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 Containment Building cooling air balance meets design requirements.

5.1.5 Containment Building meets duct/housing total leakage requirements.

14.2.12.8.2 Containment Building Cooling Subsystem (Test #074)

1.0 OBJECTIVE

1.1 To verify the proper operation of the containment building cooling subsystem. This system provides cool air to the reactor coolant pumps (RCP), steam generators (SG), chemical and volume control system (CVCS), control rod drive mechanism (CRDM) system and vent and drain system.

2.0 PREREQUISITES

2.1 Construction activities on the containment building cooling subsystem are complete.

2.2 Permanently installed instrumentation is functional and calibrated and is operating satisfactorily prior to performing the following test.

2.3 Test instrumentation is available and calibrated.

2.4 Plant systems required to support testing are functional.

2.5 Reactor pit cooling system is operating.

2.6 Support systems required for operation of the containment building cooling subsystem are functional.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Operate the system in the normal alignment and perform testing, adjusting, and balancing of the ventilation systems.

3.3 Verify that operation of interlocks and alarms meet design requirements.

4.0 DATA REQUIRED

4.1 Air flow rates.

4.2 RCS temperatures and pressures.

4.3 Setpoints at which interlocks and alarms occur.

4.4 RCP operating temperatures.

4.5 CVCS operating temperatures.

4.6 CRDMS operating temperatures.

5.0 ACCEPTANCE CRITERIA

5.1 The system temperatures are within the limits designed (refer to Section 9.4.7):

5.1.1 Containment cooling and ventilation system, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 Containment cooling and ventilation system fan performance meets design requirements.

5.1.3 Containment cooling and ventilation system dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 The containment cooling and ventilation system air balance meets design requirements.

14.2.12.8.3 Containment Building Ventilation System (Test #075)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the reactor containment building ventilation system (CBVS) to maintain design temperature conditions.

1.2 To verify that radiation monitors respond as designed to check sources.

1.3 To verify that the radiation sample point provides a representative sample of the CBVS.

2.0 PREREQUISITES

2.1 Construction activities on the CBVS have been completed.

2.2 CBVS instrumentation, including radiation monitors, has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems are complete and functional for operation of the CBVS.

2.4 Test Instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify that operation, stroking speed and position indication of dampers meet design requirements.

3.3 Verify the system maintains the Reactor Containment at a negative pressures relative to outside air pressure (only when purge system is operating).

3.4 Verify the system maintains the differential pressure between the equipment compartment and the service compartments (only when exhaust is operating).

3.5 Verify that operation of the ventilation supply units and fans meets design requirements.

3.6 Verify that operation of the ventilation exhaust units and fans meet design requirements.

3.7 Verify that operation of the equipment compartment cooling units meets design requirements.

3.8 Verify that operation of the equipment compartment ventilation units meets design requirements.

3.9 Verify HEPA filter efficiency, carbon adsorber efficiency, and air flow capacity.

3.10 Verify the system rated air flow and air balance.

3.11 Verify that operation of protective devices, controls, interlocks instrumentation, and alarms using actual or simulated inputs meet design requirements.

3.12 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Point R-10) and external test equipment, as necessary:

3.12.1 Check the self-testing features of radiation monitors.

3.12.2 Record the response of radiation monitors to check sources.

3.12.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.12.4 Record alarm actuations at local and remote locations, as appropriate.

3.13 Verify that sample point (refer to Table 11.5-1, Radiation Measuring Point R-10) is capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Air balancing verification.

4.2 Fan and damper operating data.

4.3 Temperature data of building areas.

4.4 Setpoints of alarms, interlocks, and controls.

4.5 Reactor Containment Building negative pressurization data.

4.6 HEPA filter and carbon adsorber data.

4.7 CBVS performance data in response to radiation monitors.

4.8 Radiation monitor response to check source.

4.9 Technical data associated with check source.

4.10 Signal levels necessary to initiate alarm actuation.

5.0 ACCEPTANCE CRITERIA

5.1 The CBVS operate as designed (refer to Section 9.4.7):

5.1.1 CBVS alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 CBVS fan performance meets design requirements.

5.1.3 CBVS dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.2 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Point R-10). This includes, but is

not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.2.1 Range.

5.2.2 Response time.

5.2.3 Sensitivity.

5.3 Radiation sample point (refer to Table 11.5-1, Radiation Measuring Point R-10) is capable of collecting the required samples.

5.4 The radiation monitoring system (containment building ventilation system - internal filtration subsystem) meets design requirements for RCS leak detection required to demonstrate compliance with Technical Specification Chapter 16, LCO 3.4.14 (refer to Section 11.5.4.8, Section 11.5.3.1.4, and Table 11.5-1, Footnote 16 for Radiation Measuring Point R-10).

14.2.12.8.4 Containment Purge (Test #076)

1.0 OBJECTIVE

1.1 To demonstrate the capability of the containment purge systems, both low-flow and full-flow, to maintain the containment air quality and cleanliness at the required value during normal operation (low-flow), inspection, testing, maintenance, and refueling operations.

1.2 To demonstrate electrical independence and redundancy of power supplies.

1.3 Demonstrate containment purge system response to protection system (PS) signals.

1.4 To verify that radiation monitors respond as designed to check sources.

1.5 To verify that radiation monitors initiate automatic control functions upon detecting high activity levels.

1.6 To verify that the response time from when radiation monitors detect a high radiation condition until each actuated component travels to the required position meets design requirements.

1.7 Verify that the containment purge path can be realigned to the required ELAP event containment exhaust alignment during a simulated compressed air failure.

2.0 PREREQUISITES

2.1 Construction activities in the containment have been completed and acceptable levels of cleanliness established.

2.2 Construction activities on the containment purge systems have been completed.

2.3 Containment purge system instrumentation, including radiation monitors, has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the containment purge systems are complete and functional.

2.5 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Demonstrate manual and automatic system controls.

3.2 Verify alarms, indicating instruments and status lights are functional.

3.3 Verify design air flows for high purge, low purge.

3.4 Perform HEPA filters and carbon adsorber efficiency tests.

3.5 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.6 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 9.4.7).

3.7 Simulate the following and observe isolation valve response:

3.7.1 CIAS.

3.7.2 High radiation actuation signal.

3.8 Verify that operation of containment purge system radiation monitors meets design requirements (refer to Table 11.5-1, Monitor R-7 through R-9).

3.9 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.10 Verify that the containment purge system functions as designed.

Note: Response time of actuated components is to be determined from a single test.

3.11 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Points R-7 through R-9) and external test equipment, as necessary:

3.11.1 Check the self-testing features of radiation monitors.

3.11.2 Record the response of radiation monitors to check sources.

3.11.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.11.4 Record alarm actuations at local and remote locations, as appropriate.

3.11.5 Initiate a high radiation signal to emergency push button to measure the response time for each actuated component from

the time until the actuated component has traveled to the designated position.

3.12 Confirm that Automatic Control Function (refer to Table 11.5-1, Radiation Measuring Point R-9) initiate upon actuation of emergency push button.

3.13 Verify that sample points (refer to Table 11.5-1, Radiation Measuring Points R-7 through R-8) are capable of collecting representative samples.

3.14 Verify that the normal filtered purge path can be isolated and the ELAP containment exhaust bypass path can be aligned to the plant vent stack.

3.15 Verify that the ELAP containment purge can be aligned during a simulated failure of the compressed air system.

3.15.1 Verify that the normal compressed air source has been isolated from the containment purge valves.

3.15.2 Align the ELAP compressed air source to the containment low flow purge valves.

3.15.3 Verify that the ELAP compressed air source can realign the normal containment purge valves, as applicable.

3.15.4 Verify that the ELAP power supply can realign the ELAP containment bypass path valves, as applicable.

4.0 DATA REQUIRED

4.1 Air balancing report, including fan operating data for low purge and high purge fans.

4.2 HEPA filter and carbon absorber data for exhaust filter trains.

4.3 Valve performance data, where required.

4.4 Valve position indication.

4.5 Position response of valves to loss of motive power.

4.6 Setpoints at which alarms and interlocks occur.

4.7 Temperature of air supply (outside) to high purge supply and discharge into containment.

4.8 Valves respond to the following simulated signals:

4.8.1 CIS.

4.8.2 High radiation actuation signal.

4.9 Containment purge system radiation monitors performance data.

4.10 Radiation monitor response to check source.

4.11 Technical data associated with check source.

4.12 Signal levels necessary to initiate alarm actuation.

4.13 Response time of each actuated component.

5.0 ACCEPTANCE CRITERIA

5.1 The containment purge system meets design requirements (refer to Section 9.4.7):

5.1.1 The containment purge alarms, remote indications, interlocks, and controls (manual and automatic) respond as designed.

5.1.2 The containment purge valves meet the design requirements (i.e., thrust opening speed, closing speed, failure mode upon loss of motive power).

- Table 14.3-2 Item 2-10.

5.1.3 The containment purge flow rate meets design requirements.

5.2 The containment purge system responds to the radiation monitors as designed (refer to Section 11.5.3.1.4 and Table 11.5-1, Monitor R-9):

5.2.1 The containment purge system isolates purge flow as designed upon detection of high activity.

5.2.2 The radiation monitors perform as designed in response to high activity levels.

5.3 Verify that safety-related components meet electrical independence and redundancy requirements.

5.4 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Points R-7 through R-9). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.4.1 Range.

5.4.2 Response time.

5.4.3 Sensitivity.

5.5 Radiation monitoring instrumentation meets design requirements to monitor radiation (refer to Table 11.5-1, Radiation Measuring Point R-9).

5.5.1 The response time from actuation of the emergency push button until each actuated component has reached the required position meets the design requirement.

5.6 Radiation sample points (refer to Table 11.5-1, Radiation Measuring Points R-7 through R-8) are capable of collecting the required samples.

5.7 The normal purge path can be isolated and the ELAP bypass containment exhaust path can be aligned as designed.

14.2.12.8.5 Annulus Ventilation System (Test #077)

1.0 OBJECTIVE

1.1 To demonstrate the capability of the annulus ventilation system (AVS) to produce and maintain a negative pressure in the annulus following a loss of coolant accident (LOCA).

1.2 To minimize the release of radioisotopes following a LOCA by filtering annulus air prior to discharge to the vent stack.

1.3 To demonstrate electrical independence and redundancy of power supplies.

1.4 To verify that radiation monitors respond as designed to check sources.

1.5 To verify that the radiation sample point provides a representative sample of the AVS.

2.0 PREREQUISITES

2.1 Construction activities on the containment wall and shield wall are complete with penetrations sealed in place.

2.2 Construction activities on the AVS have been completed.

2.3 AVS instrumentation, including radiation monitors, has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the AVS are complete and functional.

2.5 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic, including response to Protection signals.

3.2 Verify that operation, failure mode, stroke speed and position indication of control valves and dampers meets design requirements.

3.3 Demonstrate that the AVS shall achieve a negative pressure in the Annulus within the design requirements:

3.3.1 Greater than or equal to the required inches water gauge.

3.3.2 Within the required elapsed time since actuation.

3.4 Verify that operation of protective devices, controls, interlocks, instrumentation and alarms meet design requirements.

3.5 Verify design air flow for normal and emergency operation.

3.6 Perform HEPA filter and carbon adsorber efficiency tests on the accident filtration train.

3.7 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.8 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Point R-27) and external test equipment, as necessary:

3.8.1 Check the self-testing features of radiation monitors.

3.8.2 Record the response of radiation monitors to check sources.

3.8.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.8.4 Record alarm actuations at local and remote locations, as appropriate.

3.9 Verify that sample point (refer to Table 11.5-1, Radiation Measuring Point R-28) is capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms, interlocks, and controls occur.

4.2 Valve and damper operating data.

4.3 Air balancing report, including fan operating data.

4.4 HEPA filter and carbon adsorber efficiency data.

4.5 Annulus negative pressurization data: Annulus pressure and drawdown time response curve.

4.6 Radiation monitor response to check source.

4.7 Technical data associated with check source.

4.8 Signal levels necessary to initiate alarm actuation.

5.0 ACCEPTANCE CRITERIA

5.1 The AVS operates as designed (refer to Section 6.2.3):

5.1.1 Verify that the response of alarms, interlocks, and control logic meets design requirements.

5.1.2 Verify that operation of valves and dampers meet design requirements.

5.1.3 Verify that system response to simulated accident signal meets design requirements.

- Table 14.3-2 Item 2-1.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

5.3 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Point R-27). This includes, but is

not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.3.1 Range.

5.3.2 Response time.

5.3.3 Sensitivity.

5.4 Radiation sample point (refer to Table 11.5-1, Radiation Measuring Point R-28) is capable of collecting the required samples.

14.2.12.8.6 Electrical Division of Safeguard Building Ventilation System (Test #078)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the electrical division of safeguard building ventilation system (SBVSE):

1.1.1 Vital instrument and equipment room ventilation subsystems.

1.1.2 Electrical and mechanical equipment room air handling units, recirculation fans, battery rooms/safety chilled water room exhaust fans.

1.1.3 Component cooling water/heat exchanger rooms fan coil units.

1.1.4 Emergency feedwater pump rooms fan coil units.

1.2 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities in the Safeguard Building controlled area are complete with penetrations sealed.

2.2 Construction activities on the SBVSE have been completed.

2.3 SBVSE instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the SBVSE are functional.

2.5 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify the operation of the electrical and mechanical equipment room air handling units, recirculation fans, battery rooms/safety chilled water room exhaust fans.

3.3 Verify the operation of the component cooling water/heat exchanger rooms fan coil units.

3.4 Verify the operation of the emergency feedwater pump rooms fan coil units.

3.5 Verify alarms, indicating lights, and status lights are functional.

3.6 Perform air flow balancing of the SBVSE.

3.7 Verify that operation of dampers meet the requirements of ASME AG-1 (Reference 9).

3.8 Verify that operation of the vital instrument and equipment room HVAC units, fans, or both meet design requirements.

3.9 For separate HVAC units check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.10 Verify that duct/housing total leakage requirements are met.

4.0 DATA REQUIRED

4.1 Damper operating data.

4.2 Air flow and balancing verification.

4.3 Setpoints at which alarms, center backs and control occur.

4.4 Temperature data for each of the SBVSE.

5.0 ACCEPTANCE CRITERIA

5.1 The SBVSE operates as designed (refer to Section 9.4.6):

5.1.1 Safeguard Building cooling alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 Safeguard Building cooling fan performance meets design requirements.

5.1.3 Safeguard Building cooling dampers/valve performance (thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 Safeguard Building cooling air balance meets design requirements.

5.1.5 SBVSE meets duct/housing total leakage requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.8.7 Nuclear Auxiliary Building Ventilation System (Test #079)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the nuclear auxiliary building ventilation system (NABVS).

1.2 To demonstrate electrical independence and redundancy of power supplies.

1.3 To verify that radiation monitors respond as designed to check sources.

1.4 To verify that radiation monitors initiate automatic control functions upon detecting high activity levels.

1.5 To verify that the response time from when radiation monitors detect a high radiation condition until each actuated component travels to the required position meets design requirements.

2.0 PREREQUISITES

2.1 Construction activities in the nuclear auxiliary building are complete with penetrations sealed.

2.2 Construction activities on the NABVS have been completed.

2.3 NABVS instrumentation, including radiation monitors, has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the NABVS are functional.

2.5 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify the operation of the air handling units or fans or both.

3.3 Verify alarms, indicating lights and status lights are functional.

3.4 Perform air flow balancing of the NABVS.

3.5 Verify that operation of dampers meets design requirements.

3.6 Perform HEPA filter and carbon adsorber efficiency tests.

3.7 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.8 Verify that duct/housing total leakage requirements are met.

3.9 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Points R-11 through R-15) and external test equipment, as necessary:

3.9.1 Check the self-testing features of radiation monitors.

3.9.2 Record the response of radiation monitors to check sources.

3.9.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.9.4 Record alarm actuations at local and remote locations, as appropriate.

3.9.5 Initiate a high radiation signal to each radiation monitor to measure the response time for each actuated component from the time that the radiation monitor reaches the control

setpoint until the actuated component has traveled to the designated position.

Note: Response time of actuated components is to be determined from a single test using the check source specified in Table 11.5-1 that is specified for each radiation monitor until travel is completed for each actuated component impacted by the radiation monitor signal.

3.10 Confirm that Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Points R-11 through R-13) initiate upon detecting high activity levels.

3.11 Verify that sample points (refer to Table 11.5-1, Radiation Measuring Points R-11 through R-16) are capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Damper operating data.

4.2 Air flow and balancing verification.

4.3 Setpoints at which alarms and control occur.

4.4 Temperature data for each of the NABVS.

4.5 HEPA filter and carbon adsorber efficiency data.

4.6 Radiation monitor response to check source.

4.7 Technical data associated with check source.

4.8 Signal levels necessary to initiate alarm actuation.

4.9 Signal levels necessary to initiate Automatic Control Functions.

4.10 Response time of each actuated component.

5.0 ACCEPTANCE CRITERIA

5.1 The NABVS operates as designed (refer to Section 9.4.3):

5.1.1 NABVS alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 NABVS fan performance meets design requirements.

5.1.3 NABVS dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 NABVS air balance meets design requirements.

5.1.5 The NABVS meets design requirements to monitor radiation (refer to Table 11.5-1, Monitors R-11 through R-15).

5.1.6 NABVS meets duct/housing total leakage requirements.

5.2 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Points R-11 through R-15). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.2.1 Range.

5.2.2 Response time.

5.2.3 Sensitivity.

5.3 Radiation monitoring instrumentation meets design requirements to monitor radiation and initiate Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Points R-11 through R-13) upon detection of high activity levels.

5.3.1 For each applicable radiation monitor, the response time from the radiation monitor reaching the level to initiate the automated control function until each actuated component has reached the required position meets the design requirement.

5.4 Radiation sample points (refer to Table 11.5-1, Radiation Measuring Points R-11 through R-16) are capable of collecting the required samples.

14.2.12.8.8 Radioactive Waste Processing Building Ventilation System (Test #080)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the radioactive waste processing building ventilation system (RWBVS) to maintain design condition.

1.2 To verify that radiation monitors respond as designed to check sources.

1.3 To verify that radiation monitors initiate automatic control functions upon detecting high activity levels.

1.4 To verify that radiation sample points provide representative samples of the RWBVS.

1.5 To verify that the response time from when radiation monitors detect a high radiation condition until each actuated component travels to the required position meets design requirements.

2.0 PREREQUISITES

2.1 Construction activities on the RWBVS have been completed.

2.2 RWBVS instrumentation, including radiation monitors, has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the RWBVS are complete and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify that operation, stroking speed and position indication of dampers meets design requirements.

3.3 Verify the capacity of the HVAC system to maintain the area temperature.

3.4 Verify the system maintains the Radioactive Waste Processing Building at a negative pressure.

3.5 Verify that operation of the general ventilation supply units and fans meets design requirements.

3.6 Verify that operation of the general ventilation exhaust units and fans meets design requirements.

3.7 Perform HEPA filter and carbon adsorber efficiency tests.

3.8 Verify the systems rated air flow and air balance.

3.9 Verify that operation of protective devices, controls, interlocks instrumentation and alarms using actual or simulated inputs meets design requirements.

3.10 Verify that operation of the RWBVS response to high radiation monitor signal meets design requirements (refer to Table 11.5-1, Monitors R-20 and R-22).

3.11 Verify that duct/housing total leakage requirements are met.

Note: Response time of actuated components is to be determined from a single test using the check source specified in Table 11.5-1 that is specified for each radiation monitor until travel is completed for each actuated component impacted by the radiation monitor signal.

3.12 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Points R-20, R-22 through R-24) and external test equipment, as necessary:

3.12.1 Check the self-testing features of radiation monitors.

3.12.2 Record the response of radiation monitors to check sources.

3.12.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.12.4 Record alarm actuations at local and remote locations, as appropriate.

3.12.5 Initiate a high radiation signal to each radiation monitor to measure the response time for each actuated component from the time that the radiation monitor reaches the control setpoint until the actuated component has traveled to the designated position.

3.13 Confirm that Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Points R-20 and R-22) initiate upon detecting high activity levels.

3.14 Verify that sample points (refer to Table 11.5-1, Radiation Measuring Points R-20 through R-24) are capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Air balancing verification.

4.2 Fan and damper operating data.

4.3 Temperature data.

4.4 Setpoints of alarms interlocks and controls.

4.5 The Radioactive Waste Processing Building negative pressure readings.

4.6 RWBVS performance data in response to radiation monitor signals.

4.7 HEPA filter and carbon adsorber efficiency data.

4.8 Radiation monitor response to check source.

4.9 Technical data associated with check source.

4.10 Signal levels necessary to initiate alarm actuation.

4.11 Signal levels necessary to initiate Automatic Control Functions.

4.12 Response time of each actuated component.

5.0 ACCEPTANCE CRITERIA

5.1 The RWBVS operates as designed (refer to Section 9.4.8):

5.1.1 RWBVS alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 RWBVS fan performance meets design requirements.

5.1.3 RWBVS dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 RWBVS air balance meets design requirements.

5.1.5 RWBVS meets duct/housing total leakage requirements.

5.2 The RWBVS responds as designed to radiation monitor signals designed (refer to Table 11.5-1, Monitors R-20 through R-22).

5.3 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Points R-20, R-22 through R-24). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.3.1 Range.

5.3.2 Response time.

5.3.3 Sensitivity.

5.4 Radiation monitoring instrumentation meets design requirements to monitor radiation and initiate Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Points R-20 and R-22) upon detection of high activity levels.

5.4.1 For each applicable radiation monitor, the response time from the radiation monitor reaching the level to initiate the automated control function until each actuated component has reached the required position meets the design requirement.

5.5 Radiation sample points (refer to Table 11.5-1, Radiation Measuring Points R-20 through R-24) are capable of collecting the required samples.

14.2.12.8.9 Fuel Building Ventilation System (Test #081)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the fuel building ventilation system (FBVS) to maintain design conditions.

1.2 To demonstrate electrical independence and redundancy of power supplies.

1.3 To verify that radiation monitors respond as designed to check sources.

1.4 To verify that radiation monitors initiate automatic control functions upon detecting high activity levels.

1.5 To verify that the response time from when radiation monitors detect a high radiation condition until each actuated component travels to the required position meets design requirements.

2.0 PREREQUISITES

2.1 Construction activities on the FBVS have been completed.

2.2 FBVS instrumentation, including radiation monitors, has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the FBVS are complete and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify that operation, stroke speed and position indication of dampers meet design requirements.

3.3 Verify the system maintains the Fuel Building at a negative pressure.

3.4 Verify the NABVS supplies and exhausts air to the Fuel Building.

3.5 Verify that the operation of the fuel handling area ventilation exhaust units and fans meet design requirements.

3.6 Verify that operation of the heating and cooling units meet design requirements.

3.7 Verify HEPA filter efficiency, carbon adsorber efficiency, and air flow capacity.

3.8 Verify the systems rated air flow and air balance.

3.9 Verify that operation of protective devices, controls, interlocks instrumentation, and alarms using actual or simulated inputs.

3.10 Verify system response to a high radiation signal (refer to Table 11.5-1, Monitors R-17, R-18, and R-19).

3.11 Verify that operation of the FBVS radiation monitors meet design requirements (refer to Table 11.5-1, Monitors R-17, R-18, and R-19).

3.12 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.13 Verify that duct/housing total leakage requirements are met.

Note: Response time of actuated components is to be determined from a single test using the check source specified in Table 11.5-1 that is specified for each radiation monitor until travel is completed for each actuated component impacted by the radiation monitor signal.

3.14 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Points R-17 through R-19) and external test equipment, as necessary:

3.14.1 Check the self-testing features of radiation monitors.

3.14.2 Record the response of radiation monitors to check sources.

3.14.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.14.4 Record alarm actuations at local and remote locations, as appropriate.

3.14.5 Initiate a high radiation signal to each radiation monitor to measure the response time for each actuated component from the time that the radiation monitor reaches the control setpoint until the actuated component has traveled to the designated position.

3.15 Confirm that Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Points R-17 through R-19) initiate upon detecting high activity levels.

3.16 Verify that sample points (refer to Table 11.5-1, Radiation Measuring Points R-17 through R-18) are capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Air balancing verification.

4.2 Fan and damper operating data.

4.3 Temperature data in the Fuel Building.

4.4 Setpoints at which alarms, interlocks, and controls occur.

4.5 Fuel Building negative pressurization data during normal and postulated emergency conditions.

4.6 Filter and carbon adsorber data.

4.7 FBVS performance data in response to radiation monitor signals.

4.8 Radiation monitor response to check source.

4.9 Technical data associated with check source.

4.10 Signal levels necessary to initiate alarm actuation.

4.11 Signal levels necessary to initiate Automatic Control Functions.

4.12 Response time of each actuated component.

5.0 ACCEPTANCE CRITERIA

5.1 The FBVS operates as designed (refer to Section 9.4.2):

5.1.1 FBVS alarms, interlocks, and controls (manual and automatic) function as designed.

5.1.2 FBVS valves and dampers function as design.

5.1.3 FBVS maintains the Fuel Building at the required negative pressure.

- Table 14.3-2 Item 2-9.

5.1.4 FBVS recirculation rate (e.g., through the HEPA filters, carbon adsorber) meet design requirements.

5.1.5 FBVS normal operation heating and ventilation system performs as designed.

5.1.6 FBVS meets duct/housing total leakage requirements.

5.2 The FBVS responds to radiation monitor signals as designed (refer to Table 11.5-1, Monitors R-17, R-18, and R-19).

5.3 Verify that safety-related components meet electrical independence and redundancy requirements.

5.4 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Points R-17 through R-19). This

includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.4.1 Range.

5.4.2 Response time.

5.4.3 Sensitivity.

5.5 Radiation monitoring instrumentation meets design requirements to monitor radiation and initiate Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Points R-17 through R-19) upon detection of high activity levels.

5.5.1 For each applicable radiation monitor, the response time from the radiation monitor reaching the level to initiate the automated control function until each actuated component has reached the required position meets the design requirement.

5.6 Radiation sample points (refer to Table 11.5-1, Radiation Measuring Points R-17 through R-18) are capable of collecting the required samples.

14.2.12.8.10 Main Control Room Air Conditioning System (Test #082)

1.0 OBJECTIVE

1.1 To verify that operation of the main control air conditioning system (CRACS) establishes that a proper environment for personnel and equipment under postulated conditions in the following areas:

1.1.1 MCR.

1.1.2 Technical Support Center.

1.1.3 Other offices and equipment areas of the control room envelope (CRE).

1.2 To demonstrate electrical independence and redundancy of power supplies.

1.3 To verify that radiation monitors respond as designed to check sources.

1.4 To verify that radiation monitors initiate automatic control functions upon detecting high activity levels.

1.5 To verify that the response time from when radiation monitors detect a high radiation condition until each actuated component travels to the required position meets design requirements.

2.0 PREREQUISITES

2.1 Construction activities in the MCR complex have been completed and penetrations sealed.

2.2 Construction activities on the CRACS have been completed.

2.3 The CRACS system instrumentation, including radiation monitors, has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the CRACS are complete and functional.

2.5 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify that operation, stroke speed and position indication of dampers meet design requirements.

3.3 Verify in manual operating mode that system rated air flow and air balance meet design requirements.

3.4 Demonstrate in automatic mode the transfer to emergency-operations as a result of the following:

3.4.1 Detection of radiation in one of the outside inlets places the CREF (iodine filtration) units in the filtered alignment.

3.4.2 Safety injection actuation/primary containment isolation signal.

3.5 Verify the HEPA filter efficiency, carbon adsorber efficiency, and filter bank air flow capacity.

3.6 Verify that operation of protective devices, controls, interlocks, instrumentation, and alarms using actual or simulated inputs meets design requirements.

3.7 Verify that the system maintains the CRE at the required positive pressure relative to external areas adjacent to the CRE boundary while operating in the design basis accident alignment.

3.8 Verify that the system maintains the CRE at the required positive pressure while in the normal operation alignment.

3.9 Demonstrate the operation of the battery room exhaust fans.

3.10 Verify the CRE air in-leakage rate when aligned in the emergency mode.

3.11 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

Note: Response time of actuated components is to be determined from a single test using the check source specified in Table 11.5-1 that is specified for each radiation monitor until travel is completed for each actuated component impacted by the radiation monitor signal.

3.12 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Points R-29 and R-30) and external test equipment, as necessary:

3.12.1 Check the self-testing features of radiation monitors.

3.12.2 Record the response of radiation monitors to check sources.

3.12.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.12.4 Record alarm actuations at local and remote locations, as appropriate.

3.13 Confirm that Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Points R-29 and R-30) initiate upon detecting high activity levels.

3.14 Verify that duct/housing leakage requirements are met.

4.0 DATA REQUIRED

4.1 Air balancing verification.

4.2 Fan and damper operating data.

4.3 Temperature data in the CRE.

4.4 Response to smoke.

4.5 Setpoints of alarms, interlocks, and controls.

4.6 Pressurization data for the CRE.

4.7 Filter and carbon adsorber data.

4.8 CRE in-leakage rate when aligned in the emergency mode.

4.9 Radiation monitor response to check source.

4.10 Technical data associated with check source.

4.11 Signal levels necessary to initiate alarm actuation.

4.12 Signal levels necessary to initiate Automatic Control Functions.

4.13 Response time of each actuated component.

5.0 ACCEPTANCE CRITERIA

5.1 The CRACS operates as designed (refer to Section 9.4.1).

5.1.1 CRACS alarms, interlocks, and controls (manual and automatic) function as designed.

5.1.2 CRACS valves and dampers function as design.

5.1.3 CRACS responds as designed to a simulated smoke signal.

5.1.4 CRACS recirculation flow rate meets design requirements.

- Table 14.3-2 Item 2-7.

5.1.5 CRACS unfiltered air in-leakage rate while in recirculation mode meets design requirements.

- Table 14.3-2 Item 2-8.

5.1.6 CRACS is capable of generating a positive MCR pressure relative to adjacent areas, as designed.

- Table 14.3-2 Item 2-6.

5.1.7 CRACS responds as designed to a simulated SIS signal.

- Table 14.3-2 Item 2-5.

5.1.8 CRACS meets duct/housing total leakage requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

5.3 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Points R-29 and R-30). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.3.1 Range.

5.3.2 Response time.

5.3.3 Sensitivity.

5.4 Radiation monitoring instrumentation meets design requirements to monitor radiation and initiate Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Points R-29 and R-30) upon detection of high activity levels.

5.4.1 For each applicable radiation monitor, the response time from the radiation monitor reaching the level to initiate the automated control function until each actuated component has reached the required position meets the design requirement.

5.5 The radiation monitoring system (MCR air intake duct activity) generates a Main Control Room air intake activity measurement signal as an input to the protection system (refer to Table 12.3-3).

14.2.12.8.11 Safeguard Building Controlled Area Ventilation System (Test #083)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the safeguard building controlled area ventilation system (SBVS):

1.1.1 Hot mechanical area serviced by the SBVS.

1.1.2 SBVS air supply subsystem.

1.1.3 SBVS air exhaust subsystem.

1.1.4 Electric air heating convectors (area heaters).

1.2 To demonstrate electrical independence and redundancy of power supplies.

1.3 To verify that radiation monitors respond as designed to check sources.

1.4 To verify that radiation monitors initiate automatic control functions upon detecting high activity levels.

1.5 To verify that the response time from when radiation monitors detect a high radiation condition until each actuated component travels to the required position meets design requirements.

2.0 PREREQUISITES

2.1 Construction activities in the safeguard building mechanical area are complete with penetrations sealed.

2.2 Construction activities on the SBVS have been completed.

2.3 Safeguard building mechanical area ventilation subsystem instrumentation, including radiation monitors, has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the SBVS are functional.

2.5 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify the operation of air handling units or fans or both.

3.3 Verify operation of the operational air exhaust mode in the mechanical area.

3.4 Verify operation of the accident air exhaust mode in the mechanical area.

3.5 Verify operation of the electric air convectors (area heaters).

3.6 Verify operation of the filter air heaters, prefilters, HEPA filters, and adsorbers.

3.7 Verify operation of the recirculation cooling units.

3.8 Verify alarms, indicating lights and status lights are functional.

3.9 Perform air flow balancing of the SBVS.

3.10 Verify that operation of dampers meet design requirements.

3.11 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.12 Verify that duct/housing leakage requirements are met.

Note: Response time of actuated components is to be determined from a single test using the check source specified in Table 11.5-1 that is specified for each radiation monitor until

travel is completed for each actuated component impacted by the radiation monitor signal.

3.13 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Points R-25 and R-26) and external test equipment, as necessary:

3.13.1 Check the self-testing features of radiation monitors.

3.13.2 Record the response of radiation monitors to check sources.

3.13.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.13.4 Record alarm actuations at local and remote locations, as appropriate.

3.13.5 Initiate a high radiation signal to each radiation monitor to measure the response time for each actuated component from the time that the radiation monitor reaches the control setpoint until the actuated component has traveled to the designated position.

3.14 Confirm that Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Point R-25) initiate upon detecting high activity levels.

3.15 Verify that sample points (refer to Table 11.5-1, Radiation Measuring Points R-25 and R-26) are capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Damper operating data.

4.2 Air flow and balancing verification.

4.3 Setpoints at which alarms, center backs and control occur.

4.4 Temperature data for each of the SBVS.

4.5 Radiation monitor response to check source.

4.6 Technical data associated with check source.

4.7 Signal levels necessary to initiate alarm actuation.

4.8 Signal levels necessary to initiate Automatic Control Functions.

4.9 Response time of each actuated component.

5.0 ACCEPTANCE CRITERIA

5.1 The SBVS operates as designed (refer to Section 9.4.5):

5.1.1 SBVS air handlers/fans perform as designed.

5.1.2 The operation of the SBVS operational air exhaust mode in the mechanical area meets design requirements.

5.1.3 The operation of the SBVS accident air exhaust mode in the mechanical area meets design requirements.

5.1.4 The operation of the SBVS electric air convectors (area heaters) meets design requirements.

5.1.5 The operation of the SBVS filter air heaters, prefilters, HEPA filters, and adsorber meets design requirements.

5.1.6 The operation of the SBVS recirculation cooling units meets design requirements.

5.1.7 SBVS alarms, indicating lights and status lights meet design requirements.

5.1.8 SBVS meets duct/housing total leakage requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

5.3 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Points R-25 and R-26). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.3.1 Range.

5.3.2 Response time.

5.3.3 Sensitivity.

5.4 Radiation monitoring instrumentation meets design requirements to monitor radiation and initiate Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Point R-25) upon detection of high activity levels.

5.4.1 For each applicable radiation monitor, the response time from the radiation monitor reaching the level to initiate the automated control function until each actuated component has reached the required position meets the design requirement.

5.5 Radiation sample points (refer to Table 11.5-1, Radiation Measuring Points R-25 and R-26) are capable of collecting the required samples.

14.2.12.8.12 Emergency Power Generating Building Ventilation System (Test #084)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the emergency power generating building ventilation system (EPGBVS).

1.2 To demonstrate proper operation of the EPGBVS.

1.3 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the EPGBVS have been completed.

2.2 EPGBVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the EPGBVS are complete and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify design air flow with each EPGBVS in operation.

3.3 Verify design temperature can be maintained in each Emergency Power Generating Building.

3.4 Verify alarms, indicating instruments, and status lights are functional.

3.5 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.6 Verify that operation of dampers meet the requirements of ASME AG-1.

3.7 Verify that duct/housing leakage requirements are met.

4.0 DATA REQUIRED

4.1 Fan and damper operating data.

4.2 Air flow verification.

4.3 Setpoint at which alarms, interlocks, and controls occur.

4.4 Temperature data of each Emergency Power Generating Building.

5.0 ACCEPTANCE CRITERIA

5.1 The EPGBVS operates as designed (refer to Section 9.4.9):

5.1.1 EPGBVS alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 EPGBVS fan performance meets design requirements.

5.1.3 EPGBVS dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 EPGBVS air balance meets design requirements.

5.1.5 EPGBVS meets duct/housing total leakage requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.8.13 Smoke Confinement System (Test #085)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the smoke confinement system (SCS) for Nuclear Island.

2.0 PREREQUISITES

2.1 Construction activities in the SCS are complete with penetrations sealed.

2.2 SCS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the SCS.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify the operation of the supply air fans.

3.3 Verify operation of the smoke purge fans.

3.4 Verify alarms, indicating lights and status lights are functional.

3.5 Perform air flow balancing of the SCS.

3.6 Verify that operation of dampers meets design requirements.

4.0 DATA REQUIRED

4.1 Air balancing reports, including fan operating data for each of the air handling units and the smoke purge fans.

4.2 Damper operating data.

4.3 Air flow and balancing verification.

4.4 Setpoints at which alarms and control occur.

5.0 ACCEPTANCE CRITERIA

5.1 The SCS operates as designed (refer to Section 9.4.13):

5.1.1 SCS alarms, status lights, interlocks, and control logic meets design requirements.

5.1.2 The operation of the SCS smoke purge fans meet the design requirements.

5.1.3 The air balance of the SCS meets design requirements.

5.1.4 SCS dampers meet the design requirements.

14.2.12.8.14 Station Blackout Room Ventilation System (Test #086)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the ventilation to the station diesel generator divisions located inside the Switchgear Building.

1.2 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the station blackout room ventilation system (SBORVS) have been completed.

2.2 SBORVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the SBORVS are complete and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify design air flow with each SBORVS in operation.

3.3 Verify design temperature can be maintained in each station blackout diesel ventilation area.

3.4 Verify alarms, indicating instruments, and status lights are functional.

3.5 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Fan and damper operating data.

4.2 Air flow verification.

4.3 Setpoint at which alarms, interlocks, and controls, occur.

4.4 Temperature data of each station blackout diesel area with and without diesel operating.

5.0 ACCEPTANCE CRITERIA

5.1 The SBORVS operates as designed (refer to Section 9.4.10):

5.1.1 SBORVS alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 SBORVS fan performance meets design requirements.

5.1.3 SBORVS dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 SBORVS air balance meets design requirements.

14.2.12.8.15 Turbine Island Ventilation Systems (Test #087)

A COL applicant that references the U.S. EPR design certification will provide site-specific test abstract information for the turbine island ventilation systems. The following is a typical COLA test; if a site-specific test will be used, the COL applicant will provide the test.

1.0 OBJECTIVE

1.1 To demonstrate that the turbine building ventilation system (TBVS) provides a suitable operating environment for equipment and personnel during normal operations.

1.2 To demonstrate that the switchgear building ventilation system, turbine island (SWBVS) provides a suitable operating environment for equipment and personnel during normal operations.

2.0 PREREQUISITES

2.1 Construction activities on the TBVS have been completed.

2.2 Construction activities on the SWBVS have been completed.

2.3 TBVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 SWBVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.5 Support systems required for operation of the TBVS are complete and functional.

2.6 Support systems required for operation of the SWBVS are complete and functional.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify that operation of inlet air dampers and damper controls meets design requirements.

3.3 Verify that operation of the exhaust fan units and dampers meets design requirements.

3.4 Verify that operation of protective devices, controls, interlocks, instrumentation, and alarms meets design requirements.

4.0 DATA REQUIRED

4.1 Fan and damper operating data.

4.2 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The SWBVS operates as designed (refer to Section 9.4.4):

5.1.1 SWBVS alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 SWBVS fan performance meets design requirements.

5.1.3 SWBVS dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 SWBVS air balance meets design requirements.

5.2 The TBVS operates as designed (refer to Section 9.4.4):

5.2.1 TBVS alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.2.2 TBVS fan performance meets design requirements.

5.2.3 TBVS dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.2.4 TBVS air balance meets design requirements.

14.2.12.8.16 Essential Service Water Pump Building Ventilation System (Test #088)

1.0 OBJECTIVE

1.1 To verify the essential service water pump building ventilation system (ESWPBVS) can maintain the space temperature as required.

1.2 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the ESWPBVS have been completed.

2.2 ESWPBVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the ESWPBVS are complete and functional.

2.4 Test Instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic and interlock.

3.2 Verify design air flow of each fan.

3.3 Verify alarms, indicating instruments and status lights are functional.

3.4 Verify design temperatures can be maintained in the structure.

3.5 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.6 Verify that operation of isolation dampers meet the requirements of ASME AG-1.

3.7 Verify operation of the electric air convectors (area heaters).

4.0 DATA REQUIRED

4.1 Temperature data for the structure from each fan unit.

4.2 Air balancing report, including fan operating data.

4.3 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The ESWPBVS operates as designed (refer to Section 9.4.11):

5.1.1 ESWPBVS alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 ESWPBVS fan performance meets design requirements.

5.1.3 ESWPBVS dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 ESWPBVS air balance meets design requirements.

5.1.5 ESWPBVS electric air heaters meet design requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.8.17 Main Steam and Feedwater Valve Room System (Test #089)

1.0 OBJECTIVE

1.1 To demonstrate that the main steam and feedwater valve room ventilation system (VRVS) provides a suitable operating environment for equipment and personnel during normal operations.

2.0 PREREQUISITES

2.1 Construction activities on the VRVS have been completed.

2.2 VRVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the VRVS are complete and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify design air flow with each VRVS in operation.

3.3 Verify design temperature can be maintained in each main steam and feedwater valve room.

3.4 Verify alarms, indicating instruments, and status lights are functional.

4.0 DATA REQUIRED

4.1 Fan and damper operating data.

4.2 Air flow verification.

4.3 Setpoint at which alarms, interlocks, and controls, occur.

4.4 Temperature data for each main steam and feedwater valve room train.

5.0 ACCEPTANCE CRITERIA

5.1 The VRVS operates as described in Section 9.4.12.

14.2.12.8.18 Plant Laboratory Equipment (Test #090)

A COL applicant that references the U.S. EPR design certification will provide site-specific test abstract information for the plant laboratory equipment. The following is a typical COL test; if a site-specific test will be used, the COL applicant will provide the test.

1.0 OBJECTIVE

1.1 To demonstrate proper operation of laboratory equipment used to analyze or measure radiation levels.

1.2 To demonstrate proper operation of laboratory equipment used to analyze or measure isotopic concentrations (such as a mass spectrometer) of radioactive samples.

2.0 PREREQUISITES

2.1 Construction activities on laboratory equipment support systems used to analyze or measure radiation levels are complete.

2.2 Construction activities on laboratory equipment support systems used to analyze or measure isotopic concentrations of radioactive samples are complete.

2.3 Construction activities related to the installation of vendor supplied laboratory equipment used to analyze or measure radiation levels are

complete. The laboratory equipment has been installed per manufacture's recommendations.

2.4 Construction activities related to the installation of vendor supplied laboratory equipment used to analyze or measure isotopic concentrations of radioactive samples are complete. The laboratory equipment has been installed per manufacture's recommendations.

2.5 The laboratory equipment area radiological controls (such as postings, shielding, radioactive work permits, operation of ventilated hoods, interim storage of incoming and archived radioactive samples, and the availability of radwaste containers as interim means to store/hold laboratory radioactive wastes) have been implemented or are capable of being implemented.

2.6 Verify the availability of proper radioactive standards and check sources as well as non-radioactive standards.

2.7 Airborne and liquid radioactivity monitoring and sampling equipment, portable radiation survey equipment and radio-analytical equipment installed in the laboratory are calibrated in accordance with RG 1.21 and RG 4.15.

3.0 TEST METHOD

3.1 Confirm that all drains from laboratory equipment that analyze or measure radiation levels are routed correctly and verifying that drains discharge as designed. This could be performed by pouring a liquid down the drain colored with food dye or by some other suitable means and confirm the presence of the food dye in the receiving tank.

3.2 Confirm that all drains from laboratory equipment that analyze or measure isotopic concentrations of radioactive samples are routed correctly and verifying that drains discharge as designed. This could be performed by pouring a liquid down the drain colored with food dye or by some other suitable means, and confirm the presence of the food dye in the receiving tank.

3.3 Confirm that ventilation hoods and other engineered radioactive containment devices are vented as designed. This could be accomplished by tracer gas or some other suitable means.

3.4 Measure the ventilation hood discharge flow rates for engineered devices.

3.5 Perform vendor supplied startup checks and calibrations for all laboratory equipment that analyze or measure radiation levels.

3.6 Perform vendor supplied startup checks and calibrations for all laboratory equipment that analyze or measure isotopic concentrations of radioactive samples.

4.0 DATA REQUIRED

4.1 Inspection report from verification of laboratory equipment drains.

4.2 Inspection report from verification of ventilation hood flow and routing.

4.3 Completed vendor specified laboratory equipment startup procedures.

5.0 ACCEPTANCE CRITERIA

5.1 The laboratory equipment drain interface with the plant systems performs as designed.

5.2 The laboratory equipment ventilation hood interface with the plant systems performs as designed.

5.3 The laboratory equipment checkout and calibration procedures meet design requirements as described in Sections 11.5 and 13.4.

14.2.12.8.19 Access Building Ventilation System (Test #224)

1.0 OBJECTIVE

1.1 To verify the access building ventilation system (ABVS) can maintain the space temperature as required.

1.2 To verify that the radiation sample point provides a representative sample of the ABVS.

2.0 PREREQUISITES

2.1 Construction activities on the ABVS have been completed.

2.2 ABVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the ABVS are complete and functional.

2.4 Test Instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic and interlock.

3.2 Verify design air flow of each fan.

3.3 Verify alarms, indicating instruments and status lights are functional.

3.4 Verify design temperatures can be maintained in the structure.

3.5 Verify that duct/housing leakage requirements are met.

3.6 Verify that sample point (refer to Table 11.5-1, Radiation Measuring Point R-31) is capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Temperature data for the structure from each HVAC unit.

4.2 HVAC unit operating data.

4.3 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The ABVS operates as designed (refer to Section 9.4.14):

5.1.1 ABVS alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 ABVS fan performance meets design requirements.

5.1.3 ABVS dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 ABVS air balance meets design requirements.

5.1.5 ABVS meets duct/housing total leakage requirements.

5.2 Radiation sample point (refer to Table 11.5-1, Radiation Measuring Point R-31) is capable of collecting the required samples.

14.2.12.9 Auxiliary Systems

14.2.12.9.1 Leak-off System (Test #091)

1.0 OBJECTIVE

1.1 To demonstrate the functionality of the leak-off system (LOS) to provide a flow path for inflating/deflating the containment in support of integrated leak rate test (ILRT).

1.2 To demonstrate the functionality of the LOS to provide a flow path for measuring leak tightness of the containment in support of ILRT.

2.0 PREREQUISITES

2.1 Construction activities on the LOS have been completed.

2.1.1 The inflation line has the required hose connection outside of the Fuel Building.

2.1.2 The deflation line is routed to the designed release path that routes the containment depressurization air to the vent stack.

2.2 LOS instrumentation, as applicable, has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 LOS valves have been stroked and readied for preoperational testing.

2.4 Support systems required for operation of the LOS are completed and functional.

3.0 TEST METHOD

3.1 Verify leak tightness and operation of manual components of the inflation/deflation sub-system.

3.2 Verify leak tightness and operation of manual components of the ILRT test manifold that is used to measure containment pressure during ILRT testing.

3.3 Verify that the humidity sensor cables and associated test devices that are used to perform ILRT testing are functional.

3.4 Verify that the temperature sensor cables and associated test devices that are used to perform ILRT testing are functional.

4.0 DATA REQUIRED

4.1 System flow path data.

4.2 Humidity response data.

4.3 Temperature response data.

4.4 Response to containment Stage 1 isolation signal.

5.0 ACCEPTANCE CRITERIA

5.1 The containment ILRT inflating/deflating sub system meets design requirements.

5.2 The containment ILRT leak tightness sub system meets design requirements.

14.2.12.9.2 Sampling Activity Monitoring System (Test #092)

1.0 OBJECTIVE

1.1 To verify that the sampling activity monitoring system (SAMS) can detect and record specific radiation levels in the sampling stream.

1.2 To verify SAMS alarms and interlocks.

1.3 To verify that radiation monitors respond as designed to check sources.

1.4 To verify that radiation sample points provide representative samples of the SAMS.

2.0 PREREQUISITES

2.1 Construction activities on the SAMS have been completed.

2.2 SAMS instrumentation, including radiation monitors, has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the SAMS is completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Calibration check sources are available in the appropriate forms (gaseous, solutions, or plated sources) for the analyses referenced in Table 11.5-1.

3.0 TEST METHOD

3.1 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Points R-4 through R-6) and external test equipment, as necessary:

3.1.1 Check the self-testing features of radiation monitors.

3.1.2 Record the response of radiation monitors to check sources.

3.1.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.1.4 Record alarm actuations at local and remote locations, as appropriate.

3.2 Verify that sample points (refer to Table 11.5-1, Radiation Measuring Points R-4 and R-5) are capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 The monitor response to check source.

4.2 Technical data associated with the source.

4.3 Signal levels necessary to cause alarm actuation.

4.4 Response time of the monitor to perform control functions.

4.5 Radiation monitor response to check source.

4.6 Technical data associated with check source.

4.7 Signal levels necessary to initiate alarm actuation.

5.0 ACCEPTANCE CRITERIA

5.1 The SAMS operates as designed (refer to Section 11.5).

5.2 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Points R-4 through R-6). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.2.1 Range.

5.2.2 Response time.

5.2.3 Sensitivity.

5.3 Radiation sample points (refer to Table 11.5-1, Radiation Measuring Points R-4 and R-5) are capable of collecting the required samples.

14.2.12.9.3 Solid Waste Storage System (Test #093)

1.0 OBJECTIVE

1.1 To demonstrate the functionality of the solid waste storage system to collect and package solid wastes for shipment.

2.0 PREREQUISITES

2.1 Construction activities on the solid waste management system have been completed.

2.2 Solid waste management system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the solid waste management system are completed and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify the radioactive waste processing building crane can reach design points.

3.2 Solid radioactive waste processing and storage components (dry active wastes) function as designed.

3.2.1 Sorting box (shredder and in-drum compactor).

3.2.2 Drum transport carts.

3.2.3 Shielding casks.

3.2.4 Vehicle entrance area crane.

3.2.5 Drum store crane.

3.2.6 Drum store.

3.2.7 Tubular shaft store.

3.3 Verify that operation of alarms, controls and interlocks meets design requirements.

3.4 Verify system design flow paths.

3.5 Verify the integrity of the concrete shielding for the drum store and tubular shaft store location in the Radwaste Building.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms and interlocks occur.

4.2 Solid waste transfer system operating data.

4.3 Radioactive waste processing building crane data.

4.4 System flow path data.

5.0 ACCEPTANCE CRITERIA

5.1 The solid waste management system operates as designed (refer to Section 11.4).

5.2 The concrete shielding associated with the solid waste management system meets design requirements.

14.2.12.9.4 Radioactive Concentrates Processing System - Solid Waste (Test #094)

1.0 OBJECTIVE

1.1 To verify the performance of the radioactive concentrates processing system.

1.2 To verify that radiation monitors respond as designed to check sources.

1.3 To verify that radiation sample point provide representative samples of the radioactive concentrates processing system.

2.0 PREREQUISITES

2.1 Construction activities have been completed on the radioactive concentrates processing system.

2.2 Support systems required for operation of the radioactive concentrates processing evaporator are complete and functional.

2.3 Radioactive concentrates processing system instrumentation, including radiation monitors, has been calibrated and is operating satisfactorily prior to performing the following test.

3.0 TEST METHOD

3.1 Radioactive concentrates processing system components (wet solid wastes) function as designed.

3.1.1 Vacuum unit.

3.1.2 High pressure cleaning device.

3.1.3 Condensate collection pump.

3.1.4 Resin proportioning tank.

3.1.5 Concentrate buffer tank.

3.1.6 Condensate collection tank.

3.1.7 Scrubber tank.

3.1.8 Resin traps.

3.1.9 Condenser drying unit.

3.1.10 Condensate counter.

3.1.11 Condensate buffer sluice.

3.1.12 Transfer station.

3.1.13 Measuring glass.

3.1.14 Drum drying stations.

3.1.15 Drum transfer device.

3.1.16 High integrity container.

3.1.17 Sampling box.

3.1.18 Drum capping device.

3.1.19 Sampling device for dried waste.

3.1.20 Drum handling device.

3.1.21 Drum measuring device.

3.2 Line up the radioactive concentrates processing system to interfacing systems and, using appropriate operating modes and indications, establish flow paths to these systems.

3.3 Verify that expended resin beds from the LWPS can be sluiced to the radioactive concentrates processing system.

3.4 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Point R-43) and external test equipment, as necessary:

3.4.1 Check the self-testing features of radiation monitors.

3.4.2 Record the response of radiation monitors to check sources.

3.4.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.4.4 Record alarm actuations at local and remote locations, as appropriate.

3.5 Verify that sample point (refer to Table 11.5-1, Radiation Measuring Point R-43) is capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Valve position indication.

4.2 Radioactive concentrates processing system response to simulated interlocks.

4.3 Setpoints at which alarms interlock and automatic actuations occur.

4.4 Flow indications.

4.5 Radiation monitor response to check source.

4.6 Technical data associated with check source.

4.7 Signal levels necessary to initiate alarm actuation.

5.0 ACCEPTANCE CRITERIA

5.1 The radioactive concentrates processing system performs as described in Sections 11.2.2, 11.4, and 11.5.

5.2 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Point R-43). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.2.1 Range.

5.2.2 Response time.

5.2.3 Sensitivity.

5.3 Radiation sample point (refer to Table 11.5-1, Radiation Measuring Point R-43) is capable of collecting the required samples.

14.2.12.9.5 Liquid Waste Processing System (Test #095)

1.0 OBJECTIVE

1.1 To demonstrate the functionality of the liquid waste processing system (LWPS) for collection, processing and recycling of liquid wastes and for preparation of liquid waste for release to the environment.

1.2 To verify that radiation monitors respond as designed to check sources.

1.3 To verify that radiation monitors initiate automatic control functions upon detecting high activity levels.

1.4 To verify that the response time from when radiation monitors detect a high radiation condition until each actuated component travels to the required position meets design requirements.

2.0 PREREQUISITES

2.1 Construction activities on the liquid waste processing system have been completed.

2.2 Verify that the liquid waste processing system's demineralizers and ultra filtration are loaded with the proper types and amounts of ion exchange resins and filtration media.

2.3 Liquid waste processing system instrumentation, including radiation monitors, has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the liquid waste processing system are completed and functional.

2.5 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Evaporator system components function as designed.

3.1.1 Evaporator feed pumps.

3.1.2 Pre-heater.

3.1.3 Forced recirculation pump.

3.1.4 Evaporator.

3.1.5 Evaporator column.

3.1.6 Vapor compressor.

3.1.7 Distillate tank.

3.1.8 Distillate pump.

3.1.9 Distillate cooler.

3.1.10 Compressor injection cooler.

3.1.11 Electric heater.

3.1.12 Vent gas cooler.

3.1.13 Control valves.

3.1.14 Sealing liquids.

3.2 Centrifuge system components function as designed.

3.2.1 Centrifuge feed pump.

3.2.2 Decanter.

3.2.3 Separator.

3.2.4 Sludge tank.

3.2.5 Decanter feed pump.

3.2.6 Control valves.

3.3 Demineralizer system components function as designed.

3.3.1 Prefilter.

3.3.2 Demineralizer.

3.3.3 Ultrafilter.

3.3.4 Spent resin dryer.

3.3.5 Resin trap.

3.3.6 Solids collection.

3.3.7 Demineralizer booster pump.

3.4 Operate radioactive concentrates processing evaporator control valves from appropriate control positions:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g. thrust, opening and closing times).

3.5 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 11.2).

3.6 Verify that operation of the tank level alarms and interlocks meets design requirements.

3.7 Verify that operation of system pumps meet design requirements.

3.8 Verify that operation of high differential pressure alarms for the process vessel meet design requirements.

3.9 Verify that operation of the tank mixers meet design requirements.

3.10 Verify alarms, indicating instruments, and status lights are functional.

3.11 Verify system response to exceeding a pre-established discharge flow rate:

3.11.1 Initiate a signal that simulates a discrepancy in a pre-established flow rate.

3.11.2 Verify closure of both discharge valves.

Note: Response time of actuated components is to be determined from a single test using the check source specified in Table 11.5-1 that is specified for each radiation monitor until travel is completed for each actuated component impacted by the radiation monitor signal.

3.12 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Point R-32) and external test equipment, as necessary:

3.12.1 Check the self-testing features of radiation monitors.

3.12.2 Record the response of radiation monitors to check sources.

3.12.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.12.4 Record alarm actuations at local and remote locations, as appropriate.

3.12.5 Initiate a high radiation signal to each radiation monitor to measure the response time for each actuated component from the time that the radiation monitor reaches the control setpoint until the actuated component has traveled to the designated position.

3.13 Confirm that Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Point R-32) initiate upon detecting high activity levels.

3.14 Verify that sample points (refer to Table 11.5-1, Radiation Measuring Point R-32) are capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Waste pump operating data.

4.2 Valve performance data, where required.

4.3 Valve position indication.

4.4 Position response of valves to loss of motive power.

4.5 Setpoints at which alarms and interlocks occur.

4.6 Radiation monitor response to check source.

4.7 Technical data associated with check source.

4.8 Signal levels necessary to initiate alarm actuation.

4.9 Signal levels necessary to initiate Automatic Control Functions.

4.10 Response time of each actuated component.

5.0 ACCEPTANCE CRITERIA

5.1 The LWPS operates as designed (refer to Section 11.2).

5.2 The LWPS discharge radiation monitor operates as designed (refer to Sections 7.3.1, 11.2, and 11.5).

5.3 The LWPS discharge valves close upon detection of flow discrepancy signal.

5.4 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Point R-32). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.4.1 Range.

5.4.2 Response time.

5.4.3 Sensitivity.

5.5 Radiation monitoring instrumentation meets design requirements to monitor radiation and initiate Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Point R-32) upon detection of high activity levels.

5.5.1 For each applicable radiation monitor, the response time from the radiation monitor reaching the level to initiate the automated control function until each actuated component has reached the required position meets the design requirement.

5.6 Radiation sample points (refer to Table 11.5-1, Radiation Measuring Point R-32) are capable of collecting the required samples.

14.2.12.9.6 Reactor Coolant Drain Tank (Test #096)

1.0 OBJECTIVE

1.1 To verify the proper performance of the reactor coolant drain tank (RCDT) subsystem.

2.0 PREREQUISITES

2.1 Construction activities on the RCDT subsystem have been completed.

2.2 The RCDT subsystem instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Process drain tank subsystem is ready to accept water from the RCDT.

2.4 Support systems required for operation of the RCDT subsystem are functional.

3.0 TEST METHOD

3.1 Operate control valves remotely while:

3.1.1 Observing each valve operation and position indication.

3.1.2 Measuring valve performance data (e.g., thrust, opening and closing times).

3.2 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 9.3.4).

3.3 Simulate a CIAS and observe isolation valve response.

3.4 Fill the RCDT from any convenient source and observe level and pressure indications and alarms.

3.5 Pressurize the RCDT, using simulated signals, to a full range of operating pressures and observe indications and alarms.

3.6 Line up the RCDT to the EDT and drain the RCDT using each RCDT pump.

3.7 Observe level and pressure indicators, alarms and interlocks.

3.8 Simulate RCDT full range of operating temperatures and observe indications and alarms.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indications.

4.3 Response of valves to simulated failed conditions.

4.4 Position response of valves to loss of motive power.

4.5 The RCDT level, pressure and temperature.

4.6 Setpoints of alarms and interlocks.

5.0 ACCEPTANCE CRITERIA

5.1 The reactor coolant drain tank subsystem meets design requirements (refer to Section 9.3.3.2.2).

14.2.12.9.7 Process Drain Tank (Test #097)

1.0 OBJECTIVE

1.1 To verify the proper performance of the process drain tank subsystem.

2.0 PREREQUISITES

2.1 Construction activities on the process drain tank subsystem have been completed.

2.2 The process drain tank subsystem instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Verify radwaste and reactor makeup water subsystems are functional.

3.0 TEST METHOD

3.1 Operate control valves from appropriate control positions and observe valve operation and position indication.

3.2 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 9.3.4).

3.3 Fill the process drain tank from the reactor makeup water subsystem and observe indications, alarms, and interlocks.

3.4 Drain the process drain tank using an RCDT pump and observe indications, alarms, and interlocks.

3.5 Simulate a range of process drain tank temperatures while observing indications and alarms.

3.6 Simulate a range of process drain tank pressures while observing indications and alarms.

4.0 DATA REQUIRED

4.1 Valve position indications.

4.2 Position response of valves to loss of motive power.

4.3 The process drain tank level, pressure and temperature.

4.4 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The process drain tank subsystem meets design requirements (refer to Section 9.3.3.2.2).

14.2.12.9.8 Equipment and Floor Drainage System (Test #098)

1.0 OBJECTIVE

1.1 To demonstrate that the drain lines are correctly routed to their designated destination.

1.2 To demonstrate the sump pumps operate per design including alarms and interlocks.

1.3 To demonstrate the waste tanks operate per design including alarms and interlocks.

1.4 To demonstrate the sump level instrumentation operates per design including alarms and indications to demonstrate system segregation.

2.0 PREREQUISITES

2.1 Construction activities on the equipment and floor drainage system have been completed.

2.2 Equipment and floor drainage system instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the equipment and floor drainage system is complete and functional.

2.4 Water is available for flow paths to be checked.

2.5 Several colors of non-toxic dye are available for verifying source of water.

3.0 TEST METHOD

3.1 Verify the operation of alarms and interlocks.

3.2 Verify sump levels as required to demonstrate that operation of the sump pumps meet design requirements.

3.3 Flow water in each drain path to the equipment and floor drainage system.

3.4 Verify that the drains discharge to their designated destination and that system segregation is maintained.

4.0 DATA REQUIRED

4.1 Sump pump operating data is available for review.

4.2 Setpoints at which alarms and interlocks occur.

4.3 Discharge points of each drain.

5.0 ACCEPTANCE CRITERIA

5.1 The equipment and floor drainage system operates as designed (refer to Section 9.3.3).

14.2.12.9.9 Gaseous Waste Processing System (Test #099)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the gaseous waste processing system (GWPS) to collect and process radioactive and potentially flammable gases vented from plant equipment.

1.2 To verify that radiation monitors respond as designed to check sources.

1.3 To verify that radiation monitors initiate automatic control functions upon detecting high activity levels.

1.4 To verify that radiation sample points provide representative samples of the GWPS.

2.0 PREREQUISITES

2.1 Construction activities on the GWPS have been completed.

2.2 The GWPS instrumentation, including radiation monitors, has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the GWPS are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Verify that the GWPS charcoal beds and gel driers are loaded with the proper types and amounts of charcoal and desiccant.

3.0 TEST METHOD

3.1 Verify flow paths.

3.2 Demonstrate that discharge isolation features and other system controls function as designed.

3.3 Verify alarms, indicating instruments and status lights are functional.

3.4 Demonstrate the operation of the gas drying equipment.

3.5 Demonstrate that hold up time of gas through the charcoal adsorber meet design requirements.

3.6 Demonstrate the operation of the gel dryer regeneration equipment (protects delay beds from moisture while operating in surge mode).

3.7 Demonstrate the operation of the gas analyzers to detect concentrations of O_2 and H_2 specified in the plant Technical Specifications, Section 5.5.11, "Gaseous Waste Processing System Radioactivity Monitoring Program."

3.8 Demonstrate the operation of the recombiner.

3.9 Operate control valves remotely while:

3.9.1 Observing each valve operation and position indication.

3.9.2 Measuring valve performance data (e.g., thrust, opening and closing times).

3.10 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 11.3).

3.11 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Points R-1 and R-2) and external test equipment, as necessary:

3.11.1 Check the self-testing features of radiation monitors.

3.11.2 Record the response of radiation monitors to check sources.

3.11.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.11.4 Record alarm actuations at local and remote locations, as appropriate.

3.12 Confirm that Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Point R-2) initiate upon detecting high activity levels.

3.13 Verify that sample points (refer to Table 11.5-1, Radiation Measuring Points R-1, R-2, R-40, and R-44) are capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Setpoints of alarms, interlocks, and controls.

4.2 Gas dryer operating data.

4.3 Dryer regenerating equipment operating data.

4.4 Gas analyzer operating data.

4.5 Recombiner operating data.

4.6 Gas transport times.

4.7 Position response of valves to loss of motive power.

4.8 Valve performance data.

4.9 Radiation monitor response to check source.

4.10 Technical data associated with check source.

4.11 Signal levels necessary to initiate alarm actuation.

4.12 Signal levels necessary to initiate Automatic Control Functions.

5.0 ACCEPTANCE CRITERIA

5.1 The GWPS operates as designed (refer to Sections 11.3 and 11.5).

5.2 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Points R-1 and R-2). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.2.1 Range.

5.2.2 Response time.

5.2.3 Sensitivity.

5.3 Radiation monitoring instrumentation meets design requirements to monitor radiation and initiate Automatic Control Functions (refer to Table 11.5-1, Radiation Measuring Point R-2) upon detection of high activity levels.

5.4 Radiation sample points (refer to Table 11.5-1, Radiation Measuring Points R-1, R-2, R-40, and R-44) are capable of collecting the required samples.

14.2.12.9.10 Nuclear Sampling and Severe Accident Sampling Systems (Test #100)

1.0 OBJECTIVE

1.1 To verify the ability of nuclear sampling system (NSS) to collect and deliver representative samples of liquids and gases in various process systems to sample stations for chemical and radiological analysis during operation cooldown.

1.2 To verify the ability of the severe accident sampling system (SASS) to collect and deliver gaseous and liquid samples from inside the containment following a severe accident for the purpose of confirming whether the containment atmosphere contains airborne activity.

1.3 To demonstrate electrical independence and redundancy of power supplies.

1.4 To verify that radiation monitors respond as designed to check sources.

1.5 To verify that the radiation sample point provides a representative sample of the NSS.

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested have been completed.

2.2 Systems being sampled are at or near normal operating pressure and temperature.

2.3 Calibrating gases and solutions are available.

2.4 Test instrumentation is available and calibrated.

2.5 NSS and SASS instrumentation, including radiation monitors, has been calibrated and is functional for performance of the following test.

2.6 Verify that the preoperational tests that collect representative samples described in Table 11.5-1, other than R-41, have been performed satisfactorily.

3.0 TEST METHOD

3.1 Verify adequate flow from each sample location.

3.2 Verify that operation of alarms and interlocks meet design requirements.

3.3 Verify that operation of pump and heat exchangers in normal operating modes and flow paths meets design requirements.

3.4 Verify the analytical instrumentation provides indication and response as designed.

3.5 Calculate the holdup times using the as-built piping lengths, piping volume and measured flow rate for the following:

3.5.1 RCS samples.

3.5.2 Pressurizer samples.

3.5.3 Equipment rooms inside containment.

3.5.4 Annular rooms inside containment.

3.5.5 IRWST, via severe accident heat removal system (SAHRS).

3.6 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.7 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 9.3.2).

3.8 Check electrical independence and redundancy of power supplies for NSS and SASS safety-related functions by selectively removing power and determining loss of function.

3.9 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Point R-41) and external test equipment, as necessary:

3.9.1 Check the self-testing features of radiation monitors.

3.9.2 Record the response of radiation monitors to check sources.

3.9.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.9.4 Record alarm actuations at local and remote locations, as appropriate.

3.10 Verify that sample point (refer to Table 11.5-1, Radiation Measuring Point R-41) is capable of collecting representative samples.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms and interlocks occur.

4.2 Sampling flow rate from each sample point.

4.3 Analytical instrument data.

4.4 Valve performance data, where required.

4.5 Valve position indication.

4.6 Position response of valves to loss of motive power.

4.7 Calculated holdup time for RCS and pressurizer samples.

4.8 Radiation monitor response to check source.

4.9 Technical data associated with check source.

4.10 Signal levels necessary to initiate alarm actuation.

5.0 ACCEPTANCE CRITERIA

5.1 The NSS meets design requirements (refer to Section 9.3.2.2.1.1).

5.2 The SASS performs as described in Section 9.3.2.2.1.3.

5.3 Verify that NSS and SASS safety-related components meet electrical independence and redundancy requirements.

5.4 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Point R-41). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.4.1 Range.

5.4.2 Response time.

5.4.3 Sensitivity.

5.5 Radiation sample point (refer to Table 11.5-1, Radiation Measuring Point R-41) is capable of collecting the required samples.

14.2.12.9.11 Station Blackout Diesel Generator Mechanical (Test #101)

1.0 OBJECTIVE

1.1 To demonstrate the station blackout diesel generator (SBODG) set system operates reliably.

2.0 PREREQUISITES

2.1 Construction activities on the SBODG system have been completed. This includes, but is not limited to the following:

2.1.1 SBODG fuel oil system (refer to Section 8.4.1).

2.1.2 SBODG engine lube oil system (refer to Section 8.4.1).

2.1.3 SBODG cooling system (refer to Section 8.4.1).

2.1.4 SBODG starting air system (refer to Section 8.4.1).

2.1.5 SBODG air intake and exhaust systems (refer to Section 8.4.1).

2.1.6 Crankcase ventilation system (refer to Section 9.5.8).

2.2 SBODG system instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the SBODG system are complete and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Demonstrate that each SBODG can be started in automatic and manual using the PAS and the local control station.

3.2 Demonstrate that the following mechanical and electrical trips are functional (includes protective trips bypass tests).

3.2.1 Engine over speed (electrical and mechanical).

3.2.2 Generator differential protection.

3.2.3 Low-low lube oil pressure.

3.2.4 Generator electrical protection.

3.2.5 Low level in the jacket water expansion tank.

3.2.6 Low-low lube oil sump tank level.

3.2.7 High pressure crankcase.

3.2.8 High-high temperature lube oil out.

3.2.9 High-high temperature jacket water.

3.2.10 Electronic governor failure.

3.2.11 Low fuel oil pressure.

3.3 Demonstrate that the following parameters are correctly monitored in the control room and at the SBODG local panel:

3.3.1 Lube oil temperature and pressures.

3.3.2 Bearing temperatures.

3.3.3 Cooling water temperatures and pressures.

3.3.4 Speed (rpm).

3.3.5 Starting air pressure.

3.4 Demonstrate the operation of the following status indications:

3.4.1 Cooling water expansion tank level.

3.4.2 SBODG output breaker position.

3.4.3 SBODG over speed.

3.4.4 Loss of control power.

3.4.5 Generator fault.

3.4.6 Low air and oil pressure.

3.4.7 Maintenance mode.

3.5 Demonstrate 25 consecutive starts capability.

3.6 Demonstrate full load capability.

3.7 Demonstrate SBODG speed control.

4.0 DATA REQUIRED

4.1 SBO engine operating parameters.

4.2 SBO engine consecutive starts data.

4.3 Setpoints of SBODG trips.

4.4 SBODG governor operating data.

4.5 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The SBODG mechanical system meets design requirements (refer to Section 8.4).

5.2 The SBODG electrical and instrumentation support systems meet design requirements (refer to Section 8.4.1).

14.2.12.9.12 Station Blackout Diesel Generator Electrical (Test #102)

1.0 OBJECTIVE

1.1 To verify the SBODGs can supply power at the rated load, voltage and frequency under design conditions.

2.0 PREREQUISITES

2.1 Construction activities on the SBODG system have been completed.

2.2 SBODG mechanical system test is completed (Test #101).

2.3 SBODG system instrumentation has been calibrated and is functional for performance of the following test.

2.4 Support systems required for operation of the SBODG system are complete and functional.

2.5 Test instrumentation is available and calibrated.

2.6 Electrical testing is complete as needed to allow the required buses to be energized.

2.7 The SBODG electrical voltage tests are complete.

2.8 Station blackout room ventilation system test is completed (Test #086).

3.0 TEST METHOD

3.1 Demonstrate 90 to 100 percent of the continuous rating of the SBODG, for an interval of not less than one hour and until temperature equilibrium has been attained.

3.2 Demonstrate that the SBODG unit starts from standby conditions and reaches required voltage and frequency within acceptable limits and time requirements.

3.3 Demonstrate by simulating a station blackout event that:

3.3.1 Non-essential loads are shed from the EPSS.

3.3.2 The SBODG starts on the auto-start signal from its standby conditions, attains the required voltage and frequency within

acceptable limits and time, energizes the respective NPSS buses and can be manually connected with the respective EPSS buses within 10 minutes.

3.4 Demonstrate the SBODGs capability to reject a loss of the largest single load while operating at power factor between 0.8 and 0.9, and verify that the voltage and frequency requirements are met and that the SBODG unit shall not trip on over speed.

3.5 Demonstrate the SBODGs capability to reject a load equal to 90 to 100 percent of its continuous rating while operating at power factor between 0.8 and 0.9, and verify that the voltage requirements are met and that the SBODG shall not trip on over speed.

3.6 Perform SBODG endurance and margin test to demonstrate:

3.6.1 Full-load carrying capability at a power factor between 0.8 and 0.9.

3.6.2 For an interval of not less than 24 hours, of which 2 hours are at a load equal to 105 to 110 percent of the continuous rating of the SBODG.

3.6.3 That 22 hours of the 24 hours are at a load equal to 90 to 100 percent of its continuous rating.

3.6.4 That voltage and frequency requirements are maintained.

3.6.5 That mechanical systems such as fuel, lubrication, and cooling function within design limits.

3.6.6 Operation of the station blackout room ventilation system.

3.6.7 Area temperatures are maintained within design limits.

3.7 NOTE: Perform this testing within five minutes after operations at ≥ 90 percent capacity for ≥ two hours.

3.8 Demonstrate hot restart functional capability at full-load temperature conditions (after it has operated for 2 hours at full load).

3.9 Demonstrate the ability to synchronize the SBODG unit with offsite power while loaded upon a simulated restoration of offsite power.

a. Parallel the SBO bus with offsite power, transfer SBODG and open SBODG output circuit breaker.

b. Restore the SBODG to standby status.

3.10 Demonstrate that, by starting and running both SBODG units simultaneously, potential common failure modes that may be undetected in single SBODG unit tests do not occur.

4.0 DATA REQUIRED

4.1 Test data traces for SBODG output voltage, frequency, and output circuit breaker closing data during start sequence.

4.2 Running data for the parameters monitored during each of the required testing sequences.

4.3 Verification of field performance data versus shop data.

4.4 Periodic area temperatures, collected at least once per hour.

5.0 ACCEPTANCE CRITERIA

5.1 The SBODG electrical system meets design requirements (refer to Sections 7.4.1, 8.4, and 8.4.1.4).

5.2 The station blackout room ventilation system meets design requirements (refer to Section 9.4.10).

14.2.12.9.13 Station Blackout Diesel Generator Auxiliaries (Test #103)

1.0 OBJECTIVE

1.1 To confirm whether or not the SBODG fuel oil system provides a reliable and adequate supply to each SBODG.

1.2 To confirm whether or not the operation of the SBO engine cooling water system is adequate.

1.3 To confirm whether or not the SBO engine starting air system provides adequate amount of air for five consecutive starts of its SBODG without makeup air.

1.4 To confirm adequate operation of the SBO engine lube oil system.

2.0 PREREQUISITES

2.1 Construction activities on the SBODG auxiliary systems have been completed.

2.2 SBODG auxiliary systems instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the SBODG auxiliary systems are complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 The SBODGs are available for a loaded run to measure fuel consumption and to perform consecutive starts.

3.0 TEST METHOD

3.1 Demonstrate the operation of the fuel oil automatic transfer feature from the storage tanks to the day tank.

3.2 Demonstrate the operation of the fuel oil and day tank level alarms.

3.3 Demonstrate the day tank can be filled manually.

3.4 Demonstrate the operation of the fuel oil booster pump.

3.5 Demonstrate by performing a loaded run of the SBODG with its day tank filled to its low level alarm point, that the day tank provides sufficient fuel for at least 60 minutes of SBODG operation with the

SBODG supplying the power requirements of the most limiting design conditions.

3.6 Demonstrate by performing a loaded run of the SBODG and analysis of SBODG fuel storage capacity, that each SBODG has sufficient fuel storage capacity to operate for a period of no less than 24 hours with the SBODG supplying the power requirements of the most limiting design basis accident.

3.7 Demonstrate SBODG fuel oil; consumption rate.

3.8 Demonstrate the operation of the SBODG cooling water system keep warm pump.

3.9 Demonstrate the operation of SBODG cooling system heaters.

3.10 Demonstrate the operation of the SBODG cooling system alarms.

3.11 Demonstrate the operation of the SBODG cooling system radiator fans.

3.12 Demonstrate the operation of SBODG starting air compressors.

3.13 Demonstrate that each SBODG starting air system has sufficient volume available to perform five consecutive starts of its SBODGs.

3.14 Demonstrate the SBODG starting air system operates the SBODG pneumatic controls as designed.

3.15 Demonstrate the SBODG starting air alarm interlocks and automatic operation.

3.16 Demonstrate the operation of the SBODG Lube oil pre-lube pump.

3.17 Demonstrate the operation of SBODG Lube oil heaters.

3.18 Demonstrate the operation of SBODG Lube oil alarms.

3.19 Demonstrate the operation of the SBODG lube oil transfer pump.

3.20 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 8.4).

4.0 DATA REQUIRED

4.1 SBO fuel oil consumption rate.

4.2 Setpoints of alarms, interlocks, and controls.

4.3 Operating data for pumps and compressors.

4.4 Operating data for the heaters.

4.5 SBO starting air volume parameters after consecutive starts.

4.6 Position response of valves to loss of motive power.

5.0 ACCEPTANCE CRITERIA

5.1 The SBODG engine fuel oil system operates as designed (refer to Section 8.4).

5.2 The SBODG engine cooling water system operates as designed (refer to Section 8.4).

5.3 The SBODG engine starting air system operates as designed (refer to Section 8.4).

5.4 The SBODG engine lube oil system operates as designed (refer to Section 8.4).

14.2.12.9.14 Emergency Diesel Generator Mechanical (Test #104)

1.0 OBJECTIVE

1.1 To demonstrate the emergency diesel generator (EDG) set system operates reliably.

1.2 To demonstrate electrical independence and redundancy of power supplies.

1.3 To verify that EDG diesel generator and auxiliary system alarms, interlocks, and control functions perform as designed.

2.0 PREREQUISITES

2.1 Construction activities on the EDG system have been completed. This includes, but is not limited to the following:

2.1.1 EDG fuel oil system (refer to Section 9.5.4).

2.1.2 EDG engine lube oil system (refer to Section 9.5.7).

2.1.3 EDG cooling system (refer to Section 9.5.5).

2.1.4 EDG starting air system (refer to Section 9.5.6).

2.1.5 EDG air intake system (refer to Section 9.5.8).

2.1.6 EDG exhaust system (refer to Section 9.5.8).

2.1.7 Crankcase ventilation system (refer to Section 9.5.8).

2.2 EDG system instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the EDG system are complete and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Demonstrate that each EDG can be started in automatic and manual using the SICS and PICS control interfaces.

3.2 Demonstrate that the following mechanical and electrical trips are functional (includes protective trips bypass tests).

3.2.1 Engine over speed (electrical and mechanical).

3.2.2 Generator differential protection.

3.2.3 Low-low lube oil pressure.

3.2.4 Generator electrical protection.

3.2.5 Essential service water supply low pressure.

3.2.6 Low expansion tank level.

3.2.7 High pressure crankcase.

3.2.8 Fuel oil low pressure.

3.2.9 High-high temperature lube oil out.

3.2.10 High-high temperature jacket water.

3.2.11 Low-low lube oil sump tank level.

3.2.12 Stop button located near engine.

3.2.13 Electronic governor failure.

3.3 Demonstrate that the following parameters are correctly monitored in the control room and at the local panel:

3.3.1 Lube oil temperature and pressures.

3.3.2 Bearing temperatures.

3.3.3 Cooling water temperatures and pressures.

3.3.4 Speed (rpm).

3.3.5 Starting air pressure.

3.4 Demonstrate the operation of the following status indications:

3.4.1 Cooling water not available.

3.4.2 EDG output breaker position.

3.4.3 EDG over speed.

3.4.4 Loss of control power.

3.4.5 Generator fault.

3.4.6 Low air and oil pressure.

3.4.7 Maintenance mode.

3.5 Demonstrate 25 consecutive start and load tests, without failures.

3.6 Demonstrate full load capability.

3.7 Demonstrate EDG speed control.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.9 Demonstrate that EDG instrumentation operates over the design range using actual or simulated signals.

3.10 Demonstrate that EDG alarms and interlocks occur as designed.

3.11 Demonstrate that the EDG instrumentation responds as designed to actual or simulated limiting malfunctions or failures.

3.12 Demonstrate that the EDG instrumentation response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

4.0 DATA REQUIRED

4.1 EDG engine operating parameters.

4.2 EDG engine consecutive starts and loading data.

4.3 Setpoints of EDG trips.

4.4 EDG governor operating data.

4.5 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The EDG mechanical system meets design requirements (refer to Sections 7.3.1.2.12, 8.3.1, and 8.4.1):

5.1.1 Manual and automatic controls.

5.1.2 Trips, alarms, interlocks, status lights, and system controls.

5.1.3 System responds as required to actual or simulated signals.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.9.15 Emergency Diesel Generator Electrical (Test #105)

1.0 OBJECTIVE

1.1 To verify the EDGs can supply power at the rated load, voltage, and frequency under design conditions.

1.2 To demonstrate electrical independence and redundancy of power supplies.

1.3 To verify that EDG alarms, interlocks, and control functions perform as designed.

2.0 PREREQUISITES

2.1 Construction activities on the EDG system have been completed.

2.2 EDG mechanical system test is completed (Test #104).

2.3 EDG system instrumentation has been calibrated and is functional for performance of the following test.

2.4 Support systems required for operation of the EDG system are complete and functional.

2.5 Test instrumentation is available and calibrated.

2.6 Electrical testing is complete as needed to allow the buses to be energized.

2.7 EDG electrical voltage tests are complete.

2.8 Engineered safety feature (ESF) loads are available to be loaded onto the bus.

2.9 Emergency Power Generating Building ventilation system test is completed. (Test #084).

2.10 The demonstration of EDGs must be sequenced so that loading of divisional power or alternate supplied loads are not confused with power from another EDG.

3.0 TEST METHOD

3.1 Demonstrate control logic and controls including the EDG load sequencer and response to ESF actuation signals.

3.1.1 Demonstration of the control logic and controls, including the protection system, which sequences EDG loads and responds to ESF actuation signals.

3.1.2 Demonstration of the EDG load carrying capability with the alternate feed connected between divisions (when one EDG is inoperable).

3.2 Demonstrate EDG rated load capability by operating loaded for the indicated times without exceeding the manufacturer's design limits:

a. Loaded at 90 to 100 percent of the continuous rating for the time required to reach engine temperature equilibrium plus one hour.

b. Following the load test described in item a), loaded at 105 to 110 percent for a period of two hours.

3.3 Demonstrate that the EDG starts from standby conditions, reaches required voltage and frequency within acceptable limits and time requirements.

3.4 Demonstrate by simulating a LOOP that:

3.4.1 The emergency buses are de-energized and the loads are shed from the emergency buses.

3.4.2 The EDG starts on the auto-start signal from its standby conditions, attains the required voltage and frequency within acceptable limits and time, energizes the auto-connected shutdown loads through the load sequencer and operates while loaded with its shutdown loads for greater than or equal to five minutes.

3.5 Demonstrate that on an SIAS, the EDG starts on the auto-start signal from its standby conditions, attains the required voltage and frequency within acceptable limits and time, and operates for greater than or equal to five minutes.

3.6 Demonstrate that on a combined SIAS and a LOOP that:

3.6.1 The emergency buses are de-energized and the loads are shed from the emergency buses.

3.6.2 The EDG starts on the auto-start signal from its standby conditions, attains the required voltage and frequency within

acceptable limits and time, energizes the auto-connected shutdown loads through the load sequencer, and operates while loaded with its shutdown loads for greater than or equal to five minutes.

3.6.3 The EDG starts on the auto-start signal from its standby conditions while aligned to supply alternate feed loads. The EDG attains the required voltage and frequency (with alternate feed loads) within acceptable limits and time, energizes the auto-connected shutdown loads through the load sequencer, and operates while loaded with its shutdown loads for greater than or equal to five minutes.

3.7 Demonstrate the EDGs capability to reject a loss of the largest single load while operating at power factor of ≤ 0.9, and verify that the voltage and frequency requirements are met and that the EDG output frequency is ≤ 63 Hz.

3.8 Demonstrate the EDGs capability to reject a load equal to 90 to 100 percent of its continuous rating while operating at power factor of ≤ 0.9, and verify that the voltage requirements are met and that the EDG shall not trip on over speed.

3.9 Confirm EDG endurance and margin test as follows:

3.9.1 Full-load carrying capability at a power factor between 0.8 and 0.9.

3.9.2 For an interval of not less than 24 hours, of which 2 hours are at a load equal to 105 to 110 percent of the continuous rating of the EDG.

3.9.3 That 22 hours of the 24 hours are at a load equal to 90 to 100 percent of its continuous rating.

3.9.4 That voltage and frequency requirements are maintained.

3.9.5 That mechanical systems such as fuel, lubrication, and cooling function within design limits.

3.9.6 Operation of the emergency power generating building ventilation system.

3.9.7 Area temperatures are maintained within design limits.

3.10 NOTE: Perform this testing within five minutes after the full load carrying capability demonstration.

3.11 Demonstrate hot restart functional capability at full-load temperature conditions (after it has operated for 2 hours at full load).

a. Verify that the EDG starts on a manual or automatic start signal.

b. Verify that the EDG attains the required voltage and frequency within acceptable limits and time, and operates for longer than five minutes.

3.12 Demonstrate the ability to synchronize the EDG unit with offsite power while loaded with emergency loads with a simulated restoration of offsite power.

a. Parallel EPSS bus with offsite power while the EDG is connected to the emergency load and transfer this load to offsite power.

b. Restore the EDG to standby status.

3.13 Demonstrate that with the EDG operating in a test mode while connected to its bus, a simulated SIAS overrides the test mode by returning the EDG to ready-to-load operation, and automatically energizing the emergency loads from offsite power.

3.14 Demonstrate that, by starting and running redundant EDG units simultaneously, potential common failure modes that may be undetected in single EDG unit tests do not occur.

3.15 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.16 Verify that EDG instrumentation operates over the design range using actual or simulated signals.

3.17 Verify that EDG alarms and interlocks occur as designed.

3.18 Verify that the EDG instrumentation responds as designed to actual or simulated limiting malfunctions or failures.

3.19 Verify that the EDG instrumentation response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

3.20 Demonstrate EDG load rejection capability by operating loaded at 105 to 110 percent, opening the EDG output circuit breaker, and verifying speeds and voltages that will cause tripping or component damage are not exceeded.

4.0 DATA REQUIRED

4.1 Starting and loading sequence timing.

4.2 Test data traces for starting, stopping and load shedding.

4.3 Running data for the parameters monitored during each of the required testing sequences.

4.4 Verification of field performance data versus shop data.

4.5 Periodic area temperatures, collected at least once per hour.

5.0 ACCEPTANCE CRITERIA

5.1 The EDG electrical system meets design requirements (refer to Sections 7.3.1.2.12 and 8.3.1):

5.1.1 Verify the EDG provides power to essential safety equipment if there is a simulated loss of normal power.

- Table 14.3-1 Item 1-56.

5.2 The EDG ventilation system meets design requirements (refer to Section 9.4.9).

5.3 Safety-related components meet electrical independence and redundancy requirements.

14.2.12.9.16 Emergency Diesel Generator Auxiliaries (Test #106)

1.0 OBJECTIVE

1.1 To confirm whether or not the EDG fuel oil system provides a reliable and adequate supply to each EDG.

1.2 To confirm whether or not the operation of the EDG engine cooling water system is adequate.

1.3 To confirm whether or not the EDG engine starting air system:

1.3.1 Provides adequate amount of air for five consecutive starts of its EDG without makeup air.

1.3.2 Is capable of achieving a single EDG start when the receiver is at the minimum receiver design pressure.

1.4 To confirm whether or not the operation of the EDG engine lube oil system is adequate.

1.5 To demonstrate electrical independence and redundancy of safety-related power supplies.

1.6 To confirm that the EDG intake air and exhaust gas systems demonstrate the ability to support full load capacity.

1.7 To verify that EDG auxiliary alarms, interlocks, and EDG auxiliary control functions perform as designed.

2.0 PREREQUISITES

2.1 Construction activities on the EDG auxiliary systems have been completed.

2.2 EDG auxiliary systems instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the EDG auxiliary systems are complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 The EDGs are available for a loaded run to measure fuel consumption and to perform consecutive starts.

3.0 TEST METHOD

3.1 Demonstrate the operation of the fuel oil automatic transfer feature from the storage tanks to the day tank.

3.2 Demonstrate the operation of the fuel oil and day tank level alarms.

3.3 Demonstrate the day tank can be filled manually.

3.4 Demonstrate the operation of the fuel oil booster pump.

3.5 Demonstrate the operation of the fuel oil recirculation system.

3.6 Demonstrate by performing a loaded run of the EDG with its day tank filled to its low level alarm point, that the day tank provides sufficient fuel for at least 60 minutes of EDG operation with the EDG supplying the power requirements of the most limiting design basis accident.

3.7 Demonstrate by performing a loaded run of the EDG and analysis of EDG fuel storage capacity, that each EDG has sufficient fuel storage capacity to operate for a period of no less than seven days with the EDG supplying the power requirements of the most limiting design basis accident.

3.8 Demonstrate the operation of the EDG cooling water system keep warm pump.

3.9 Demonstrate the operation of EDG cooling system heaters.

3.10 Demonstrate the operation of the EDG cooling system alarms.

3.11 Demonstrate the operation of EDG starting air compressors.

3.12 Demonstrate that each EDG starting air system:

3.12.1 Has sufficient volume available to perform five consecutive starts of its EDGs.

3.12.2 Is capable of achieving a single EDG start when the receiver is at the minimum receiver design pressure.

3.13 Demonstrate the EDG starting air system operates the EDG pneumatic controls as designed.

3.14 Demonstrate the EDG starting air alarm interlocks and automatic operation.

3.15 Demonstrate the operation of the EDG lube oil pre-lube pump.

3.16 Demonstrate the operation of EDG lube oil heaters.

3.17 Demonstrate the operation of EDG lube oil alarms.

3.18 Demonstrate the operation of the EDG lube oil transfer pump.

3.19 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 9.5).

3.20 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.21 Demonstrate by performing a loaded run of the EDG and analysis of EDG lube oil storage capacity, that each EDG has sufficient lube oil storage capacity to operate for a period of no less than seven days with the EDG supplying the power requirements of the most limiting design basis accident.

3.22 Verify that EDG auxiliary instrumentation operates over the design range using actual or simulated signals.

3.23 Verify that EDG auxiliary alarms and interlocks occur as designed.

3.24 Verify that the EDG auxiliary instrumentation responds as designed to actual or simulated limiting malfunctions or failures.

3.25 Verify that the EDG auxiliary instrumentation response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

4.0 DATA REQUIRED

4.1 EDG fuel oil consumption rate.

4.2 Setpoints of alarms, interlocks, and controls.

4.3 Operating data for pumps and compressors.

4.4 Operating data for the heaters.

4.5 EDG starting air volume parameters after consecutive starts.

4.6 Position response of valves to loss of motive power.

5.0 ACCEPTANCE CRITERIA

5.1 The EDG engine fuel oil system supplies adequate fuel for full load operation and operates as designed (refer to Section 9.5.4).

5.2 The EDG engine cooling water system provides adequate cooling for full load operation and operates as designed (refer to Section 9.5.5).

5.3 The EDG engine starting air system provides adequate starting air to recharge the receivers within the allowable design time and operates as designed (refer to Section 9.5.6).

5.4 The EDG engine lube oil system provides adequate engine lubrication and operates as designed (refer to Section 9.5.7).

5.5 Verify that safety-related components meet electrical independence and redundancy requirements.

5.6 The EDG intake air and exhaust gas systems provide sufficient capacity to support full load operation and operate as described in Section 9.5.8.

14.2.12.9.17 Auxiliary Steam Generating System (Test #107)

1.0 OBJECTIVE

1.1 To demonstrate the auxiliary steam generating system (ASGS) provides the steam to various plant components at designed pressures and flow.

2.0 PREREQUISITES

2.1 Construction activities on the ASGS have been completed.

2.2 ASGS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the ASGS are completed and functional.

2.4 Test Instrumentation is available and calibrated.

2.5 Sufficient loads are available to allow loading to the auxiliary boiler to its designed capacity. The steam loads can be actual (operating equipment) or simulated (steam discharged to the atmosphere).

3.0 TEST METHOD

3.1 Verify that operation of designated components such as protective devices, controls, interlocks, instrumentation and alarms, using actual or simulated inputs meets design requirements.

3.2 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., failure position to loss of power, thrust, stroke time), if required.

3.3 Verify power–operated valves fail upon loss of motive power to their appropriate position.

3.4 Verify that operation of system pumps meets design requirements.

3.5 Perform measurements of the auxiliary boiler performance using ASME PTC-4, “Fired Steam Generators” (Reference 4).

4.0 DATA REQUIRED

4.1 Boiler operating and capacity data per PTC-4.

4.2 Valve performance data, where required.

4.3 Valve position indication.

4.4 Response of power-operated valves to loss of motive power.

4.5 Setpoints at which alarms and interlocks occur.

4.6 Pump operating data.

5.0 ACCEPTANCE CRITERIA

5.1 The ASGS provides steam flow to designated components and systems as designed.

5.2 The auxiliary steam boiler meets the manufacturers design performance specification.

5.3 The ASGS provides adequate steam flow to the following loads that could be used to perform a normal shutdown:

5.3.1 Turbine gland seals.

5.3.2 Deaerator pegging steam.

14.2.12.10 Electrical Systems

14.2.12.10.1 Switchyard and Preferred Power System (Test #108)

1.0 OBJECTIVE

1.1 To verify the switchyard and preferred power system is capable of supplying power as designed to the unit through the preferred power circuits.

1.2 To verify the power generated by the turbine generator can be fed to grid through the switchyard.

2.0 PREREQUISITES

2.1 Construction activities on the switchyard and preferred power system have been completed.

2.2 Offsite power system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems are completed and functional for operation of the switchyard and preferred power system.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify operation of the switchyard protective relaying system.

3.2 Verify operation of switchyard power circuit breakers and motor-operated disconnects from the following, as applicable:

3.2.1 PICS controls.

3.2.2 Switchyard relay house.

3.2.3 Switchyard local control cabinet.

3.3 Verify operation of the switchyard dc auxiliary supply system and its associated controls, alarms, and dual battery supplies.

3.4 Verify the operation of the switchyard ac auxiliary power system and its associated controls, alarms, and annunciators.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms and interlocks occur.

4.2 Setpoint of protective relays.

5.0 ACCEPTANCE CRITERIA

5.1 The switchyard and preferred power system operates as designed (refer to Section 8.2).

14.2.12.10.2 Main Generator (Test #109)

1.0 OBJECTIVE

1.1 To demonstrate that the turbine generator is capable of transmitting power to the transmission system and designated house loads through the switchyard.

2.0 PREREQUISITES

2.1 Construction activities on the turbine generator and support systems have been completed.

2.2 The offsite power distribution system is available.

2.3 Buses and equipment have been voltage tested with acceptable results.

2.4 Equipment has been visually inspected.

2.5 Control power is available.

2.6 Plant conditions are such that the main generator can be operated.

3.0 TEST METHOD

3.1 Demonstrate the ability of the main step-up transformers to transmit power from the main generator to the offsite power transmission system at rated voltage and load.

3.2 Demonstrate the ability of the main generator to generate designed voltage and load.

3.3 Demonstrate the ability of the unit auxiliary transformers to supply station loads.

3.4 Verify the operation of each of the main generator circuit breakers, in the plant switchyard.

3.5 Verify the operation of interlocks, alarms and protective relays.

3.5.1 Verify that the backup protection scheme works for simulated single failures by verifying operation of the primary and backup relay systems.

3.6 Verify the operation of the main generator auxiliary systems.

4.0 DATA REQUIRED

4.1 Turbine generator operating data at load.

4.2 Main step-up transformer operating data.

4.3 Alarm values, interlock actuation valves, and plant operating data.

5.0 ACCEPTANCE CRITERIA

5.1 The turbine generator, main generator output breakers, and main step-up transformers operate as designed (refer to Section 8.2.1).

14.2.12.10.3 Class 1E Uninterruptible Power Supply (Test #110)

1.0 OBJECTIVE

1.1 To demonstrate the Class 1E uninterruptible power supply (EUPS) systems supply power as designed in required operating modes.

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

1.3 To demonstrate the ability to shed loads by remote manual and local manual means to extend the DC power coping time.

2.0 PREREQUISITES

2.1 Construction activities on the EUPS system have been completed.

2.2 EUPS system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the EUPS system are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 EUPS batteries are fully charged.

2.6 Load banks are available for discharge test.

2.7 Operation of breakers and cables has been verified.

2.8 Ventilation systems are in operation, as needed.

2.9 Buses and associated equipment have been meggered with acceptable results.

2.9.1 Alternating Current (AC) loads.

2.9.2 Direct Current (DC) loads.

2.10 EUPS components have been visually inspected.

3.0 TEST METHOD

3.1 Demonstrate that the batteries and battery chargers meet design capacities by performing discharge and charging tests as follows:

3.1.1 Perform battery modified performance discharge or service test per IEEE Standard 450-2002 as endorsed by RG 1.129 with exceptions.

3.1.2 Perform battery charger capacity test to verify battery charger output meets design criteria.

3.2 Verify that EUPS battery minimum bank and individual cell limits are not exceeded during battery discharge test.

3.3 Verify that operation of the inverters, manual transfer switches and frequency synchronization meets design requirements.

3.4 Verify operation of the EUPS inverters as follows:

3.4.1 Verify operation of each EUPS inverter with the respective EUPS battery charger removed from service.

3.4.2 Verify each EUPS inverter bypass switch forward and reverse transfer operation.

3.5 Place each battery charger in the equalize mode and verify battery charger, battery, and inverter performance meets design requirements.

3.6 Verify that operation of protective devices, controls, interlocks, alarms, computer inputs, and ground detection meet design requirements.

3.7 Verify that operation of the vital instrumentation and control power status information subsystem meets design requirements.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.9 Verify operation of the AC/DC and DC/DC converter output to the I&C cabinets by alternately removing power and verifying continued power to the I&C cabinet from the converter remaining in operation.

3.10 Verify that Class 1E Uninterruptible Power remote loads can be shed to meet ELAP event mitigation strategy.

3.10.1 Remote manual operated disconnect loads.

- AC loads.
- DC loads.

3.10.2 Local manual operated disconnect loads, as applicable.

4.0 DATA REQUIRED

4.1 Record of the charger float voltage and current.

4.2 Test discharge recordings of battery terminal voltage, current, temperature, capacity in ampere hours, and individual cell voltages.

4.3 Inverter voltage, frequency, and current from battery source.

4.3.1 Prior to dropping loads.

4.3.2 After dropping remote manual operated disconnect loads.

4.3.3 After dropping local manual operated disconnect loads, as applicable.

4.4 Values at which alarms, interlocks, and controls occur.

4.5 System status information subsystem indications.

4.6 Capacity of the EUPS batteries.

5.0 ACCEPTANCE CRITERIA

5.1 The EUPS system supplies the loads as designed (refer to Section 8.3.2).

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

5.3 Loads shed to meet the ELAP event mitigation strategy meets or exceeds the class 1E battery load reduction target.

14.2.12.10.4 Non–Class 1E Uninterruptible Power Supply (Test #111)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the non-Class 1E uninterruptible power supply (NUPS) system.

2.0 PREREQUISITES

2.1 Construction activities on the NUPS system have been completed.

2.2 NUPS system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the NUPS system are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 NUPS batteries are fully charged.

2.6 Load banks are available for discharge test.

2.7 Operation of breakers and cables is verified.

2.8 Ventilation systems are in operation, as needed.

2.9 Buses and associated equipment have been meggered with acceptable results.

2.10 The NUPS equipment has been visually inspected.

3.0 TEST METHOD

3.1 Demonstrate that the batteries and battery chargers of the 250 Vdc auxiliary power system meet design capacities by performing discharge and charging tests as follows:

a. Perform battery modified performance discharge test or service test per IEEE 450-2002 as endorsed by RG 1.129 with exceptions.

b. Perform battery charger capacity test to verify battery charger output meets design criteria.

3.2 Verify that minimum bank and individual cell limits are not exceeded during battery discharge tests.

3.3 Verify that operation of the inverters, manual transfer switches, frequency synchronization and blocking diodes of the NUPS meets design requirements.

3.4 Verify operation of the NUPS inverters as follows:

a. Verify operation of each NUPS inverter with the respective NUPS battery charger removed from service.

b. Verify each NUPS inverter static bypass switch forward and reverse transfer operation.

3.5 Place each battery charger in equalize mode and verify battery charger, battery, and inverter performance meets design requirements.

3.6 Verify that operation of protective devices, controls, interlocks, alarms, computer inputs, and ground detection meets design requirements.

3.7 Verify operation of the AC/DC and DC/DC converter output to the I&C cabinets by alternately removing power and verifying continued power to the I&C cabinet from the converter remaining in operation.

4.0 DATA REQUIRED

4.1 Charger float voltage and current.

4.2 Test discharge recording of battery terminal voltage, current, temperature, capacity in ampere hours, and individual cell voltages.

4.3 Inverter voltage, frequency, and current.

4.4 Value at which alarms, interlocks, and controls occur.

4.5 Capacity of the NUPS batteries.

5.0 ACCEPTANCE CRITERIA

5.1 The NUPS system supplies the loads as designed (refer to Section 8.3.2).

14.2.12.10.5 Communication System (Test #130)

1.0 OBJECTIVE

1.1 To demonstrate the adequacy of the intra-plant communication system to provide communications between vital plant areas.

1.2 To demonstrate the offsite communication system to provide communications with exterior entities.

1.3 Verify that non-safety-related communication system functions as designed to malfunctions or failures.

1.4 To demonstrate that COMS meets design requirements.

2.0 PREREQUISITES

2.1 Construction activities on the intraplant communication system have been completed.

2.2 Support systems required for operation of the intraplant communication system are complete and functional.

2.3 Plant equipment that contributes to the ambient noise level shall be in operation.

3.0 TEST METHOD

3.1 Verify the intraplant portable wireless communication system functions as designed.

3.2 Verify that the intraplant (PABX) telephone system functions as designed.

3.3 Verify the intraplant sound powered telephone system functions as designed.

3.4 Verify the intraplant public address system functions as designed.

3.5 Verify the security radio system functions as designed at locations throughout the plant.

3.6 Verify the normal offsite telephone system functions as designed.

3.7 Verify the emergency telephone system (emergency notification system, health physics network) function as designed.

3.8 Verify that the communication system responds as designed to actual or simulated limiting malfunctions or failures.

3.9 Verify that the communications equipment will perform under anticipated maximum plant noise levels.

3.10 Verify the effectiveness of the exclusion zones established for protecting the safety-related I&C equipment from mis-operation due to EMI/RFI effects from the portable phones and radios of the communication system.

4.0 DATA REQUIRED

4.1 Record the results of communication attempts from each system and its locations.

5.0 ACCEPTANCE CRITERIA

5.1 The portable wireless communication system provides radio coverage throughout the plant, except in areas restricted due to potential EMI/ RFI considerations.

5.2 The portable wireless communication system provides an interconnection to the public switched telephone network (PSTN) to allow offsite communications.

5.3 The digital telephone system provides plant-wide intercom capability.

5.4 The digital telephone system provides an interconnection to the public switched telephone network (PSTN) to allow offsite communications.

5.5 The public address and alarm system operates as described in the design specification.

5.6 The sound powered system operates as described in the design specification.

5.7 The security communication system operates as described in the design specification.

5.8 The communication system provides communication with the emergency notification system and the health physics network.

5.9 The communication equipment is capable of operating under maximum noise conditions.

5.10 Safety-related I&C equipment is not adversely impacted by the portable phones and radios of the communication system.

5.11 The intraplant and offsite communication systems function as described in Section 9.5.2.

14.2.12.10.6 Normal Lighting System (Test #113)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the normal lighting system.

2.0 PREREQUISITES

2.1 Construction activities on the normal lighting system have been completed.

2.2 Normal lighting system instrumentation has been calibrated and is operating satisfactorily prior to performing the test, if applicable.

2.3 Support systems required for operation of the normal lighting system are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Equipment has been visually inspected.

2.6 Normal lighting system power is available.

3.0 TEST METHOD

3.1 Demonstrate the functionality of the source and feeder circuit breakers.

3.2 Verify acceptable lighting levels for each system with other lighting systems de-energized in each room.

4.0 DATA REQUIRED

4.1 Plant area illumination levels.

5.0 ACCEPTANCE CRITERIA

5.1 Normal lighting systems operate as designed (refer to Section 9.5.3).

14.2.12.10.7 Heat Tracing (Test #114)

1.0 OBJECTIVE

1.1 To demonstrate that the temperature maintenance portion of the heat tracing system meets design requirements.

1.2 To demonstrate that the freeze protection portion of the heat tracing system meets design requirements.

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the temperature maintenance portion of the heat tracing system have been completed.

2.2 Construction activities on the freeze protection portion of the heat tracing system have been completed.

2.3 Test instruments are calibrated per applicable procedures and are available; this includes temperature-sensors for remote readings if insulation is installed.

2.4 Support systems that provide power to the heat tracing control cabinets are functional and available for testing.

3.0 TEST METHODS

3.1 Simulate temperatures to the freeze protection cabinets that are below the low temperature setpoint and verify that the heat tracing that provides freeze protection is energized.

3.2 Simulate temperatures to the freeze protection cabinets that are above the low temperature setpoint and verify that the heat tracing that provides freeze protection is de-energized.

3.3 Demonstrate that the safety-related freeze protection system remains powered from the redundant emergency power supply buses by

selectively removing power and verifying staggered freeze protection loss.

3.4 Simulate temperatures to the temperature maintenance cabinets that are below the low temperature setpoint and verify that the heat tracing that provides temperature maintenance is energized.

3.5 Simulate temperature to the temperature maintenance cabinets that are above the low temperature setpoint and verify that the heat tracing that provides temperature maintenance is de-energized.

3.6 Demonstrate that the safety-related temperature maintenance system remains powered from the redundant emergency power supply buses by selectively removing power and verifying staggered temperature maintenance loss.

4.0 DATA REQUIRED

4.1 Simulated temperature inputs.

4.2 Record of energized freeze protection cabinet circuits.

4.3 Piping temperature with freeze protection circuits energized.

4.4 Record of temperature maintenance circuits energized.

5.0 ACCEPTANCE CRITERIA

5.1 The freeze protection system functions as designed (refer to Section 8.3.1.1.15).

5.2 The temperature maintenance system functions as designed (refer to Section 8.3.1.1.15).

14.2.12.10.8 Emergency Lighting System (Test #115)

1.0 OBJECTIVE

1.1 To demonstrate that the emergency lighting system provides adequate illumination to operate equipment during emergency operations.

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the emergency lighting system have been completed.

2.2 Test instruments are calibrated per applicable procedures and available.

3.0 TEST METHODS

3.1 Demonstrate that the emergency lighting system provides levels of illumination as required in designated control areas.

3.2 Demonstrate that the emergency lighting system provides levels of illumination in other designated areas of the plant.

3.3 Demonstrate that the emergency lighting system remains energized upon loss of normal lighting.

3.4 Demonstrate that the battery operated emergency lights provide adequate illumination at designated locations.

3.5 Demonstrate that the battery operated emergency lights are capable of providing lighting for the designated amount of time.

3.6 Demonstrate that the MCR emergency lighting is powered from redundant EUPS buses by selectively removing power and verifying staggered lighting loss.

3.7 Demonstrate that the remote shutdown station (RSS) emergency lighting is powered from redundant EUPS buses by selectively removing power and verifying staggered lighting loss.

4.0 DATA REQUIRED

4.1 Illumination levels in designated areas.

4.2 Battery powered lighting data.

5.0 ACCEPTANCE CRITERIA

5.1 The emergency lighting system operates as designed (refer to Section 9.5.3).

14.2.12.10.9 6.9 kV Emergency Power Supply System (Test #116)

1.0 OBJECTIVE

1.1 To demonstrate the operation of 6.9 kV emergency power supply system (EPSS) equipment.

1.1.1 Normal supply.

1.1.2 Alternate supply.

1.1.3 Automatic transfer from normal to alternate supply.

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the 6.9 kV EPSS equipment have been completed.

2.2 The 6.9 kV EPSS equipment instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the 6.9 kV EPSS are completed and functional.

2.4 Test Instrumentation is available and calibrated.

2.5 All 6.9 kV feeders and buses voltage tested with acceptable results.

2.6 6.9 kV power is available from the normal and alternate offsite power sources.

2.7 Switchgear assembly, breakers, control and protective equipment, and circuits have been inspected and tested and are capable of being placed into service.

2.8 The EDG and SBODG sources are available.

3.0 TEST METHOD

3.1 Demonstrate the functionality of the switchgear and load center feeder and circuit breakers locally and remotely.

3.2 Demonstrate the functionality of the bus interlocks, alarms, and protective relays.

3.3 Verify the operation of indication and automatic responses.

3.4 Load the systems to the extent practical and verify full load voltage is within system design parameters.

3.4.1 Verify the capability of 6.9 kV and 480 V bus loads to start and operate as designed when connected to the respective Class 1E 6.9 kV BDA bus at ±5 percent nominal voltage.

3.5 Verify the 6.9 kV and 480 V safety-related systems load shed as designed on undervoltage, as described in Section 8.3.1.1.3.

3.6 Verify the applicable 6.9 kV Class 1E buses can be energized from the following normal sources:

3.6.1 Respective emergency auxiliary transformer.

3.6.2 Respective EDG.

3.6.3 Respective SBODG.

3.7 Verify the applicable 6.9 kV Class 1E buses can be energized from the following alternate sources:

3.7.1 Alternate emergency auxiliary transformer.

3.7.2 EDG via alternate feed.

3.8 Verify that the automatic bus transfer occurs when a simulated normal emergency auxiliary transformer fault is detected. Verify that loads are reconnected to the alternate supply.

3.9 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.10 Demonstrate control logic and controls including the load sequencer function in the protection system and response to ESF actuation signals.

4.0 DATA REQUIRED

4.1 Bus voltage data at maximum attainable load.

4.2 Values at which alarms, interlocks, and protective relays occur.

4.3 Data collected should be sufficient to demonstrate system response to bus undervoltage and degraded voltage condition as described in Section 8.3.1.1.3.

5.0 ACCEPTANCE CRITERIA

5.1 The 6.9 kV Class 1E emergency power system operates as designed (refer to Section 8.3.1).

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.10.10 480 V Emergency Power Supply System (Test #117)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the 480 V Class 1E EPSS.

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the 480 V EPSS have been completed.

2.2 The 480 V EPSS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the 480 V EPSS are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Buses and equipment meggered with acceptable results.

2.6 Applicable equipment has been visually inspected.

3.0 TEST METHOD

3.1 Demonstrate the functionality of the 480 Vac source and feeder circuit breakers locally and remotely, as applicable.

3.2 Demonstrate the functionality of the bus interlocks alarms and protective relays.

3.3 Verify the operation of indication and automatic responses.

3.4 Perform energization of 480 V EPSS.

3.5 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms, interlocks, and protective relays occur.

5.0 ACCEPTANCE CRITERIA

5.1 The 480 V Class 1E emergency power system operates as designed (refer to Section 8.3.1).

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.10.11 13.8 kV Normal Power Supply System (Test #118)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the 13.8 kV normal power supply system (NPSS).

1.1.1 Verify ability of 13.8 kV bus to be supplied power from the normal offsite supply.

1.1.2 Verify ability of 13.8 kV bus to be supplied power from the alternate offsite supply.

1.2 To demonstrate electrical independence and redundancy of safety-related RCP breaker protective devices.

2.0 PREREQUISITES

2.1 Construction activities on the 13.8 kV NPSS have been completed.

2.2 13.8 kV NPSS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the 13.8 kV NPSS are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Normal auxiliary transformers available.

2.6 All 13.8 kV feeders and buses have been voltage tested with acceptable results.

2.7 Switchgear assembly, breaker, control and protective equipment, and circuits have been inspected and tested and are capable of being placed into service.

3.0 TEST METHOD

3.1 Demonstrate the functionality of the switchgear and load center 13.8 kV feeder circuit breakers locally and remotely.

3.2 Demonstrate the functionality of the bus interlocks, alarms, and protective relays.

3.3 Verify the operation of indication and automatic responses.

3.3.1 Simulate a loss of normal offsite supply and verify automatic re-alignment to the alternate offsite supply.

3.4 Demonstrate the functionality of the feeder circuit breakers from the normal transformers to the NPSS locally and remotely.

3.5 Check electrical independence and redundancy of RCP breaker protective devices by selectively removing power and determining that loss of function (ability to trip RCP) does not occur.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms, interlocks, and protective relays occur.

5.0 ACCEPTANCE CRITERIA

5.1 The 13.8 kV normal power system operates as designed (refer to Sections 8.2 and 8.3.1).

5.2 Safety-related components meet electrical independence and redundancy requirements.

14.2.12.10.12 6.9 kV Normal Power Supply System (Test #119)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the 6.9 kV normal power supply system (NPSS).

2.0 PREREQUISITE

2.1 Construction activities on the 6.9 kV NPSS have been completed.

2.2 The 6.9 kV NPSS instrumentation are calibrated and are operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the 6.9 kV NPSS are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 All 6.9 kV feeders and buses have been voltage tested with acceptable results.

2.6 The 6.9 kV power is available from the following:

2.6.1 Normal auxiliary transformer.

2.6.2 Respective SBODG.

2.7 Switch gear assembly, breakers, and control and protective equipment and circuits have been inspected and tested and are capable of being placed into service.

3.0 TEST METHOD

3.1 Demonstrate the functionality of the switchgear and load center feeder circuit breakers locally and remotely.

3.2 Demonstrate the functionality of the bus interlocks, alarms and protective relays.

3.3 Verify the operation of indication and automatic responses.

3.4 Verify the 6.9kV buses can be energized from the normal auxiliary transformer, and the respective SBODG.

4.0 DATA REQUIRED

4.1 Values at which alarms, interlocks, and protective relays occur.

5.0 ACCEPTANCE CRITERIA

5.1 The 6.9 kV NPSS supplies the loads as described in Section 8.3.1.

14.2.12.10.13 480 V Normal Power Supply System (Test #120)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the 480 V normal power supply system (NPSS).

2.0 PREREQUISITES

2.1 Construction activities on the 480 V NPSS have been completed.

2.2 480 V NPSS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the 480 V NPSS are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Buses and equipment have been meggered with acceptable results.

2.6 Equipment has been visually inspected.

2.7 The 13.8 kV and 6.9 kV NPSS is available.

3.0 TEST METHOD

3.1 Demonstrate the functionality of the 480 Vac source and feeder circuit breakers locally and remotely, as applicable.

3.2 Demonstrate the functionality of the bus interlocks alarms and protective relays.

3.3 Verify the operation of indication and automatic responses.

3.4 Perform energization of 480 V NPSS.

4.0 DATA REQUIRED

4.1 Values at which alarms, interlocks, and protective relays occur.

5.0 ACCEPTANCE CRITERIA

5.1 The 480 V NPSS operates as designed (refer to Section 8.3.1).

14.2.12.10.14 12-Hour Uninterruptible Power Supply (Test #123)

1.0 OBJECTIVE

1.1 To demonstrate the 12-hour uninterruptible power supply system (12UPS) supply power as designed in required operating modes.

2.0 PREREQUISITES

2.1 Construction activities on the 12UPS have been completed.

2.2 12UPS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the12UPS are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 12UPS batteries are fully charged.

2.6 Load banks are available for discharge test.

2.7 Operation of breakers and cables has been verified.

2.8 Ventilation systems are in operation, as needed.

2.9 Megger and perform visual inspection of buses and associated components.

3.0 TEST METHOD

3.1 Demonstrate that the 12UPS batteries and battery chargers meet design capacities by performing discharge and charging tests.

3.2 Verify that minimum bank and individual cell limits are not exceeded during battery discharge test.

3.3 Verify that operation of the inverters, manual transfer switches, and frequency synchronization meets design requirements.

3.4 Verify operation of the 12UPS inverters as follows:

a. Verify operation of each 12UPS inverter with the respective UPS battery charger removed from service.

b. Verify each 12UPS inverter static bypass switch forward and reverse transfer operation.

3.5 Place each battery charger in equalize mode and verify battery charger, battery, and inverter performance meets design requirements.

3.6 Verify that operation of protective devices, controls, interlocks, alarms, computer inputs, and ground detection meet design requirements.

3.7 Verify that operation of the vital instrumentation and control power status information subsystem meets design requirements.

3.8 Verify operation of the AC/DC and DC/DC converter output to the I&C cabinets by alternately removing power and verifying continued power to the I&C cabinet from the converter remaining in operation.

3.9 Demonstrate that the batteries and battery charger meet design capacities by performing discharge and charging tests as follows:

3.9.1 Perform battery modified performance discharge or service test per IEEE Standard 450-2002 as endorsed by RG 1.129 with exceptions.

3.9.2 Perform battery charger capacity test to verify battery charger output meets design criteria.

4.0 DATA REQUIRED

4.1 Charger float voltage and current.

4.2 Test discharge recordings of battery terminal voltage, current, temperature, capacity in ampere hours, and individual cell voltages.

4.3 Inverter voltage, frequency, and current.

4.4 Values at which alarms, interlocks, and controls occur.

4.5 System status information subsystem indications.

4.6 Capacity of the 12UPS batteries.

5.0 ACCEPTANCE CRITERIA

5.1 The 12UPS supplies the loads as designed (refer to Section 8.3.2).

14.2.12.11 I&C Systems

14.2.12.11.1 Safety Information and Control System (Test #124)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the safety-related monitoring and control functions of the safety information and control system (SICS), including the requirements of Regulatory Guide 1.97 type A, B, and C variable. (This test should be performed in coordination with safe shutdown, the safety automation system, and the protection system, where applicable.)

2.0 PREREQUISITES

2.1 The instrumentation that provides inputs to the SICS has been calibrated and is operating satisfactorily prior to performing the following test.

2.1.1 Signal conditioning and distribution system (SCDS).

2.1.2 Diverse actuation system (DAS).

2.1.3 Protection system (PS).

2.1.4 Safety automation system (SAS).

2.1.5 Priority and actuator control system (PACS).

2.2 Programming and diagnostic testing is complete.

2.3 Support systems required for testing SICS are installed and have successfully completed initial testing.

3.0 TEST METHOD

3.1 Energize power supplies and verify operation.

3.2 Activate manual trips and monitor operation.

3.3 Activate ESF actuations and monitor operation.

3.4 Simulate safe shutdown scenarios and observe appropriate alarms and indications.

3.5 Exercise the transfer of control functions to SICS from PICS.

3.6 Exercise manual control of individual components required in the Chapter 15 analysis.

3.7 Verify the SICS control signals override lower priority signals where appropriate.

3.8 Verify permissive and interlocks can be manually controlled.

3.9 Verify monitoring and control of safety-related auxiliary support systems required to mitigate Chapter 15 events and recovery.

3.10 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing from service (i.e., loss of power conditions) SICS divisions and determining which functions are lost on the energized PS division and which overall SICS functions are lost. Repeat test for all SICS divisions.

4.0 DATA REQUIRED

4.1 Power supply voltages.

4.2 Circuit breaker and indicator operation.

4.3 Safety parameter trends during testing.

4.4 Response time for manually initiated actions.

4.5 Reactor trip and actuation path response.

5.0 ACCEPTANCE CRITERIA

5.1 The SICS has been verified to be capable of control and monitoring of critical plant functions automatically and in response to manual signals.

5.2 The SICS commands have priority over PICS commands.

5.3 The response times meet those assumed in the safety analysis.

14.2.12.11.2 Seismic Monitoring System (Test #125)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the non-safety-related seismic monitoring system (SMS).

2.0 PREREQUISITES

2.1 Construction activities on the SMS have been completed.

2.2 Seismic instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Test instrumentation is available and calibrated.

2.4 Factory acceptance testing of the SMS is complete.

3.0 TEST METHOD

3.1 Verify functionality of internal calibration devices by recording calibration records on applicable sensors.

3.2 Verify system response to simulated seismic events by actuating the appropriate trigger units, recording accelerograph outputs, and playing back records for analysis.

3.3 Verify and calibrate systems alarms and indicators.

3.4 Verify that operation and installation of peak recording accelerographs meet design requirements.

3.5 Verify proper operation of alarm, control and indication functions.

3.6 Verify that the SMS system operates over the design range using actual or simulated signals.

3.7 Verify that the SMS system responds as designed to actual or simulated limiting malfunctions or failures.

3.8 Verify that the SMS system response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

3.9 Verify redundancy and electrical independence of the SMS design (internal and external battery power supplies).

4.0 DATA REQUIRED

4.1 Record sensor response to simulated seismic inputs.

5.0 ACCEPTANCE CRITERIA

5.1 The as-built location of the SMS equipment is as shown on the plant layout drawings.

5.2 The SMS system can compute the cumulative absolute velocity (CAV) and provide indication of the CAV.

5.3 The SMS has sufficient dynamic range.

5.4 The SMS has a sufficient bandwidth.

5.5 The SMS has a sufficient sampling rate.

5.6 The SMS has a sufficient trigger level.

5.7 The SMS backup battery has sufficient capacity to power its instruments for continuous operation as described in the equipment specification.

5.8 The SMS functions as described in Section 3.7.4.

14.2.12.11.3 Boron Concentration Measurement System (Test #126)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the safety-related boron concentration measurement system (BCMS). The system measures the nuclear cross-section of CVCS fluid and provides this information to the PS for calculation of the corresponding boron concentration.

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 The BCMS has been calibrated and is operating satisfactorily prior to performing the following test.

2.2 Support systems required for BCMS operation are complete and functional.

2.3 Verify that factory acceptance testing has been completed.

2.4 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Observe boron cross-section measurement indications using the built-in test features.

3.2 Formulate sample concentrations of 500 ppmB, 1000 ppmB, 1500 ppmB and 2000 ppmB using naturally occurring boron-10 isotopic enrichments.

3.3 Flush test samples through the associated BCMS piping while observing system response.

3.4 Formulate sample concentrations of 500 ppmB, 1000 ppmB, 1500 ppmB and 2000 ppmB using 37 percent enriched boron-10.

3.5 Flush the samples through the charging pump suction pipe while observing system response.

3.6 Verify that the BCMS system operates over the design range using actual or simulated signals.

3.7 Verify that the BCMS system responds as designed to actual or simulated limiting malfunctions or failures.

3.8 Verify that the BCMS system response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

3.9 Check electrical independence and redundancy of the BCMS power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Pulse rates and boron cross-section measurement output (boron concentration).

4.2 Alarm setpoints and actuation levels.

5.0 ACCEPTANCE CRITERIA

5.1 The BCMS equipment is installed in the locations shown on the plant layout drawings.

5.2 The BCMS provides input signals for the engineered safety feature function described in the equipment specification.

5.3 The Class 1E BCMS equipment receives power from its respective Class 1E division.

5.4 The BCMS functions as described in Sections 9.3.4.2.3.4 and 7.1.1.5.4.

5.5 Verify that BCMS safety-related components meet electrical independence and redundancy requirements.

14.2.12.11.4 Aeroball Measurement System (Test #127)

1.0 OBJECTIVE

1.1 To measure cable insulation resistance.

1.2 To verify proper amplifier operation.

1.3 To demonstrate proper operation of the non-safety-related counting table and the signal processing equipment.

2.0 PERQUISITES

2.1 Construction activities on the Aeroball measurement system (AMS), i.e. movable incore nuclear instrumentation system, are complete (Aeroball lances and vanadium balls do not need to be installed at this time).

2.2 AMS incore nuclear signal channel instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 External test equipment has been checked and calibrated.

2.4 Support systems required for operation of the AMS are functional.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Measure and record cabling insulation resistance.

3.2 Simulate AMS detector signals into the signal conditioning circuits using external test instrumentation.

3.3 Test each amplifier for as designed operation in accordance with the manufacturer instruction manual using internal test circuits.

3.4 Simulate variable inputs to the amplifier and record displayed values.

3.5 Verify that the AMS operates over the design range using actual or simulated signals.

4.0 DATA REQUIRED

4.1 Cabling insulation resistance readings.

4.2 Status and performance of the internal test circuits.

4.3 Values of simulated input and derived output signals for correlation purposes.

4.4 Satisfactory operation of AMS detectors.

5.0 ACCEPTANCE CRITERIA

5.1 The cable insulation resistance for the cables associated with the AMS are within specification.

5.2 Amplifiers associated with the AMS are operating properly.

5.3 The non-safety-related counting table and the signal processing equipment respond as designed to a test source.

5.4 The AMS nuclear signal channel cables and instrumentation function as described in Section 7.1.1.5.2.

14.2.12.11.5 Process Automation System (Test #128)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the non-safety-related process automation system (PAS) to monitor and control non-safety processes.

1.1.1 Automatic primary plant limitation functions.

1.1.2 Automatic operational functions, including:

- Equipment protection.
- Closed loop controls.

1.1.3 Manual control functions.

1.1.4 Processing of information for display, including:

- Type A-E post-accident monitoring (PAM) variables.
- Process system instrumentation.
- Alarms.

2.0 PREREQUISITES

2.1 Construction activities on the PAS have been completed.

2.2 Instrumentation that provides input signals to PAS has been calibrated and is functional for performance of the following test.

2.2.1 Signal conditioning and distribution system (SCDS).

2.2.2 PAS sensors and black boxes.

2.2.3 Priority and actuator control system (PACS) devices.

2.2.4 Actuators/black boxes.

2.2.5 Turbine generator instrumentation and control (TG I&C).

2.3 Support systems required for operation of the PAS are complete and functional.

2.3.1 SCDS.

2.3.2 PACS.

2.4 Test instrumentation is available and calibrated.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Demonstrate that operation of the PAS meets design requirements.

3.2 Verify that PAS operates over the design range using actual or simulated signals.

3.3 Verify that PAS responds as designed to actual or simulated limiting malfunctions or failures.

3.4 Verify redundancy and electrical independence of the PAS design.

4.0 DATA REQUIRED

4.1 Setpoints under which alarms and interlocks occur.

4.2 PAS functional data (input data and corresponding output).

5.0 ACCEPTANCE CRITERIA

5.1 The PAS provides the following operational I&C functions.

5.1.1 Automatic primary plant limitation functions.

5.1.2 Automatic operational functions, including:

- Equipment protection.
- Closed loop controls.

5.1.3 Manual control functions, as described in Sections 7.1.1.4.6 and 7.4.1.3.4.

5.1.4 Processing of information for display, including:

- Type A-E post-accident monitoring (PAM) variables.
- Process system instrumentation.
- Alarms.

14.2.12.11.6 Process Information and Control System (Test #129)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the non-safety-related process information and control system (PICS) to monitor and control plant processes.

2.0 PREREQUISITES

2.1 Construction activities on the PICS have been completed.

2.2 Support systems required for operation of the PICS are complete and functional.

2.2.1 Protection system (PS).

2.2.2 Safety automation system (SAS).

2.2.3 Reactor control, surveillance and limitation system (RCSL).

2.2.4 Turbine generator instrumentation and control (TG I&C).

2.2.5 Process automation system (PAS).

2.2.6 Remote shutdown station (RSS).

2.3 Test instrumentation is available and calibrated.

2.4 Verify that factory acceptance testing has been completed.

2.5 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Demonstrate that operation of the PICS meets design requirements.

3.2 Verify that the PICS operates over the design range using actual or simulated signals.

3.3 Verify that the PICS responds as designed to actual or simulated limiting malfunctions or failures.

3.4 Verify redundancy and electrical independence of the PICS design.

3.5 Verify full capability and independence of PICS operation at the MCR and RSS.

4.0 DATA REQUIRED

4.1 Setpoints under which alarms and interlocks occur.

4.2 PICS functional data (input data and corresponding output).

5.0 ACCEPTANCE CRITERIA

5.1 Each PICS operator interface that provides monitoring and control capabilities is enabled.

5.2 Each PICS operator interface that provides monitoring only capabilities is enabled and does not allow control capabilities.

5.3 The PICS provides monitoring and control of process systems.

5.4 The PICS provides the status of the automatic reactor trip and engineered safety features.

5.5 The PICS provides the manual reset of automatic reactor trip and engineered safety features.

5.6 The PICS provides manual component control of safety-related process systems via the PAS and the PACS.

5.7 The PICS provides safety parameter display system (SPDS) functions.

5.8 The PICS displays the Type A-E post-accident monitoring (PAM) variables.

5.9 The PICS provides monitoring and control of systems required to mitigate severe accidents.

5.10 The PICS displays bypassed and inoperable status of safety systems.

5.11 The PICS provides alarm management capability.

5.12 The PICS provides the capability to archive plant and other selected data.

5.13 The PICS provides the interface to external I&C computers.

5.14 The PICS provides an interface to external computers via a unidirectional firewall.

5.15 The PICS functions as described in Section 7.1.1.3.2.

14.2.12.11.7 Control Rod Drive Control System (Test #112)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the control rod drive control system (CRDCS).

1.2 To demonstrate electrical independence and redundancy of power supplies.

1.3 Verify operation of CRDCS to signals generated by the reactor control, surveillance and limitation (RCSL) system.

2.0 PREREQUISITES

2.1 Construction activities on the CRDCS have been completed.

2.2 The CRDCS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the CRDCS are completed and functional.

2.3.1 Protection system (PS).

2.3.2 Diverse actuation system (DAS).

2.3.3 RCSL system.

2.4 Test instrumentation is available and calibrated.

2.5 Applicable equipment has been visually inspected.

3.0 TEST METHOD

3.1 Demonstrate the functionality of the CRDCS trip contactors and control transistors.

3.2 Demonstrate the functionality of the bus interlocks alarms and protective features.

3.3 Verify the operation of indication and automatic responses.

3.4 Perform energization of CRDCS.

3.5 Check electrical independence and redundancy of power supplies for functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms, interlocks, and protective relays occur.

5.0 ACCEPTANCE CRITERIA

5.1 The CRDCS operates as designed (refer to Section 7.7).

5.2 Verify that components meet electrical independence and redundancy requirements.

14.2.12.11.8 Vibration Monitoring System (Test #131)

1.0 OBJECTIVE

1.1 To verify that the operation of the non-safety-related vibration monitoring system meets the design requirements.

1.2 To verify that the vibration monitoring setpoints are suitable for initial power operation.

2.0 PREREQUISITES

2.1 Construction activities on the vibration monitoring system are completed.

2.2 Sensors, cables, and conditioning electronics are installed and functional.

2.3 Power cabinets, test circuits, and amplifiers are ready to support testing.

2.4 Required test equipment is functional.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Verify the response of the vibration monitoring channels by simultaneously monitoring equipment operation with calibrated portable instrumentation.

3.2 Verify alarm functions.

3.3 Establish baseline data for a cold subcritical plant.

3.4 Establish alarm levels in a cold subcritical plant.

4.0 DATA REQUIRED

4.1 Baseline vibration data.

4.2 Alarm levels applicable to protect plant equipment.

5.0 ACCEPTANCE CRITERIA

5.1 The sensors of the vibration monitoring system are functioning properly.

- Accelerometers.

- Absolute displacement transducers.
- Relative displacement transducers.
- Pressure fluctuation transducers.
- Relative shaft displacement transducers.
- Absolute velocity transducer.

5.2 The signal conditioning equipment is operating properly.

5.3 The portions of the vibration monitoring system that provide data recording, data analysis, and alarm functions are operating satisfactorily.

5.4 The vibration monitoring system functions as described in Section 7.1.1.5.10.

14.2.12.11.9 Plant Fire Alarm System (Test #132)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the non-safety-related plant fire alarm system (PFAS) to detect the presence of fire, alert plant personnel, and perform designed function in protected areas.

2.0 PREREQUISITES

2.1 Construction activities associated with the portion of the PFAS have been completed.

2.2 PFAS instrumentation has been calibrated and is functional for performing the applicable tests.

2.3 Support system(s) required for operation of the PFAS.

2.4 Verify that factory acceptance testing has been completed.

2.5 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Demonstrate that operation of the PFAS is in accordance with the requirements of Chapter 10 of NFPA 72 (Reference 5).

3.2 Verify input devices and circuits annunciate and the corresponding output and control logic properly occurs as designed.

3.3 Verify circuit integrity and device operability under required circuit conditions.

3.4 Verify the input and output functions operability under loss of primary power source event.

3.5 Verify that notification circuits and appliances deliver the required audible and visual signaling levels required for the area.

3.6 Verify that the PFAS operates over the design range using simulated signals.

3.7 Verify that the PFAS responds as designed to simulated limiting malfunctions or failures.

3.8 Verify that the PFAS response meets the analysis assumptions, such as time response, accuracy, and control stability.

3.9 Verify redundancy and electrical independence of the PFAS design.

3.10 Verify that the plant fire alarm system can be manually actuated.

4.0 DATA REQUIRED

4.1 Set points under which alarms are activated and control outputs occur.

4.2 Fire alarm system circuit and device integrity meets design requirements.

4.3 Fire alarm system output functions occur as designed for each corresponding alarm input received.

4.4 All initiating, notification appliance, releasing, and control circuits and devices function as designed during loss of primary power source.

4.5 Notification devices meet design requirements for the given area.

5.0 ACCEPTANCE CRITERIA

5.1 The PFAS provides control and monitoring capability of the plant fire suppression and detection system.

5.2 The PFAS provides the plant operators with information displays and supports automatic and manual control of fire protection equipment where applicable.

5.3 The PFAS is provided with both an electrically supervised primary and secondary power source that will transfer automatically to the secondary power source upon loss of the primary power source. A trouble signal is provided upon loss of either power source to any local fire control panel or workstation.

5.4 The PFAS operates as designed (refer to Section 9.5.1.2.1).

14.2.12.11.10 Loose Parts Monitoring System (Test #133)

1.0 OBJECTIVE

1.1 To verify that operation of the non-safety-related loose parts monitoring system (LPMS) meets design requirements.

1.2 To verify that the loose parts setpoints are suitable for initial power operation.

2.0 PREREQUISITES

2.1 Construction activities on the loose parts monitoring system are completed.

2.2 Sensors, cables, and signal conditioning electronics are installed and functional.

2.3 Power cabinets, test circuits, and amplifiers are ready to support testing.

2.4 Required test equipment is functional.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Verify the response of the loose parts monitoring channels with a mechanical impulse type device.

3.2 Verify alarm functions using simulated signals.

3.3 Establish baseline monitoring data for a cold subcritical plant.

3.4 Establish the alarm level for loose parts monitoring channels in a cold subcritical plant.

3.5 Verify that the LPMS operates over the design range using actual or simulated signals.

3.6 Verify that the LPMS responds as designed to actual or simulated limiting malfunctions or failures.

Note: This alarm level shall apply to the preoperational test phase, to startup and, to power operations unless it is found to be unsuitable by subsequent equipment operation.

4.0 DATA REQUIRED

4.1 Baseline loose parts data.

4.2 Alarm levels applicable to detectable loose parts.

5.0 ACCEPTANCE CRITERIA

5.1 The accelerometers of the LPMS are operating properly.

5.2 The signal conditioning equipment of the LPMS is operating properly.

5.3 The equipment of the LPMS that provides data recording, data analysis, and alarming is operating properly.

5.4 The LPMS setpoints have been adjusted for initial power operation.

5.5 The LPMS functions as described in Section 7.1.1.5.9.

14.2.12.11.11 Turbine–Generator Instrumentation and Control System (Test #134)

1.0 OBJECTIVE

1.1 To verify the proper installation and operation of the non-safety-related turbine-generator instrumentation and control system (TG I&C).

2.0 PREREQUISITES

2.1 Construction activities on the TG I&C system are essentially complete and the applicable systems and components are ready for testing.

2.1.1 Process information and control system (PICS).

2.1.2 Protection system (PS).

2.1.3 Diverse actuation system (DAS).

2.2 Applicable operating manuals are available for developing detailed procedures.

2.3 Instrumentation that provide inputs to TG I&C has been calibrated and operating satisfactorily prior to performing the following test.

2.3.1 Reactor control, surveillance and limitation system (RCSL).

2.3.2 Process automation system (PAS).

2.4 TG I&C software is installed.

2.5 Plant systems required to support testing are functional to the extent necessary to perform the testing or suitable simulations are used.

2.6 Verify that factory acceptance testing has been completed.

2.7 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Verify input data and control paths from systems associated with the turbine-generator instrumentation and control system.

3.2 Simulate inputs and verify system responses and demand settings.

3.3 Verify that the operator interface allows turbine control to the following simulated signals as designed.

3.3.1 Manual operation.

3.3.2 Increasing load.

3.3.3 Decreasing load.

3.3.4 Latching turbine turning gear.

3.3.5 Unlatching turbine turning gear.

3.4 Verify that turbine-generator instrumentation responds as designed to the following simulated signals:

3.4.1 Turbine rpm.

3.4.2 Reactor trip.

3.4.3 Turbine trip.

3.4.4 Turbine alarms.

4.0 DATA REQUIRED

4.1 Input signals from associated systems.

4.2 Turbine-generator instrumentation and control system demand outputs in response to inputs.

4.3 Alarm and trip values.

5.0 ACCEPTANCE CRITERIA

5.1 The turbine-generator instrumentation and control system trip logic operates properly. Verify that the following valves respond as designed:

5.1.1 Main steam stop.

5.1.2 Reheat steam intercept.

5.1.3 Main steam control.

5.1.4 Reheat steam stop.

5.1.5 Extraction steam non-return.

5.2 The turbine-generator I&C system provides grid synchronization capability.

5.3 The turbine-generator I&C system startup and shutdown controls operate properly.

5.4 The controls for startup and shutdown of the turbine-generator auxiliaries operate properly.

5.5 The automatic and manual controls to preheat the turbines, to close the main output breaker and load the generator, to adjust generator load, to perform all normal test functions, and to unload the generator are operating properly.

5.6 The turbine-generator speed control is operating properly and control oscillations are self dampening.

5.7 The turbine-generator load control is operating properly and control oscillations are self dampening.

5.8 The primary and backup turbine overspeed trip devices are automatically tested and are operating properly.

5.9 The turbine-generator I&C system provides monitoring of thermal, hydraulic, and electrical parameters associated with the turbine generator and initiates a turbine trip for the conditions listed in Section 10.2.2.10.

5.10 The turbine-generator I&C system functions as described in Section 10.2.

14.2.12.11.12 Reactor Pressure Vessel Level Measurement System (Test #135)

1.0 OBJECTIVE

1.1 To verify the non-safety-related reactor pressure vessel level (RPVL) measurement system is capable of indicating vessel level.

2.0 PREREQUISITES

2.1 Construction activities on the RPVL measurement system have been completed.

2.2 The RPVL measurement system instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the RPVL measurement system are complete and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Demonstrate control logic and controls and response to reactor pressure vessel level changes.

3.2 Verify that the RPVL system operates over the design range using actual or simulated signals.

3.3 Verify that the RPVL system responds as designed to actual or simulated limiting malfunctions or failures.

3.4 Verify that the RPVL system response meets the design assumptions, such as time response, accuracy, and control stability.

3.5 Verify redundancy and electrical independence of the RPVL system design.

4.0 DATA REQUIRED

4.1 RPVL measurement system indication.

5.0 ACCEPTANCE CRITERIA

5.1 The RPVL measurement system provides reactor vessel water level measurement.

5.2 The RPVL measurement system response to simulated malfunctions and failures is as designed.

5.3 The RPVL measurement system functions as described in Section 7.1.1.5.7.

14.2.12.11.13 Fatigue Monitoring System (Test #136)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the non-safety-related fatigue monitoring system (FAMOS) to continuously collect and store temperatures and pressure readings of previously identified sensitive zones.

1.2 To verify recorded data consists of parameters such as temperature and pressure that are clearly identified.

2.0 PREREQUISITES

2.1 Construction activities on the FAMOS have been completed.

2.2 Support system(s) required for operation of the FAMOS is complete and functional.

2.3 FAMOS instrumentation is available and functional.

2.4 Special test instrumentation is available and calibrated, as required.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Demonstrate the operation of the FAMOS by verifying that the system is monitoring previously identified sensitive zones as designed.

3.2 Verify that FAMOS alarms occur when sensitive zone data triggers are initiated (may be necessary to simulate data to meet trigger values).

3.3 Verify that FAMOS alarms, indicating instruments, and status lights are functional.

4.0 DATA REQUIRED

4.1 FAMOS functional data (input data and corresponding output).

5.0 ACCEPTANCE CRITERIA

5.1 The FAMOS equipment is capable of measuring loading conditions on monitored plant equipment.

5.2 The FAMOS functions as described in Section 7.1.1.5.11.

14.2.12.11.14 Leak Detection System (Test #137)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the non-safety-related leak detection system.

1.2 To adjust the alarm setpoints under functional conditions.

1.3 To demonstrate automated calibration features.

2.0 PREREQUISITES

2.1 Construction activities on the LDS are complete.

2.2 Sensors, cables, and signal conditioning electronics are installed and functional.

2.3 Power cabinets, test circuits, and amplifiers are ready to support testing.

2.4 Required test equipment is functional.

2.5 Data analysis, storage, and trending software are functional for humidity methods.

2.6 Verify that factory acceptance testing has been completed.

2.7 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Verify the calibration and alarm setpoints using simulated signals to the humidity monitoring channels.

3.2 Verify alarm functions.

3.3 Establish baseline monitoring data under operating conditions for a cold, subcritical plant.

3.4 Verify the automated electronics calibration functions.

3.5 Verify the ability to detect leakage with design basis limits.

4.0 DATA REQUIRED

4.1 Baseline humidity data.

4.2 Alarm levels applicable to detection of coolant leaks.

5.0 ACCEPTANCE CRITERIA

5.1 The LDS provides condensate flow measurement capability.

5.2 The LDS provides temperature and humidity measurement capability of the containment environment.

5.3 The LDS provides local humidity detection for the main steam piping.

5.4 The alarm setpoints have been established.

5.5 The LDS functions as designed (refer to Sections 3.6.3.7, 5.2.5 and 7.1.1.5.12).

5.6 Verify that the LDS meets the regulatory requirements for leakage detection, refer to Regulatory Guide 1.45, Rev. 1.

14.2.12.11.15 Safety Automation System (Test #139)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the safety-related safety automation system (SAS) to perform the following automatic and selected manual control functions on safety-related processes:

1.1.1 During normal operations.

1.1.2 During abnormal operational occurrences.

1.1.3 Postulated accident mitigation.

1.1.4 Postulated post-accident mitigation operations.

2.0 PREREQUISITES

2.1 Construction activities on the SAS have been completed.

2.2 Signal conditioning and distribution system (SCDS) instrumentation has been calibrated and is functional for performance of this test.

2.3 Support systems required for operation of the SAS are complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control, and indication functions are available or performing this test.

3.0 TEST METHOD

3.1 Simulate SCDS sensor inputs over the instrument range and verify that SAS receives SCDS inputs.

3.2 Verify that SAS responds as designed over the design range using simulated signals from SCDS.

3.3 Verify that SAS responds as designed to actual or simulated limiting malfunctions or failures.

3.4 Verify redundancy and electrical independence of the SAS design.

3.5 Verify the functionality of the SAS self-test features by simulating SAS component failures and observing through human-machine interfaces that the self-test features identified the failure.

3.6 Verify both operating bypass, and maintenance bypass features, including, where applicable, observation that bypasses are cancelled automatically.

3.7 Test the SAS response to loss of power and subsequent power restoration as follows:

3.7.1 Simulate normal steady state full power conditions for the SAS.

3.7.2 Remove electrical power to one SAS division and verify all SAS outputs in that division are "zero."

3.7.3 Re-energize the SAS division and verify that all SAS outputs in that division are "zero" during the time that the SAS division computers perform their start up self test.

3.7.4 Upon completion of the startup self test, verify the SAS outputs return to their normal steady state full power condition.

3.7.5 Repeat test for all SAS divisions.

4.0 DATA REQUIRED

4.1 Setpoints under which alarms and interlocks occur.

4.2 SAS functional data (input data and corresponding output).

5.0 ACCEPTANCE CRITERIA

5.1 Monitoring and control of safety related automatic and manual functions after initiation through the Protection System.

5.2 Monitoring and control of essential auxiliary support systems.

5.3 Processing Type A-C PAM variables for display on the SICS.

5.4 Interlock functions respond as described in Section 7.8.

5.5 SAS equipment passes all applicable self tests.

5.6 The SAS outputs attain a predefined state upon loss and restoration of electrical power.

14.2.12.11.16 Remote Shutdown Station (Test #140)

1.0 OBJECTIVE

1.1 To verify proper operation of the remote shutdown station (RSS).

1.2 To determine transfer of control occurs and that the plant can be controlled and cooled down from the RSS.

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 All construction activities on the RSS have been completed.

2.2 The RSS instrumentation has been calibrated and is functional for performing the following test.

2.3 The communication systems between the MCR and RSS location have been demonstrated to be functional.

2.4 Verify that factory acceptance testing has been completed.

2.5 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Simulate signals to verify that operation of RSS instrumentation meets design requirements.

3.2 Perform a full transfer of control from the MCR during the performance of the HFT.

3.3 Perform a controlled cooldown from the remote shutdown panel during the performance of the HFT.

3.4 Verify that the RSS operates over the design range using actual or simulated signals.

3.5 Verify that the RSS responds as designed to actual or simulated limiting malfunctions or failures.

3.6 Verify that the RSS response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

3.7 Verify redundancy and electrical independence of the RSS.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 RCS temperatures and pressures.

5.0 ACCEPTANCE CRITERIA

5.1 The ability to cooldown using remote shutdown instrumentation and controls has been demonstrated.

5.2 The RSS transfer switches provide the capability to transfer control from the Main Control Room (MCR) to the RSS.

5.3 Electrical isolation is provided between MCR and RSS controls.

5.4 Verify that safety-related components meet electrical independence and redundancy requirements.

5.5 The RSS functions as described in Sections 6.4.2, 7.4.1, and 7.4.2.

14.2.12.11.17 Incore Instrumentation System (Test #141)

1.0 OBJECTIVE

1.1 To measure fixed incore cable insulation resistance.

1.2 To verify proper amplifier operation.

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the incore instrumentation system are complete. However, detectors (instrument lances) do not need to be installed.

2.2 Fixed incore nuclear signal channel instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Special test instrumentation has been calibrated, as applicable.

2.4 Incore instrumentation system support systems are functional.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Measure and record cabling insulation resistance.

3.2 Simulate incore signals into the signal conditioning circuits using external test instrumentation.

3.3 Test each amplifier for as designed operation in accordance with the manufacturer instruction manual using the internal test circuits.

3.4 Simulate variable inputs to the amplifier and record its output values.

3.5 Verify that the incore instrumentation system operates over the design range using actual or simulated signals.

3.6 Verify that the incore instrumentation system responds as designed to actual or simulated limiting malfunctions or failures.

3.7 Verify that the incore instrumentation system response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

3.8 Verify redundancy and electrical independence of the incore design.

3.9 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Cabling insulation resistance readings.

4.2 Status and performance of the internal test circuits.

4.3 Values of simulated input and derived output signals for correlation purposes.

5.0 ACCEPTANCE CRITERIA

5.1 The incore instrumentation is arranged as shown on the plant layout drawings. Reference Figure 4.4-8 for additional information.

5.2 The self-powered neutron detectors generate neutron flux measurement signals as input to the protection system using simulated signals.

5.3 The core outlet thermocouples generate core outlet temperature measurement signals as input to the safety automation system using simulated signals.

5.4 Verify that safety-related components meet electrical independence and redundancy requirements.

5.5 The incore instrumentation cables and instrumentation function as described in Section 7.1.1.5.2.

14.2.12.11.18 Excore Instrumentation System (Test #142)

1.0 OBJECTIVE

1.1 To verify the proper functional performance of the safety-related excore instrumentation system.

1.2 To verify the proper performance of audio and visual indicators.

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the excore instrumentation system have been completed.

2.2 Excore instrumentation system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 External test equipment has been calibrated and is functional.

2.4 Support systems required for operation of the excore instrumentation system are functional.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Simulate and vary input signals to the startup, safety, and control channels of the excore instrumentation system using appropriate test instrumentation.

3.2 Monitor and record output signals as a function of variable inputs provided by test instrumentation.

3.3 Record the performance of audio and visual indicators in response to changing input signals.

3.4 Verify that the excore instrumentation system operates over the design range using actual or simulated signals.

3.5 Verify that the excore system responds as designed to actual or simulated limiting malfunctions or failures.

3.6 Verify that the excore system response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

3.7 Verify redundancy and electrical independence of the excore design.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Values of input and output signals for correlation purposes, as required.

4.2 Values of output signals triggering audio and visual alarms.

5.0 ACCEPTANCE CRITERIA

5.1 The excore instrumentation is arranged as illustrated on the plant layout drawings. Reference Figure 7.1-15 for additional information.

5.2 The intermediate range and power range detectors generate neutron flux measurement signals as inputs to the protection system using simulated signals.

5.3 The excore instrumentation receives power from its respective Class 1E division.

5.4 Verify that safety-related components meet electrical independence and redundancy requirements.

5.5 The excore instrumentation system functions as described in Section 7.1.1.5.3.

14.2.12.11.19 Radiation Monitoring System (Test #143)

1.0 OBJECTIVE

1.1 To verify the functional performance of the airborne radiation monitoring system.

1.2 To verify the functional performance of the area radiation monitoring system.

1.3 To verify high radiation activity generates appropriate PS isolation signals.

1.4 To verify that the common radiation monitor features (alarms, displays, operator interfaces, etc.) adequately communicate between the various radiations monitors· described in Table 12.3-3 and Table 12.3-4.

1.5 To verify that radiation monitors initiate Automatic Control Functions upon detecting high activity levels.

2.0 PREREQUISITES

2.1 Construction activities on the radiation monitoring system have been completed with all radiation monitors positioned per Table 12.3-3, Table 12.3-4, and Table 11.5-1.

2.2 Radiation monitoring system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the radiation monitoring system are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Calibration check source is available, as required.

2.6 Verify that factory acceptance testing has been completed.

2.7 Verify proper operation of alarm setpoints, operation, control, and indication functions.

2.8 Verify that upon loss and restoration of electrical power to each area radiation monitor division, as described in Table 12.3-3 and Table 12.3-4, that the area radiation monitoring system outputs attain a predefined state.

3.0 TEST METHOD

3.1 Verify the operation of the radiation monitor (refer to Table 11.5-1) using a check source and external test equipment, as applicable.

3.2 Check the self-testing feature of the radiation monitor, as applicable.

3.3 Compare local and remote indications.

3.4 Verify as-designed local and remote alarm actuations, as applicable.

3.5 Initiate a high radiation signal to the MCR air intake (refer to Table 11.5-1, Monitors R-29 and R-30), main steam line (refer to Table 11.5-1, Monitors R-55 through R-58), and containment high range radiation monitors (refer to Table 12.3-3) to verify that control actuations meet design requirements. The source of initiation of the signal, listed in order of preference, should be one of the following:

3.5.1 Internal check source (verify that check source strength is capable of generating desired control actuations).

3.5.2 Radiation calibration check source (verify that check source does not generate a personnel hazard during the test).

3.5.3 Simulated high radiation signal at the radiation detector.

3.6 Verify that the radiation monitoring system operates over the design range using actual or simulated signals.

3.7 Verify that the radiation monitoring system responds as designed to actual or simulated limiting malfunctions or failures.

3.8 Verify that the radiation monitoring system response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

3.9 Verify redundancy and electrical independence of the radiation monitoring system design.

3.9.1 Check electrical independence and redundancy of power supplies for safety- related functions by selectively removing from service (i.e., loss of power condition) area radiation monitoring divisions and determining which functions are lost on the energized area radiation monitoring division and which overall functions are lost. Repeat test for all area radiation monitoring divisions.

3.10 Verify the functionality of the self-test features by simulating area radiation monitoring component failures and observing through human-machine interfaces that the self-test features identified the failure.

3.11 Confirm that Automatic Control Functions (refer to Table 12.3-3, Reactor Building Area Radiation Monitors "Containment Stage 1 Isolation" and Table 12.3-4) initiate upon detecting high activity levels.

Note: Response time of actuated components is to be determined from a single test using the check source specified in Table 12.3-3 and Table 12.3-4 that is specified for each radiation monitor until travel is completed for each actuated component impacted by the radiation monitor signal.

3.11.1 Initiate a high radiation signal to each radiation monitor to measure the response time for each actuated component from the time that the radiation monitor reaches the control setpoint until the actuated component has traveled to the designated position.

4.0 DATA REQUIRED

4.1 Radiation monitor response to a check source, as applicable.

4.2 Technical data associated with the source.

4.3 Local and remote responses to test signals, as applicable.

4.4 Signals levels necessary to cause alarm actuation.

4.5 Signal levels necessary to initiate Automatic Control Functions.

5.0 ACCEPTANCE CRITERIA

5.1 The airborne and area radiation monitors function as described in Sections 7.1.1.5.5, 7.3.1, 7.5.1, and 12.3.4. The airborne and area radiation monitors are listed in Table 11.5-1, Table 12.3-4, and Table 12.3-3.

5.2 The radiation monitoring system (containment building ventilation system - internal filtration subsystem) meets design requirements for RCS leak detection required to demonstrate compliance with Technical Specification Chapter 16, LCO 3.4.14 (refer to Section 11.5.4.8, 11.5.3.1.4, and Table 11.5-1, Footnote 16 for Monitor R-10).

5.3 Electrical independence and redundancy requirements are met.

5.4 The radiation monitoring outputs attain a predefined state upon loss and restoration of electrical power.

5.5 Radiation monitoring instrumentation meets design requirements to monitor radiation and initiate Automatic Control Functions (refer toTable 12.3-3 and Table 12.3-4, Reactor Building Area Radiation Monitors "Containment Stage 1 Isolation") upon detection of high activity levels.

14.2.12.11.20 Process and Effluent Radiological Monitoring System (Test #144)

1.0 OBJECTIVE

1.1 To verify that the process and effluent radiological monitoring system can detect and record specific radiation levels, and to verify alarms and interlocks.

1.2 To verify that radiation monitors respond as designed to check sources.

1.3 To verify that radiation sample points provide representative samples of the process and effluent radiological monitoring system.

1.4 To verify that the common radiation monitor features (alarms, displays, operator interfaces, etc.) adequately communicate between the various radiations monitors described in Table 11.5-1.

2.0 PREREQUISITES

2.1 Construction activities on the process and effluent radiological monitoring system have been completed.

2.2 Process and effluent radiological monitoring system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the process and effluent radiological monitoring system is completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Calibration check sources are available in appropriate forms (gaseous, solutions, or plated sources) for the analyses referenced in Table 11.5-1.

2.6 Verify that factory acceptance testing has been completed.

2.7 Verify proper operation of alarm, control, and indication functions.

2.8 Verify that the preoperational tests that test the various radiation monitors described in Table 11.5-1, other than R-50 and R-61, have been performed satisfactorily.

2.9 Verify that upon loss and restoration of electrical power to each radiation monitor division, as described in Table 11.5-1, that the radiation monitoring system outputs attain a predefined state.

3.0 TEST METHOD

3.1 Verify calibration and operation of the monitor using a check source and external test equipment, as necessary.

3.2 Verify operation of radiation monitors using check sources (refer to Table 11.5-1, Radiation Measuring Point R-50) and external test equipment, as necessary:

3.2.1 Check the self-testing features of radiation monitors.

3.2.2 Record the response of radiation monitors to check sources.

3.2.3 Initiate a high radiation signal to each radiation monitor to verify monitor response (alarm actuations) meets design requirements.

3.2.4 Record alarm actuations at local and remote locations, as appropriate.

3.3 Verify that sample points (refer to Table 11.5-1, Radiation Measuring Points R-50 and R-61) are capable of collecting representative samples.

3.4 Verify the response of common radiation monitor alarms and displays of radiation monitors described in Table 11.5-1.

3.5 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing from service (i.e., loss of power condition) radiation monitor divisions and determining which functions are lost on the energized radiation monitor division and which overall functions are lost. Repeat test for all radiation monitor divisions.

3.6 Verify the functionality of the self-test features by simulating radiation monitoring component failures and observing through human-machine interfaces that the self-test features identified the failure.

4.0 DATA REQUIRED

4.1 The monitor response to check source, as necessary.

4.2 Technical data associated with the source.

4.3 Signal levels necessary to cause alarm actuation.

4.4 Radiation monitor response to check source.

4.5 Technical data associated with check source.

4.6 Signal levels necessary to initiate alarm actuation.

5.0 ACCEPTANCE CRITERIA

5.1 Radiation monitoring instrumentation meets design requirements to monitor radiation and respond as designed to radiation sources (refer to Table 11.5-1, Radiation Measuring Point R-50). This includes, but is not limited to, the following that could adversely impact the ability to measure the parameters described in Table 11.5-1:

5.1.1 Range.

5.1.2 Response time.

5.1.3 Sensitivity.

5.2 Radiation sample points (refer to Table 11.5-1, Radiation Measuring Points R-50 and R-61) are capable of collecting the required samples.

5.3 Electrical independence and redundancy requirements are met.

5.4 The radiation monitoring outputs attain a predefined state upon loss and restoration of electrical power.

14.2.12.11.21 Hydrogen Monitoring System (Test #145)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the non-safety related hydrogen monitoring system (HMS).

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the hydrogen monitoring system have been completed.

2.2 Hydrogen monitoring instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Electrical power systems required for the hydrogen monitoring system are available.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify hydrogen monitoring system logic and indication.

3.2 Verify hydrogen monitoring system response to sample hydrogen concentrations.

3.3 Verify that the hydrogen monitoring system operates over the design range using actual or simulated signals.

3.4 Verify that the hydrogen monitoring system responds as designed to actual or simulated limiting malfunctions or failures.

3.5 Verify that the hydrogen monitoring system response meets the accident analysis assumptions, such as time response, and accuracy.

3.6 Verify redundancy and electrical independence of the hydrogen monitoring system design.

3.7 Check electrical independence and redundancy of power supplies by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Response to hydrogen samples.

5.0 ACCEPTANCE CRITERIA

5.1 The low range HMS consists of hydrogen sensors arranged in the following containment areas: upper dome, upper pressurizer compartment, upper steam generator compartments 1/2 and 3/4, annular rooms.

5.2 The low range HMS signal processing units are located in Safeguard Buildings 1 and 4, and are powered from the Class 1E electrical power supplies.

5.3 Deleted.

5.4 The HMS functions as described in Section 6.2.5.

14.2.12.11.22 Protection System (Test #146)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the safety-related protection system (PS).

1.2 To verify the PS response times.

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

1.4 Verify operation of PS interlocks.

1.5 Verify that upon loss and restoration of electrical power to each PS division, the PS outputs attain a predefined state.

1.6 Verify the receipt of plant signals (sensors/black boxes) from the signal conditioning and distribution system (SCDS).

1.7 Verify the output of PS signals to the following:

1.7.1 Reactor trip breakers (RTB).

1.7.2 Control rod drive control system (CRDCS) trip contactors.

1.7.3 Turbine-generator instrumentation and control (TG I&C).

1.7.4 Priority and actuator control system (PACS).

2.0 PREREQUISITES

2.1 Construction activities on the following are complete:

2.1.1 Reactor trip breakers.

2.1.2 Reactor trip contactors.

2.1.3 Safety conditioning and distribution system (SCDS).

2.1.4 Priority and actuator control system (PACS).

2.2 SCDS instrumentation (sensors and black boxes) have been calibrated and are operating satisfactorily prior to performing the following test.

2.3 External test instrumentation is available and calibrated.

2.4 Factory acceptance testing has been completed.

2.5 Support systems required for PS operation are functional and the plant is configured so that equipment damage or personnel injury will not occur. For example, pump breakers racked to test to prevent inadvertent pump start, or pump motors uncoupled:

2.5.1 Reactor trip circuit breakers.

2.5.2 Reactor trip contactors.

2.5.3 Manual reactor trip (RT) controls on SICS.

2.5.4 Engineered Safety Features systems components are energized and positioned in a manner to respond to a PS actuation signal to the PACS modules.

2.5.5 The TG I&C system is capable of providing a turbine signal response to a PS signal.

2.5.6 The CRDCS trip contactors are capable of responding to a PS signal.

2.5.7 The PS is receiving signals from the SCDS.

3.0 TEST METHOD

3.1 Energize power supplies and verify power supply output voltage.

3.2 Simulate combinations of the actuation voting trip logic for each of the actuation signals and observe actuation and associated alarms.

3.3 Simulate PS inputs from SCDS described in Section 7.2 that would generate a reactor trip signal and trip each reactor trip breaker. Observe reactor trip breaker operation.

3.4 Simulate PS inputs described in Section 7.2 that would generate a reactor trip signal and trip each reactor trip contactor. Observe reactor trip contactor operation.

3.5 Initiate a manual reactor trip from SICS and observe the following:

3.5.1 Reactor trip breaker operation.

3.5.2 Reactor trip contactor operation.

3.5.3 CRDM operating coil transistor discharge in response to PS signal to the CRDCS.

3.5.4 TG I&C turbine trip signal in response to a reactor trip.

3.6 Simulate SCDS inputs described in Section 7.3 that would generate an ESF actuation output. Observe ESF actuators response.

3.7 Initiate each manual ESF actuation from SICS while observing ESF actuator response.

3.8 Verify both operating bypass and maintenance bypass features, including, where applicable, observation that bypasses are cancelled automatically.

3.9 Inject signals into appropriate sensors or sensor terminals and measure the elapsed time to achieve actuation of the field device (e.g., breaker, contactor). Trip or actuation paths may be tested in several segments.

3.10 Observe protection system operation over the design range using actual or simulated input signals to the SCDS.

3.11 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing from service (i.e., loss of power condition) PS divisions and determining which functions are lost on the energized PS division and which overall PS functions are lost. Repeat test for all PS divisions.

3.12 Verify operation of PS interlocks described in Section 7.6 using actual or simulated inputs and verify corresponding interlock function.

3.13 Test the PS response to loss of power and subsequent power restoration as follows:

3.13.1 Simulate normal steady state full power conditions for the PS and verify all PS RT outputs are "one" and all PS ESFAS outputs are "zero."

3.13.2 Remove electrical power to one PS division and verify all PS outputs in that division are "zero."

3.13.3 Re-energize the PS division and verify that all PS outputs in that division are "zero" during the time that the PS division computers perform their start up self test.

3.13.4 Upon completion of the startup self test, verify the PS RT outputs attain "one" and the PS ESFAS outputs attain "zero" for the division under test.

3.13.5 Repeat test for all PS divisions.

3.14 Verify the functionality of the PS self-test features by simulating PS component failures and observing through human-machine interfaces that the self-test features identified the failure.

4.0 DATA REQUIRED

4.1 Power supply voltages.

4.2 Circuit breaker and indicator operational data.

4.3 PS functional logic diagrams.

4.4 PS activation values.

4.5 Reset margin and rate of setpoint change of variable setpoints.

4.6 Maximum and minimum values of variable setpoints.

4.7 PS response times described in the safety analyses.

4.8 ESF system actuator operational data.

5.0 ACCEPTANCE CRITERIA

5.1 The PS generates automatic RT signals.

5.2 The PS generates automatically actuated engineered safety feature signals.

5.3 The PS provides the correct operating bypasses for reactor trip functions.

5.4 The PS provides the correct operating bypasses for the engineered safety features.

5.5 Operating bypasses are automatically removed when required.

5.6 Manual actuation of reactor trip and engineering safety features occurs when initiated.

5.7 The PS provides outputs to the following:

5.7.1 PAS.

5.7.2 SAS.

5.7.3 PACS.

5.7.4 TG I&C.

5.7.5 CRDCS.

5.7.6 Reactor trip circuit breakers.

5.8 The total response time of each PS trip or actuation path is verified to be conservative with respect to the times used in the safety analysis.

5.9 Electrical independence and redundancy requirements are met.

5.10 The PS functions as described in Sections 7.1.1.4.1, 7.2, 7.3, and 7.6.

5.11 The PS outputs attain a predefined state upon loss and restoration of electrical power.

5.12 PS equipment passes all applicable self tests.

14.2.12.11.23 Reactor Control, Surveillance and Limitation System (Test #147)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the non-safety-related reactor control, surveillance and limitation system (RCSL).

1.2 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the RCSL have been completed.

2.2 RCSL software is installed and instrumentation that provides RCSL input and control signals has been calibrated and is operating satisfactorily. External test equipment has been calibrated and is functional.

2.3 Support systems required for operation of the RCSL are functional.

2.4 Cabling has been completed between the RCSL and interface equipment.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Simulate inputs to the RCSL; observe receipt of these signals at the RCSL and system response.

3.2 Verify that the RCSL operates over the design range using actual or simulated signals.

3.3 Verify that the RCSL responds as designed to actual or simulated limiting malfunctions or failures.

3.4 Verify that the RCSL response meets design bases assumptions.

3.5 Verify redundancy and electrical independence of the non-safety RCSL design.

4.0 DATA REQUIRED

4.1 Input signal values.

4.2 RCSL output.

5.0 ACCEPTANCE CRITERIA

5.1 Verify that preliminary control setpoints have been established for the following:

5.1.1 RCCA withdrawal limits.

5.1.2 Full power target axial offset (AO).

5.1.3 Positive and negative AO bands about the target AO.

5.1.4 Power ramp rate limits.

5.1.5 Limits with respect to approaching heat flux control limits.

5.2 The RCSL responds as designed to simulated inputs (AO, SPNDs, reactor power, etc.).

5.3 The RCSL functions as described in Section 7.1.1.4.5.

14.2.12.11.24 Diverse Actuation System (Test #157)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the non-safety-related diverse actuation system (DAS) to monitor and control non-safety processes using sensor and black box inputs from the signal conditioning and distribution system (SCDS).

1.1.1 Automatic risk reduction functions, including:

- Mitigation of ATWS.
- Mitigation of SBO.
- Mitigation of other risk significant events.

1.2 To demonstrate that DAS generated reactor trip signals to reactor trip breakers (RTB) function as designed.

1.3 To demonstrate that risk mitigation DAS functions to the following function as designed.

1.3.1 Control rod drive control system (CRDCS).

1.3.2 Turbine generator instrumentation and controls (TG I&C).

1.3.3 Priority and actuator control system (PACS).

2.0 PREREQUISITES

2.1 Construction activities on the DAS have been completed.

2.2 SCDS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support system(s) required for operation of the DAS is complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Demonstrate that operation of the DAS meets design requirements.

3.2 Verify that DAS operates over the design range using actual or simulated signals from the SCDS.

3.3 Verify that DAS responds as designed to actual or simulated limiting malfunctions or failures.

3.4 Verify redundancy and electrical independence of the DAS design.

3.5 Verify that DAS meets design requirements for diverse reactor trip system (without Protection system inputs or outputs).

4.0 DATA REQUIRED

4.1 Setpoints under which alarms and interlocks occur.

4.2 DAS functional data (input data and corresponding output).

5.0 ACCEPTANCE CRITERIA

5.1 The DAS provides the following operational I&C functions.

5.1.1 Automatic risk reduction functions, including:

- Mitigation of ATWS and software common cause failure, as described in Sections 7.1.3.6.27 and 7.8.2.1.3.
- Mitigation of SBO, as described in Section 7.4.1.4.
- Mitigation of other risk significant events, as described in Section 7.4.2.2.1.

5.2 DAS generates signals for the following automatic actuation of the functions described in the software design specification:

5.2.1 RTB.

5.2.2 CRDCS.

5.2.3 TG I&C.

5.2.4 PACS.

5.3 The DAS generates independent reactor trip signals in response to simulated inputs.

5.4 The DAS functions as described in Section 7.8.1.2.1.

14.2.12.11.25 Rod Position Measurement System (Test #158)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the rod position measurement system (RPMS) input signals:

1.1.1 Primary and main secondary coils which indicate rod position over the entire range of rod travel.

1.1.2 Auxiliary secondary coils (two coils) which indicate rod position at its lowest or highest rod end position.

1.1.3 CRDM temperature.

1.2 To demonstrate the independence and redundancy of safety-related power supplies.

1.3 Verify that upon loss and restoration of electrical power to each RPMS division, the RPMS outputs attain a predefined state.

1.4 Verify the output of RPMS signals to the following:

1.4.1 Signal conditioning and distribution system (SCDS).

1.4.2 Process automation system (PAS).

2.0 PREREQUISITES

2.1 Construction activities on the following are complete:

2.1.1 Safety conditioning and distribution system (SCDS).

2.1.2 Process automation system (PAS).

2.1.3 Control rod drive mechanisms (CRDM).

2.2 External test instrumentation is available and calibrated.

2.3 Factory acceptance testing has been completed on the RPMS.

2.4 Support systems required for RPMS operation are functional and the plant is configured so that equipment damage or personnel injury will not occur.

2.4.1 Reactor trip breakers.

2.4.2 Reactor trip contactors.

2.4.3 Manual reactor trip (RT) controls on SICS.

2.4.4 The CRDCS trip contactors are capable of responding to a PS signal.

2.4.5 The PS is receiving signals from the SCDS.

2.4.6 Fuel or suitable dummy assemblies have been installed in the reactor vessel.

2.4.7 RCCAs have been installed at the proper locations.

2.4.8 Upper internals have been installed and RCCA drive shafts have been latched.

2.4.9 The reactor head has been installed and tensioned.

2.4.10 The reactor coolant system (RCS) has been filled, vented, and pressurized.

2.5 Verify that adequate shutdown margin exists to perform rod drop testing. If there are restrictions on number of RCCAs that can be withdrawn at any time ensure that Operations are aware of the restrictions and that adequate administrative controls have been established to preclude violation of shutdown margin limits.

3.0 TEST METHOD

3.1 Energize RPMS power supplies and verify power supply output voltage.

3.2 Simulate RPMS inputs from secondary coils described in Section 7.1.1.5.4 and Figure 7.1-25that would generate a rod position signal and verify output signal to SCDS. Observe rod position indication.

3.3 Verify reactor trip breakers open and CRDM coils deenergized.

3.4 With primary and secondary coils energized observe the following:

3.4.1 Auxiliary coil corresponding to lowest RCCA position indicates that each corresponding RCCA is fully inserted.

3.4.2 Auxiliary coil corresponding to highest RCCA position indicates that each corresponding RCCA is not fully withdrawn.

3.4.3 Main secondary coil that indicates entire range of RCCA travel for each corresponding RCCA indicates that the RCCA is fully inserted.

3.5 Close the reactor trip breakers, select each bank of RCCAs one at a time and verify that the CRDMs can step the corresponding RCCAs from the fully inserted position to a position where the following indications are observed (repeat for each bank of RCCAs):

3.5.1 Auxiliary coil corresponding to lowest RCCA position indicates that each corresponding RCCA is no longer fully inserted.

3.5.2 Auxiliary coil corresponding to highest RCCA position indicates that each corresponding RCCA is not fully withdrawn.

3.5.3 Main secondary coil that indicates entire range of RCCA travel for each corresponding RCCA indicates that the RCCA is no longer fully inserted.

3.6 Open the reactor trip breaker with one bank of RCCAs partially withdrawn and verify by the following indications that the RCCAs are fully inserted (repeat for each bank of RCCAs):

3.6.1 Auxiliary coil corresponding to lowest RCCA position indicates that each corresponding RCCA is fully inserted.

3.6.2 Auxiliary coil corresponding to highest RCCA position indicates that each corresponding RCCA is not fully withdrawn.

3.6.3 Main secondary coil that indicates entire range of RCCA travel for each corresponding RCCA indicates that the RCCA is fully inserted.

3.7 Close the reactor trip breakers, select each bank of RCCAs one at a time and verify that the CRDMs can step the corresponding RCCAs from the fully inserted position to a partially withdrawn position where the following indications are observed (repeat for each bank of RCCAs):

3.7.1 Auxiliary coil corresponding to lowest RCCA position indicates that each corresponding RCCA is no longer fully inserted.

3.7.2 Auxiliary coil corresponding to highest RCCA position indicates that each corresponding RCCA is not fully withdrawn.

3.7.3 Main secondary coil that indicates entire range of RCCA travel for each corresponding RCCA indicates that the RCCA is no longer fully inserted.

3.8 With one bank of RCCAs partially withdrawn insert the corresponding bank of RCCAs to the fully inserted position using the CRDMs and verify by the following indications that the RCCAs are fully inserted (repeat for each bank of RCCAs):

3.8.1 Auxiliary coil corresponding to lowest RCCA position indicates that each corresponding RCCA is fully inserted.

3.8.2 Auxiliary coil corresponding to highest RCCA position indicates that each corresponding RCCA is not fully withdrawn.

3.8.3 Main secondary coil that indicates entire range of RCCA travel for each corresponding RCCA indicates that the RCCA is fully inserted.

3.9 Close the reactor trip breakers, select each bank of RCCAs one at a time and verify that the CRDMs can step the corresponding RCCAs from the fully inserted position to a fully withdrawn position where the following indications are observed (repeat for each bank of RCCAs):

3.9.1 Auxiliary coil corresponding to lowest RCCA position indicates that each corresponding RCCA is no longer fully inserted.

3.9.2 Auxiliary coil corresponding to highest RCCA position indicates that each corresponding RCCA is fully withdrawn.

3.9.3 Main secondary coil that indicates entire range of RCCA travel for each corresponding RCCA indicates that the RCCA is fully withdrawn.

3.10 With one bank of RCCAs fully withdrawn insert the corresponding bank of RCCAs using the CRDMs to the fully inserted position and verify by the following indications that the RCCAs are fully inserted (repeat for each bank of RCCAs):

3.10.1 Auxiliary coil corresponding to lowest RCCA position indicates that each corresponding RCCA is fully inserted.

3.10.2 Auxiliary coil corresponding to highest RCCA position indicates that each corresponding RCCA is not fully withdrawn.

3.10.3 Main secondary coil that indicates entire range of RCCA travel for each corresponding RCCA indicates that the RCCA is fully inserted.

3.11 Check electrical independence and redundancy of power supplies for safety-related functions as follows:

3.11.1 Select each bank of RCCAs one at a time and verify that the CRDMs can step the corresponding RCCAs from the fully

inserted position to a partially withdrawn position (near the core mid-plane).

3.11.2 Electively removing from service (i.e., loss of power condition) RPMS divisions and determining which safety-related functions are lost on the energized RPMS division and which overall RPMS safety-related functions are lost.

3.11.3 Repeat test for all RPMS divisions.

3.12 Test the RPMS response to loss of power and subsequent power restoration as follows:

3.12.1 Simulate normal steady state full power conditions for the RPMS and verify all RPMS outputs indicate correctly.

3.12.2 Remove electrical power to one RPMS division and verify all RPMS outputs indicate that the corresponding RCCA is "withdrawn."

3.12.3 Re-energize the RPMS division and verify that all RPMS outputs in that division indicate correctly after being reenergized.

3.13 Verify the functionality of the RPMS self-test features by simulating RPMS component failures and observing through human-machine interfaces that the self-test features identified the failure.

4.0 DATA REQUIRED

4.1 Power supply voltages.

4.2 Circuit breaker and indicator operational data.

4.3 RPMS functional logic diagrams.

4.4 RPMS activation values.

4.5 Reset margin and rate of setpoint change of variable setpoints.

4.6 Maximum and minimum values of variable setpoints.

5.0 ACCEPTANCE CRITERIA

5.1 The RPMS provides status information to the following:

5.1.1 SCDS.

5.1.2 PAS.

5.2 Electrical independence and redundancy requirements are met.

5.3 The RPMS functions as described in Section 7.1.1.5.14, and Figure 7.1-25.

5.4 The RPMS outputs attain a predefined state upon loss and restoration of electrical power.

5.5 The self-test features of the RPMS are operating properly.

14.2.12.11.26 Reserved

14.2.12.11.27 Personnel Radiation Monitors (Test #160)

A COL applicant that references the U.S. EPR design certification will provide site-specific test abstract information for personnel radiation monitors. The following is a typical COL test; if a site-specific test will be used, the COL applicant will provide the test.

1.0 OBJECTIVE

1.1 To demonstrate proper operation of personnel radiation monitors.

2.0 PREREQUISITES

2.1 Construction activities on personnel radiation monitor support systems are complete.

2.2 Construction activities related to the installation of vendor supplied personnel radiation monitors are complete. The personnel radiation monitors have been installed per manufacture's recommendations.

2.3 A suitable test source is available for testing.

2.4 A portable radiation monitoring device is available for measuring the background radiation.

3.0 TEST METHOD

3.1 Measure the background radiation in the area where the personnel radiation monitors will be located.

3.2 Perform vendor supplied startup checks and calibrations for all personnel radiation monitors.

3.3 Measure the response of the personnel radiation monitors to the test source.

4.0 DATA REQUIRED

4.1 Completed vendor specified personnel radiation monitor startup procedures.

5.0 ACCEPTANCE CRITERIA

5.1 The personnel radiation monitors meet design requirements for preventing the release of radioactive materials via personnel egress to the following:

5.1.1 Offsite.

5.1.2 Clean areas onsite.

5.2 The personnel radiation monitors checkout and calibration procedures meet design requirements.

14.2.12.11.28 Signal Conditioning and Distribution System (Test #121)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the safety-related signal conditioning and distribution system (SCDS) to acquire inputs from the following sources:

1.1.1 Safety-related sensors.

1.1.2 Black boxes.

1.2 To demonstrate the ability of the SCDS to distribute acquired inputs to the following I&C platforms:

1.2.1 Safety information and control system (SICS).

1.2.2 Diverse actuation system (DAS).

1.2.3 Protection system (PS).

1.2.4 Safety automation system (SAS).

1.2.5 Reactor control, surveillance and limitation (RCSL) system.

1.2.6 Process automation system (PAS).

2.0 PREREQUISITES

2.1 Construction activities on the SCDS have been completed.

2.2 Support system(s) required for operation of the SCDS is complete and functional.

2.3 Test instrumentation is available and calibrated.

2.4 Verify that factory acceptance testing has been completed.

2.5 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Demonstrate that operation of the SCDS meets design requirements such as:

3.1.1 Data processing rates.

3.1.2 Data quality.

3.2 Verify that the SCDS operates over the design range using actual or simulated signals for the following:

3.2.1 Sensor inputs.

3.2.2 Black box inputs.

3.2.3 Sensor outputs.

3.2.4 Black box outputs.

3.3 Verify that the SCDS responds as designed to actual or simulated limiting malfunctions or failures.

3.4 Verify redundancy and electrical independence of the SCDS design.

4.0 DATA REQUIRED

4.1 Setpoints under which alarms and interlocks occur.

4.2 SCDS functional data (input data and corresponding output).

5.0 ACCEPTANCE CRITERIA

5.1 Each SCDS operator interfaces that provide monitoring and control capabilities is enabled.

5.2 Each SCDS operator interface that provides monitoring only capabilities is enabled and does not allow control capabilities.

5.3 The SCDS functional status is displayed as designed.

5.4 The SCDS provides alarm management capability.

5.5 The SCDS provides the interface to the following via an unidirectional firewall with qualified isolation devices:

5.5.1 DAS.

5.5.2 RCSL.

5.5.3 PAS.

5.6 The SCDS provides an interface to the following via an unidirectional firewall:

5.6.1 SICS.

5.6.2 PS.

5.6.3 SAS.

5.7 The SCDS functions as described in Section 7.1.1.4.8.

14.2.12.11.29 Priority and Actuator Control System (Test #122)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the priority and actuator control system (PACS) to prioritize outputs from the following sources:

1.1.1 Protection system (PS).

1.1.2 Safety information and control system (SICS).

1.1.3 Safety automation system (SAS).

1.1.4 Diverse actuation system (DAS).

1.1.5 Process automation system (PAS).

1.2 To demonstrate the ability of the PACS to acquire inputs from the following I&C components:

1.2.1 Safety-related actuators.

1.2.2 Safety-related black boxes.

1.2.3 Non-safety related actuators.

1.2.4 Non-safety related black boxes.

1.3 To demonstrate the ability of the PACS to communicate with the following:

1.3.1 SICS.

1.3.2 SAS.

1.4 Verify that upon loss of electrical power to each PACS module, the associated actuator attains a predefined state.

2.0 PREREQUISITES

2.1 Construction activities on the PACS have been completed.

2.2 Support systems required for operation of the PACS are complete and functional.

2.3 Test instrumentation is available and calibrated.

2.4 Verify that factory acceptance testing has been completed.

2.5 Verify proper operation of alarm, control, and indication functions.

2.6 PICS and SICS are available to display the status of actuators associated with the PACS modules.

3.0 TEST METHOD

3.1 Demonstrate that operation of the PACS meets design requirements such as:

3.1.1 Data processing rates.

3.1.2 Prioritization.

3.2 Verify that the PACS operates using actual or simulated signals to each component:

3.3 Verify that the PACS responds as designed to actual or simulated limiting malfunctions or failures.

3.4 Verify redundancy and electrical independence of the PACS design.

3.5 Test the PACS response to a loss of power as follows:

3.5.1 Remove electrical power to one PACS module and verify all outputs from that module are “zero.”

3.5.2 Repeat test for all PACS modules.

4.0 DATA REQUIRED

4.1 Setpoints under which alarms and interlocks occur.

4.2 PACS functional data (input data and corresponding output).

4.3 Verify that each PACS module responds to a signal produced at the originating platform:

4.3.1 PS.

4.3.2 SICS.

4.3.3 SAS.

4.3.4 PAS.

4.3.5 DAS.

4.4 Actuator position, as indicated by PICS and SICS.

5.0 ACCEPTANCE CRITERIA

5.1 Each PACS operator interfaces that provide monitoring and control capabilities is enabled.

5.2 Each PACS operator interface that provides monitoring only capabilities is enabled and does not allow control capabilities.

5.3 The PACS functional status is displayed as designed.

5.4 The PACS provides alarm management capability.

5.5 The PACS provides the interface to the following via an unidirectional firewall with qualified isolation devices:

5.5.1 PAS.

5.5.2 DAS.

5.6 The PACS provides an interface to the following via an unidirectional firewall:

5.6.1 SICS.

5.6.2 PS.

5.6.3 SAS.

5.7 The PACS functions as described in Section 7.1.1.4.3.

5.8 Actuators attain a predefined state upon loss of electrical power.

14.2.12.12 I&C Functions

14.2.12.12.1 ELAP Diesel Generator (Test #138)

1.0 OBJECTIVE

1.1 To demonstrate the ELAP diesel generator system operates reliably.

Note: It is not possible to establish some test conditions, such as low voltage and off-normal frequency. Design correlations will be required between actual test conditions and postulated design conditions.

1.2 To verify the ELAP diesel generator can supply power at the rated load, voltage, and frequency under design conditions.

2.0 PREREQUISITES

2.1 Construction activities on the ELAP diesel generator system have been completed. This includes, but is not limited to the following:

2.1.1 ELAP diesel generator fuel oil system.

2.1.2 ELAP diesel generator engine lube oil system.

2.1.3 ELAP diesel generator cooling system.

2.1.4 ELAP diesel generator starting system.

2.1.5 ELAP diesel generator air intake and exhaust systems.

2.1.6 Crankcase ventilation system.

2.2 ELAP diesel generator engine system instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the ELAP diesel generator system are complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 ELAP diesel generator electrical system instrumentation has been calibrated and is functional for performance of the following test.

2.6 Electrical testing is complete as needed to allow the required buses to be energized.

2.7 The ELAP diesel generator electrical voltage tests are complete.

2.8 Room ventilation system test is completed.

3.0 TEST METHOD

3.1 Demonstrate that each ELAP diesel generator can be started in automatic and manual using the SICS and the local control station.

3.2 Demonstrate that the following mechanical and electrical trips are functional (includes protective trips bypass tests).

3.2.1 Engine over speed (electrical and mechanical).

3.2.2 Generator differential protection.

3.2.3 Low-low lube oil pressure.

3.2.4 Generator electrical protection.

3.2.5 Low level in the jacket water expansion tank.

3.2.6 Low-low lube oil sump tank level.

3.2.7 High pressure crankcase.

3.2.8 High-high temperature lube oil out.

3.2.9 High-high temperature jacket water.

3.2.10 Electronic governor failure.

3.2.11 Low fuel oil pressure.

3.3 Demonstrate that the following parameters are correctly monitored in the control room and at the ELAP diesel generator local panel:

3.3.1 Lube oil temperature and pressures.

3.3.2 Bearing temperatures.

3.3.3 Cooling water temperatures and pressures.

3.3.4 Speed (rpm).

3.3.5 Starting system readiness.

3.4 Demonstrate the operation of the following status indications:

3.4.1 Cooling water expansion tank level.

3.4.2 ELAP diesel generator output breaker position.

3.4.3 ELAP diesel generator over speed.

3.4.4 Loss of control power.

3.4.5 Generator fault.

3.4.6 Low oil pressure.

3.4.7 Start system not ready.

3.4.8 Maintenance mode.

3.5 Demonstrate 25 consecutive starts capability.

3.6 Demonstrate full load capability.

3.7 Demonstrate ELAP diesel generator speed control.

3.8 Demonstrate 90 to 100 percent of the continuous rating of the ELAP diesel generator for an interval of not less than one hour and until temperature equilibrium has been attained.

3.9 Demonstrate that the ELAP diesel generator unit starts from standby conditions and reaches required voltage and frequency within acceptable limits and time requirements.

3.10 Perform ELAP diesel generator endurance and margin test to demonstrate:

3.10.1 Full-load carrying capability at a power factor between 0.8 and 0.9.

3.10.2 For an interval of not less than 24 hours, of which 2 hours are at a load equal to 105 to 110 percent of the continuous rating of the ELAP diesel generator.

- That 22 hours of the 24 hours are at a load equal to 90 to 100 percent of its continuous rating.
- That voltage and frequency requirements are maintained.
- That mechanical systems such as fuel, lubrication, and cooling function are within design limits.
- The Fire Protection Building ventilation system maintains the ELAP diesel generator room temperatures within design limits.

NOTE: Perform the following testing within five minutes after operations at ≥ 90 percent capacity for ≥ two hours.

3.11 Demonstrate hot restart functional capability at full-load temperature conditions (after it has operated for 2 hours at full load).

4.0 DATA REQUIRED

4.1 ELAP diesel generator operating parameters.

4.2 ELAP diesel generator consecutive starts data.

4.3 Setpoints of ELAP diesel generator trips.

4.4 ELAP diesel generator governor operating data.

4.5 Setpoints at which alarms and interlocks occur.

4.6 Test data traces for ELAP diesel generator output voltage, frequency, and output circuit breaker closing data during start sequence.

4.7 Running data for the parameters monitored during each of the required testing sequences.

4.8 Verification of field performance data versus shop data.

4.9 Periodic area temperatures, collected at least once per hour.

5.0 ACCEPTANCE CRITERIA

5.1 The ELAP diesel generator mechanical system meets design requirements.

5.2 The ELAP diesel generator electrical and instrumentation support systems meet design requirements.

5.3 The ELAP diesel generator electrical system meets design requirements.

5.4 The Fire Protection Building ventilation system meets design requirements.

14.2.12.12.2 Main Steam Relief Trains (Test #148)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the MSRT.

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the MSRT (MSRCV and MSRIV) and interfacing equipment have been completed.

2.2 The MSRIV pilot valves have been calibrated and are operating satisfactorily prior to performing the following test.

2.3 External test equipment has been calibrated and is functional.

2.4 Support systems required for operation of the MSRT are functional.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control, and indication functions.

2.7 Verify that the MSRT tested flow capacity meets the design requirements.

2.7.1 Table 14.3-1 Item 1-50.

3.0 TEST METHOD

3.1 Simulate inputs to the MSRT and observe receipt of these signals as follows:

3.1.1 Verify that the MSRCV responds as follows to simulated levels of thermal power:

- From zero to 20 percent thermal power-40 percent open.
- From 20 to 50 percent thermal power-linear variation between 40 and 100 percent open.
- For greater than 50 percent thermal power-100 percent open.

3.1.2 Verify that the MSRIV responds to simulated steam pressure changes.

3.2 Verify that the MSRT (MSRCV and MSRIV) operates over the design range using actual or simulated signals.

3.3 Simulate varying system inputs and observe output responses at the MSRT and at interfacing equipment.

3.4 Verify response of the MSRT valves and position indicators.

3.5 Demonstrate dynamic operation of the MSRT valves during HFT, using Test #152.

3.6 Verify that the MSRT responds as designed to actual or simulated limiting malfunctions or failures.

3.7 Verify that the MSRT system response meets the accident analysis assumptions, i.e., time response, accuracy, and control stability.

3.7.1 Table 14.3-1 Item 1-61.

3.8 Verify redundancy and electrical independence of the MSRT design.

3.9 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Input signal values.

4.2 MSRT output response.

5.0 ACCEPTANCE CRITERIA

5.1 The MSRT preliminary setpoints have been calibrated into the system.

5.2 The MSRT responds as designed to simulated signals.

5.3 Verify that safety-related components meet electrical independence and redundancy requirements.

5.4 The MSRT functions as described in Sections 7.3 and 10.3.

14.2.12.12.3 Steam Generator Level Control System (Test #149)

Note: The steam generator level control is performed by the PAS and is separated from other PAS functions in this test to describe a function that should be verified during HFT.

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the SG level control system.

2.0 PREREQUISITES

2.1 Construction activities on the SG level control system and interfacing equipment have been completed.

2.2 The SG level control system instrumentation has been calibrated and is functional for performance of the following test.

2.3 External test equipment has been calibrated and is functional.

2.4 Support systems required for the operation of the SG level control system are functional.

2.5 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Simulate inputs to the SG level control system and observe receipt of these signals at the non-safety control system.

3.2 Simulate varying input signals to the SG level control system and observe output responses at the non-safety control system.

3.3 Monitor the system during initial operation and verify as-designed operation, including control stability.

3.4 Verify that the steam generator level controls respond as designed to simulated steam generator level transmitter failures.

3.5 Verify that the steam generator level control function operates over the design range using actual or simulated signals.

4.0 DATA REQUIRED

4.1 Input signal values.

4.2 The SG level control system response.

5.0 ACCEPTANCE CRITERIA

5.1 The steam generator level control setpoints have been installed in the PAS computer.

5.2 The steam generator controls respond as designed to simulated high and low signals by opening and closing the feedwater regulating valves.

5.3 The steam generator level controls start the startup and shutdown feedwater pump and EFW pumps, as designed.

5.4 Verify that safety-related components meet electrical independence and redundancy requirements.

5.5 The steam generator level control system functions as described in Sections 7.7.2 and 10.4.7.

14.2.12.12.4 Partial Trip (Test #150)

Note: The partial trip function is performed by the RCSL system and is separated from other RCSL functions in this test for clarity.

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the partial trip function.

2.0 PREREQUISITES

2.1 The partial trip RCCAs have been installed in actual or dummy assembles and are available to be tripped.

2.2 Support systems required for the operation of the partial trip are functional.

2.3 Verify that factory acceptance testing has been completed.

2.4 Verify proper operation of alarm, control and indication functions.

2.5 The reactor trip breakers and associate support systems required to position the partial trip RCCAs are functional.

2.6 Partial trip setpoints have been installed in the RCSL software.

3.0 TEST METHOD

3.1 Simulate signals to plant control system that are equivalent to hot full power.

3.2 Simulate loss of single RCP input to the partial trip; observe response.

3.3 Simulate loss of feedwater pump without startup of standby feedwater pump input to the partial trip; observe response.

3.4 Observe response of turbine controls to partial trip signal.

4.0 DATA REQUIRED

4.1 Input signal values.

4.2 Response time from injection of signal to partial trip RCCAs on bottom.

5.0 ACCEPTANCE CRITERIA

5.1 The partial trip function sends the signal to drop the designated RCCAs upon receiving the appropriate simulated signal.

5.2 The partial trip function sends the signal to runback the turbine load upon receiving the appropriate simulated signal.

5.3 The partial trip functions as described in Section 7.7.2.3.1.

14.2.12.12.5 Primary Depressurization System (Test #151)

1.0 OBJECTIVE

1.1 To verify the flow paths of the primary depressurization system.

1.2 To verify that pressurizer safety valves and associated piping perform as designed.

1.3 To verify that pressurizer severe accident valves and associated piping perform as designed.

1.4 To verify the proper operation of the reactor coolant gas vent system and the associated piping.

1.5 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the system to be tested are essentially complete.

2.2 Plant is at hot zero power (HZP) (pressure and temperature) conditions during HFT.

2.3 Plant systems required to support testing are functional, or temporary systems are installed and functional.

2.4 Permanently installed instrumentation is functional and calibrated, and is functional for performance of the following test.

3.0 TEST METHOD

3.1 Verify the performance of the pressurizer safety valves from the pressurizer to the pressurizer relief tank (PRT) by simulating an over pressurizer condition. To simulate an overpressure condition, a test device is used to apply the required differential pressure between the normal operating pressure and the lift setpoint.

3.1.1 Record the response time from initiation of simulated RCS overpressure condition to valve opening time.

3.1.2 Record the reset pressure when the valve shuts.

3.2 Verify the performance of the pressurizer severe accident valves from the pressurizer to the PRT by simulating an over pressurizer condition.

3.3 Verify that the reactor coolant gas vent system (both the pressurizer vent and the reactor vessel upper head vent) meets design depressurization rates.

3.4 Verify flow paths through the rapid depressurization system from the pressurizer to the PRT during valve discharge at HZP fluid conditions.

3.5 Verify pressurizer safety relief and reactor coolant gas vent valves fail to the closed position upon loss of motive power.

3.6 Verify pressurizer severe accident valves fail-as-is upon loss of motive power.

3.7 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Valve position indications.

4.2 RCS temperature and pressures.

4.3 RCS depressurization rates.

4.4 PRT temperature, pressure, and level.

4.5 Reactors drain tank temperature, pressure, and level.

4.6 IRWST temperature, pressure, and level.

4.7 Position response of valves to loss of motive power.

5.0 ACCEPTANCE CRITERIA

5.1 The RCS allows venting of the pressurizer and reactor vessel through designed flow paths, as shown on the plant layout drawings.

5.2 The primary depressurization system provides a depressurization path through designed flow paths.

5.3 The primary depressurization piping systems vibration and displacement data has been collected and is being evaluated.

5.4 The primary depressurization system functions as described in Section 5.4.

5.5 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.12.6 Partial Cooldown (Test #152)

1.0 OBJECTIVE

1.1 To verify the flow path of the MSRT during partial cooldown.

1.2 To verify the MSRT setpoint is reduced upon receipt of a safety injection signal.

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

1.4 To verify response of the MSRT (MSRCV and MSRIV) to simulated signals.

2.0 PREREQUISITES

2.1 Construction activities on the MSRT and main steam system are essentially complete.

2.2 Plant is at HZP (pressure and temperature) conditions during HFT.

2.3 Plant systems required to support testing are functional.

2.4 Permanently installed instrumentation is calibrated and functional for performance of the following test.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Verify the performance of the MSRT by simulating a safety injection signal and verifying that the MSRT setpoint is reduced.

3.2 Verify power-operated valves fail upon loss of motive power as designed.

3.3 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.4 Verify that the MSRCV positions to 40 percent open based on a thermal power level of 0 percent.

4.0 DATA REQUIRED

4.1 Valve position indication as a function of time.

4.2 RCS temperature and pressure as a function of time.

4.3 RCS depressurization rate as a function of time.

4.4 SG pressure and level as a function of time.

4.5 Position response of MSRT valves to loss of motive power.

5.0 ACCEPTANCE CRITERIA

5.1 The main steam system provides a depressurization path through the MSRT valves and associated silencers to atmosphere, as designed (refer to Section 10.3.2.2).

5.2 The MSRT setpoint is reduced upon receipt of a safety injection signal, as designed (refer to Sections 6.3.3.1, 10.3.2.2, and 16 B3.3.1).

5.3 Verify that safety-related components meet electrical power supply independence and redundancy requirements, as designed (refer to Section 8.1.4.2).

5.4 The MSRCV positions to 40 percent based on a thermal power of 0 percent, as designed (refer to Section 10.3.2.2).

5.5 The MSRIV positions as required to control the rate of steam pressure reduction with minimal overshoot.

5.6 Verify the response of the partial cooldown function to a SIS signal.

5.6.1 Table 14.3-1, Item 1-44.

14.2.12.12.7 Integrity of Systems Likely to Contain Radioactive Material (Test #153)

1.0 OBJECTIVE

1.1 This system integrity test is applicable to portions of systems that are located outside of containment that could contain radioactive material following a serious transient or accident. The objective of this test is to limit the exposure to personnel from leakage.

1.2 The list of systems that are tested is based on the NRC Action Plan developed as a result of the TMI-2 accident.

1.3 To verify the system integrity of the following impacted systems:

1.3.1 Low Head Safety Injection.

1.3.2 Severe Accident Heat Removal System.

1.3.3 Medium Head Safety Injection.

1.3.4 Nuclear Sampling System.

1.3.5 Severe Accident Sampling System.

1.3.6 Hydrogen Monitoring.

1.3.7 Chemical and Volume Control System (makeup and letdown).

1.3.8 Gaseous Waste Processing.

2.0 PREREQUISITES

2.1 Construction activities on the impacted systems have been completed.

2.2 System hydrostatic testing on the impacted systems has been completed prior to performing leakage testing.

2.3 Support systems required for operation of the impacted systems are completed and functional.

2.4 Initial preoperational testing scheduled prior to hot functional testing on the impacted systems has been completed.

2.5 Test instrumentation for detecting the presence of helium/SF_6 is available and calibrated.

2.6 An adequate supply of helium/SF_6 is available, as required.

3.0 TEST METHOD

3.1 Verify that the impacted systems that contain liquids are leak tight when pressurized at normal system operating pressure and temperature, as applicable.

3.2 Identified leaks should be repaired and retested, as applicable.

3.3 Verify that impacted systems that contain gases are pressurized to normal operating pressure with a mixture of compressed air and a suitable tracer gas, such as helium/SF_6.

3.4 Leaking portions of impacted systems can be corrected by maintenance activities and retested by either of the methods described above.

4.0 DATA REQUIRED

4.1 Walkdown inspection reports completed by qualified personnel.

4.2 Helium/SF_6 equipment calibration references.

5.0 ACCEPTANCE CRITERIA

5.1 The leakage from impacted systems meets the requirements of NUREG-0578, Recommendation 2.1.6.a.

5.2 The leakage from impacted systems meets the requirements of NUREG-0660, Item III.D.1.1.

5.3 The leakage from impacted systems meets the requirements of NUREG-0664, Part 2.

14.2.12.12.8 Remote Safe Shutdown (Test #154)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the remote safe shutdown function.

2.0 PREREQUISITES

2.1 The instrumentation used during safe shutdown has been calibrated and is operating satisfactorily prior to performing the following test.

2.2 External test instrumentation is available and calibrated.

2.3 Support systems required for testing safe shutdown are functional.

3.0 TEST METHOD

3.1 Verify that safe shutdown control signals override lower priority signals.

3.2 Verify functionality of hard-wired functions at the RSS.

3.2.1 RSS transfer switches are repositioned to allow RSS control.

3.2.2 Manual reactor trip is available at the RSS.

3.3 Simulate safe shutdown scenarios and observe actuation of the appropriate trip circuit and associated alarms.

3.4 Exercise the control functions to the safety depressurization and shutdown cooling system to verify as designed operations.

4.0 DATA REQUIRED

4.1 Power supply voltages.

4.2 Circuit breaker and indicator operation.

4.3 Safety parameter trends during testing.

4.4 Reactor trip and actuation path response.

5.0 ACCEPTANCE CRITERIA

5.1 The plant remote safe shutdown function has been verified to be capable of controlling critical plant functions when activated.

5.2 The plant safe shutdown function overrides all other commands and controls.

5.3 The ability to reach a safe shutdown using systems described in Section 7.4 has been verified.

14.2.12.12.9 Post-Accident Monitoring Instrumentation (Test #155)

Note: Post-accident monitoring instrumentation is not a completely separate system, but is a collection of functions that are provided by sensors that are located in other systems. Post-accident monitoring instrumentation presents the information from the sensors in a manner that is convenient for post-accident monitoring. The individual radiation monitors described in Table 11.5-1 are preoperational tested in the process system where the radiation monitor is located.

1.0 OBJECTIVE

1.1 To verify that the post-accident monitor instrumentation (PAM) is installed properly, responds correctly to external inputs and provides proper outputs to the distributed display and recording equipment. The systems that are used for post-accident monitoring consist of

radiation monitoring, reactor vessel water level indicating system, and selected instrumentation.

1.2 To verify that the post-accident monitoring instrumentation correctly display information from sensors that were preoperational tested in the process system that contains the sensors.

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested are complete.

2.2 Applicable operating manuals are available.

2.3 Required software is installed and functional.

2.4 External test equipment and instrumentation is available and calibrated.

2.5 Plant systems required to support testing are functional to the extent necessary to perform the testing or suitable simulation of this system is used.

2.6 Verify preoperational testing has been satisfactorily completed for post-accident monitoring instrumentation.

3.0 TEST METHOD

3.1 Verify power sources to post accident related equipment.

3.2 Validate that external inputs are received and processed correctly by the appropriate system devices.

3.3 Verify that alarms and indication displays respond correctly to actual or simulated inputs that are indicative of normal and abnormal accident data.

3.4 Verify the functionality of required software application programs.

3.5 Verify the correct operation of data output devices and displays at applicable work stations and terminals.

4.0 DATA REQUIRED

4.1 Computer generated summaries of external input data, data processing, analysis functions, displayed information, and permanent data records.

5.0 ACCEPTANCE CRITERIA

5.1 The instruments that are designated as the post-accident monitoring instruments have been verified to include all of the instruments listed in the emergency operating procedures (Abnormal Operating Procedures, Emergency Operating Procedures, Severe Accident Mitigation Guidelines, etc.).

5.2 The PAM instrumentation functions as described in Section 7.5.

14.2.12.12.10 Pressurizer Pressure and Level Control (Test #156)

1.0 OBJECTIVE

1.1 To verify the proper operation of the pressurizer pressure control (PPC) and pressurizer level control (PLC).

2.0 PREREQUISITES

2.1 Construction activities on the PPC and PLC have been completed.

2.2 PPC and PLC software is installed; local instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of components in the PPC and PLC are functional.

2.4 The RCS including the pressurizer is filled sufficiently to cover the pressurizer heaters.

2.5 Verify that the PAS factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Operate heater breakers from PICS. Observe breaker operation and indicating light response.

3.2 Simulate a decreasing pressurizer pressure and verify as designed outputs to the heater control circuits. Verify alarm values.

3.3 Simulate an increasing pressurizer pressure and verify as designed outputs to the heater and spray valves control valve circuits. Verify alarm values.

3.4 Simulate a low level error in the pressurizer and verify as designed outputs to the CVCS letdown control valve circuit. Verify alarm values.

3.5 Simulate a high level error in the pressurizer and verify as designed outputs to the pressurizer backup heater and the CVCS letdown control valve circuits. Verify alarm values.

3.6 Simulate signals to pressurizer pressure and level controllers and verify as designed outputs.

3.7 Simulate a low-low pressurizer level and verify as-designed outputs.

3.8 Simulate a low pressurizer level and verify as designed output signals to the CVCS letdown control valve circuits.

4.0 DATA REQUIRED

4.1 Pressurizer level, pressure signals, and outputs to pressurizer heaters control circuits.

4.2 Pressurizer pressure signals and outputs to spray valve control circuits.

4.3 Pressurizer level signals and outputs to CVCS letdown control valve circuits.

4.4 Pressurizer level to letdown valve control circuits.

4.5 Setpoints at which alarm, indications, and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The pressurizer level and pressure control setpoints have been configured in the PAS software.

5.2 The pressurizer level controls respond as designed to simulated high and low signals by repositioning the letdown control valves.

5.3 The pressurizer pressure controls respond as designed to simulated low and high pressurizer pressure.

5.4 The pressurizer pressure and level control systems function as described in Section 5.4.10.

14.2.12.13 Hot Functional Tests

14.2.12.13.1 Hot Functional Sequencing Document (Test #161)

1.0 OBJECTIVE

1.1 To demonstrate the proper integrated operation of plant systems when in simulated or actual operating configurations.

1.2 To demonstration that RCS temperature and pressure can be lowered to permit operation of the RHRS, and the RHRS can be used to achieve cold shutdown.

1.3 The residual heat removal (RHR) cooldown rate shall not exceed Technical Specification limits.

1.4 Demonstrate operation of the steam bypass valves to perform a controlled plant cooldown.

1.5 To verify electrical distribution system voltages per BTP 8-6.

1.6 Verify that secondary systems impacted by hot functional test conditions meet design assumptions with respect to thermal growth. Piping and components are free to expand thermally as designed during initial plant heatup and return to their baseline cold position after the initial cooldown to ambient temperatures.

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested are completed.

2.2 Permanently installed instrumentation on systems to be tested has been calibrated and is functional.

2.3 Necessary test instrumentation is available and calibrated.

2.4 Hydrostatic testing of the primary and secondary systems has been completed.

2.5 SGs are in wet lay-up in accordance with the secondary water chemistry program.

2.6 Reactor internals, as appropriate for pre-core HFT, have been installed.

2.7 Full flow debris filters, dummy fuel assemblies, or equivalents have been installed in the internals to simulate the flow resistance of the fuel assemblies.

2.8 Adjustment, setting, and marking of initial positions of fixed supports, hydraulic restraints, whip restraints, and special devices of the secondary systems have been completed.

2.9 Locations for thermal displacement measurements (horizontal and vertical) along the secondary systems have been clearly identified and spreadsheets have been prepared to record predicted and as-measured displacement valves.

2.10 Temporary scaffolding and ladders are installed as required to make observations and record data.

3.0 TEST METHOD

3.1 Specify plant conditions and coordinate the execution of the related pre-core HFT test abstracts.

3.1.1 Check clearances at snubbers spring can supports and selected hangers at 50°F increments during heatup and recorded at least 100°F increments.

3.1.2 Record the following displacements, and selected clearances at 50°F increments during heatup and at stabilized HZP (pressure and temperature) conditions:

- Steam generator blowdown.
- Emergency feedwater.
- Main feedwater.
- Main steam.

4.0 DATA REQUIRED

4.1 As specified by the individual pre-core HFT test procedures.

4.2 Plant conditions.

4.3 Piping displacement measurements at selected points.

4.4 Clearances at test points after cooldown.

5.0 ACCEPTANCE CRITERIA

5.1 Integrated operation of the RCS, secondary, and related auxiliary systems perform in accordance with design criteria.

5.2 RCS temperature and pressure can be lowered in a controlled manner to permit operation of the RHRS.

5.3 The RHRS is used to achieve cold shutdown at a cooldown rate not in excess of Technical Specification limits.

5.4 The turbine bypass valves can be operated to control RCS temperature.

5.5 The RCPs can be secured one at a time at HZP conditions and the RCP seal package, including the standstill seal, can be verified to limit RCS leakage within design limits.

5.6 Unrestricted expansion for selected points on piping systems and components as designed.

5.7 Verification that components return to their baseline ambient position as designed.

5.8 Verification that as designed gaps exist for selected piping systems and components as designed.

14.2.12.13.2 Pre–Core Instrument Correlation (Test #162)

1.0 OBJECTIVE

1.1 To demonstrate that the inputs and appropriate outputs between the following safety-related systems are in agreement:

1.1.1 Plant Protection system.

1.1.2 Process instrumentation.

1.1.3 Discrete indication and alarm system.

1.2 To verify safety-related temperature and pressure instrumentation accuracy and operation by comparing similar channels of instrumentation.

2.0 PREREQUISITES

2.1 Instrumentation has been calibrated and is functional.

3.0 TEST METHOD

3.1 Record safety-related wide range instrumentation readings as directed by the pre-core HFT.

3.2 Record safety-related narrow range instrumentation readings as directed by the pre-core HFT.

4.0 DATA REQUIRED

4.1 PICS and SICS readings.

4.2 DAS readings.

5.0 ACCEPTANCE CRITERIA

5.1 Safety-related instrument readings shall agree within the accuracy of the instrumentation as designed (refer to Sections 7.1.2 and 7.5.1).

5.2 Wide range instrument readings shall agree within the accuracy of the instrumentation as designed (refer to Sections 7.1.2 and 7.5.1).

14.2.12.13.3 Pre–Core Test Data Record (Test #163)

1.0 OBJECTIVE

1.1 To monitor non-safety-related instrumentation during integrated plant operation.

1.2 To verify, by cross checking channels, the satisfactory tracking of process instrumentation.

1.3 To provide a permanent record of plant pre-core loading parameter indication.

2.0 PREREQUISITES

2.1 Non-safety-related instrumentation has been calibrated and is functional.

3.0 TEST METHOD

3.1 Record non-safety-related instrumentation steady-state readings as directed by the pre-core HFT controlling document.

4.0 DATA REQUIRED

4.1 Plant conditions at the time instrument readings are recorded.

4.2 Instrument readings.

5.0 ACCEPTANCE CRITERIA

5.1 Non-safety-related instrumentation readings shall agree within the accuracy limits of the instrumentation as designed (refer to Section 7.1.4).

14.2.12.13.4 Pre–Core Reactor Internals Vibration Measurements (Test #164)

1.0 OBJECTIVE

1.1 To verify that reactor vessel vibration levels are within design limits using a program that meets the guidelines defined in Regulatory Guide 1.20.

1.1.1 Measure and record the displacement amplitude at mechanical interference connections as described in Regulatory Guide 1.20.

1.1.2 Measure and record the estimated vibration frequency at mechanical interference connections as described in Regulatory Guide 1.20.

2.0 PREREQUISITES

2.1 Construction activities have been completed on the reactor vessel.

2.2 The heavy reflector lower internals have been installed.

2.3 Dummy fuel assemblies have been constructed from fuel skeletons with stainless fuel pins or suitable alternate flow restriction devices that have been constructed.

2.4 Dummy fuel assemblies or suitable alternate flow restriction devices have been installed in available core locations.

2.5 If the ITAAC requires vibration data from inside the reactor, install instrumentation per Regulatory Guide 1.20 with data cables routed through one of the instrument ports in the reactor head.

2.6 Construct a table of reactor internal components and local areas to be inspected.

2.6.1 Major load-bearing elements of the reactor internals that are relied upon to retain the core support structure in position.

2.6.2 Lateral, vertical, and torsional restraints provided within the vessel.

2.6.3 Locking and bolting components whose failure could adversely affect the structural integrity of the reactor internals.

2.6.4 Surfaces that are known to be or may come in contact with surfaces during operation.

2.6.5 Critical locations on the reactor internal components as identified by the vibration analysis.

3.0 TEST METHOD

3.1 Operate the reactor normally and record operating data during HFT.

3.2 Remove the upper internals, dummy fuel assemblies, and lower internals and place in storage location.

3.3 Inspect upper and lower internals, paying special attention to contact surfaces between internals and reactor vessel or upper and lower internals using the inspection guidance specified in Regulatory Guide 1.20.

3.4 Verify that the reactor internals vibration measurements are performed in accordance with RG 1.20.

3.5 Inspect the interior of the reactor vessel for evidence of loose parts or foreign material.

4.0 DATA REQUIRED

4.1 Plant conditions.

4.2 Clearances at the upper to lower internals interfaces.

4.3 Clearances at the upper and lower internals interface with the reactor vessel.

4.4 Record of observed wear marks.

4.4.1 Displacement measurements at each mechanical interference location where wear was observed.

4.4.2 Estimated number of vibration cycles at each mechanical interference location where wear was observed.

5.0 ACCEPTANCE CRITERIA

5.1 Observed vibration and wear scars are within design limits.

5.1.1 Verify that observed displacements and estimated cycles are within design limits described in Regulatory Guide 1.20.

5.2 Verify that the vibration monitoring program meets the requirements of Regulatory Guide 1.20.

14.2.12.13.5 Pre–Core Reactor Coolant System Expansion Measurements (Test #165)

1.0 OBJECTIVE

1.1 To demonstrate that RCS components are free to expand thermally as-designed during initial plant heatup and return to their baseline cold position after the initial cooldown to ambient temperatures.

1.2 Verify the absence of thermal stratification and striping in the pressurizer surge line.

2.0 PREREQUISITES

2.1 All construction activities have been completed on the RCS components.

2.2 Initial ambient dimensions have been set on the SG and RCP hydraulic snubbers, upper and lower SG and reactor vessels keys, and RC pump columns.

2.3 Initial ambient dimensions for the SG, reactor vessel and RCP supports have been recorded.

2.4 Adjustment, setting, and marking of initial positions of fixed supports, hydraulic restraints, whip restraints, and special devices of the RCS systems have been completed.

2.5 Locations for thermal displacement measurements (horizontal and vertical) along reactor coolant loop piping and pressurizer surge line

have been clearly identified and spreadsheets have been prepared to record predicted and as-measured displacement values.

2.6 Temporary scaffolding and ladders are installed as required to make observations and record data.

3.0 TEST METHOD

3.1 Check clearances at hydraulic snubber joints, keys and column clevises at 50°F increments during heatup and recorded at least 100°F increments.

3.2 Record SG, reactor vessel pressurizer surge line displacements, and RCP clearances at 50°F increments during heatup and at stabilized HZP (pressure and temperature) conditions.

4.0 DATA REQUIRED

4.1 Plant conditions.

4.2 Column angels from vertical at the SG and hydraulic snubber travel measurements.

4.3 Clearance between the reactor vessel upper and lower supports and expansion plates.

4.4 Reactor vessel support temperature.

4.5 Clearances at the RCP snubbers, column joints, and piston positions for the hydraulic snubbers.

4.6 Clearances at test points after cooldown.

4.7 Piping displacement measurements at selected RCS and pressurizer surge line points.

5.0 ACCEPTANCE CRITERIA

5.1 Unrestricted expansion for selected points on components as described in Section 3.9.2.

5.2 Verification that components return to their baseline ambient position as designed (refer to Section 3.9.2).

5.3 Verification that as designed gaps exist for selected points on components as designed (refer to Section 3.9.2).

14.2.12.13.6 Pre-Core Primary and Secondary Chemistry Data (Test #166)

1.0 OBJECTIVE

1.1 To demonstrate that as-designed water chemistry for the RCS and SG can be maintained.

2.0 PREREQUISITES

2.1 Primary and secondary sampling systems are functional.

2.2 Chemicals to support HFT are available.

2.3 The primary and secondary chemical addition systems are functional.

2.4 Purification ion exchangers are charged with resin.

3.0 TEST METHOD

3.1 Perform sampling frequency for the SG and RCS as specified by the AREVA chemistry specifications. The sampling frequency can be increased as necessary to confirm the as-designed RCS and SG water chemistry.

3.2 Perform RCS and SG sampling and chemistry analysis after every significant change in plant conditions (i.e., heatup, cooldown, chemical additions).

4.0 DATA REQUIRED

4.1 Plant conditions.

4.2 SG chemistry analysis.

4.3 RCS chemistry analysis.

5.0 ACCEPTANCE CRITERIA

5.1 RCS and SG water chemistry can be maintained as designed (refer to Section 5.4.2 and the AREVA chemistry specifications).

14.2.12.13.7 Pre-Core Pressurizer Performance (Test #167)

1.0 OBJECTIVE

1.1 The pressurizer pressure and level control systems function properly.

1.2 To demonstrate proper operation of the auxiliary spray valves and pressurizer heaters.

1.3 To demonstrate proper operation of the letdown control valves and charging pumps.

2.0 PREREQUISITES

2.1 Pressurizer pressure and level control system instrumentation has been calibrated.

2.2 Support systems required for the operation of the pressurizer pressure and level control systems are functional.

2.3 Test equipment is available and calibrated.

3.0 TEST METHOD

3.1 Simulate a decreasing pressurizer pressure and observe heater response and alarm and interlock setpoints.

3.2 Simulate an increasing pressurizer pressure and observe heater and spray valve response and alarm and interlock setpoints.

3.3 Simulate a low level error in the pressurizer and observe as-designed CVCS response and alarm and interlock setpoints.

3.4 Simulate a high level error in the pressurizer and observe as designed CVCS response and alarm and interlock setpoints.

3.5 Simulate a low-low pressurizer level and observe heater response and alarm and interlock setpoints.

4.0 DATA REQUIRED

4.1 Response of pressurizer heaters to simulated pressure and level signals.

4.2 Response of spray valves to simulated pressurizer pressure.

4.3 Response of CVCS to simulated pressurizer level.

4.4 Values of parameters at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The pressurizer meets design requirements (refer to Section 5.4.10).

14.2.12.13.8 Pre-Core Pressurizer Surge Line Stratification (Test #168)

1.0 OBJECTIVE

1.1 To demonstrate pressurizer surge line stratification temperature measurements are within acceptable limits.

2.0 PREREQUISITES

2.1 Pressurizer pressure and level control system instrumentation has been calibrated.

2.2 Support systems required for the operation of the pressurizer pressure and level control systems are functional.

2.3 Pressurizer and pressurizer surge line insulation is installed.

2.4 Special test equipment is available and calibrated.

2.5 Temperature sensors have been installed on the pressurizer surge line at specified locations.

2.5.1 Sensors located at the 0 and 180 degree positions:

- Above the hot leg connection.
- Below the elbow that is located above the hot leg.

- Above the elbow that is located below the pressurizer.

2.5.2 Sensors located at the 0, 30, 60, 90, 120, 150, and 180 degree positions:

- Below the elbow that is located below the pressurizer in the nearly horizontal piping.
- Above the elbow that is located above the hot leg in the nearly horizontal piping.

3.0 TEST METHOD

3.1 Establish a normal pressurizer level with the proportional heaters in service and no other pressurizer heaters in service.

4.0 DATA REQUIRED

4.1 Pressurizer heater output.

4.2 Pressurizer surge line temperatures at temporary instrument locations.

4.3 Pressurizer surge line temperatures at permanent plant instrument location.

5.0 ACCEPTANCE CRITERIA

5.1 The pressurizer surge line temperature has been evaluated to not cause unanalyzed thermal cycles.

14.2.12.13.9 Pre-Core Control Rod Drive Mechanism Performance (Test #169)

1.0 OBJECTIVE

1.1 To determine the coil resistance of the CRDM system at several temperature plateaus during RCS heatup.

1.2 To determine the operating temperature of the upper gripper coils.

1.3 To verify proper operation and sequencing of the CRDM system.

2.0 PREREQUISITES

2.1 RCCAs have been installed.

2.2 RCCA drive shafts have been latched.

2.3 CRDM coil stacks are assembled and associated cabling is connected.

2.4 Cabling between the reactor bulkhead and the CRDM control system is disconnected.

2.5 CRDM cold coil resistance has been measured and recorded.

2.6 Individual CRDM cable resistance has been measured and recorded.

2.7 Containment pit cooling system is functional and operating in normal.

2.8 Test equipment is available and calibrated.

2.9 Support systems required for operation of the CRDM system are functional.

2.10 Preoperational Test #036 has been completed satisfactorily.

3.0 TEST METHOD

3.1 Measure the loop resistance for each of the CRDM coils at specified RCS temperature and pressures.

3.2 Balance the containment pit cooling system as required to maintain the coil temperatures within the specified limits.

3.3 Verify that the cabling between the reactor bulkhead and the CRDM cabinets has been connected.

3.4 Energize each CRDM.

3.5 Measure the DC voltage across the upper gripper coil and across the shunt on the CRDM.

3.6 Operate each CRDM a minimum of 24 steps and observe rod demand count operation.

3.7 Demonstrate that rod withdrawal block functions in accordance with design requirements.

4.0 DATA REQUIRED

4.1 CRDM cold coil resistance.

4.2 CRDM cable resistance.

4.3 RCS temperature and pressure.

4.4 CRDM coil loop resistance at specified RCS temperature and pressure.

4.5 DC voltage across the upper gripper coil at the specified RCS temperature and pressure.

4.6 DC voltage across the shunt.

4.7 CRDM rod demand digital position readings.

5.0 ACCEPTANCE CRITERIA

5.1 The CRDM system meets design requirements (refer to Sections 4.5 and 4.6).

14.2.12.13.10 Pre-Core Reactor Coolant System Flow Model Verification (Test #170)

Note: It is not possible to measure RCS flow prior to operating at a core power that allows measurement of calorimetric power. The RCS flow transmitters will be normalized to 100 percent but this activity will have to be repeated after fuel loading. This is because the core provides a significant portion of the resistance to RCS flow during normal operation that may not match the resistance during hot functional testing.

1.0 OBJECTIVE

1.1 To predict the pre-core RCS flow rate.

1.2 To establish baseline RCS pressure drops.

1.3 To collect RCP coastdown data.

2.0 PREREQUISITES

2.1 Permanently installed instrumentation has been calibrated and is functional.

2.2 Test instrumentation has been checked and calibrated.

2.3 Reactor vessel internals have been installed with full flow debris filters, dummy fuel assemblies, or equivalent that approximates the pressure drop across the core.

2.4 RCS operating at nominal HZP (pressure and temperature) conditions.

2.5 Desired RCPs are operating.

3.0 TEST METHOD

3.1 The RCS flow instrumentation has been normalized to 100 percent RCS flow.

3.2 RCS flow, pressure drops, and the data necessary to calculate RCS flows for four RCP operations shall be obtained for various RCP configurations.

3.3 Measure RCP coastdown data for each RCP during a simultaneous four-pump coastdown.

3.3.1 Table 14.3-1 Item 1-6.

3.4 Verify that each RCP doesn't rotate in the reverse direction when other RCPs are operating.

3.5 Verify that operating restrictions for RCP restart are followed.

4.0 DATA REQUIRED

4.1 Steam generator differential pressure.

4.2 RCP differential pressure.

4.3 RCS flow indication.

4.4 RCS temperature and pressures at practical locations.

4.5 RCP speed (rpm).

4.6 RCP motor current.

4.7 Reactor vessel differential pressure.

4.8 Operating RCP configuration corresponding to data set.

5.0 ACCEPTANCE CRITERIA

5.1 The predicted RCS flow exceeds the value necessary to establish that post-core flow is in excess of that used for analysis in Chapter 15 and Section 5.0.

5.2 The predicted RCS flow is less than the design maximum flow rate (refer to Section 5.1).

5.3 The simultaneous four RCP coastdown data has been compared to the accident analyses and the data indicates that similar data that will be collected in Test #183 has a high probability of meeting accident analysis assumptions.

14.2.12.13.11 Pre-Core Reactor Coolant System Heat Loss (Test #171)

1.0 OBJECTIVE

1.1 To measure RCS heat loss under HZP (pressure and temperature) conditions.

1.2 To measure the pressurizer heat loss under HZP (pressure and temperature) conditions.

2.0 PREREQUISITES

2.1 Test instrumentation is available and calibrated.

2.2 Construction activities on the RCS and associated systems are completed.

2.3 Verify pressurizer spray bypass valves are closed.

2.4 Permanently installed instrumentation on the system to be tested is available and calibrated.

3.0 TEST METHOD

3.1 Determine the RCS heat loss using the steamdown method:

3.1.1 Stabilize the SG levels with the RCS at HZP (pressure and temperature) conditions.

3.1.2 Secure SG feedwater and blowdown.

3.1.3 By leaving pressurizer spray flow in automatic and varying the number of pressurizer heaters maintain RCS temperature constant.

3.1.4 Measure the pressurizer heater power required to maintain RCS temperature and pressure constant.

3.1.5 Measure the RCP power during the period.

3.1.6 Perform a heat balance calculation to determine heat loss.

3.2 Determine the pressurizer heat loss without continuous spray flow as follows:

3.2.1 Manually close the spray bypass valves.

3.2.2 Measure the pressurizer heater power required to maintain the pressurizer pressure constant with the RCS at HZP (pressure and temperature).

3.2.3 Perform a heat balance calculation to determine heat loss for the pressurizer (ignore RCP power).

4.0 DATA REQUIRED

4.1 RCS temperatures.

4.2 Pressurizer pressure and level.

4.3 SG pressures and levels.

4.4 Pressurizer heater power.

4.5 RCP power.

5.0 ACCEPTANCE CRITERIA

5.1 The measured heat loss is less than the capacity of the containment cooling subsystem.

Note: Pressurizer heat loss with continuous spray flow to be determined during post-core HFT after spray valve adjustments have been performed.

14.2.12.13.12 Pre-Core Primary System Leak Rate Measurement (Test #172)

1.0 OBJECTIVE

1.1 To measure the RCS leakage at HZP (pressure and temperature) conditions.

2.0 PREREQUISITES

2.1 Hydrostatic testing of the RCS and associated systems has been completed.

2.2 The RCS and the CVCS are operating as a closed system.

2.3 The RCS is at HZP (pressure and temperature) conditions.

2.4 The VCT level is high in the operating band but letdown diversion is not expected during the test.

2.5 The RCDT level is low in the operating band and a pump down is not expected to be necessary during the test.

3.0 TEST METHOD

3.1 Measure and record the changes in water inventory of the RCS and CVCS for a specified interval of time as follows:

3.1.1 Maintain SG levels constant.

3.1.2 Maintain VCT temperature constant.

3.1.3 Maintain RCS temperature constant, if this is not possible make sure that initial and final readings are as close as possible.

3.1.4 Maintain RCS pressure constant, if this is not possible make sure that initial and final readings are as close as possible. May be easier to energize available pressurizer heaters and let the pressurizer spray valves stabilize prior to starting the test.

3.1.5 Maintain pressurizer level constant, if this is not possible make sure that initial and final readings are as close as possible (control letdown flow as necessary).

3.1.6 Measure the final VCT level and determine the equivalent volume change (gallons).

3.1.7 Measure the final RCDT level and determine the equivalent volume change (gallons).

4.0 DATA REQUIRED

4.1 Pressurizer pressure, level, and temperature.

4.2 VCT level, temperature, and pressure.

4.3 Reactor drain tank level, temperature, and pressure.

4.4 RCS temperature and pressure.

4.5 Safety injection accumulator level and pressure.

4.6 Time interval.

5.0 ACCEPTANCE CRITERIA

5.1 Identified and unidentified leakage shall be within the limits described in the Technical Specification as described in Section 16.3.4.12.

5.2 The LDS functions as designed (refer to Section 5.2.5).

14.2.12.13.13 Pre-Core CVCS Integrated Test (Test #173)

1.0 OBJECTIVE

1.1 To verify proper operation of the letdown subsystem and ion exchangers.

2.0 PREREQUISITES

2.1 The CVCS is in operation.

2.2 Selected ion exchanger has been filled with an appropriate resin.

2.3 Selected ion exchanger has been placed into service.

2.4 Ion exchangers not to be used have been bypassed.

2.5 Associated instrumentation has been checked, calibrated, and is functioning satisfactorily prior to performing the test.

3.0 TEST METHOD

3.1 Measure and record the pressure drops across the following:

3.1.1 The ion exchanger (demineralizer).

3.1.2 Reactor coolant filter.

3.1.3 Seal water injection filter.

3.1.4 Seal return filter.

3.1.5 Seal water control valve.

3.1.6 Letdown flow control valve.

4.0 DATA REQUIRED

4.1 Letdown temperature, pressure and flow rates.

4.2 Charging temperature and flow rates.

4.3 Charging pump parameters (i.e., motor power, vibration levels, bearing temperatures).

4.4 Differential pressure across specified components.

4.5 VCT pressure and level.

4.6 Pressurizer level.

4.7 RCS temperature and pressure.

4.8 Regenerative heat exchanger inlet and outlet temperatures:

4.8.1 Shell side.

4.8.2 Tube side.

4.9 High pressure cooler inlet and outlet temperatures:

4.9.1 Shell side.

4.9.2 Tube side.

5.0 ACCEPTANCE CRITERIA

5.1 The CVCS meets design requirements (refer to Section 9.3.4).

14.2.12.13.14 Pre-Core Turbine Overspeed (Test #174)

1.0 OBJECTIVE

1.1 Verify that the manual overspeed trip is functional.

1.2 To demonstrate that the primary and secondary overspeed trip systems protect the turbine as designed.

1.3 To demonstrate electrical independence and redundancy of non-safety-related power supplies.

2.0 PREREQUISITES

2.1 Associated instrumentation has been checked, calibrated, and is functioning satisfactorily prior to performing the test.

2.2 Verify that manual and automatic (electronic) trip functions have been successfully tested (Test #134) with simulated signals.

2.3 RCS at HZP (temperature and pressure) conditions with the corresponding RCS pressure and temperature conditions.

2.4 Turbine overspeed protection is available and functioning properly.

2.5 Manual turbine trip circuits in the control room and at the turbine are functioning properly and are manned throughout the preoperational test.

2.6 Turbine is operating at normal speed but not synchronized to the grid.

3.0 TEST METHOD

3.1 Verify that the primary overspeed trip is functional, not bypassed.

3.2 Make the secondary overspeed trip not functional and verify that the primary overspeed trip remains functional.

3.3 Slowly increase turbine speed until the primary overspeed occurs.

3.4 Verify that when the turbine trip occurs the turbine returns to turning gear.

3.5 Restore to functional the secondary overspeed trip that was previously not functional and make the primary overspeed trip that was previously tested, not functional.

3.6 Verify that the secondary overspeed trip remains functional.

3.7 Slowly increase turbine speed until the secondary electronic overspeed occurs.

3.8 Verify that when the turbine trip occurs the turbine returns to turning gear.

4.0 DATA REQUIRED

4.1 Actual primary turbine trip setpoints.

4.2 Actual secondary turbine trip setpoint.

5.0 ACCEPTANCE CRITERIA

5.1 Verification that the primary and secondary turbine trips occur within the design limits (refer to Section 10.2.2.9).

14.2.12.13.15 Pre-Core Safety Injection Check Valve Test (Test #175)

1.0 OBJECTIVE

1.1 To verify that the SI RCS loop check valves shall pass flow with the RCS at design pressure and temperature conditions.

1.2 To verify that the SI accumulator discharge check valve shall pass flow with the RCS at design pressure and temperature conditions.

2.0 PREREQUISITES

2.1 RCS at HZP (temperature and pressure) conditions with the corresponding RCS pressure and temperature conditions.

2.2 SI accumulators are filled and pressurized to their normal operating conditions.

3.0 TEST METHOD

3.1 Secure four of four SI accumulators by closing the discharge isolation valves.

3.2 Secure three of the four MHSI trains.

3.3 Simulate a SI signal and verify that the protection system reduces RCS pressure to the point that RCS pressure is less than that of the available MHSI pump.

3.4 Verify flow through each of the SI loop check valves as follows:

3.5 Pressurizer level increasing.

3.6 Secure the operating MHSI pump.

3.7 Place into service each MHSI pump one at a time and verify flow by increasing pressurizer level, terminating MHSI pump operation as soon as indication of increasing pressurizer level is observed.

3.8 Verify that RCS pressure is 50 to 100 psig greater than the accumulator pressure.

3.9 Open one of the four SI accumulator discharge isolation valves.

3.10 Slowly reduce RCS pressure until decreasing SI accumulator level is observed.

3.11 Verify flow through the SI accumulator discharge check valves by observing decreasing SI accumulator level and increasing pressurizer level.

3.12 Terminate the discharge flow from the SI accumulator by closing the discharge isolation valve.

3.13 Repeat steps 3.6 through 3.10 for each of the remaining SI accumulators until flow from each accumulator is verified.

4.0 DATA REQUIRED

4.1 SI accumulator level and pressure.

4.2 SI discharge header pressure during MHSI injection.

4.3 Pressurizer pressure and level.

5.0 ACCEPTANCE CRITERIA

5.1 Verification that the RCS loop check valves shall pass flow with the RCS at elevated pressure and temperature conditions.

5.2 Verification that the SI accumulator discharge check valves shall pass flow with the RCS at elevated pressure and temperature conditions.

14.2.12.13.16 Pre-Core Boration and Dilution Measurements (Test #176)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the CVCS to control the boron concentration of the RCS by the feed and bleed method.

1.2 To demonstrate the ability of the CVCS to supply concentrated boric acid to the RCS.

2.0 PREREQUISITES

2.1 BAST is filled to a suitable level with borated water.

2.2 The reactor boron and water makeup system (RBWMS) (i.e., boron addition system) is functional.

2.3 The boron measurement system is functional.

2.4 RCS and CVCS boron concentration is approximately zero (0 ppmB).

3.0 TEST METHOD

3.1 Line up the boric acid pumps to take suction from the BAST and discharge to the charging pump suction and to the RCS, and observe operation of the RBWMS.

3.2 Perform boration and dilution operation of the RCS by operating the boric acid makeup control system in its various modes of operation.

3.3 Sample the RCS during boration and dilution operations and observe operation of the boron measurement system.

4.0 DATA REQUIRED

4.1 RCS temperature and pressure.

4.2 Makeup controller flow readings and setpoints.

4.3 Chemical analysis of boron concentration.

4.4 VCT level.

4.5 Boron measurement system readings.

4.6 Charging flow rates.

4.7 Letdown flow rate.

5.0 ACCEPTANCE CRITERIA

5.1 The RBWMS perform as designed (refer to Section 9.3.4).

14.2.12.13.17 Pre-Core Safety Injection Initiated at HZP (Test #177)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the SI system to inject into a pressurized RCS.

2.0 PREREQUISITES

2.1 The RCS is at HZP (pressure and temperature) conditions.

2.2 The normal RCP trip function on SI injection has been disabled. With no decay heat, the RCS could cool uncontrollably.

3.0 TEST METHOD

3.1 Initiate an SI signal.

4.0 DATA REQUIRED

4.1 The following time dependent data shall be collected at a frequent scan rate:

4.1.1 RCS parameters (temperature and pressure).

4.1.2 SI parameters (e.g., flow, pump discharge pressure, fluid temperature).

4.2 Pressurizer parameters (e.g., pressure, level).

4.3 VCT pressure and level.

4.4 Letdown flow rate.

5.0 ACCEPTANCE CRITERIA

5.1 The safety injection system meets design requirements (refer to Section 6.3).

14.2.12.13.18 Pre-Core Loss of Instrument Air (Test #178)

1.0 OBJECTIVES

1.1 To demonstrate that a reduction and loss of instrument air pressure causes no adverse operation of active safety-related equipment.

2.0 PREREQUISITES

2.1 Construction activities on items to be tested have been completed.

2.2 Individual valves and equipment are functional.

2.3 The instrument air system is in service at rated pressure with support systems functional to the extent necessary to conduct the test. Pneumatic loads are cut-in to the extent possible at the time test begins.

2.4 A listing of the air-operated active safety-related equipment which includes the loss of air failed position and the fail safe position of each component has been compiled.

2.5 This test satisfies the requirements of RG 1.68.3, regulatory positions C.1-C.11.

2.6 Loss-of-air supply tests shall be conducted on branches of the instrument air system simultaneously, if practicable, or on the largest number of branches of the system that can be adequately managed.

3.0 TEST METHOD

3.1 Place the valves in the normal operating position, and maintain plant in as close to normal conditions as it practicable and verify proper operation of the following components:

3.1.1 Compressors.

3.1.2 Aftercoolers.

3.1.3 Oil separator units, if applicable.

3.1.4 Air receivers.

3.1.5 Dryers including a full regeneration cycle, if applicable.

3.1.6 Pressure controls and compressor unloaders.

3.1.7 Pressure reducing stations.

3.1.8 Automatic and manual start / stop circuits of standby compressors.

3.1.9 Controls to change operating sequence of units (spread operating time and starting duty).

3.1.10 High and low pressure alarms.

3.1.11 Pressure indicators.

3.1.12 Temperature indicators.

3.1.13 Safety and relief valve settings.

3.1.14 Bypass valve operation.

3.1.15 Differential pressure switches.

3.2 Where safe to personnel and equipment, conduct a loss of air test on integrated systems by performing the following tests:

3.2.1 Shutoff the instrument air system in a manner that would simulate a sudden air pipe break and verify that the affected components respond as designed.

3.2.2 Repeat Test A, but shut the instrument air system off slowly to simulate a gradual loss of pressure.

3.2.3 Where deemed necessary, depressurize individual components. Note component response.

3.2.4 Return instrument air to the depressurized systems and components. Note responses.

3.2.5 Verify automatic isolations between safety and non-safety or between plant critical and plant non-critical components function as designed.

3.2.6 Simulate worse case loads by simultaneous operation of components or by creating a false parasitic load that bounds estimates of simultaneous operation of worse case loads.

3.2.7 Verify acceptable operation at the full load capacity.

3.2.8 Verify proper operation of alarms and automatic and manual alarm resets.

3.2.9 Verify that the instrument and control air system meet design requirements for the following during normal and maximum conditions:

- Flow.
- Pressure.
- Temperature.
- Air quality (moisture, oil contamination, particulate matter, etc.) using continuous flow techniques or by analyzing a discrete sample.
- System leakage.

3.2.10 Demonstrate that plant equipment designated by design to be supplied by the instrument and control air system is not being supplied by other compressed air supplies (such as service air) that may have less restrictive air quality requirements.

3.2.11 Plant components requiring large quantities of instrument and control air for operation (such as large valve operators) should be operated simultaneously while the system is operating at normal steady-state conditions.

3.2.12 Verify that the backup supplies for the protected loads supplied by the system, e.g., accumulators and backup bottled gas supplies, will maintain sufficient air pressure to permit these loads to perform their design function, if applicable.

4.0 DATA REQUIRED

4.1 Response of systems and components to loss of instrument air and subsequent restoration.

4.1.1 Fail open.

4.1.2 Fail closed.

4.1.3 Fail as is.

4.1.4 Fail upscale.

4.1.5 Fail downscale.

4.1.6 Fail to perform other required functions.

5.0 ACCEPTANCE CRITERIA

5.1 Valves fail to their designated fail position upon loss of air and remain in the design position upon restoration.

5.2 Verify that the air-operated or air-powered loads that are a part of (or support the operation of) portions of the facility respond as designed to a loss of air pressure.

5.3 The instrument air system meets the design requirements described in Section 9.3.1.

14.2.12.13.19 Pre-Core Electrical Distribution System Voltage Verification (Test #226)

1.0 OBJECTIVE

1.1 To demonstrate the analytical techniques and assumptions used in the electrical transient analyzer program (ETAP) model for distribution system voltage analyses are valid.

2.0 PREREQUISITES

2.1 ETAP analyses completed in accordance with BTP 8-6.

2.2 The station distribution buses, including Class 1E buses down to the 120/208 V level, are loaded to at least 30 percent.

3.0 TEST METHOD

3.1 Record the existing grid and Class 1E bus voltages and bus loading down to the 120/208 V level at steady-state conditions and during the start of both a large Class 1E and non-Class 1E motor (not concurrently). The location of the voltage readings is to be determined in accordance with guidance provided in BTP 8-6.

4.0 DATA REQUIRED

4.1 Class 1E bus voltage readings in accordance with BTP 8-6.

5.0 ACCEPTANCE CRITERIA

5.1 Measured bus voltages are not more than 3 percent lower than the analytical results.

5.2 The difference between the measured values and the analytical results, when subtracted from the original analyses, are not less than the Class 1E equipment-rated voltages.

14.2.12.13.20 Pre-Core Protection System Operation (Test #228)

1.0 OBJECTIVE

1.1 To demonstrate proper reactor trip points, logic, and operability of reactor trip breakers and accident mitigation values prior to fuel loading.

1.2 To demonstrate the operability of manual reactor trip functions prior to fuel loading.

2.0 PREREQUISITES

2.1 Preoperational Test #146 Protection System has been completed.

3.0 TEST METHOD

3.1 Verify that Protection System setpoints, including reactor trip setpoints, have been installed and are working as designed.

3.2 Verify that Protection System logic has been verified and is working as designed.

3.3 Verify that Protection System reactor trip breaker trip initiating devices function as designed.

3.4 Verify that Protection System accident mitigating features function as designed.

3.5 Verify that the manual functions of the Protection System perform as designed.

4.0 DATA REQUIRED

4.1 Protection System response times.

5.0 ACCEPTANCE CRITERIA

5.1 The Protection System functions as described in Section 7.1.1.

14.2.12.14 Phase II: Initial Fuel Loading and Precritical Tests

14.2.12.14.1 Initial Fuel Load (Test #179)

1.0 OBJECTIVES

1.1 To specify the prerequisites for initial fuel load.

1.2 To demonstrate that the dissolved boron concentration in the RCS and connected systems are in equilibrium and within the Technical Specification limits.

1.3 To demonstrate that the temporary neutron detector responds when detector is placed in the vicinity of a neutron source.

2.0 PREREQUISITES

2.1 Verify that required pre-core tests have been completed and specify the status of support systems required for fuel loading (e.g., CCW, MHSI, and RHR).

2.2 Permanently installed nuclear instrumentation is calibrated in accordance with regulatory requirements and test procedures. One operating channel should have audible indication or annunciation in the control room (refer to Technical Specification 3.9.2).

2.3 Test instrumentation is available and installed in accordance with plant requirements and calibrated per the calibrated tool program.

2.4 Permanent and temporary neutron detectors that are being used to monitor the core load have been energized for greater than 60 minutes, to allow time for electronic stabilization.

2.5 A core load sequence has been developed that meets the AREVA fuel load guidelines.

2.6 Boron samples from available sources have been confirmed to contain a boron isotopic abundance and concentration that is greater than that assumed in the safety analyses (refer to Technical Specification 3.9.1).

2.7 Plant systems required for initial fuel loading are turned over to operations and have been aligned per operations procedures.

2.8 Verify that the reactor vessel water level is greater than the reactor hot legs and is being circulated by the RHRS.

2.9 A portable neutron source is available for checking the response of neutron detectors.

2.10 Specify the composition, duties, and emergency procedure responsibilities of the fuel handling crew. Expectations should include actions to be taken upon loss of communications between fuel handling personnel or between the fuel handling personnel and the main control room.

2.11 Test the radiation monitors, nuclear instrumentation, manual initiation, and other devices, and verify that they are operable to actuate the building evacuation alarm and ventilation control.

2.12 Conduct receipt inspections of fuel, rod cluster control assemblies (RCCAs), thimble plugs, and instrument lances.

2.13 Perform a response check of nuclear instruments to a neutron source within 12 hours prior to loading (or resumption of loading, if delayed for 12 hours or more).

2.14 Verify that containment closure meets Technical Specification requirements for fuel loading.

2.15 Verify that the lower internals are installed in the vessel and the upper internals are located in the storage stand.

2.16 The boron dilution mitigation system meets the design requirements (refer to Technical Specifications 3.1.8 and 3.3.1).

2.17 Verify that the fuel handling system testing is completed satisfactorily (Test #038).

2.18 Verify that the Protection System meets Technical Specification requirements.

2.19 Perform chemistry sampling of the RCS and verify compliance with the AREVA chemistry specifications.

3.0 TEST METHOD

3.1 Collect representative boron samples from four different vessel elevations and connected auxiliary systems.

3.2 Continue sampling the circulated volume until the boron concentration at each location is within ± ten ppmB.

3.3 Periodically (no more than every eight hours) verify that each of the permanent and temporary detectors that are being used to monitor the fuel load respond to neutrons from the source.

3.4 Monitor neutron counts during the load of each fuel assembly and plot an independent inverse count rate ratio "ICRR" for each source range detector. Monitoring of neutron counts, at least once every 15 minutes, must continue during periods when fuel loading is interrupted.

3.5 Maintain a display for indicating the status of the core and fuel pool, as well as appropriate records of core loading.

3.6 Maintain constant communication between fuel handling personnel and the main control room.

3.7 Verify that each fuel assembly, RCCA, and thimble plug is in the specified design location.

4.0 DATA REQUIRED

4.1 Boron sample data.

4.2 Log of neutron counts and plot of ICRR, with data point for each loaded fuel assembly.

4.3 As-built core load map.

5.0 ACCEPTANCE CRITERIA

5.1 ICRR does not show significant approach to criticality.

14.2.12.14.2 Post-Core Sequencing Document (Test #180)

1.0 OBJECTIVE

1.1 To verify system function of systems impacted by fuel load, prior to Mode 2 and Mode 1 operation.

1.2 To demonstrate the proper integrated operation of plant systems with fuel assemblies loaded in the core.

2.0 PREREQUISITES

2.1 Required pre-core tests have been completed.

2.2 Permanently installed instrumentation on systems to be tested is available and calibrated in accordance with regulatory requirements and test procedures.

2.3 Test instrumentation is available and installed in accordance with plant requirements and calibrated per the calibrated tool program.

2.4 Fuel loading has been completed.

2.5 The CRDMs and the CRDM control system are functional.

2.6 The SGs are in wet lay-up in accordance with the secondary water chemistry program.

3.0 TEST METHOD

3.1 Establish the specific plant conditions required by each procedure while maintaining Technical Specification operability.

3.2 Coordinate the execution of tests to prevent unanalyzed configurations.

4.0 DATA REQUIRED

4.1 As specified by the individual post-core tests.

5.0 ACCEPTANCE CRITERIA

5.1 Tests are completed within Technical Specification limitations.

14.2.12.14.3 Post-Core Loose Parts Monitoring Baseline (Test #181)

1.0 OBJECTIVE

1.1 To obtain baseline data on the loose parts and vibration monitoring systems.

1.2 To eliminate nuisance alarms during normal operation.

2.0 PREREQUISITES

2.1 Pre-functional tests on the loose parts and vibration monitoring systems have been completed.

2.2 The loose parts and vibration monitoring systems instrumentation has been calibrated and is functional.

3.0 TEST METHOD

3.1 Collect baseline data using the loose parts and vibration monitoring systems during plant heatup and at normal operating conditions.

3.2 Analyze baseline data and, if necessary, adjust alarm setpoints.

4.0 DATA REQUIRED

4.1 Baseline data using the loose parts and vibration monitoring systems.

4.2 Loose parts and vibration monitoring systems alarm setpoints.

4.3 RCS temperature and pressure.

5.0 ACCEPTANCE CRITERIA

5.1 The loose parts and vibration monitoring systems perform as designed (refer to Section 7.1.1).

5.2 The loose parts and vibration monitoring systems alarm setpoints have been adjusted using the baseline data.

14.2.12.14.4 Post-Core RCS Temperature Cross Calibration (Test #182)

1.0 OBJECTIVE

1.1 To normalize the RCS temperature transmitters.

1.2 To measure post-core RCS pressure drops.

2.0 PREREQUISITES

2.1 Construction activities have been completed and the RCS is operational or functional as required by regulatory requirements.

2.2 Permanently installed temperature instrumentation is calibrated and functional or operable, as required.

2.3 The RCS is operating at nominal 350°F conditions with RHR removed from service.

2.4 Test #188 has measured the resistance of the thermocouples.

3.0 TEST METHOD

3.1 Collect T_{cold} and T_{hot} data from each RCS RTD.

3.2 Collect core exit thermocouple data from each thermocouple located in the core area.

3.3 Slowly increase RCS temperature and collect data at 50°F increments.

3.4 Perform the cross-calibration of the RCS RTDs.

3.5 Verify that the RCS temperature indication meets design requirements for correlation between the various sources.

4.0 DATA REQUIRED

4.1 The following data shall be recorded with a frequent scan rate and time stamped.

4.1.1 RCS T_{cold} data.

4.1.2 RCS T_{hot} data.

4.1.3 RCS core exit thermocouple data for each functional thermocouple.

5.0 ACCEPTANCE CRITERIA

5.1 The RCS RTD data has been incorporated into the RTD calibration procedures.

14.2.12.14.5 Post-Core Reactor Coolant System Flow Baseline (Test #183)

1.0 OBJECTIVE

1.1 To normalize the RCS flow transmitters.

1.2 To determine the RCP flow coastdown characteristics.

1.3 To measure post-core RCS pressure drops.

1.4 To collect flow related data on the operation of the RCPs for steady-state and transient conditions.

1.5 To collect post-core RCP coastdown data.

2.0 PREREQUISITES

2.1 Construction activities have been completed and the RCS is operational or functional as required by regulatory requirements.

2.2 Permanently installed instrumentation is calibrated and functional or operable, as required.

2.3 Temporary test instrumentation is calibrated and installed in a manner that complies with Technical Specification limitations. The test instrumentation shall be installed to collect RCS pressures at accessible locations around the RCS.

2.4 The RCS is operating at nominal HZP (pressure and temperature) conditions.

3.0 TEST METHOD

3.1 Verify that the RCS flow indications are normalized at 100 percent RCS flow.

3.2 Record indicated RCS flow data for functionally allowed RCP combinations.

3.3 Record RCS pressures that have been corrected for the same reference elevation as the permanently installed instrumentation. Coordinate data timestamps with permanent plant instrumentation.

3.4 Measure the RCS flow coastdown data while tripping various RCPs.

3.5 Measure RCP coastdown data for each RCP during a simultaneous four pump coastdown.

3.6 Verify that operating restrictions for RCP restart are followed.

4.0 DATA REQUIRED

4.1 The following data shall be recorded with a frequent scan rate and time stamped:

4.1.1 RCS flow related data.

4.1.2 RCP speed for pumps.

4.1.3 RCS pressure at permanent and temporary instrumentation locations.

4.1.4 RCS temperature.

4.1.5 RCP breaker status.

4.1.6 RCP coastdown speed.

5.0 ACCEPTANCE CRITERIA

5.1 RCS flow loops indications are normalized to 100 percent.

5.2 The data from this test has been correlated with the RCS model that was used to predict RCS flow.

5.3 The simultaneous four RCP coastdown data has been compared with data used in the accident analyses and the data (duration of coastdown) meets accident analysis assumptions.

14.2.12.14.6 Post-Core Control Rod Drive Mechanism Performance (Test #184)

1.0 OBJECTIVE

1.1 To demonstrate that operation of the CRDMs at HZP (pressure and temperature) conditions meets design requirements.

1.2 To demonstrate the as designed operation of the RCCAs, including RCCA drop times, at cold conditions with all four RCPs in operation.

1.3 To demonstrate the as designed operation of the RCCAs, including RCCA drop times, at HZP (pressure and temperature) conditions with all four RCPs in operation.

1.4 To demonstrate as designed operation of the RCCA position indicating system and alarms.

2.0 PREREQUISITES

2.1 The CRDM (Rod Pilot) pre–core performance test has been completed.

2.2 The CRDM (Rod Pilot) instrumentation is functional and calibrated.

2.3 The plant monitoring system is functional.

2.4 The CRDM cooling system (i.e., containment pit cooling) is functional.

2.5 CRDM coil resistance values have been measured.

3.0 TEST METHOD

3.1 Withdraw and insert each RCCA to verify as designed operation of CRDM.

3.2 Measure and record at least three drop times for each RCCA:

3.2.1 Perform three measurements of rod drop time for each of those RCCAs falling outside the two-sigma limit for similar RCCAs.

3.3 Withdraw and insert each RCCA while recording position indications and alarms.

4.0 DATA REQUIRED

4.1 RCCA drop time.

4.2 RCS temperature and pressure to be taken during measurement and recording of drop time for each RCCA.

4.3 RCCA position and alarm indications.

5.0 ACCEPTANCE CRITERIA

5.1 The CRDM, RCCAs and their associated position indications operate as designed (refer to Section 4.6).

5.2 RCCA drop times are in agreement with the limits specified in accident analyses, with margin or as specified in regulatory documents.

14.2.12.14.7 Post-Core Reactor Coolant and Secondary Water Chemistry Data (Test #185)

1.0 OBJECTIVE

1.1 To maintain the proper water chemistry for the RCS and SGs during post-core heatup.

2.0 PREREQUISITES

2.1 Primary and secondary sampling systems are functional.

2.2 Primary and secondary chemical addition systems are functional.

2.3 The coolant purification ion exchangers are charged with resin.

2.4 The SG blowdown demineralizing ion exchangers are charged with resin.

2.5 Chemicals to support cleanup are available.

3.0 TEST METHOD

3.1 Perform sampling frequency for the SG and RCS as specified by the AREVA chemistry specifications. The sampling frequency shall be modified as required to make sure the as-designed RCS and SG water chemistry.

3.2 Perform RCS and SG sampling and chemistry analysis after every significant change in plant conditions (i.e., heatup, cooldown, chemical additions).

4.0 DATA REQUIRED

4.1 Plant conditions.

4.2 SG chemistry analysis.

4.3 RCS chemistry analysis.

5.0 ACCEPTANCE CRITERIA

5.1 RCS and SG water chemistry can be maintained within the AREVA primary and secondary limits.

5.2 Baseline data for the SGs and RCS is established.

14.2.12.14.8 Post-Core Pressurizer Spray Valve and Control Adjustments (Test #186)

1.0 OBJECTIVE

1.1 To establish the proper settings of continuous spray valves (i.e., bypass valves).

1.2 To measure the rate at which pressurizer pressure can be reduced using pressurizer spray.

2.0 PREREQUISITES

2.1 The RCS is being maintained at HZP (pressure and temperature) conditions.

2.2 Permanently installed instrumentation, associated with this test, is functional, calibrated, and is operating satisfactorily prior to performing the following test.

2.3 Pressurizer surge line insulation is installed in the configuration that is anticipated for plant operation.

3.0 TEST METHOD

3.1 Secure pressurizer heaters except the proportional band heaters. Continuously monitor the proportional heater output throughout the remainder of the test.

3.2 Secure the spray valves, so that the only flow through the spray header and the pressurizer surge line is passing through the continuous spray valves.

3.3 Adjust the continuous spray valves to just clear the minimum pressurizer surge line temperature. Verify that both continuous spray valves are open approximately the same amount.

3.4 Determine the remaining proportional band heater capacity and adjust the continuous spray valves until only 50 percent of the previously determined margin remains. Verify that both continuous spray valves are open approximately the same amount.

3.5 Using various combinations of pressurizer spray valves, measure and record the rate at which the pressurizer pressure can be reduced.

4.0 DATA REQUIRED

4.1 RCS temperature and pressure.

4.2 Pressurizer surge line temperature.

4.3 Pressurizer proportional heater output with the pressurizer spray valves closed.

4.4 Continuous spray valve settings.

4.5 Pressurizer pressure and pressurization spray valve positions during depressurization.

5.0 ACCEPTANCE CRITERIA

5.1 The pressurizer meets design requirements (refer to Section 5.4.10).

14.2.12.14.9 Post-Core Reactor Coolant System Leak Rate Measurement (Test #187)

1.0 OBJECTIVE

1.1 To measure the RCS leakage at HZP (pressure and temperature) conditions. In general, it is better to measure leakage over a one hour period unless VCT makeup precludes test duration of one hour.

1.2 To distinguish between identified and unidentified leakage, refer to Chapter 16, SR 3.4.12.1.

2.0 PREREQUISITES

2.1 The RCS is at HZP (pressure and temperature) conditions.

2.2 The RCS and the CVCS are operating normally with no makeup or letdown diversion.

2.3 The VCT level is high enough to prevent makeup during the test.

2.4 Permanently mounted instrumentation is calibrated and is operating satisfactorily prior to performing the following test.

2.5 Verify that one containment sump level monitor is available. This monitor meets the requirements of Chapter 16 LCO 3.4.14 a. Note that this monitor can only detect RCS leakage that occurs in the containment.

2.6 Verify preoperational Test #143 has been satisfactorily completed for radiation monitoring instrumentation.

2.7 Verify that radiation Monitor R-10 is available for subsequent RCS leakage tests that will be performed at power (refer to Table 11.5-1, Footnote 16). Monitor R-10 meets the requirements of Chapter 16 LCO 3.4.14.b. Note that this monitor can only detect radioactive reactor coolant pressure boundary leakage that occurs in the containment atmosphere.

2.8 Verify that one containment air cooler condensate flow rate monitor is available. This monitor meets the requirements of Chapter 16 LCO 3.4.14 c. Note that this monitor can only detect RCS leakage that occurs in the containment.

3.0 TEST METHOD

3.1 Convert mass changes to gallons of water at normal atmospheric conditions (pressure and temperature).

3.2 Measure changes in water inventory of the RCS as follows:

3.2.1 Record mass changes in the pressurizer due to temperature and level changes.

3.2.2 Record mass changes due to RCS pressure and temperature changes.

3.3 Measure changes in water inventory of the CVCS and connected systems as follows:

3.3.1 Record mass changes in the VCT due to temperature and level changes.

3.3.2 Record mass changes in the RCDT due to level changes.

3.3.3 Record mass changes in the passive SI accumulators due to temperature and level changes. If SI accumulator mass has not increased it shall be ignored in the RCS leakrate calculation.

3.4 Determine total leakage, identified leakage (i.e., leakage into identifiable sources) and unidentified leakage (e.g., leakage into the

containment atmosphere and other, valve packing and other paths that include leakage from non–RCS sources).

3.5 Demonstrate proper response of radiation monitors that are used to determine RCS leakage by comparing calculated values to the radiation monitor estimated leakage values.

4.0 DATA REQUIRED

4.1 Pressurizer pressure, level, and temperature.

4.2 VCT level, temperature, and pressure.

4.3 RCDT level, temperature, and pressure.

4.4 RCS temperature and pressure.

4.5 SI Accumulator level and pressure.

4.6 Time interval.

5.0 ACCEPTANCE CRITERIA

5.1 Identified and unidentified leakage shall be within the limits described in Technical Specification 3.4.12 and design leakage rates described in Section 5.2.5.

5.2 The instrumentation that is used detects and monitors unidentified leakage inside the Containment Building is available (refer to Section 5.2.5 and Chapter 16, LCO 3.4.14):

5.2.1 Containment sump level monitor.

5.2.2 Containment atmosphere radiation monitor (refer to Section 11.5.4.8 and Table 11.5-1, Footnote 16 for Monitor R-10).

5.2.3 Containment air cooler condensate monitor.

14.2.12.14.10 Post-Core Incore Instrumentation (Test #188)

1.0 OBJECTIVE

1.1 To measure the leakage resistance of the fixed incore detectors.

1.2 To demonstrate that the incore thermocouples are functional (refer to Section 7.1.1.5.2 for a description of fixed thermocouples).

2.0 PREREQUISITES

2.1 Permanently installed instrumentation is calibrated and is operating satisfactorily prior to performing the following test.

2.1.1 The calibration will demonstrate that currents generated by the thermocouples will be accurately translated into temperature indications.

2.2 Special test equipment for measurement of thermocouple resistance is available and calibrated.

2.3 The reactor is at 350°F conditions.

3.0 TEST METHOD

3.1 Measure and record the leakage resistance of each incore detector. This step can be performed at a lower RCS temperature than 350°F but the test can not be completed until the various temperature indications are compared at 350°F.

3.2 Verify that the core exit thermocouples indicate a temperature that corresponds to 350°F.

3.3 Increase RCS temperature by 50°F and collect corresponding thermocouple and RTD data.

3.4 Repeat data collection until RCS temperature is ≥568°F.

4.0 DATA REQUIRED

4.1 RCS temperature and pressure.

4.2 Leakage resistance measurements.

4.3 Plant monitoring system readout.

5.0 ACCEPTANCE CRITERIA

5.1 Leakage resistance of the fixed incore detectors is as described in manufacturer's recommendations.

5.2 The calibration of the thermocouples meets the requirements of 10 CFR 50.34(f)(2)(viii).

14.2.12.14.11 Leak Detection Systems (Test #189)

1.0 OBJECTIVE

1.1 To obtain baseline data on the LDS.

1.2 To adjust leak detection alarm setpoints as necessary to reflect actual plant operational conditions.

2.0 PREREQUISITES

2.1 Preoperational test (Test #137) on the LDS has been completed.

2.2 The leak detection instrumentation has been calibrated and is functional.

3.0 TEST METHOD

3.1 Collect baseline data using the LDS during plant heatup and at normal operation.

4.0 DATA REQUIRED

4.1 Leak detection baseline data.

4.2 RCS temperature and pressure.

5.0 ACCEPTANCE CRITERIA

5.1 Performance of the LDS is as designed (refer to Sections 3.6.3.7 and 5.2.5).

5.2 The leak detection alarm setpoints have been adjusted using the baseline data.

14.2.12.15 Phase III: Initial Criticality and Low Power Physics Tests

14.2.12.15.1 Critical Boron Concentration: All Rods Out (Test #190)

1.0 OBJECTIVE

1.1 To measure the HZP critical boron concentration with rods fully withdrawn.

2.0 PREREQUISITES

2.1 Verify that support systems required for initial criticality are available.

2.2 Verify that nuclear instrumentation (source range, intermediate range, and power range) are available for use during initial criticality and been calibrated per Technical Specification requirements.

2.3 Required control rod testing, including rod drop timing, has been completed prior to initial criticality.

2.4 The boron dilution mitigation system meets the design requirements (refer to Technical Specifications 3.1.8 and 3.3.1).

2.5 Verify that the Protection System meets Technical Specification requirements.

2.6 Perform chemistry sampling of the RCS and verify compliance with the AREVA chemistry specifications.

2.7 The initial criticality procedure includes steps to demonstrate that the startup will proceed in a deliberate and orderly manner, changes in reactivity will be continuously monitored, and inverse multiplication plots will be maintained and interpreted. Individual plots of inverse count rate ratio “ICRR” will be generated for each source and intermediate range detector. New points will be plotted for selected control rod positions and each boron concentration sample.

2.8 The estimated critical position (control rod position and boron concentration) will be calculated and the 1000 pcm early criticality window (refer to Technical Specification 3.1.1) will be established. If criticality occurs prior to reaching the early criticality window the operator will take conservative actions.

2.9 The shutdown banks have been fully withdrawn and the control banks are withdrawn in proper sequence and overlap.

2.10 A neutron count rate (of at least ½ count per second) should register on startup channels before the startup begins, and the signal-to-noise ratio should be greater than two.

2.11 A maximum acceptable startup rate limit (less than 30 second period) should be established by control room personnel and conservative actions taken if the startup rate is exceeded.

2.12 The intermediate and power range high flux trips should be set at 5 to 8% reactor power.

2.13 The control banks are fully withdrawn except for the control bank D, which is 50 pcm to 200 pcm inserted.

2.14 Available pressurizer heaters are energized.

2.15 The reactivity computer is functional.

3.0 TEST METHOD

3.1 The reactor is taken critical by boron dilution method.

3.2 Reactor power is below the point of adding heat.

3.3 Verify that just critical reactor is maintained by rod movement until boron concentration is stabilized and boron sample results are recorded.

3.4 Verify that rods are fully withdrawn except for the control bank, which is 50 pcm to 200 pcm inserted. If rod position is no longer within required limits borate or dilute as necessary to restore rod position and return to previous step.

3.5 Measure critical boron concentration in a known reactivity configuration using an approved method.

4.0 DATA REQUIRED

4.1 Critical conditions:

4.1.1 Boron concentration (i.e., RCS and pressurizer).

4.1.2 RCCA positions.

4.1.3 RCS temperature.

4.1.4 Pressurizer pressure.

5.0 ACCEPTANCE CRITERIA

5.1 The measured critical boron concentration when compared to the predicted boron concentration is within the acceptance criteria.

14.2.12.15.2 Isothermal Temperature Coefficient (Test #191)

1.0 OBJECTIVE

1.1 To measure the isothermal temperature coefficient (ITC) for the reactor.

2.0 PREREQUISITES

2.1 Available pressurizer heaters are energized.

2.2 The reactor is critical with a stable boron concentration, RCS temperature and pressure.

2.3 The rods are fully withdrawn except for the control bank, which is 50 pcm to 200 pcm inserted.

2.4 The reactivity computer is functional.

2.5 Reactor power is below the point of adding heat.

3.0 TEST METHOD

3.1 Introduce changes in RCS temperature while measuring the resultant changes in reactivity.

3.2 Measure isothermal temperature coefficient in a known reactivity configuration using an approved method.

4.0 DATA REQUIRED

4.1 Critical conditions:

4.1.1 Pressurizer pressure.

4.1.2 RCCA configuration.

4.1.3 Boron concentration (i.e., RCS and Pressurizer).

4.1.4 Time dependent information:

- Reactivity.
- RCCA position.
- Temperature.

5.0 ACCEPTANCE CRITERIA

5.1 The measured ITC when compared to the predicted ITC is within the acceptance criteria.

14.2.12.15.3 Rod Worth (Test #192)

1.0 OBJECTIVE

1.1 To measure the integral and differential worth of the reference bank (the test bank with the highest predicted worth).

1.1.1 The worth of the reference bank will be measured from the nearly full withdrawn position to the fully withdrawn position, approximately 100 pcm from fully withdrawn, with the reactivity computer.

1.1.2 The integral and differential worth of the reference bank will be measured by the reactivity computer during a slow dilution that terminates with the reference bank nearly fully inserted, approximately 100 pcm from fully inserted.

1.1.3 The worth of the reference bank will be measured from the nearly full inserted position to the fully inserted position with the reactivity computer.

1.2 To measure the worth of the RCCA with the highest worth.

1.2.1 Measure the integral RCCA worth by rod swap.

1.3 To measure the worth of the Partial Trip Bank.

1.3.1 Measure the integral Partial Trip Bank worth by rod swap.

1.4 To measure the worth of the remaining RCCA test banks.

1.4.1 Measure the integral worth of the remaining test banks using rod swap.

2.0 PREREQUISITES

2.1 The reactor is critical.

2.2 All available pressurizer heaters are energized.

2.3 The reactivity computer is operating.

2.4 Reactor power is below the point of adding heat.

2.5 The reactivity computer is available for measuring reactivity (pcm).

3.0 TEST METHOD

3.1 Measure the worth of the reference bank from the nearly full withdrawn position to the fully withdrawn position using the reactivity computer.

3.2 Measure the integral and differential worth of the reference bank using the reactivity computer during a slow dilution that terminates with the reference bank nearly fully inserted.

3.3 Measure the worth of the reference bank to the fully inserted position with the reactivity computer.

3.4 Measure the integral worth of the RCCA with the highest worth using rod swap in accordance with RG 1.68 Appendix A, item e.

3.5 Measure the integral worth of the Partial Trip Bank using rod swap.

3.6 Measure the integral worth of the remaining test banks using rod swap.

4.0 DATA REQUIRED

4.1 Conditions of the measurement:

4.1.1 RCS temperature.

4.1.2 Pressurizer pressure.

4.1.3 RCCA configuration.

4.1.4 Boron concentration.

4.2 Time dependent information:

4.2.1 Reactivity variation.

4.2.2 RCCA positions.

5.0 ACCEPTANCE CRITERIA

5.1 The worth of the reference bank is within 10% of predicted value.

5.2 The worth of the highest worth RCCA is bounded by the value used in the rod ejection analysis (pseudo-rod-ejection test).

5.3 The worth of the Partial Trip Bank is within 15% of the predicted value.

5.4 The worth of the remaining test banks is within 15% of the predicted values.

14.2.12.16 Phase IV: Power Ascension Tests, 5 Percent Power Ascension Plateau

Some of the following tests are performed in more than one plateau. In those instances the test is listed in the first plateau that it is recommended to be performed. The plant instrumentation shall be functional prior to each test.

14.2.12.16.1 Low Power Biological Shield Survey (Test #193)

1.0 OBJECTIVE

1.1 To measure radiation in accessible locations of the plant outside of the biological shield.

1.2 To obtain baseline levels for comparison with future measurements of level buildup with operation.

2.0 PREREQUISITES

2.1 Radiation survey instruments are calibrated and operating satisfactorily prior to performing the following test.

2.2 Background radiation levels have been measured in designated areas prior to initial criticality.

3.0 TEST METHOD

3.1 Measure gamma and neutron dose rates while holding reactor power at the specified power plateau.

4.0 DATA REQUIRED

4.1 Reactor power level.

4.2 Gamma and neutron dose rates at each specified location.

5.0 ACCEPTANCE CRITERIA

5.1 The biological shield in containment meets design requirements (refer to Section 12.3.2.2).

14.2.12.16.2 Comparison of Control Systems and Design Predictions (Test #194)

1.0 OBJECTIVE

1.1 To compare measured plant parameters with predicted values (i.e., design models).

1.2 To compare control room indications with those collected from field sensors (i.e., transmitters) remotely.

1.3 This procedure shall be repeated at the following plateaus:

1.3.1 ≤ 5 percent reactor power.

1.3.2 25 percent reactor power in accordance with RG 1.68.

1.3.3 50 percent reactor power in accordance with RG 1.68.

1.3.4 75 percent reactor power.

1.3.5 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The plant is operating at the desired power level with equilibrium xenon conditions.

2.2 The following systems are in automatic operation:

2.2.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

2.2.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.2.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.2.4 Primary and secondary temperature controls (e.g., RCS T_{avg}).

3.0 TEST METHOD

3.1 Monitor the trend data for parameters listed in the previous step. Determine if parameters are within design tolerances.

3.2 Collect data from transmitters in the field and compare the local parameters with indications displayed on PICS and SICS. The intent is not to verify each transmitter, but rather sample various types and applications.

3.3 Verify that plant indications meet design predictions or that discrepancies are investigated and dispositioned.

4.0 DATA REQUIRED

4.1 Time stamped data with a short scan rate:

4.1.1 Power measurements (e.g., including thermal power, AO, DNB, LPD).

4.1.2 Boron concentration.

4.1.3 RCS parameters (e.g., temperature, flow).

4.1.4 Pressurizer pressure and level.

4.1.5 SG pressures and levels.

4.1.6 RCP speeds and differential pressures.

4.1.7 Turbine-generator output.

4.1.8 Secondary performance data.

5.0 ACCEPTANCE CRITERIA

5.1 The measured plant parameters are within established tolerances of the design model.

5.2 If the measured parameter is outside of the established tolerances a condition report has been generated to investigate the difference. Reactor power will not be increased until the issue has been evaluated and plant management concurs that power may be increased.

14.2.12.16.3 Main, Startup and Emergency Feedwater Systems (Test #195)

1.0 OBJECTIVE

1.1 To record the operation of the following feedwater supplies during normal and transient conditions (e.g., plant trips, load swings):

1.1.1 Main feedwater.

1.1.2 Startup feedwater.

1.1.3 EFWS.

1.2 This procedure shall be repeated at the following plateaus:

1.2.1 ≤5 percent reactor power.

1.2.2 25 percent reactor power.

1.2.3 50 percent reactor power.

1.2.4 75 percent reactor power.

1.2.5 ≥98 percent reactor power.

1.3 Verify the absence of thermal stratification in the main feedwater lines.

2.0 PREREQUISITES

2.1 Establish list of parameters that indicate satisfactory feedwater operation. The list shall include as a minimum the following:

2.1.1 Feedwater pump status for each pump.

2.1.2 Feedwater flow, temperature, and pressure.

2.1.3 SG level, pressure, and component noise/vibration.

2.1.4 Reactor power, RCCA position, and RCS temperatures.

2.2 Install temporary instrumentation as necessary to measure system vibration in transient conditions.

2.3 Install temporary instrumentation to monitor thermal stratification on at least three sections of horizontal piping on each of the following systems:

2.3.1 Main feedwater.

- Fast Response RTD on top of horizontal piping section with ability to monitor locally.
- Fast response RTD on bottom of horizontal piping section with ability to monitor locally.

2.3.2 Startup feedwater.

- Fast response RTD on top of horizontal piping section with ability to monitor locally.
- Fast response RTD on bottom of horizontal piping section with ability to monitor locally.

2.3.3 EFWS.

- Fast response RTD on top of horizontal piping section with ability to monitor locally.
- Fast response RTD on bottom of horizontal piping section with ability to monitor locally.

3.0 TEST METHOD

3.1 Performance of the feedwater systems shall be monitored during standby, normal operation, transients, and trips.

3.2 Operate systems in a manner to include a full range of flows, including minimum and maximum conditions.

3.3 Check for water hammer noise using appropriately placed personnel or check for water hammer vibration using suitable instrumentation.

3.4 Check for signs of thermal stratification during periods of no or very low flow using the temporary installed instrumentation.

3.5 Verify that the following feedwater systems are capable of removing decay heat, residual heat from the metal mass, and RCP heat following shutdown:

3.5.1 Startup and shutdown feedwater.

3.5.2 Emergency feedwater.

3.6 Verify that the turbine bypass system is capable of removing residual heat (this step is only applicable at the 25% plateau).

3.7 Verify that the atmospheric dump valves are capable of removing residual heat (this step is only applicable at the 25% plateau).

4.0 DATA REQUIRED

4.1 Conditions of the measurement:

4.1.1 Reactor power.

4.1.2 RCS temperatures.

4.1.3 Pressurizer pressure.

4.1.4 SG levels and pressures.

4.1.5 Steam and feedwater flows.

4.1.6 Feedwater temperature and pressure.

4.1.7 RCCA position.

4.2 Attach a copy of isometric drawings to indicate the areas where thermal stratification instrumentation was installed.

5.0 ACCEPTANCE CRITERIA

5.1 The main, startup and EFWS perform as designed (refer to Section 10.4.7).

5.2 No effects due to water hammer are detected.

5.3 Thermal stratification is not detected.

5.4 The following feedwater systems demonstrate the design capability to remove decay heat, residual heat from the metal mass, and RCP heat following a reactor trip:

5.4.1 Startup and shutdown feedwater.

5.4.2 Emergency feedwater.

14.2.12.16.4 Natural Circulation (Test #196)

A COL applicant that references the U.S. EPR certified design will either perform the natural circulation test (Test #196) or provide justification for not performing the test.

The need to perform the test will be based on evaluation of previous natural circulation test results and a comparison of reactor coolant system (RCS) hydraulic resistance coefficients applicable to normal flow conditions. Justification for not performing the test will be based on the following:

- Test results from the U.S. EPR reference prototype plant indicate that natural circulation flow rates are adequate for core decay heat removal, boron mixing, plant cooldown/ depressurization, and stable natural circulation conditions are maintained throughout the test.
- As-built plant and the U.S. EPR reference prototype plant configurations are the same relative to the general configuration of the piping and components in each reactor coolant loop, the general arrangement of the reactor core and internals, and similar elevation head represented by these components and the system piping.
- Hydraulic resistance coefficients applicable to normal flow conditions and temperature data, and loss of coolant flow delay-time data (as measured during the RCS flow measurement and coastdown test data in the post-core RCS flow baseline test (Test #183)) are comparable with the reference prototype plant.
- Results of the natural circulation test from the U.S. EPR reference prototype plant are incorporated into a plant-referenced simulator that meets the requirements of 10 CFR 55.46(c) and used in the operator training program to provide training on plant evaluation and abnormal events for each operating shift.

1.0 OBJECTIVE

1.1 To confirm that natural circulation flow shall remove decay heat from the reactor (no forced circulation from the RCPs).

1.2 To confirm boron mixing occurs under natural circulation conditions.

1.3 To determine the response to a sudden loss of forced RCS flow. This procedure shall be performed at the following plateau:

1.3.1 Less than or equal to five percent reactor power in accordance with RG 1.68.

1.3.2 The natural circulation test shall be performed with emergency feedwater providing water to the steam generators.

2.0 PREREQUISITES

2.1 The reactor is operating at the required power level.

2.2 RCS and pressurizer samples have determined the boron concentration.

2.3 Verify that natural circulation flow is adequate to remove decay heat equivalent to ≤ 5 percent reactor power following a reactor trip.

3.0 TEST METHOD

3.1 Secure operating RCPs.

3.2 Verify that the emergency feedwater system is capable of removing residual heat from the metal mass and simulated end of core life decay heat. The core remains critical at ≤ 5 percent reactor power until natural circulation is established and core is made subcritical.

3.3 Verify that the reactor is operating at ≤ 5 percent rated thermal power prior to injecting boric acid to establish the reactor in a subcritical state.

3.4 Reduce the RCS pressure using the CVCS auxiliary pressurizer spray.

3.5 Continuously sample the RCS and the pressurizer while monitoring the boron trend on the boron monitor.

3.6 Continuously inject boron until adequate shutdown margin is achieved.

3.7 Initiate a reactor trip after verifying that the reactor has been verified to be in a subcritical state via boron injection.

4.0 DATA REQUIRED

4.1 The following data shall be collected at a short sampling frequency:

4.1.1 RCS Temperature.

4.1.2 Pressurizer pressure and level.

4.1.3 SG levels and pressure.

4.1.4 RCS boron concentration and isotopic abundance of boron-10.

5.0 ACCEPTANCE CRITERIA

5.1 The natural circulation power to flow ratio is less than 1.0.

5.2 The RCS can be borated while in natural circulation.

5.3 The emergency feedwater system demonstrates the capability to remove residual heat from the metal mass and simulated end of core life decay heat, using steam generators with no forced RCS flow.

14.2.12.16.5 Control Systems Checkout (Test #199)

1.0 OBJECTIVE

1.1 To verify that the control systems not required for safety are controlling the plant in a manner that does not challenge safety limits established by the protection system computer.

1.2 To demonstrate that the automatic control systems operate satisfactorily during steady-state conditions. The control systems shall control plant parameters in manner that minimizes oscillations of

critical parameters (e.g., SG level, FW flow, rod position, turbine load) when in automatic.

1.3 To demonstrate that the automatic control systems operate satisfactorily during transient conditions. When a control parameter is perturbed it shall return to steady-state as soon as practical. The control systems shall control plant parameters in manner that minimizes oscillations of critical parameters (e.g., SG level, FW flow, rod position, turbine load, hotwell level, letdown flow controls) when in automatic.

1.4 To determine the plant response to a sudden change in electrical generator output. This procedure shall be repeated at the following plateaus:

1.4.1 ≤5 percent reactor power in accordance with RG 1.68.

1.4.2 25 percent reactor power in accordance with RG 1.68.

1.4.3 50 percent reactor power in accordance with RG 1.68.

1.4.4 75 percent reactor power in accordance with RG 1.68.

1.4.5 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The reactor is operating at the desired conditions and equilibrium core conditions exist.

2.2 The following systems are in automatic operation:

2.2.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

2.2.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.2.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.2.4 Primary and secondary temperature controls (e.g., RCS T_{avg}).

2.3 The Turbine-generator instrumentation and control system is functional.

3.0 TEST METHOD

3.1 The performance of the control systems including the turbine-generator instrumentation and control system during steady-state and transient conditions shall be monitored to demonstrate that the systems are operating satisfactorily. The control systems not required for safety include the following functions:

3.1.1 Neutron flux control.

3.1.2 Average coolant temperature control.

3.1.3 Azimuthal power imbalance control.

3.1.4 Bank position control.

3.1.5 Rod return control.

3.1.6 RCCA actuation control.

3.1.7 Manual RCCA control.

3.1.8 RCS pressure control.

3.1.9 Pressurizer pressure control.

3.1.10 RCS loop level control.

3.1.11 HP cooler outlet temperature control.

3.1.12 RHR control.

3.1.13 SG level control.

3.2 Perform system walkdowns when conditions permit entry to containment. The walkdowns shall record systems with excessive vibration levels, rapid stem movement of control valves, and other signs of system instability.

3.3 Perform dynamic tuning of control systems, as necessary.

4.0 DATA REQUIRED

4.1 Time dependent data:

4.1.1 Pressurizer level and pressure.

4.1.2 RCS temperatures.

4.1.3 RCCA position.

4.1.4 Power level and demand.

4.1.5 SG levels and pressures.

4.1.6 Feedwater and steam flow.

4.1.7 Feedwater temperature.

5.0 ACCEPTANCE CRITERIA

5.1 The control systems maintain critical parameters within established control bands during steady-state operation. This test overlaps with the comparison of control systems and design predictions test (Test #194) and shall be coordinated with that test.

5.2 The control systems rapidly return critical parameters to steady-state following a transient.

5.3 Control systems do not cause transients in plant systems that are field observable.

5.4 The non-safety control systems control parameters in a way that does not challenge safety limits established in the accident analyses assumptions.

14.2.12.17 Phase IV: Power Ascension Tests, ≥10 Percent Power Ascension Plateau (Prior to Turbine Synchronization)

Some of the following tests are performed in more than one plateau, in those instances the test is listed in the first plateau that it is recommended to be performed. Each test assumes that plant instrumentation shall be functional prior to the test.

14.2.12.17.1 Baseline NSSS Integrity Monitoring (Test #197)

1.0 OBJECTIVE

1.1 To obtain initial operating data for the RCS monitoring systems. This data shall be used to determine system performance data (i.e., acceptance criteria) as well as to establish baseline data for system trending. Data shall be collected on the following systems:

1.1.1 Loose parts and vibration monitoring.

1.1.2 Diagnostics of rotating machinery.

1.1.3 Leak detection.

1.1.4 Fatigue monitoring.

1.1.5 Seismic monitoring.

1.2 To verify existing, or establish new alarm setpoints.

1.2.1 This procedure shall be repeated at the following plateaus:

1.2.2 25 percent reactor power in accordance with RG 1.68.

1.2.3 50 percent reactor power in accordance with RG 1.68.

1.2.4 75 percent reactor power in accordance with RG 1.68.

1.2.5 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 Plant is stable at the applicable power level.

2.2 Temporary test instrumentation has been installed, if necessary.

3.0 TEST METHOD

3.1 Collect baseline data at the applicable power levels.

3.2 Collect baseline data with various RCP combinations prior to power plateaus where reactor trip function is enabled.

3.3 Since RCS flow is not calibrated until it is calculated via a secondary calorimetric data will have to be normalized prior to attaching as a test record.

3.4 Verify that the loose parts monitoring data is collected and archived for different operating conditions.

4.0 DATA REQUIRED

4.1 Collect plant time stamped data to correlate plant data with integrity monitoring instrumentation.

5.0 ACCEPTANCE CRITERIA

5.1 Baseline data have been collected for various RCP combinations and analyzed using RG 1.20 (i.e., Safety Guide 20) as a basis.

5.2 Baseline data has been collected at specified power levels.

5.3 Alarm setpoints have been evaluated for adequacy.

14.2.12.17.2 Total Loss of Offsite Power (Test #198)

1.0 OBJECTIVE

1.1 To verify that the reactor can be maintained at hot standby (Mode 3) in the event of LOOP.

1.2 To determine the response to a sudden LOOP. This procedure shall be performed at the following plateau:

1.2.1 10 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The reactor is operating at the specified power level.

3.0 TEST METHOD

3.1 The plant is tripped in a manner to produce a loss of the turbine-generator and offsite power. The intent is to deenergize the power supply to the RCPs.

3.2 Verify that RCPs coastdown, as designed.

3.3 The plant is maintained in hot standby (Mode 3) for at least 30 minutes before restoring power.

3.4 Verify that the following feedwater system is capable of removing decay heat, residual heat from the metal mass, and reactor coolant pump heat following shutdown:

3.4.1 Emergency feedwater.

3.5 Verify that the plant responds as designed to a loss of offsite power.

4.0 DATA REQUIRED

4.1 Time dependent data:

4.1.1 SG parameters (i.e., pressure, flow and levels).

4.1.2 Pressurizer pressure and level.

4.1.3 RCS parameters (i.e., temperature and flow).

4.1.4 Boron concentration.

4.1.5 RCP coastdown characteristics.

4.1.6 RCCA drop times.

5.0 ACCEPTANCE CRITERIA

5.1 The reactor is shut down and maintained in hot standby on emergency power for at least 30 minutes during a simulated LOOP as described in Section 15.2.6.

5.2 The following feedwater system is capable of removing decay heat, residual heat from the metal mass, and reactor coolant pump heat following shutdown:

5.2.1 Emergency feedwater.

14.2.12.18 Power Ascension Plateau, 25 Percent Power Ascension Plateau

Some of the following tests are performed in more than one plateau. In those instances the test is listed in the first plateau that it is recommended to be performed. Each test assumes that plant instrumentation shall be functional prior to the test.

14.2.12.18.1 Load Swings (Test #200)

1.0 OBJECTIVE

1.1 To demonstrate that rapid load changes can be accomplished in a manner that maintains plant safety.

1.2 To determine the plant response to a sudden change in electrical generator output. This procedure shall be repeated at the following plateaus:

1.2.1 25 percent reactor power in accordance with RG 1.68.

1.2.2 50 percent reactor power in accordance with RG 1.68.

1.2.3 75 percent reactor power in accordance with RG 1.68.

1.2.4 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The reactor is operating at the desired power level and equilibrium core conditions exist.

2.2 Establish a band of operation in which there are no restrictions as to rate of load increase or decrease due to AREVA Fuel Preconditioning Guidelines.

2.3 The following systems are in automatic operation:

2.3.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

2.3.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.3.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.3.4 Primary and secondary temperature controls (e.g., RCS T_{avg}).

2.3.5 Turbine-Generator overspeed and load controls are in automatic.

3.0 TEST METHOD

3.1 Load increases and decreases (i.e., steps and ramps) shall be performed within the established test band.

3.1.1 Step load increases and decreases should be performed by using the normal plant turbine controls.

3.1.2 Step load changes should be as close to instantaneous as possible.

3.1.3 Ramp load increases should be performed by using the normal plant controls.

3.1.4 Ramp load increases should be as challenging as possible without exceeding commercial limits on the fuel and turbine limits described in Section 10.2.2.5.

3.2 Monitor margin to Protection setpoints during designed load increases and decreases and terminate the load step or load ramp if the margin to Protection setpoint is unacceptable.

3.3 Monitor main steam and feedwater systems and terminate the load step or load ramp if the margin to system limits is unacceptable.

4.0 DATA REQUIRED

4.1 Time dependent data:

4.1.1 Pressurizer level and pressure.

4.1.2 VCT parameters.

4.1.3 RCS temperatures.

4.1.4 RCCA position.

4.1.5 Power level and demand.

4.1.6 SG levels and pressures.

4.1.7 Feedwater and steam flow.

4.1.8 Feedwater temperature.

4.1.9 Turbine operating data.

4.1.10 Feedwater heater levels.

4.1.11 Condenser hotwell and deaerator levels.

4.1.12 Reactor power level.

5.0 ACCEPTANCE CRITERIA

5.1 The step and ramp transients demonstrate that the plant performs load changes allowed by the AREVA Fuel Preconditioning Guidelines and data has been taken that shall demonstrate the plant's ability to meet unit load swing design transients as designed (refer to Sections 3.9.1.1, 4.4.3.4, and 7.7.1.1).

5.2 That no audible noise or significant vibration is observed in the SG or in the rest of the feedwater and EFWS due to water hammer.

5.3 Verify that designed load increases and decreases can be performed without challenging the protection setpoints.

5.4 Main steam, feedwater, and other secondary systems meet design requirements as described in Section 10.2, Section 10.3, and Section 10.4.

5.5 Secondary parameters for the turbine-generator, condenser hotwell, feedwater heater trains, and other secondary systems are tuned to provide rapid response to system transients without being unstable.

14.2.12.18.2 Secondary Calorimetric Power (Test #201)

1.0 OBJECTIVE

1.1 To verify that various indications of core power have been calibrated to the calculated calorimetric power produced by the secondary systems.

1.2 The secondary calorimetric power and associated calibrations shall be performed prior to determining the core power distributions using incore instrumentation. This procedure shall be repeated at the following plateaus:

1.2.1 25 percent reactor power in accordance with RG 1.68.

1.2.2 50 percent reactor power in accordance with RG 1.68.

1.2.3 75 percent reactor power in accordance with RG 1.68.

1.2.4 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The reactor is operating at the desired power.

2.2 The data required for calculating secondary calorimetric power is available.

3.0 TEST METHOD

3.1 Maintain reactor power, T_{avg}, and pressurizer level constant during data collection.

3.2 Compare secondary calorimetric power to power calculated by independent sources (e.g., reactor enthalpy power, first stage steam

pressure, excore nuclear instrumentation) and recalibrate as necessary to maintain acceptable disagreement between secondary calorimetric power and independent power indication sources.

4.0 DATA REQUIRED

4.1 Reactor power indicated by various sources.

5.0 ACCEPTANCE CRITERIA

5.1 The various reactor power indications have been calibrated to agree with the calculated secondary calorimetric power.

14.2.12.18.3 Primary Calorimetric (Test #202)

Note: Test results at lower power levels may be unreliable and not indicative of results performed at higher power levels.

1.0 OBJECTIVE

1.1 To determine the RCS flow rate by calorimetric.

1.2 This procedure shall be repeated at the following plateaus:

1.2.1 25 percent reactor power in accordance with RG 1.68.

1.2.2 50 percent reactor power in accordance with RG 1.68.

1.2.3 75 percent reactor power in accordance with RG 1.68.

1.2.4 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The reactor is operating at the desired power.

2.2 The data required for calculating secondary calorimetric power, RCS temperature, and RCS flow data is available.

3.0 TEST METHOD

3.1 Maintain reactor power, T_{avg}, and pressurizer level constant during data collection.

3.2 Calculate RCS flow.

4.0 DATA REQUIRED

4.1 Secondary calorimetric data.

4.2 RCS flow data.

4.3 RCS temperature data.

4.4 Design value for RCP pump heat.

5.0 ACCEPTANCE CRITERIA

5.1 The RCS flow indications have been calibrated to agree with the calculated primary calorimetric.

5.2 The RCS flow rate meets the requirements of Technical Specification 3.4.1 or the discrepancy has been analyzed and appropriate levels of management have determined that it is acceptable to proceed to the next test plateau.

5.2.1 Table 14.3-1 Item 1-3.

14.2.12.18.4 Ventilation Capability (Test #203)

1.0 OBJECTIVE

1.1 To verify that various heating, ventilating and air conditioning (HVAC) systems for the following buildings and structures are capable of maintaining design temperatures:

1.1.1 Containment.

1.1.2 Containment annulus.

1.1.3 Safeguard Buildings.

1.1.4 Nuclear Auxiliary Building.

1.1.5 Fuel Building.

1.1.6 Radioactive Waste Processing Building.

1.1.7 Essential Service Water Buildings.

1.1.8 Emergency Diesel Buildings.

1.1.9 Station Blackout Diesel Rooms.

1.2 This test shall be performed at the following power plateaus:

1.2.1 25 percent reactor power.

1.2.2 50 percent reactor power.

1.2.3 ≥98 percent reactor power.

2.0 PREREQUISITES

2.1 The plant is operating at or near the desired power.

3.0 TEST METHOD

3.1 Verify that the minimum number of operable air handlers is supplying cooling to each area. If there is more than one potentially limiting alignment make sure that limiting alignments are tested.

3.2 Record temperature values in rooms with safety-related components while operating with normal ventilation lineups.

3.3 Record temperature readings in specified areas during the LOOP test.

3.4 Verify that environmental temperatures meet design requirements.

3.5 Verify performance of cooling and heating system at operating conditions. Use testing and analysis to determine performance in order to extrapolate to design basis conditions.

4.0 DATA REQUIRED

4.1 Reactor power level.

4.2 Temperature data in designated locations (i.e., general area and adjacent to major heat loads).

4.3 Equipment operating data.

5.0 ACCEPTANCE CRITERIA

5.1 Design temperatures are maintained during all plant operating conditions within the operable limits in areas as designed (refer to Sections 6.2.3 and 9.4).

14.2.12.18.5 Sampling Primary and Secondary Systems (Test #204)

1.0 OBJECTIVE

1.1 To collect chemistry samples of the RCS and secondary at various power levels to record the following:

1.1.1 Boron concentration and boron-10 isotopic abundance.

1.1.2 Concentration of non-radioactive elements and soluble particulates.

1.1.3 Measured pH of the fluids.

1.1.4 Radio isotopic concentration data of the radioactive elements (e.g., cesium, iodine, iron, cobalt).

1.2 To demonstrate performance of permanent plant sampling and analysis procedures, while confirming that primary and secondary chemistry requirements are being met.

1.3 To verify that the primary and secondary systems are operating within design limits. This procedure shall be performed at the following plateau:

1.3.1 25 percent reactor power in accordance with RG 1.68.

1.3.2 50 percent reactor power in accordance with RG 1.68.

1.3.3 75 percent reactor power in accordance with RG 1.68.

1.3.4 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The reactor is stable at the desired power level.

2.2 Required sampling systems are functional and analysis instrumentation are calibrated using calibration gases and solutions as

referenced in the radioactive and non-radioactive analyses of Tables 9.3.2-1 and 9.3.2-2.

2.3 Verify preoperational tests have been satisfactorily completed for radiation sampling instrumentation described in Table 11.5-1.

3.0 TEST METHOD

3.1 Samples shall be collected from the RCS and secondary system at various power levels and analyzed in the laboratory using applicable sampling and analysis procedures.

3.2 Collect samples at various process radiation monitors, perform analysis in the laboratory, and compare the samples with the process radiation monitor output (refer to Table 11.5-1).

3.3 Verify that primary and secondary sample results meet design limits.

4.0 DATA REQUIRED

4.1 Reactor power.

4.2 RCS and secondary temperature.

4.3 Boron concentration and boron-10 isotopic abundance.

4.4 Core average burnup.

4.5 Isotopic activities.

4.6 Chemistry sample results.

5.0 ACCEPTANCE CRITERIA

5.1 Samples of RCS and secondary fluids can be obtained from design locations as designed (refer to Tables 9.3.2-1 and 9.3.2-2, and 11.5-1).

5.2 Continuous and batch sample instrumentation used to analyze primary and secondary sampling parameters described in Tables 9.3.2-1 and 9.3.2-2, and 11.5-1 will meet the design requirements for the measurements.

5.3 Measured activity levels are within their limits.

5.3.1 Samples agree with the within measurement uncertainties as designed (refer to Section 9.3.2), or investigation of the discrepancies has been initiated.

5.4 Laboratory analyses and process radiation monitors agree with the within measurement uncertainties as designed (refer to Section 9.3.2), or investigation of the discrepancies has been initiated.

5.5 Samples of RCS and secondary fluids can be obtained from design locations as designed (refer to Sections 9.3.2 and 11.5).

5.6 Continuous instrumentation used to analyze primary and secondary sampling parameters described in Table 9.3.2-1 and Table 9.3.2-2 will meet the design requirements for the measurements. This includes,

but is not limited to, the following (that could adversely impact the ability to measure the parameters described in Table 9.3.2-1 and Table 9.3.2-2):

5.6.1 Range.

5.6.2 Response time.

5.6.3 Sensitivity.

5.7 Radiation monitoring instrumentation used to perform radiation monitoring that is described in Table 11.5-1 will meet the design requirements for the radiation monitor. This includes, but is not limited to, the following (that could adversely impact the ability to measure the parameters described in Table 11.5-1, Monitor R-10):

5.7.1 Range.

5.7.2 Response time.

5.7.3 Sensitivity.

14.2.12.18.6 Failed Fuel Detection (Test #205)

1.0 OBJECTIVE

1.1 To collect chemistry samples of the RCS and secondary at the specified power level to record the following:

1.1.1 Boron concentration and boron-10 isotopic abundance.

1.1.2 Concentration of non-radioactive elements and soluble particulates.

1.1.3 Measured pH of the fluids.

1.1.4 Radioisotopic concentration data of the radioactive elements (e.g., cesium, iodine, strontium, barium, cerium, and noble gases).

1.2 To demonstrate performance of permanent plant sampling and analysis procedures. There is typically some RCS activity from tramp, fuel dust that is on the outer surface of the cladding.

1.3 To perform a cross-check of the failed fuel monitor instrumentation.

1.4 This test shall be performed at the following power plateaus:

1.4.1 25 percent reactor power.

1.4.2 ≥98 percent reactor power.

2.0 PREREQUISITES

2.1 The reactor is stable at the desired power level.

2.2 Required sampling systems are functional.

2.3 Calibrating gases and solutions are available for radioactive and non-radioactive analyses referenced in Tables 9.3.2-1 and 9.3.2-2.

2.4 Verify preoperational Test #100 has been satisfactorily completed for radiation monitoring instrumentation.

3.0 TEST METHOD

3.1 Samples shall be collected from the RCS and secondary system at various power levels and analyzed in the laboratory using applicable sampling and analysis procedures.

3.2 Collect samples at various process radiation monitors, perform analysis in the laboratory, and compare the samples with the process radiation monitor output (refer to Table 11.5-1, R-41).

4.0 DATA REQUIRED

4.1 Reactor power.

4.2 RCS and secondary temperature.

4.3 Boron concentration and boron-10 isotopic abundance.

4.4 Core average burnup.

4.5 Isotopic activities.

5.0 ACCEPTANCE CRITERIA

5.1 Measured activity levels are within their limits.

5.2 Laboratory analyses and process radiation monitors agree with the within measurement uncertainties as designed (refer to Section 9.3.2 or investigation of the discrepancies has been initiated.

5.3 Samples of RCS and secondary fluids can be obtained from design locations as designed (refer to Sections 9.3.2 and 11.5).

5.4 Continuous instrumentation used to analyze primary sampling parameters described in Tables 9.3.2-1 and 9.3.2-2 will meet the design requirements for the measurements. This includes, but is not limited to, the following (that could adversely impact the ability to measure the parameters described in Tables 9.3.2-1 and 9.3.2-2):

5.4.1 Range.

5.4.2 Response time.

5.4.3 Sensitivity.

14.2.12.18.7 Self Powered Neutron Detector Calibration (Test #206)

1.0 OBJECTIVE

1.1 To perform a test on the Aeroball Measurement System (AMS) to verify the adequacy of time dependent decay constant functions of the vanadium steel flux measurement balls.

1.2 To perform a full core flux map using the following:

1.2.1 Moveable incore system - AMS.

1.2.2 Fixed incore system - Self powered neutron detectors (SPND).

1.3 Normalize the SPNDs to the full core flux map produced by the POWERTRAX-E system at the following power plateaus:

1.3.1 25 percent reactor power.

1.3.2 50 percent reactor power.

1.3.3 75 percent reactor power.

1.3.4 ≥98 percent reactor power.

2.0 PREREQUISITES

2.1 The reactor is at the specified power level.

2.2 The reactor is at equilibrium xenon conditions prior to performing tests to meet 1.2 and 1.3.

2.3 The incore detector systems, related processing computers, and POWERTRAX-E are functional.

2.4 Verify that theoretical time dependent decay constant functions for the vanadium steel flux measurement balls (AMS) have been entered into the measurement software.

3.0 TEST METHOD

3.1 Calculate/measure the resident time in the core to achieve AMS vanadium ball stack saturation at the current reactor power (neutron fluence).

3.2 Verify that the AMS residence time exceeds the time to reach AMS vanadium ball stack saturation at the current power level.

3.3 Perform an AMS flux map with the measuring table sequence set in “normal” (A, B, C, and D sequence) and analyze the map using POWERTRAX-E.

3.4 Perform an AMS flux map with the measuring table sequence set in “reverse from normal” (A, B, C, and D sequence) and analyze the map using POWERTRAX-E.

3.5 Compare the AMS flux maps generated by the “normal” and the “reverse from normal” sequence using POWERTRAX-E focusing on differences that could be attributed to change in sequence. If xenon equilibrium has not been achieved, the maps may not be identical. If this is the case, verify that differences are not due to sequence.

3.6 Verify that the time dependent decay constant functions are adequate or establish revised time dependent decay constant functions.

3.7 Verify that the POWERTRAX-E AMS sequence flux maps are not used to calibrate the SPNDs unless equilibrium xenon conditions have been achieved.

3.8 Perform an AMS flux map with the measuring table sequence set in "normal" (A, B, C, and D sequence) once equilibrium xenon conditions have been achieved. If the previous AMS flux maps were not performed with equilibrium xenon conditions, analyze the map using POWERTRAX-E.

3.9 Calibrate the SPNDs using constants generated by POWERTRAX-E prior to increasing reactor power to the next power ascension plateau.

4.0 DATA REQUIRED

4.1 Reactor power as indicated by the secondary calorimetric.

4.2 Reactor power as indicated by the primary enthalpy calorimetric.

4.3 RCCA position.

4.4 Boron concentration and boron-10 isotopic abundance.

4.5 Incore detector system data.

5.0 ACCEPTANCE CRITERIA

5.1 The time dependent decay constant functions for the vanadium steel flux measurement balls do not create a data bias for the AMS flux maps.

5.2 The full core flux map data is available for determining SPND calibration constants from measured core power distributions, using POWERTRAX-E.

14.2.12.18.8 Steady-State Core Performance (Test #207)

1.0 OBJECTIVE

1.1 To demonstrate that the core has been assembled as designed.

1.2 To determine if the measured and predicted power distributions are consistent. This test indirectly confirms that the predicted reactivity coefficients are within design assumptions.

1.3 To perform calibrations of fixed incore and excore instrumentation based on a full core flux map performed with the movable incore flux mapping (i.e., Aeroball) system.

1.4 To determine core power distributions using the movable incore instrumentation. This procedure shall be repeated at the following plateaus:

1.4.1 25 percent reactor power in accordance with RG 1.68.

1.4.2 50 percent reactor power in accordance with RG 1.68.

1.4.3 75 percent reactor power in accordance with RG 1.68.

1.4.4 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The reactor is operating at the desired power level and the RCCA configuration is within the suggested limits proposed by the core designer.

2.2 The following data is available for updating the three dimensional nodal model (POWERTRAX):

2.2.1 Core power history.

2.2.2 RCCA configuration.

2.2.3 Boron concentration and boron-10 isotopic abundance.

2.2.4 Full core flux map data has been collected using the movable incore instrumentation.

3.0 TEST METHOD

3.1 The measured core power distribution from the movable incore system (i.e., Aeroball) is analyzed by the core nodal model in (POWERTRAX).

3.2 The calculated core power distribution for each fuel assembly is obtained from POWERTRAX.

3.3 Normalize the signals from the fixed incore detectors with the results from the movable incore (i.e., Aeroball) system.

3.4 Normalize the signal from the excore detectors with the results from the movable incore (i.e., Aeroball) system.

4.0 DATA REQUIRED

4.1 Reactor power measurements (i.e., movable and fixed incore systems).

4.2 RCCA positions.

4.3 Boron concentration and boron-10 isotopic abundance.

4.4 Core burnup.

4.5 Incore detector flux map.

5.0 ACCEPTANCE CRITERIA

5.1 The following POWERTRAX calculated power distributions and core peaking factors are within the Technical Specification limits:

5.1.1 LPD, reference Technical Specification 3.2.1.

5.1.2 FΔH, reference Technical Specification 3.2.2.

5.1.3 DNBR, reference Technical Specification 3.2.3.

5.1.4 AO, reference Technical Specification 3.2.4.

5.1.5 AZI, reference Technical Specification 3.2.5.

5.2 The maximum allowable power level as calculated by POWERTRAX shall allow power ascension to the next power plateau or ≥98 percent.

14.2.12.18.9 Core-Related Reactor Trips (Test #208)

1.0 OBJECTIVE

1.1 To verify that reactor trips that use reactor inputs are functional.

1.2 To determine functionality of core related reactor trips. This procedure shall be repeated at the following plateaus:

1.2.1 25 percent reactor power.

1.2.2 50 percent reactor power.

1.2.3 75 percent reactor power.

1.2.4 ≥98 percent reactor power.

2.0 PREREQUISITES

2.1 The fixed incore detector system is functional and has been normalized to the movable incore (i.e., Aeroball) system.

2.2 The excore nuclear detectors have been normalized to the movable incore (i.e., Aeroball) system and a secondary calorimetric.

2.3 The reactor is at the desired power level and RCCA configuration.

2.4 The reactor trip system is functional.

3.0 TEST METHOD

3.1 Verify that the following core related reactor trips are functional:

3.1.1 Low DNBR (permissive P2).

3.1.2 High linear power density (permissive P2).

3.1.3 Excore high neutron flux rate of change and nuclear power level trip (permissive P2 and P3).

3.1.4 High core power level.

3.1.5 Low loop flow rate (permissive P2).

3.1.6 Low RCP speed (permissive P2).

3.1.7 High neutron flux intermediate range (permissive P6).

3.1.8 Low doubling time (permissive P6).

4.0 DATA REQUIRED

4.1 Reactor power.

4.2 RCCA positions.

4.3 Boron concentration and boron-10 isotopic abundance.

5.0 ACCEPTANCE CRITERIA

5.1 The core related reactor trips have been normalized to the movable incore (i.e., Aeroball) detectors and the reactor trips have been normalized.

14.2.12.18.10 Incore/Excore Cross-Calibration (Test #209)

1.0 OBJECTIVE

1.1 To demonstrate that a controlled axial offset (i.e., AO) transient can be deliberately generated and terminated using control rod movement. The first order effect is an AO swing but the second order effect is a xenon transient that must be stabilized to prevent adverse impact on future testing.

1.2 To determine effectiveness of controlling a xenon transient using control rod insertion and removal. Required to be performed at 75 percent in accordance with RG 1.68.

1.3 To verify that the AO calibration constants are generated by Powertrax using a full core flux map using the AMS.

2.0 PREREQUISITES

2.1 The reactor is at the required power level and equilibrium core conditions exist.

2.2 The RCCA position has been evaluated to determine if there is sufficient margin to insertion and withdrawal limits to induce a 6 percent AO swing and dampen out the swing with rod movement.

3.0 TEST METHOD

3.1 Record the position of each control rod bank using available means of indication.

3.2 Determine the value of AO using the movable incore (i.e., AMS) flux mapping system.

3.3 Slowly insert the control bank rods while maintaining reactor power constant via dilution.

3.4 Take a full core flux map after each change of AO that is ≥2 percent using the movable incore (i.e., AMS) flux mapping system.

3.5 Terminate the negative AO transient after measuring a change of 6 to 10 percent.

3.6 Slowly withdraw the control bank rods while maintaining reactor power constant via boration.

3.7 Take a full core flux map after each change of AO that is ≥2 percent using the movable incore (i.e., AMS) flux mapping system.

3.8 Terminate the negative transient after measuring a change of 6 to 10 percent compared to the original AO reading.

3.9 Let the automatic systems determine the control rod position changes needed to terminate the AO (i.e., xenon) transient and perform actions to dampen out the transient. Rod movement must be implemented at the appropriate time (do not insert rods with AO trending negative). If practical return control rods to the initial control rod position.

4.0 DATA REQUIRED

4.1 Reactor thermal power.

4.2 RCCA positions using available indications, including flux maps.

4.3 Boron concentration and boron-10 isotopic abundance.

4.4 Core burnup.

4.5 Incore detector flux map data.

4.6 RCS Temperatures (i.e., T_{hot}, T_{cold} & T_{avg}).

5.0 ACCEPTANCE CRITERIA

5.1 The xenon transient is controlled by rod movement at the appropriate time.

5.2 Correlate available indications of RCCA position including the following:

5.2.1 Rod position measurement as designed (refer to Section 7.1.1.5.14).

5.2.2 Fixed incore detector system data.

5.2.3 Movable incore detector (i.e., AMS) flux mapping system.

5.3 Incore flux map data is available to calibrate the excore indication of AO.

14.2.12.18.11 Penetration Temperature Survey (Test #210)

1.0 OBJECTIVE

1.1 To verify concrete temperatures surrounding containment penetrations do not exceed design allowable temperatures.

1.2 This procedure shall be repeated at the following plateaus:

1.2.1 25 percent reactor power.

1.2.2 50 percent reactor power.

1.2.3 ≥98 percent reactor power.

2.0 PREREQUISITES

2.1 Plant is at the desired power plateau.

3.0 TEST METHOD

3.1 Collect baseline fluid temperature data for fluid systems that operate above 100°F.

3.2 Collect penetration sleeve concrete temperature data inside and outside the containment building for each fluid system that operates above 100°F.

3.3 Collect penetration sleeve concrete temperature data inside and outside the containment shield building for each fluid system that operates above 100°F.

3.4 Verify that penetration temperatures meet design requirements.

4.0 DATA REQUIRED

4.1 Fluid temperatures.

4.2 Penetration sleeve temperatures on each adjacent surface.

5.0 ACCEPTANCE CRITERIA

5.1 Concrete temperature does not exceed allowable temperature per ANSI/ACI 349 code (Reference 6) requirements for nuclear safety related concrete structures.

14.2.12.18.12 Remote Shutdown Station Checkout (Test #211)

1.0 OBJECTIVE

1.1 To transfer control of the plant from the MCR to the remote shutdown station.

1.2 To demonstrate that the plant can be maintained in hot standby using the remote shutdown station.

1.3 To determine the response to a transfer of control of the plant from the MCR to a remote shutdown station. This procedure shall be performed at the following plateau:

1.3.1 25 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 Reactor is operating at required power plateau with following conditions:

2.1.1 The turbine-generator is synchronized to the grid.

2.1.2 The NSSS and BOP systems are in their normal alignment.

2.1.3 The remote shutdown station preoperational test has been completed satisfactorily.

2.2 The remote shutdown station functionality has been demonstrated prior to criticality.

2.3 A walkdown of the remote shutdown station equipment (computer panel displays, control switches and communication equipment) has been performed and deficiencies have been corrected or determined to not adversely affect this test.

2.4 A standby crew of operators shall be stationed in the MCR that is prepared to assume control of plant systems if the transfer is suddenly terminated.

2.5 Control room operations staff is reduced to minimum number allowed by Technical Specifications.

3.0 TEST METHOD

3.1 Control room operators determine that the plant is operating normally.

3.2 Control room operators evacuate the control room (standby crew remains).

3.3 The reactor is tripped from outside the control room.

3.4 Control room operators bring plant to hot standby and maintained in this condition for ≥30 minutes.

3.5 Transfer control of the plant back to the MCR using the switches located outside of the control room.

3.6 Verify that the following feedwater system is capable of removing decay heat, residual heat from the metal mass, and RCP heat following shutdown:

3.6.1 Emergency feedwater.

4.0 DATA REQUIRED

4.1 Collect the following time stamped data with a short scan rate:

4.1.1 Pressurizer pressure and level.

4.1.2 RCS temperatures.

4.1.3 SG pressure and level.

4.1.4 Reactor power.

4.1.5 RCCA position.

4.1.6 Steam isolation valve times (elapsed time from reactor trip signal to valve closure).

5.0 ACCEPTANCE CRITERIA

5.1 The reactor controlled in mode 3 (hot standby) from the remote shutdown station is demonstrated to perform as designed (refer to Section 7.4.1.1).

5.2 Transfer of control to the RSS is demonstrated from switches near the MCR exits and at appropriate locations inside the equipment rooms.

5.3 Steam valve isolation occurs within the times described in the accident analyses, with margin, or as specified in regulatory documents.

5.4 The following feedwater system is capable of removing decay heat, residual heat from the metal mass, and RCP heat following shutdown:

5.4.1 Emergency feedwater.

14.2.12.18.13 Load Follow (Test #220)

1.0 OBJECTIVE

1.1 To demonstrate that the plant responds as designed to a requested change to reduce power, stabilize power at lower power level, and return to original power level.

1.2 This procedure shall be repeated at the following plateaus:

1.2.1 25 percent reactor power in accordance with RG 1.68.

1.2.2 50 percent reactor power in accordance with RG 1.68.

1.2.3 75 percent reactor power in accordance with RG 1.68.

1.2.4 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The following systems are in automatic operation:

2.1.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

2.1.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.1.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.1.4 Primary and secondary temperature controls (e.g., RCS T_{avg}, feedwater temperature).

2.1.5 Reactor reactivity controls (i.e., control rods, boration and dilution).

3.0 TEST METHOD

3.1 Plant power is reduced 10 percent from the original power level to a new power level over a one hour duration without operator intervention.

3.2 Plant power is stabilized at the new power level for two hours without operator intervention.

3.3 Plant power is increased ten percent from the reduced power level to the original power level over one and half hour duration without operator intervention.

3.4 Turbine ramp rates during the load follow testing are bounded by the turbine-generator ramp rates described in Section 10.2.2.5.

3.5 The plant behavior is monitored to establish that the control systems maintain the NSSS within operating limits.

4.0 DATA REQUIRED

4.1 Plant condition prior to transient.

4.2 The following acceptance criteria parameters are monitored prior to and throughout the transient:

4.2.1 Pressurizer parameters (i.e., pressure and level).

4.2.2 RCS temperatures (i.e., T_{cold}, T_{hot} and T_{avg}).

4.2.3 SG parameters (i.e., flow, pressure, temperature and level).

4.2.4 RCS parameters (i.e., flow, pressure, temperature and pressurizer level).

4.2.5 RCCA position.

4.2.6 RCS boron concentration.

4.3 Additional key plant parameters shall be monitored for baseline data.

5.0 ACCEPTANCE CRITERIA

5.1 The plant responds as designed (refer to Sections 10.2, 10.3, and 10.4).

14.2.12.19 Power Ascension Plateau, 50 Percent Power Ascension Plateau

Some of the following tests are performed in more than one plateau. In those instances the test is listed in the first plateau that it is recommended to be performed. Each test assumes that plant instrumentation shall be functional prior to the test.

14.2.12.19.1 Biological Shield Survey (Test #212)

1.0 OBJECTIVE

1.1 To measure the radiation levels in accessible locations of the plant outside of the biological shield.

1.2 To determine permissible stay times for these areas during power operation.

1.3 To perform radiation surveys to determine shielding effectiveness. This procedure shall be repeated at the following plateaus:

1.3.1 50 percent in accordance with RG 1.68.

1.3.2 ≥98 percent in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 Radiation survey instruments have been calibrated and are functional for performance of the following test.

2.2 Results of the radiation surveys performed at zero power conditions are available.

3.0 TEST METHOD

3.1 Measure gamma and neutron dose rates at 50 and ≥98 percent power levels.

4.0 DATA REQUIRED

4.1 Power level.

4.2 Gamma dose rates in the accessible locations.

4.3 Neutron dose rates in the accessible locations.

5.0 ACCEPTANCE CRITERIA

5.1 Accessible areas and occupancy times during power operation have been defined as described in Section 12.3.2.

5.2 The biological shield meets design requirements (refer to Section 12.3.2.2).

14.2.12.19.2 Single RCCA Misalignment (Test #213)

1.0 OBJECTIVE

1.1 To demonstrate multiple indications of one high worth misaligned control rod.

1.2 This procedure shall be repeated at the following plateau:

1.2.1 50 percent reactor power in accordance with RG 1.68.

1.2.2 ≥ 98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The reactor is at the required power level with the following:

2.1.1 RCCAs are within 20 steps of the rods out position.

2.1.2 AO has been stable (±4 percent) for previous 12 hours.

3.0 TEST METHOD

3.1 Record the position of each control rod bank.

3.2 Insert one control bank rod until the rod is fully inserted and record indications of misaligned control rods, including a full core flux map performed with the movable incore (i.e., AMS) flux mapping system when RCCA is fully inserted. This test is only performed at the 50 percent plateau in accordance with RG 1.68.

3.3 Return the misaligned control rod to the initial control rod position and record indications.

3.4 Insert RCCA D9 until the indicated analog position is seven steps below the group digital RCCA position for all other Control Bank D RCCAs.

3.5 Record indications of misaligned control rods, including a full core flux map performed with the movable incore (i.e., AMS) flux mapping system when RCCA is inserted.

3.6 Return the misaligned control rod (RCCA D9) to the initial control rod position and record indications. This test is performed at the 50 and ≥

3.7 98 percent plateau.

4.0 DATA REQUIRED

4.1 Reactor thermal power.

4.2 RCCA configuration.

4.3 RCS temperatures (i.e., T_{hot}, T_{cold} & T_{avg}).

4.4 POWERTRAX indications.

5.0 ACCEPTANCE CRITERIA

5.1 The indications of a misaligned RCCA include the following:

5.1.1 Rod position measurement as designed (refer to Section 7.1.1.5.14).

5.1.2 Fixed incore detector system (i.e., self powered neutron detectors).

5.1.3 Movable incore detectors (i.e., AMS) flux mapping system.

14.2.12.19.3 Securing a Single Train of Feedwater Heaters (Test #214)

1.0 OBJECTIVE

1.1 To demonstrate impact on primary and secondary systems due to securing a single train of feedwater heaters.

1.2 This procedure shall be repeated at the following plateaus:

1.2.1 50 percent reactor power in accordance with RG 1.68.

1.2.2 75 percent reactor power in accordance with RG 1.68.

1.2.3 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The reactor is operating at the desired power level.

2.2 The following systems are in automatic operation:

2.2.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

2.2.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.2.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.2.4 Primary and secondary temperature controls (e.g., RCS T_{avg}).

3.0 TEST METHOD

3.1 Secure one train of feedwater heaters by bypassing the feedwater heaters.

3.2 Verify that loss of feedwater heating design limits are met.

4.0 DATA REQUIRED

4.1 Secondary temperature, pressure, and flow data.

4.2 Primary flow, temperature, pressurizer, and reactor power data.

5.0 ACCEPTANCE CRITERIA

5.1 The feedwater temperature remains above the temperature in Table 15.0-5 (Note 2).

14.2.12.20 Power Ascension Plateau, 75 Percent Power Ascension Plateau

Some of the following tests are performed in more than one plateau. In those instances the test is listed in the first plateau that it is recommended to be performed.

14.2.12.20.1 Liquid Waste Storage and Processing Systems (Test #215)

1.0 OBJECTIVE

1.1 To demonstrate that the operation of the liquid waste storage and processing systems (LWSPS) for collection, processing, recycling, and preparation of liquid waste for release to the environment is satisfactory.

1.2 To determine the ability of plant systems to process radioactive effluents. This procedure shall be performed at the following plateaus:

1.2.1 75 percent reactor power in accordance with RG 1.68.

1.2.2 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The liquid waste processing equipment is functional.

2.2 Verify preoperational Test #095 has been satisfactorily completed for radiation monitoring instrumentation.

3.0 TEST METHOD

3.1 Monitor the performance of the LWSPS.

3.2 Verify isotopic concentrations in the liquid stream.

3.3 Verify that the LWSPS is capable of collecting and processing liquid waste per design.

4.0 DATA REQUIRED

4.1 Conditions of Measurement.

4.1.1 Reactor power history and RCS radioactivity level.

4.1.2 Liquid waste processing system tank levels.

4.1.3 Liquid waste processing system demineralizer data.

4.1.4 Liquid waste processing system evaporator data.

4.1.5 Liquid waste processing system centrifuge data.

5.0 ACCEPTANCE CRITERIA

5.1 The LWSPS processes radioactive effluents as designed (refer to Sections 11.2, 11.5, and 13.4).

14.2.12.20.2 Gaseous Waste Processing System (Test #216)

1.0 OBJECTIVE

1.1 To demonstrate that the operation of the gaseous waste processing system (GWPS) for collection and processing of radioactive and potentially flammable gases vented from plant equipment is performing satisfactorily.

1.2 To determine the ability of plant systems to process radioactive effluents. This procedure shall be performed at the following plateaus:

1.2.1 75 percent reactor power in accordance with RG 1.68.

1.2.2 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The gaseous waste processing equipment is functional.

2.2 Verify preoperational Test #099 has been satisfactorily completed for radiation monitoring instrumentation.

3.0 TEST METHOD

3.1 Verify that the gaseous waste processing simultaneously collects and processes gaseous waste per design.

4.0 DATA REQUIRED

4.1 Conditions of Measurement:

4.1.1 Reactor power history and RCS radioactivity level.

4.1.2 Containment temperature and humidity.

4.1.3 Condenser operating data.

4.1.4 Effluent control monitor operating data.

4.1.5 Gas analyzer operating data.

4.1.6 Gas transport times.

4.1.7 Recombiner operating data

5.0 ACCEPTANCE CRITERIA

5.1 The GWPS processes radioactive and potentially flammable gases effluent as designed (refer to Sections 11.3, 11.5, and 13.4).

14.2.12.20.3 Loss of Feedwater Pump (Test #217)

1.0 OBJECTIVE

1.1 To evaluate system response to a loss of one of three operating feedwater pumps.

1.2 To demonstrate that rapid load changes can be accomplished in a manner that maintains plant safety.

1.3 This procedure shall be performed at the following plateau:

1.3.1 75 percent reactor power.

2.0 PREREQUISITES

2.1 The reactor is operating at the desired power level.

2.2 Establish a band of operation in which there are no restrictions on the rate of load increase or decrease based on AREVA Fuel Preconditioning Guidelines.

2.3 The following systems are in automatic operation:

2.3.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

2.3.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.3.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.3.4 Primary and secondary temperature controls (e.g., RCS T_{avg}).

2.3.5 Rod control (the rod pilot system is operating in automatic with no RCCA movement prior (20 minutes) to the test).

2.4 Verify that each feedwater pump is providing approximately 33 percent of the required feedwater flow.

3.0 TEST METHOD

3.1 Loss of main feedwater pump:

3.1.1 One of the three operating feedwater pumps is tripped.

3.1.2 Standby feedwater pump starts or partial trip occurs.

3.2 RCCA Drop:

3.2.1 If standby feedwater pumps fail to start, verify that a partial reactor trip occurred in response to the change in feedwater flow.

3.3 Verify that response to loss of feedwater is as designed.

4.0 DATA REQUIRED

4.1 Time dependent data:

4.1.1 Pressurizer level and pressure.

4.1.2 VCT parameters.

4.1.3 RCS temperatures.

4.1.4 RCCA position (each available position indication, including movable incore flux traces (i.e., Aeroball) and fixed incore detectors).

4.1.5 Power level and demand.

4.1.6 SG levels and pressures.

4.1.7 Feedwater and steam flow.

4.1.8 Feedwater temperature.

5.0 ACCEPTANCE CRITERIA

5.1 The control systems stabilize the plant to normal operating control bands.

5.2 RCCA position during partial scram is indicated by independent systems.

5.3 No safety actuation limits are exceeded.

14.2.12.21 Power Ascension Plateau, ≥98 Percent Power Ascension Plateau

Some of the following tests are performed in more than one plateau, in those instances the test is listed in the first plateau that it is recommended to be performed. Each test assumes that plant instrumentation shall be functional prior to the test.

14.2.12.21.1 HZP to HFP Reactivity Difference (Test #218)

1.0 OBJECTIVE

1.1 To measure the reactivity coefficients at a high power level.

1.2 To measure the full-power critical boron concentration with rods fully withdrawn. This procedure shall be performed at the following plateau:

1.2.1 ≥98 percent reactor power in accordance with RG 1.68. This test combined with the steady-state core performance test satisfies the reactivity coefficient evaluation requirement of RG 1.68.

2.0 PREREQUISITES

2.1 The reactor is at a high power level with the following:

2.1.1 Equilibrium xenon.

2.1.2 RCCAs are within 10 steps of the rods out position.

2.1.3 AO has been stable (±2 percent) for previous 24 hours.

2.1.4 Measure boron concentration and boron–10 isotopic concentration.

3.0 TEST METHOD

3.1 The reactivity coefficients are determined by updating the three dimensional core model (POWERTRAX) with current plant data.

3.2 The tests.

4.0 DATA REQUIRED

4.1 Reactor thermal power.

4.2 RCCA configuration.

4.3 Boron concentration (ppmB) and isotopic abundance of boron-10.

4.4 Core burnup.

4.5 RCS temperature.

5.0 ACCEPTANCE CRITERIA

5.1 The core designer shall investigate differences greater than 500 pcm between measured values and predications.

5.2 Test criteria specified by the fuel designer.

14.2.12.21.2 Trip of Generator Main Breaker (Test #219)

1.0 OBJECTIVE

1.1 To demonstrate that the plant responds and is controlled as designed following a full-power turbine trip.

1.2 This procedure shall be performed at the following plateau:

1.2.1 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The following systems are in automatic operation:

2.1.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

2.1.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.1.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.1.4 Primary and secondary temperature controls (e.g., RCS T_{avg}).

3.0 TEST METHOD

3.1 The turbine is tripped from PICS simultaneous with trip of each RCP.

3.2 Verify that RCPs cease to operate.

3.3 The plant behavior is monitored to establish that the control systems maintain the NSSS within operating limits.

3.4 Verify that the following feedwater systems are capable of removing decay heat, residual heat from the metal mass, and RCP heat following shutdown:

3.4.1 Startup and shutdown feedwater.

3.4.2 Emergency feedwater.

3.5 After verifying that the startup and shutdown feedwater system is capable of controlling the plant cooldown, secure the startup and shutdown feedwater pump and verify that the emergency feedwater pump can control the cooldown.

3.6 The plant responds as designed to a reactor trip generated by opening of the main breaker.

4.0 DATA REQUIRED

4.1 Plant condition prior to trip.

4.2 The following acceptance criteria parameters are monitored prior to and throughout the transient:

4.2.1 Pressurizer parameters (i.e., pressure and level).

4.2.2 RCS temperatures (i.e., T_{cold}, T_{hot} and T_{avg}).

4.2.3 SG parameters (i.e., flow, pressure, temperature and level).

4.2.4 RCCA position.

4.3 Additional key plant parameters shall be monitored for baseline data.

5.0 ACCEPTANCE CRITERIA

5.1 The plant responds as designed (refer to Section 15.2.2).

5.2 The following feedwater systems demonstrate the design capability to remove decay heat, residual heat from the metal mass, and RCP heat following a reactor trip:

5.2.1 Startup and shutdown feedwater.

5.2.2 Emergency feedwater.

14.2.12.21.3 (Deleted)

14.2.12.21.4 Turbine-Generator Load Rejection (Test #221)

1.0 OBJECTIVE

1.1 To demonstrate that the plant responds and is controlled as designed following a turbine-generator load rejection.

1.2 This procedure shall be performed at the following plateau:

1.2.1 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The following systems are in fully functional and in automatic operation:

2.1.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

2.1.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.1.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.1.4 Primary and secondary temperature controls (e.g., RCS T_{avg}).

2.1.5 RCSL control of RCCAs.

2.1.6 Turbine-Generator overspeed and load controls.

2.2 Manual turbine overspeed protection is available and functioning properly in the control room and locally at the turbine, and that these trip devices are manned.

3.0 TEST METHOD

3.1 The turbine-generator is removed from the grid by opening the output breakers in the switchyard.

3.2 Monitor the following RCP parameters:

3.2.1 Voltage.

3.2.2 Current.

3.2.3 Speed.

3.3 Monitor the following RCCA positions:

3.3.1 Control Bank A.

3.3.2 Control Bank B.

3.3.3 Control Bank C.

3.3.4 Control Bank D.

3.4 The plant behavior is monitored to establish that the control systems maintain the NSSS within operating limits.

3.5 Monitor secondary systems, including the turbine-generator to determine system performance. At a minimum, collect the following plant data during the evolution:

3.5.1 Feedwater flow.

3.5.2 Reactor power.

3.5.3 Feedwater heater levels.

3.5.4 Condenser hotwell level.

3.5.5 Deaerator level.

3.5.6 Steam generator level.

3.5.7 Turbine-Generator control valve position.

3.5.8 Turbine-Generator electrical output.

3.5.9 Turbine-Generator speed.

4.0 DATA REQUIRED

4.1 Plant condition prior to turbine-generator load rejection.

4.2 The following acceptance criteria parameters are monitored prior to and throughout the transient:

4.2.1 Pressurizer parameters (i.e., pressure and level).

4.2.2 RCS temperatures (i.e., T_{cold}, T_{hot} and T_{avg}).

4.2.3 SG parameters (i.e., flow, pressure, temperature and level).

4.2.4 RCS parameters (i.e., flow, pressure, temperature and pressurizer level).

4.2.5 RCCA position as a function of time.

4.2.6 Secondary performance parameters (i.e., feedwater flow, feedwater heater levels, deaerator level, condenser hotwell level).

4.3 Additional key plant parameters shall be monitored for baseline data.

4.3.1 Turbine speed and generator frequency.

4.3.2 Generator voltage.

4.3.3 Generator excitation.

5.0 ACCEPTANCE CRITERIA

5.1 RCSL and turbine controls remain within analyzed limits and reactor power is stabilized at the lower power for at least 30 minutes following the test initiation without unanticipated operator action.

5.2 RCCAs are restored to proper sequence and overlap with Technical Specification LCO limits.

5.3 RCPs continue to operate with power supplied from the off site grid.

5.4 Partial rod trip occurs but the reactor remains critical.

5.5 Turbine-Generator output breakers open.

5.6 Turbine-Generator performance remains within design limits and as described in Section 10.2.

5.7 Secondary performance remains within design limits as described in Sections 10.2, 10.3, and 10.4.

14.2.12.21.5 Actual Rod Drop Times (Test #222)

1.0 OBJECTIVE

1.1 To determine the actual RCCA drop times from actual reactor trips.

1.2 This procedure shall be performed at the following plateau:

1.2.1 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 Determine reactor trip times for reactor trips since fuel load.

3.0 TEST METHOD

3.1 Collect rod drop times for each reactor trip.

4.0 DATA REQUIRED

4.1 Rod drop times for each reactor trip.

5.0 ACCEPTANCE CRITERIA

5.1 Verify that actual rod drop data meets Technical Specification requirements and there are no adverse data trends.

14.2.12.21.6 Cooling Tower Acceptance (Test #223)

A COL applicant that references the U.S. EPR design certification will provide site-specific test abstract information for the cooling tower. The following is a typical COLA test; if a site specific test will be used the COL applicant will provide the test.

1.0 OBJECTIVE

1.1 To verify the cooling tower is capable of rejecting the design heat load.

2.0 PREREQUISITES

2.1 Construction activities are complete.

2.2 Circulating water system flow balance has been performed.

2.3 Permanently installed instrumentation is functional and calibrated.

2.4 Test instrumentation is calibrated and available.

2.5 Plant output is at approximately full-power.

3.0 TEST METHOD

3.1 Perform a measurement of the cooling tower performance using Cooling Tower Institute (CTI) standards.

4.0 DATA REQUIRED

4.1 Cooling water temperature and flows.

5.0 ACCEPTANCE CRITERIA

5.1 The cooling tower performance meets manufacturers design (refer to Section 10.4.5.1).

14.2.12.21.7 Loss of Offsite Power with Plant Auxiliary Loads Supplied in Island Mode (Test #227)

1.0 OBJECTIVE

1.1 To demonstrate that the plant responds and is controlled as designed following a loss of offsite grid. Turbine-generator output breakers are expected to remain closed, and the turbine-generator supply house loads in the island mode.

1.2 This procedure shall be performed at the following plateau:

1.2.1 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 A transient load flow analysis has been performed that demonstrates the electrical transient (voltage and frequency) from the test will not exceed safety-related equipment capabilities and protection system setpoints.

2.2 The following systems are in automatic operation:

2.2.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

2.2.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.2.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.2.4 Primary and secondary temperature controls (e.g., RCS T_{avg}).

2.2.5 RCSL control of RCCAs.

2.2.6 Turbine-Generator overspeed and load controls.

2.3 Manual turbine overspeed protection is available and functioning properly in the control room and locally at the turbine, and that these trip devices are manned.

3.0 TEST METHOD

3.1 Offsite power is removed from the plant by tripping transmission line breakers in the switchyard.

3.2 Verify that RCPs continue to operate with power supplied from the main generator.

3.3 Verify that a partial rod trip occurs but the reactor remains critical.

3.4 Verify that the turbine-generator continues to provide auxiliary loads.

3.5 The plant behavior is monitored to establish that the control systems maintain the NSSS within operating limits.

3.6 Monitor the following RCCA positions:

3.6.1 Control Bank A.

3.6.2 Control Bank B.

3.6.3 Control Bank C.

3.6.4 Control Bank D.

3.7 Monitor RCP parameters:

3.7.1 Voltage.

3.7.2 Current.

3.7.3 Speed.

3.8 Monitor the following turbine-generator parameters:

3.8.1 Speed.

3.8.2 First stage pressure.

3.9 Monitor secondary systems, including the turbine-generator, to determine system performance. At a minimum, collect the following plant data during the evolution:

3.9.1 Feedwater flow.

3.9.2 Reactor power.

3.9.3 Feedwater heater levels.

3.9.4 Condenser hotwell level.

3.9.5 Deaerator level.

3.9.6 Steam generator level.

3.9.7 Turbine-Generator control valve position.

3.9.8 Turbine-Generator electrical output.

4.0 DATA REQUIRED

4.1 Plant condition prior to trip.

4.2 The following acceptance criteria parameters are monitored prior to and throughout the transient:

4.2.1 Electrical distribution system voltage and frequency.

4.2.2 Pressurizer parameters (i.e., pressure and level).

4.2.3 RCS temperatures (i.e., T_{cold}, T_{hot}, and T_{avg}).

4.2.4 SG parameters (i.e., flow, pressure, temperature, and level).

4.2.5 RCS parameters (i.e., flow, pressure, temperature, and pressurizer level).

4.2.6 RCCA position as a function of time.

- Control Bank A.
- Control Bank B.
- Control Bank C.
- Control Bank D.

4.2.7 RCP parameters:

- Voltage.
- Current.
- Speed.

4.3 Additional key plant parameters shall be monitored for baseline data.

4.3.1 Turbine speed and generator frequency.

4.3.2 Generator voltage.

4.3.3 Generator excitation.

5.0 ACCEPTANCE CRITERIA

5.1 RCSL and turbine controls remain within analyzed limits and reactor power is stabilized at the lower power for at least 30 minutes following the test initiation without unanticipated operator action.

5.2 Electrical distribution system voltage and frequency measurements can be correlated with the transient load flow analysis.

5.3 RCPs continue to operate with power supplied from the turbine-generator.

5.4 Partial rod trip occurs but the reactor remains critical.

5.5 Turbine-Generator output breakers remain closed.

5.6 Turbine-Generator performance remains within design limits and as described in Section 10.2.

5.7 Secondary performance remains within design limits as described in Sections 10.2, 10.3, and 10.4.

14.2.13 References

1. ASME Boiler and Pressure Vessel Code, Section III, “Rules for Construction of Nuclear Facility Components,” The American Society of Mechanical Engineers, 2004.

2. ASME Code, Section III, Division 1, Subsection NE, “Class MC Components,” The American Society of Mechanical Engineers, 2004.

3. ASME PTC-6, “Steam Turbines,” The American Society of Mechanical Engineers, 2004.

4. ASME PTC-4, “Fired Steam Generators,” The American Society of Mechanical Engineers, 2008.

5. NFPA 72, “National Fire Alarm Code,” National Fire Protection Association Standards, 2007.

6. ANSI/ACI 349, “Code Requirements for Nuclear Safety Related Concrete Structures,” American National Standards Institute, 2001.

7. ASME NOG-1-2004, “Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder),” The American Society of Mechanical Engineers, 2004.

8. NFPA 13, “Standard for Installation of Sprinkler Systems,” National Fire Protection Association Standards, 2007.

9. ASME AG-1, “Code on Nuclear Air and Gas Treatment,” The American Society of Mechanical Engineers, 1997 (including the AG-1a-2000, “Housings” Addenda).

Table 14.2-1—List of Initial Tests for the U.S. EPR
Sheet 1 of 14

Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other Requirement
001	Fuel Pool Cooling and Purification System	FSAR	Appendix A, 1.m.(1)	
002	CVCS Volume Control Tank	FSAR	Appendix A, 1.b.(2)	
003	CVCS Charging and Seal Injection	FSAR	Appendix A, 1.b.(2)	
004	CVCS Letdown	FSAR	Appendix A, 1.b.(2)	
005	CVCS Chemical Addition	FSAR	Appendix A, 1.b.(2)	
006	Coolant Supply and Storage System	FSAR	Appendix A, 1.b.(2)	
007	Reactor Boron and Water Makeup System	FSAR	Appendix A, 1.b.(2)	
008	Boric Acid Mixing Tank	FSAR	Appendix A, 1.b.(2)	
009	Boric Acid Storage Tank	FSAR	Appendix A, 1.b.(2)	
010	Coolant Degasification System	FSAR	Appendix A, 1.n.(10)	
011	Coolant Purification System	FSAR	Appendix A, 1.n.(10)	
012	Reactor Coolant System	FSAR	Appendix A, 1.a.(2)	RG 1.20
013	Combustible Gas Control System	FSAR	Appendix A, 1.h.(4)	
014	Medium Head Safety Injection System	FSAR	Appendix A, 1.h.(1) & 5.k	RG 1.79
015	Safety Injection Accumulator System	FSAR	Appendix A, 1.h.(1)	RG 1.79
016	Residual Heat Removal System	FSAR	Appendix A, 1.d.(5) & 5.k	RG 1.79
017	Mid-loop Operations Verification	FSAR	Appendix A, 1.d.(5)	

Table 14.2-1—List of Initial Tests for the U.S. EPR
Sheet 2 of 14

Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other Requirement
018	Severe Accident Heat Removal System	FSAR	Appendix A, 1.d.(5)	
019	Extra Borating System	FSAR	Appendix A, 1.b.(2) & 5.k	RG 1.79
020	Emergency Feedwater System	FSAR	Appendix A, 1.d.(8)	RG 1.79
021	Emergency Feedwater Storage Pool	FSAR	Appendix A, 1.d.(8)	RG 1.79
022	In-containment Refueling Water Storage Tank System	FSAR	Appendix A, 1.h.(8)	
023	Core Melt Stabilization System	FSAR	Appendix A, 1.d.(5)	
024	Containment Equipment Hatch Functional and Leak Test	FSAR	Appendix A, 1.i.(4)	
025	Containment Personnel Airlock Functional and Leak Test	FSAR	Appendix A, 1.i.(5)	
026	Containment Electrical Penetration Assemblies	FSAR	Appendix A, 1.i.(4)	
027	Containment Isolation Valves	FSAR	Appendix A, 1.i.(2)	NRC Order EA-12-049
028	Containment Isolation Valves Leakage Rate	FSAR	Appendix A, 1.i.(3)	
029	Containment Integrated Leak Rate and Structural Integrity Tests	FSAR	Appendix A, 1.i.(6)	RG 1.136, NRC Order EA-12-049
030	Reactor Coolant System Hydrostatic	FSAR	Appendix A, 1.a.(4)	
031	Reactor Coolant Pump Motor Initial Operation	FSAR	Appendix A, 1.a.(2)(b)	
032	Steam Generator Hydrostatic	FSAR	Appendix A, 1.a.(2)(c)	
033	Steam Generator Downcomer Feedwater System Water Hammer	FSAR	Appendix A, 1.a.(2)(c)	
034	Balance of Plant Piping Thermal Expansion Measurement	FSAR	Appendix A, 1.e	
035	BOP Piping Vibration Measurement	FSAR	Appendix A, 1.e	

Table 14.2-1—List of Initial Tests for the U.S. EPR
Sheet 3 of 14

Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other Requirement
036	Control Rod Drive Mechanism Control	FSAR	Appendix A, 1.b.(1)	
037	Pressurizer Safety Relief Valves	FSAR	Appendix A, 1.a.(2)(d) & 5.t	
038	Fuel Handling System	FSAR	Appendix A, 1.m.(2)	
039	Fuel Transfer System Operation and Leak Test	FSAR	Appendix A, 1.m.(3) & (5)	
040	Containment Polar Crane	FSAR	Appendix A, 1.o.(1), (2), & (3)	NUREG-0554 NUREG-0612 ASME NOG-1
041	Fuel Building Cranes	FSAR	Appendix A, 1.m.(2)	NURGE-0554 NUREG-0612 ASME-NOG-1
042	Turbine Building Crane	FSAR	Appendix A, 1.n	
043	Raw Water Supply System	COLA	Appendix A, 1.n	
044	Reactor Containment Building Doors	FSAR	Appendix A, 1.h & 1.i	
045	Seal Water Supply System	FSAR	Appendix A, 1.n.(8)	
046	Component Cooling Water System	FSAR	Appendix A, 1.d.(11) & 1.n.(3)	
047	Spent Fuel Cask Transfer Facility	FSAR	Appendix A, 1.m. (1)	
048	Essential Service Water System	FSAR	Appendix A, 1.d.(11) & 1.n.(1)	
049	Ultimate Heat Sink	FSAR	Appendix A, 1.d.(10) & 1.h.(10)	
050	Fuel Pool Fill and Spray (ELAP)	FSAR		NRC Order EA-12-049
051	Boron Recovery	FSAR	Appendix A, 1.o(12)	
052	Safety Chilled Water System	FSAR	Appendix A, 1.n.(14)	

Table 14.2-1—List of Initial Tests for the U.S. EPR
Sheet 4 of 14

Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other Requirement
053	Secondary Feed and Bleed (ELAP)	FSAR		NRC Order EA-12-049
054	Fire Water Distribution System	FSAR	Appendix A, 1.n.(7)	
055	Spray Deluge System	FSAR	Appendix A, 1.n.(7)	
056	Sprinkler System	FSAR	Appendix A, 1.n.(7)	
057	Gaseous Fire Extinguishing System	FSAR	Appendix A, 1.n.(7)	
058	Primary Coolant Injection Subsystem (ELAP)	FSAR		NRC Order EA-12-049
059	Feedwater System	FSAR	Appendix A, 1.e.(9)	
060	Feedwater Heating System	FSAR	Appendix A, 1.e.(10)	
061	Main Steam – Turbine Bypass Systems	FSAR	Appendix A, 1.e.(2) & 5.t	
062	Main Steam Safety Valve	FSAR	Appendix A, 1.d.(1), 1.e.(4), & 5.t	
063	Main Steam Isolation Valves and MSIV Bypass Valves	FSAR	Appendix A, 1.d.(7), 1.e.(3), & 5.u	
064	Turbine Gland Sealing System	FSAR	Appendix A, 1.e.(5)	
065	Main Condenser and Main Condenser Evacuation System	FSAR	Appendix A, 1.e.(7)	
066	Condensate System	FSAR	Appendix A, 1.e.(8)	
067	Steam Generator Blowdown System	FSAR	Appendix A, 1.e.(1)	
068	Steam Turbine	FSAR	Appendix A, 1.e.(6) & 5.t	
069	Circulating Water Supply System	COLA	Appendix A, 1.d.(11) & 1.f.(1)	

Table 14.2-1—List of Initial Tests for the U.S. EPR
Sheet 5 of 14

Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other Requirement
070	Reheater Drains System	FSAR	Appendix A, 1.e.(10)	
071	Secondary Sampling System	FSAR	Appendix A, 1.l.(8)	
072	Steam Generator Blowdown Demineralizing System	FSAR	Appendix A, 1.e.(1)	
073	Containment Building Cooling	FSAR	Appendix A, 1.i.(16)	
074	Containment Building Cooling Subsystem	FSAR	Appendix A, 1.i.(16)	
075	Containment Building Ventilation System	FSAR	Appendix A, 1.i.(16)	RG 1.52
076	Containment Purge	FSAR	Appendix A, 1.i.(9) & 5.ee	
077	Annulus Ventilation System	FSAR	Appendix A, 1.i.(18)	
078	Electrical Division of Safeguard Building Ventilation System	FSAR	Appendix A, 1.n.(14)	RG 1.140
079	Nuclear Auxiliary Building Ventilation System	FSAR	Appendix A, 1.k.(4), & 1.n.(14)	RG 1.140
080	Radioactive Waste Processing Building Ventilation System	FSAR	Appendix A, 1.k.(4), & 1.n.(14)	RG 1.140
081	Fuel Building Ventilation System	FSAR	Appendix A, 1.k.(4), & 1.n.(14)	RG 1.140
082	Main Control Room Air Conditioning System	FSAR	Appendix A, 1.n.(14)	RG 1.52, RG 1.78
083	Safeguard Building Controlled Area Ventilation System	FSAR	Appendix A, 1.k.(4), & 1.n.(14)	RG 1.52
084	Emergency Power Generating Building Ventilation System	FSAR	Appendix A, 1.n.(14)	
085	Smoke Confinement System	FSAR	Appendix A, 1.n.(14)	
086	Station Blackout Room Ventilation System	FSAR	Appendix A, 1.n.(14)	
087	Turbine Island Ventilation Systems	COLA	Appendix A, 1.n.(14)	

Table 14.2-1—List of Initial Tests for the U.S. EPR
Sheet 6 of 14

Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other Requirement
088	Essential Service Water Pump Building Ventilation System	FSAR	Appendix A, 1.n.(14)	
089	Main Steam and Feedwater Valve Room System	FSAR	Appendix A, 1.n.(14)	
090	Plant Laboratory Equipment	COLA	Appendix A, 1.k	RG 1.21 RG 4.15
091	Leak-off System	FSAR	Appendix A, 1.n	
092	Sampling Activity Monitoring System	FSAR	Appendix A, 1.k.(1)	
093	Solid Waste Storage System	FSAR	Appendix A, 1.l.(3)	
094	Radioactive Concentrates Processing System – Solid Waste	FSAR	Appendix A, 1.l.(3)	
095	Liquid Waste Processing System	FSAR	Appendix A, 1.l.(1)	
096	Reactor Coolant Drain Tank	FSAR	Appendix A, 1.l.(7)	
097	Process Drain Tank	FSAR	Appendix A, 1.l.(7)	
098	Equipment and Floor Drainage System	FSAR	Appendix A, 1.l.(7)	
099	Gaseous Waste Processing System	FSAR	Appendix A, 1.l.(2)	
100	Nuclear Sampling and Severe Accident Sampling Systems	FSAR	Appendix A, 1.l.(8)	
101	Station Blackout Diesel Generator Mechanical	FSAR	Appendix A, 1.g.(1)	
102	Station Blackout Diesel Generator Electrical	FSAR	Appendix A, 1.g.(1)	
103	Station Blackout Diesel Generator Auxiliaries	FSAR	Appendix A, 1.g.(1)	
104	Emergency Diesel Generator Mechanical	FSAR	Appendix A, 1.g.(3)	RG 1.9
105	Emergency Diesel Generator Electrical	FSAR	Appendix A, 1.g.(3)	RG 1.9

Table 14.2-1—List of Initial Tests for the U.S. EPR
Sheet 7 of 14

Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other Requirement
106	Emergency Diesel Generator Auxiliaries	FSAR	Appendix A, 1.g.(3)	RG 1.9
107	Auxiliary Steam Generating System	FSAR	Appendix A, 1.n.	
108	Switchyard and Preferred Power System	FSAR	Appendix A, 1.g.(1)	
109	Main Generator	FSAR	Appendix A, 1.g.(1)	
110	Class 1E Uninterruptible Power Supply	FSAR	Appendix A, 1.g.(3)	NRC Order EA-12-049
111	Non-Class 1E Uninterruptible Power Supply	FSAR	Appendix A, 1.g.(1)	
112	Control Rod Drive Control System	FSAR	Appendix A, 1.b.(1)	
113	Normal Lighting System	FSAR	Appendix A, 1.g.(1)	
114	Heat Tracing	FSAR	Appendix, A, 1.n.(1b)	
115	Emergency Lighting System	FSAR	Appendix A, 1.g.(1)	
116	6.9 kV Emergency Power Supply	FSAR	Appendix A, 1.g.(2)	
117	480 V Emergency Power Supply	FSAR	Appendix A, 1.g.(2)	
118	13.8 kV Normal Power Supply	FSAR	Appendix A, 1.g.(1)	
119	6.9 kV Normal Power Supply	FSAR	Appendix A, 1.g.(1)	
120	480 V Normal Power Supply	FSAR	Appendix A, 1.g.(1)	
121	Signal Conditioning and Distribution System	FSAR	Appendix A 1.j	
122	Priority Actuation Control System	FSAR	Appendix A 1.j	
123	12-Hour Uninterruptible Power Supply	FSAR	Appendix A, 1.g.(1)	

Table 14.2-1—List of Initial Tests for the U.S. EPR
Sheet 8 of 14

Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other Requirement
124	Safety Information and Control System	FSAR	Appendix A, 1.c.	
125	Seismic Monitoring System	FSAR	Appendix A, 1.j.(10)	
126	Boron Concentration Measurement System	FSAR	Appendix A, 1.n.(6)	
127	Aeroball Measurement System	FSAR	Appendix A, 1.j.(11)	
128	Process Automation System	FSAR	Appendix A, 1.j.(8)	
129	Process Information and Control System	FSAR	Appendix A, 1.j.(8)	
130	Communication System	FSAR	Appendix A, 1.n.(13)	
131	Vibration Monitoring System	FSAR	Appendix A, 1.j.(2)	
132	Plant Fire Alarm System	FSAR	Appendix A, 1.n.(7)	
133	Loose Parts Monitoring System	FSAR	Appendix A, 1.j.(6)	
134	Turbine-Generator Instrumentation and Control System	FSAR	Appendix A, 1.j.(8) & (15)	
135	Reactor Pressure Vessel Level Measurement System	FSAR	Appendix A, 1.j.(22) & 5.y	
136	Fatigue Monitoring System	FSAR	Appendix A, 1.j.(8)	
137	Leak Detection Systems	FSAR	Appendix A, 1.j.(20) & 5.o	
138	Extended Loss of Alternating Current Power (ELAP) Diesel Generator	FSAR		NRC Order EA-12-049
139	Safety Automation System	FSAR	Appendix A, 1.c.	
140	Remote Shutdown Station	FSAR	Appendix A, 1.j.(19)	RG 1.68.2
141	Incore Instrumentation System	FSAR	Appendix A, 1.j.(13)	

Table 14.2-1—List of Initial Tests for the U.S. EPR
Sheet 9 of 14

Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other Requirement
142	Excore Instrumentation System	FSAR	Appendix A, 1.j.(13)	
143	Radiation Monitoring System	FSAR	Appendix A, 1.k.(1)	
144	Process and Effluent Radiological Monitoring System	FSAR	Appendix A, 1.k.(1)	
145	Hydrogen Monitoring System	FSAR	Appendix A, 1.j.(23)	
146	Protection System	FSAR	Appendix A, 1.c.	
147	Reactor Control, Surveillance and Limitation System	FSAR	Appendix A, 1.j.(8)	
148	Main Steam Relief Trains	FSAR	Appendix A, 1.d.(3), 1.e.(4), & 5.t	
149	Steam Generator Level Control	FSAR	Appendix A, 1.j.(2)	
150	Partial Trip	FSAR	Appendix A, 1.c.	
151	Primary Depressurization	FSAR	Appendix A, 1.a.(2)(d), 1.h.(2), & 5.t	
152	Partial Cooldown	FSAR	Appendix A, 1.a.(2)(d) & 1.h.(2)	
153	Integrity of Systems Likely to Contain Radioactive Material	FSAR	Appendix A, 5.cc	NUREG-0578 NUREG-0660 NUREG-0664
154	Remote Safe Shutdown	FSAR	Appendix A, 1.c	
155	Post-accident Monitoring Instrumentation	FSAR	Appendix A, 1.j.(22)	
156	Pressurizer Pressure and Level Control	FSAR	Appendix A, 1.j.(1)	
157	Diverse Actuation System	FSAR	Appendix A, 1.c & 5.gg	

Table 14.2-1—List of Initial Tests for the U.S. EPR
Sheet 10 of 14

Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other Requirement
158	Rod Position Measurement System	FSAR	Appendix A, 1.b (1)	
159	Reserved			
160	Personnel Radiation Monitors	COLA	Appendix A, 1.k.(2)	
161	Hot Functional Sequencing Document	FSAR		RG 1.68
162	Pre-Core Instrument Correlation	FSAR	Appendix C, 2.a.(5) & (6)	
163	Pre-Core Test Data Record	FSAR	Appendix C, 2.a	
164	Pre-Core Reactor Internals Vibration Measurements	FSAR	Appendix A, 5.p & Appendix C, 2.a	RG 1.20
165	Pre-Core Reactor Coolant System Expansion Measurements	FSAR	Appendix C, 2.a	
166	Pre-Core Primary and Secondary Chemistry Data	FSAR	Appendix C, 2.a	
167	Pre-Core Pressurizer Performance	FSAR	Appendix C, 2.a	
168	Pre-Core Pressurizer Surge Line Stratification	FSAR	Appendix C, 2.a	
169	Pre-Core Control Rod Drive Mechanism Performance	FSAR	Appendix A, 5.g & Appendix C, 2.a	
170	Pre-Core Reactor Coolant System Flow Model Verification	FSAR	Appendix A, 5.y & Appendix C, 2.a	
171	Pre-Core Reactor Coolant System Heat Loss	FSAR	Appendix C, 4.c	
172	Pre-Core Primary System Leak Rate Measurement	FSAR	Appendix C, 2.a	
173	Pre-Core CVCS Integrated Test	FSAR	Appendix C, 2.a.(10), (11), & (15)	

Table 14.2-1—List of Initial Tests for the U.S. EPR
Sheet 11 of 14

Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other Requirement
174	Pre-Core Turbine Overspeed	FSAR	Appendix C, 2.a	
175	Pre-Core Safety Injection Check Valve Test	FSAR	Appendix C, 2.a.(3)	
176	Pre-Core Boration and Dilution Measurements	FSAR	Appendix C, 2.a.(11)	
177	Pre-Core Safety Injection Initiated at HZP	FSAR	Appendix C, 2.a	
178	Pre-Core Loss of Instrument Air	FSAR	Appendix C, 2.a	RG 1.68.3
179	Initial Fuel Load	FSAR	Appendix A, 2	
180	Post-Core Sequencing Document	FSAR	Appendix A, 2	
181	Post-Core Loose Parts Monitoring Baseline	FSAR	Appendix A, 2.f	
182	Post-Core RCS Temperature Cross Calibration	FSAR	Appendix A, 2.f & 5.y	
183	Post-Core Reactor Coolant System Flow Baseline	FSAR	Appendix A, 2.f, 5.m, & 5.y	
184	Post-Core Control Rod Drive Mechanism Performance	FSAR	Appendix A, 2.b	
185	Post-Core Reactor Coolant and Secondary Water Chemistry Data	FSAR	Appendix A, 2.e	
186	Post-Core Pressurizer Spray Valve and Control Adjustments	FSAR	Appendix A, 2.f	
187	Post-Core Reactor Coolant System Leak Rate Measurement	FSAR	Appendix A, 2.d	
188	Post-Core Incore Instrumentation	FSAR	Appendix A, 2.g	
189	Leak Detection Systems	FSAR	Appendix A, 2.d	
190	Critical Boron Concentration: All Rods Out	FSAR	Appendix A, 3	
191	Isothermal Temperature Coefficient	FSAR	Appendix A, 4.a	

Table 14.2-1—List of Initial Tests for the U.S. EPR
Sheet 12 of 14

Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other Requirement
192	Rod Worth	FSAR	Appendix A, 4.b	
193	Low Power Biological Shield Survey	FSAR	Appendix A, 4.f	
194	Comparison of Control Systems and Design Predictions	FSAR	Appendix A, 4.u & 5.r	
195	Main, Startup and Emergency Feedwater Systems	FSAR	Appendix A, 4.k, 5.1, 5.v, & 5.oo	RG 1.20
196	Natural Circulation	FSAR	Appendix A, 4.t & 5.m	
197	Baseline NSSS Integrity Monitoring	FSAR	Appendix A, 4 & 5.n.	RG 1.20
198	Total Loss of Offsite Power	FSAR	Appendix A, 5.jj	
199	Control Systems Checkout	FSAR	Appendix A, 4.k, 4.u, 5.s, & 5.oo	
200	Load Swings	FSAR	Appendix A, 5.v & 5.hh	
201	Secondary Calorimetric Power	FSAR	Appendix A, 5.y	
202	Primary Calorimetric	FSAR	Appendix A, 5.m & 5.y	
203	Ventilation Capability	FSAR	Appendix A, 5.x & 5.ff	
204	Sampling Primary and Secondary Systems	FSAR	Appendix A, 5.aa	
205	Failed Fuel Detection	FSAR	Appendix A, 5.q	
206	Self Powered Neutron Detector Calibration	FSAR	Appendix A, 5.i & 5.y	
207	Steady-State Core Performance	FSAR	Appendix A, 5.a & 5.b	
208	Core-Related Reactor Trips	FSAR	Appendix A, 5	

Table 14.2-1—List of Initial Tests for the U.S. EPR
Sheet 13 of 14

Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other Requirement
209	Incore/Excore Cross-Calibration	FSAR	Appendix A, 5.d & 5.y	
210	Penetration Temperature Survey	FSAR	Appendix A, 5.w	
211	Remote Shutdown Station Checkout	FSAR	Appendix A, 5.dd	RG 1.68.2
212	Biological Shield Survey	FSAR	Appendix A, 5.bb	
213	Single RCCA Misalignment	FSAR	Appendix A, 5.f & 5.i	
214	Securing a Single Train of Feedwater Heaters	FSAR	Appendix A, 5.v & 5.kk	
215	Liquid Waste Storage and Processing Systems	FSAR	Appendix A, 5.z & 5.cc	
216	Gaseous Waste Processing System	FSAR	Appendix A, 5.cc	
217	Loss of Feedwater Pump	FSAR	Appendix A, 5.v	
218	HZP to HFP Reactivity Difference	FSAR	Appendix A, 5.a	
219	Trip of Generator Main Breaker	FSAR	Appendix A, 5.ll	
220	Load Follow	FSAR	Appendix A, 5.v	
221	Turbine-Generator Load Rejection	FSAR	Appendix A, 5.j & 5.nn	
222	Actual Rod Drop Times	FSAR	Appendix A, 5.h	
223	Cooling Tower Acceptance	COLA	Appendix A, 1.f	
224	Access Building Ventilation System	FSAR	Appendix A, 1.n(14)	
225	Potable and Sanitary Water Systems	FSAR	Appendix A, 1.n	10 CFR 20.1406 and GDC 60 of 10 CFR 50, Appendix A

Table 14.2-1—List of Initial Tests for the U.S. EPR
Sheet 14 of 14

Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other Requirement
226	Pre-Core Electrical Distribution System Voltage Verification	FSAR	Appendix A, 1.g(2)	
227	Loss of Offsite Power with Plant Auxiliary Loads Supplied in Island Mode	FSAR	Appendix A, 5.j	
228	Pre-Core Protection System Operation	FSAR	Appendix A, 1.k.(2)	

Next File