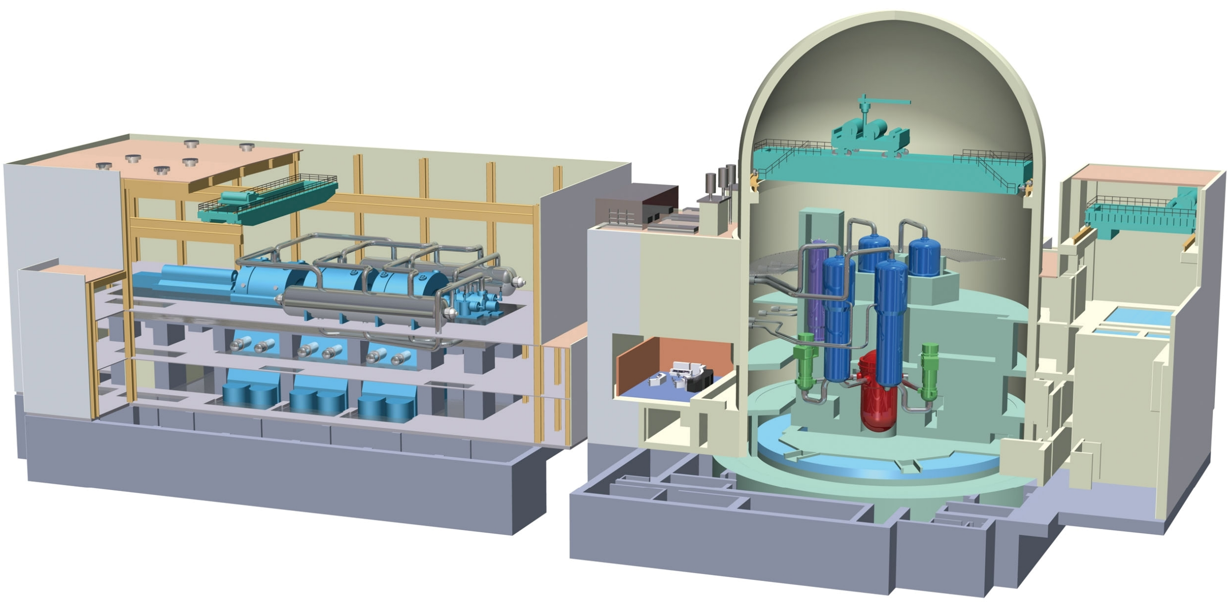
DESIGN CONTROL DOCUMENT FOR THE US-APWR

Chapter 14
Verification Programs

MUAP- DC014
REVISION 3
MARCH 2011



MITSUBISHI HEAVY INDUSTRIES, LTD.

Mitsubishi Heavy Industries, Ltd.

16-5, Konan 2-chome, Minato-ku

Tokyo 108-8215 Japan

CONTENTS

TABLES

ACRONYMS AND ABBREVIATIONS

ABVS	auxiliary building ventilation system
ac	alternating current
AHU	air handling unit
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
AOO	anticipated operational occurrence
ARMS	area radiation monitoring system
ASSS	auxiliary steam supply system
ASTM	American Society for Testing and Materials
ASME	American Society of Mechanical Engineers
ATWS	anticipated transient without scram
BTP	branch technical position
C/V	containment vessel
CAGS	compressed air and gas system
CCW	component cooling water
CCWS	component cooling water system
CFR	Code of Federal Regulations
CFS	condensate and feedwater system
CHS	containment hydrogen monitoring and control system
CIS	containment isolation system
CIV	containment isolation valve
COL	Combined License
COLA	Combined License Application
CPS	condensate polishing system
CRDM	control rod drive mechanism
CRDS	control rod drive system
CRE	control room envelope
CS	containment spray
CSS	containment spray system
CSF	condensate storage facilities
CVCS	chemical and volume control system
CVVS	containment ventilation system
CWS	circulating water system
DAS	diverse actuation system
dc	direct current
DCD	Design Control Document
DCS	data communication system

ACRONYMS AND ABBREVIATIONS (CONTINUED)

ECCS	emergency core cooling system
ECWS	essential chilled water system
EFWS	emergency feedwater system
EPS	emergency power source
ESF	engineered safety features
ESFAS	engineered safety features actuation system
ESFVS	engineered safety features ventilation system
ESW	essential service water
ESWS	essential service water system
FPS	fire protection system
FSAR	Final Safety Analysis Report
GDC	General Design Criteria
GSS	gland seal system
GWMS	gaseous waste management system
HEPA	high-efficiency particulate air
HFE	human factors engineering
HVAC	heating, ventilation, and air conditioning
HSIS	human-system interface system
I&C	instrumentation and control
IEEE	Institute of Electrical and Electronics Engineers
ILRT	integrated leak rate test
ISA	Instrumentation, Systems, and Automation Society
ITAAC	inspections, tests, analyses, and acceptance criteria
ITP	initial test program
LBB	leak before break
LCO	limiting condition for operation
LLHS	light load handling system
LOCA	loss-of-coolant accident
LOOP	loss of offsite power
LPMS	loose parts monitoring system
LWMS	liquid waste management system
MCC	motor control center
MCES	main condenser evacuation system
MCR	main control room
MFBRV	main feedwater bypass regulation valve
MFIV	main feedwater isolation valve
MFRV	main feedwater regulatory valve

ACRONYMS AND ABBREVIATIONS (CONTINUED)

MHI	Mitsubishi Heavy Industries, Ltd.
MSIV	main steam isolation valve
MSRVBV	main steam relief valve block valve
MSS	main steam supply system
MSSV	main steam safety valve
NaTB	sodium tetraborate decahydrate
NIS	nuclear instrumentation system
NRC	U.S. Nuclear Regulatory Commission
NRCA	non-radiological controlled area
NSSS	nuclear steam supply system
OHLHS	overhead heavy load handling system
PCCV	prestressed concrete containment vessel
PCMS	plant control and monitoring system
PERMS	process effluent radiation monitoring and sampling system
PMWS	primary makeup water system
PRA	probabilistic risk assessment
PSMS	protection and safety monitoring system
PSS	process and post-accident sampling system
PSWS	potable and sanitary water system
PWR	pressurized-water reactor
RCA	radiological controlled area
RCCA	rod cluster control assembly
RCDT	reactor coolant drain tank
RCP	reactor coolant pump
RCS	reactor coolant system
RG	Regulatory Guide
RHRS	residual heat removal system
RO	reactor operator
RPS	reactor protection system
RSS	remote shutdown system
RTS	reactor trip system
RTD	resistance temperature detector
RWSP	refueling water storage pit
SBO	station blackout
SCIS	secondary side chemical injection system
SDV	safety depressurization valve
SFPCS	spent fuel pit cooling and purification system

ACRONYMS AND ABBREVIATIONS (CONTINUED)

SGWFCV	steam generator water filling control valve
SG	steam generator
SGBDS	steam generator blowdown system
SIS	safety injection system
SL	safety limit
SLS	safety logic system
SPDS	safety parameter display system
SWMS	solid waste management system
TBS	turbine bypass system
TCS	turbine component cooling water system
SRO	senior reactor operator
SRP	Standard Review Plan
SRST	spent resin storage tank
SSC	structure, system, and component
T_{avg}	average temperature
T_{cold}	cold leg temperature
T_{hot}	hot leg temperature
TMI	Three Mile Island
T_{ref}	reference temperature
TSC	technical support center

14.0 VERIFICATION PROGRAMS

14.1 Specific Information to be Included in Preliminary/Final Safety Analysis Reports

This section is not applicable to the US-APWR.

14.1.1 Combined License Information

No additional information is required to be provided by a Combined License (COL) applicant in connection with this section.

14.2 Initial Plant Test Program

14.2.1 Summary of Test Program and Objectives

The initial test program (ITP) of the US–APWR plant is described in this chapter. Activities associated with the ITP occur as a part of the initial plant startup.

The ITP conforms to the relevant requirements of the regulations listed below.

- Title 10, Code of Federal Regulations (CFR) Part 30.53 (Reference 14.2-1) as it relates to testing radiation detection equipment and monitoring instruments.
- 10 CFR 50.34(b)(6)(iii) (Reference 14.2-2) as it relates to providing information associated with preoperational testing and initial operations.
- Section XI of Appendix B of 10 CFR 50 (Reference 14.2-3) as it relates test programs to demonstrate that systems, structures, and components (SSCs) will perform satisfactorily.
- Option B of Appendix J of 10 CFR 50 (Reference 14.2-4) as it relates to preoperational leakage rate testing of the containment.
- 10 CFR 52.79 (Reference 14.2-5) as it relates to preoperational testing and initial operations.
- Subpart A, Subpart B, and Subpart C, of 10 CFR 52 (Reference 14.2-6) as they relate to the inspections, tests, analyses, and acceptance criteria (ITAAC).

The objectives of the ITP include a demonstration that the plant construction is in compliance with the plant design; that the plant systems perform in accordance with that design; and that the initial fuel load, initial criticality, low power testing, and power ascension testing are performed in an approved predetermined methodology.

Preoperational and startup testing is performed on SSCs that are:

- Required for safe reactor shutdown and cooldown under normal plant conditions and for maintaining the reactor in a safe condition for an extended shutdown period
- Required for safe reactor shutdown and cooldown under transient (infrequent or moderate frequent events) conditions and postulated accident conditions and for maintaining the reactor in a safe condition for an extended shutdown period following such conditions
- Required for establishing conformance with safety limits (SLs) or limiting conditions for operation (LCOs) included in Chapter 16, “Technical Specifications”
- Classified as engineered safety features (ESF) or classified as required to support or ensure the operation of engineered safety features within design limits

- Assumed to function or which are credited in the accident analysis of the US-APWR DCD or applicable Final Safety Analysis Report (FSAR)
- Required to process, store, control, and/or limit the release of radioactive materials
- Used in the special low-power testing program to be conducted at power levels no greater than five percent for the purposes of providing meaningful technical information beyond that obtained in the normal startup test program as required for resolution of Three Mile Island (TMI) action plan item I.G.1 (Reference 14.2-7)
- Identified as risk-significant as discussed and identified in Subsection 17.4.7 and Table 17.4-1

The ITAAC required by 10CFR 52.47(b)(1) (Reference 14.2-8) for the US-APWR design are found in the Tier 1 document. The criteria for ITAAC selection are contained in Section 14.3, inspections, tests, analyses, and acceptance criteria.

The ITP consists of preoperational and startup tests.

Following the plant construction, testing is accomplished to demonstrate the proper performance of SSCs and design features.

Preoperational tests do not begin until construction and designated construction tests of the system are essentially completed. Preoperational tests are performed in cold conditions and at elevated temperatures produced by reactor coolant pump and pressurizer heater operation.

The initial fuel loading marks the beginning of startup testing. Startup tests as defined by Subsection 14.2.1.2.3 are performed to demonstrate that plant systems meet the performance requirements and that the plant can operate in an integrated fashion.

The preparation and performance of preoperational and startup tests are the responsibility of the COL licensee.

The ITP described in this chapter only addresses those systems and components within the US-APWR. A description of the program for the testing of other components and systems that are site-specific is discussed in US-APWR Test Program Description Technical Report, MUAP-08009 (Reference 14.2-29). Testing of these items demonstrates that they meet requirements as defined in the Final Safety Analysis Report (FSAR).

14.2.1.1 Test Program for Nuclear and Balance of Plant Systems

Preoperational and startup testing is conducted in accordance with an approved manual containing ITP administrative controls. The manual is prepared by the startup organization. Final approval of the manual is by the designated plant management. The preparation and approval of the manual is completed prior to the preparation of the first test procedure. This manual contains the administrative procedures and requirements that govern the activities of the startup organization and its interface with other organizations.

The procedures within the manual perform the following functions:

- Provide the organization of the startup organization and staffing (Subsections 14.2.2 and 14.2.2.1).
- Describe the preoperational and startup test procedure preparation, review, and approval (Subsection 14.2.3).
- Describe the conduct of testing of the ITP and the controls (Subsection 14.2.4)
- Specify the process for the evaluation, review and approval of the individual test results (Subsection 14.2.5).
- Specify the retention period of the test results and describe how the ITP results are compiled and maintained (Subsection 14.2.6).
- Establish the requirements for transitioning between test phases and between power test plateaus (Subsections 14.2.5.1, 14.2.10.1, 14.2.10.2, and 14.2.10.3).

The ITP includes tests on systems in both the nuclear portion of the plant, the balance of plant, or non-nuclear areas. The tests conducted on safety-related systems demonstrate the capability of the SSCs to meet performance requirements and design criteria. The tests on non safety-related systems verify the operability of the systems and/or components and their capability to support safety-related systems, where applicable. The testing continues through the initial fuel loading, startup, and power ascension.

Tests are performed to demonstrate the operation of each system independently and the operation of the systems in an integrated plant environment.

14.2.1.2 Major Phases of Test Program

14.2.1.2.1 Construction Tests

Construction and preliminary tests and inspections typically consist of activities such as hydrostatic pressure tests, flushing, cleaning, wiring continuity and separation checks, electrical distribution protection relays, initial instrument calibrations, valve functional checks, motor rotational checks, etc., and functional tests of components.

The objective of the construction and preliminary tests and inspections test phase is to verify and document that construction and installation of equipment in the facility have been accomplished in accordance with design, and that the equipment and components are functional and ready for preoperational testing.

Construction test abstracts are not included in this section. The development of construction and installation tests is based on engineering design, applicable industry standards and vendor information. A construction test matrix is developed for each system listing required tests and inspections for piping, wiring, equipment, valves, instruments and control devices. The test requirements are determined using tests listed in Regulatory Guide (RG) 1.68 Appendix C, Item 1.a (3), ITAAC tests, specific safety functions identified in the FSAR, vendor recommendations, design requirements, applicable U.S. Nuclear Regulatory Commission (NRC) RGs and NUREGs and industry standards as identified in the FSAR, and non-safety related functional performance attributes. The construction test matrix identifies the required tests and provides justification for any tests which are determined not to be required. The construction test matrix is approved by engineering, operations and the test organizations prior to the start of testing.

Division of responsibilities and administrative controls for construction tests are discussed in US-APWR Test Program Description Technical Report, MUAP-08009 (Reference 14.2-29). The technical aspects of establishing and maintaining cleaning and cleanliness control of fluid systems and associated components during preoperational and startup testing are in accordance with RG 1.37 (Table 14.2-2, Item 6).

14.2.1.2.2 Preoperational Tests

Preoperational tests are performed after the construction tests are complete and prior to fuel loading.

The major objectives of the preoperational test phase are:

- To demonstrate and document that SSCs operate in accordance with design in all operating modes throughout the full design operating range,
- To verify that systems, and interactions between systems and components, are capable of fulfilling their design bases,
- To demonstrate, to the extent practical, performance of safety-related SSCs and design features during normal and anticipated abnormal operating conditions, in order to maintain the plant in a safe condition,
- To validate, to the extent practical, plant response to transients, failures or malfunctions that could reasonably be expected to occur during the plant’s lifetime, by simulation of the effects of control systems and equipment failures or malfunctions. These failures or malfunctions are well understood through historical operating experience and include, but are not limited to, pump trips, instrument failures or malfunctions, valve failures or malfunctions, and loss of power events. Testing is limited to methods which do not degrade equipment performance or reliability, i.e., nondestructive testing,
- To familiarize the plant’s operating and technical staff with the operation of the facility,
- To verify that the normal, abnormal and emergency operating procedures, and surveillance procedures, are adequate through trial use,
- To operate equipment for a sufficient period to identify and correct any defects,

- To obtain test and operating data for future evaluation and trending, and
- To complete and document all testing required to satisfy ITAAC

The preoperational tests at elevated system pressure and temperature are identified as hot functional tests. The preoperational tests include the following:

- Manual and automatic operation of systems and components in alternate or secondary modes of control and operation.
- Demonstration of expected system operation following a loss of power and in degraded modes for which the system is designed to remain operational.
- Verification of proper functioning of instrumentation and controls, permissive and prohibit interlocks, and equipment protective devices of which malfunction or premature actuation may shutdown or defeat the operation of systems or equipment. (Software testing is described in Subsection 7.9.2.2.)
- System vibration, expansion (in discrete temperature step increments) and restraint testing.)
- Verification (by observations and measurements), as appropriate, that piping and component movements, vibrations, and expansions are acceptable for American Society of Mechanical Engineers (ASME) Class 1, 2, and 3 systems, as defined by the “Boiler and Pressure Vessel Code” (Reference 14.2-9), other high-energy piping systems inside seismic Category I structures, high-energy portions of systems of which failure could reduce the functioning of any seismic Category I plant feature to an unacceptable level, and seismic Category I portions of moderate-energy piping system outside containment.

Preoperational tests include, when practical, the incorporation of surveillance tests and the use of permanent plant operating procedures, and the documentation of test results. Plant personnel are involved in these activities in order to gain experience on the systems. The equipment is operated to the extent that run-in type failures are discovered. Upon completion of the preoperational tests, the plant systems are demonstrated to be ready for fuel loading and startup testing.

14.2.1.2.3 Startup Tests

Startup tests are performed after completion of preoperational testing. Startup tests include the following:

- Initial fuel loading (see Subsection 14.2.10.1)
- Initial criticality testing (see Subsection 14.2.10.2)
- Low power testing (less than 5% power) (see Subsection 14.2.10.3.1)

- Power ascension testing (5% to 100% of rated power) (see Subsection 14.2.10.3.2)

The general objectives of the startup test phase are:

- To perform a careful, deliberate, orderly and safe transition to full rated power within the operating limits and controls of the Technical Specifications,
- To plan and perform a controlled and safe initial core loading,
- To verify reactor monitoring, control and shutdown features necessary for a safe approach to initial criticality and subsequent power ascension,
- To achieve initial criticality in a controlled and safe manner,
- To assure plant operation remains within design and operating parameters during low power and subsequent power ascension testing,
- To provide the specific operator training related to the resolution of TMI action plan item I.G.1 during low-power testing,
- To verify the correctness or conservatism of assumptions used in the safety analyses,
- To confirm the operability of plant systems and design features that could not be completely tested during preoperational test, and
- To provide assurance that the integrated dynamic response is in accordance with design for plant events

Startup tests include steady-state and transient tests. They demonstrate adequate performance of the nuclear steam supply system (NSSS) and the other systems at various power levels.

14.2.2 Organization and Staffing

The COL licensee has the ultimate responsibility for the conduct of the ITP. The COL licensee establishes an organization to perform functions required for the US-APWR plant ITP. This organization manages, supervises, executes, and documents all phases of the ITP. It is described in approved administrative procedures that address organizational authorities and responsibilities and the degree of participation of each identified organizational unit and the principal participants. Administrative controls assure that personnel formulating and conducting the test activities are not the same personnel who designed or are responsible for the satisfactory performance of the system(s) or design feature(s). This provision does not preclude members of the design organization from participating in the performance of test activities.

A preliminary description of the organization(s) responsible for all phases of the ITP, and a description of the administrative controls that assure that experienced and qualified supervisory personnel and other principal participants are responsible for managing, developing, and conducting the ITP is provided in US-APWR Test Program Description Technical Report, MUAP-08009 (Reference 14.2-29). The COL Applicant reconciles the site-specific organization, organizational titles, organizational responsibilities, and reporting relationships to be consistent with this description.

14.2.2.1 Startup Organization

The startup organization is a temporary organization that performs the ITP including preoperational and startup tests. It administratively reports to the plant management organization. It includes members of onsite organizations such as the plant owner and operator, Mitsubishi Heavy Industries, Ltd. (MHI), and others associated with the ITP. By including these various organizational representatives, it can coordinate between them and with other onsite organizations.

Activities of the startup organization cease when the ITP is completed. At that time, all responsibilities for the plant operation are transferred to the plant operating organization. Since the startup organization is composed of personnel from other organizations, experience attained during the ITP can be applied to the commercial operation of the plant. The constructor, the electrical generator supplier, and others take a role in the ITP either directly or indirectly as appropriate.

14.2.2.2 Organizational Authorities and Responsibilities

The startup organization plans and performs the startup and testing activities that occur between the completion of construction and the beginning of commercial operation of the plant. It also documents the results of the ITP. The duties of the startup organization include the review and approval of the project test schedules and to propose and help implement changes to construction or testing to facilitate the ITP.

MHI is the primary designer and supplier of the US-APWR plant. MHI personnel are onsite to assist the constructor, the plant operator, and the startup organization. The MHI resident site manager is responsible for MHI activities. The MHI site manager performs activities as deemed appropriate including coordination with other MHI organizations.

At approval to load fuel, the plant operations organization assumes responsibility for the plant. The licensed reactor operators (ROs)/senior reactor operators (SROs) are responsible for plant operation.

14.2.2.3 Plant Operating and Technical Staff Participation

The plant operating and technical staff participates in each major test phase as much as possible. The level of participation is determined by the plant management. Experienced and qualified supervisory personnel and other principal participants are provided who are responsible for managing, developing, and conducting each test phase. The participation is conducted as a part of the use-testing during the special low power test program required by the resolution of TMI action plan item I.G.1 (Reference 14.2-7).

After turnover from construction, equipment and systems are operated by the plant operating staff. At fuel loading and afterwards, all equipment and system operation is performed by licensed unit operators. Instrumentation is calibrated or controlled by the plant staff. Maintenance and technical support is provided by the plant operating organization. The plant operating organization responsibilities, authorities, and qualifications are given in Chapter 13, “Conduct of Operations.” The plant operating organization participates in the ITP as much as possible to assist the startup organization and to gain practical plant experience.

The plant operating organization typically performs their duties according to normal plant procedures. However, when off-normal or special conditions are required for the ITP and the normal plant procedures do not provide a means to achieve the conditions, administrative procedures, preoperational test procedures, or startup test procedures address the required conditions. Controls are provided that allow the startup organization to safely perform tests on equipment, systems, and components in normal conditions, off-normal conditions, and simulated accident conditions.

The designated plant management personnel have the final approval authority for the preoperational and startup test procedures.

14.2.2.4 Experience and Qualification of Supervisory Personnel

The required number of experienced and qualified supervisory personnel and other principal participants are provided who are responsible for managing, developing, and conducting each test phase. Personnel with the appropriate technical background and experience perform the final review and approval of test procedures and test results.

14.2.2.5 Plant Operating and Technical Staff Training to Support Testing

A training program is developed for the plant personnel involved in the ITP. Subsection 14.2.9.1 addresses training for the resolution of, NUREG-0737 (Reference 14.2-7) TMI action plan item I.G.1.

Plant equipment used in the performance of preoperational tests is operated in accordance with appropriate operating, emergency, and surveillance procedures; thereby, giving the plant operating organization an opportunity to gain experience in using these procedures and demonstrating their adequacy prior to a initial criticality.

14.2.3 Test Procedures

Preoperational and startup tests are conducted using individual approved, detailed, step-by-step written procedures. Test procedures are developed from test abstracts contained in Subsection 14.2.12. The abstracts address SSCs and unique design features that are tested to verify that system and component performance are in accordance with the design. The abstracts include objectives, test methods, and acceptance criteria included in the test procedures. The plant management organization has the ultimate responsibility for preoperational and startup test procedure preparation, review, and approval. MHI and other major participants associated with the ITP provide plant preoperational and startup test system information specific enough to determine test objectives, acceptance criteria applicable to the plant design, delineation of specific plant operational conditions at which tests are to be conducted, testing methodologies to be utilized, specific data to be collected, and acceptable data analysis techniques. The test procedures are consistent with normal plant procedures in as many aspects as possible.

The startup organization develops test procedures. The test procedures are prepared in accordance with the approved administrative procedures. Controls are established to assure that procedures are prepared in adherence to U.S. Nuclear Regulatory Commission (NRC) Regulatory Guides (RGs). Controls assure that the startup organization provides the approved test procedures to the NRC at least 60 days prior to their use. The startup organization reconciles any concerns the NRC may have with the test procedures.

The process used to develop test specifications and test procedures is described in US-APWR Test Program Description Technical Report, MUAP-08009 (Reference 14.2-29).

Before proceeding with testing, the COL licensee is to establish controls relating to the methods used for initial review of individual parts of multiple tests (e.g., hot functional testing) in order to assure coordination of plant conditions related to these tests.

14.2.3.1 Organizational Functions during Development, Review and Approval of Test Procedures

The startup organization conducts preoperational and startup tests in accordance with approved test procedures. Administrative procedures govern the activities of the startup organization and its interface with other participants involved in the ITP. The review and approval process for both initial procedures and subsequent revisions are defined.

An approved program is used to develop, review, and approve the individual test procedures, including the organizational units or personnel performing the activities and their respective responsibilities. This includes the designated functions of each organizational unit, as well as the general steps to be followed in conducting the development, review, and approval of the test procedures. The program is documented in administrative procedures.

The test requirements and test procedures are developed and reviewed by personnel with appropriate technical backgrounds and experience. This includes the participation of principal design organizations (e.g., MHI, architect engineer, etc.) to establish test performance requirements and acceptance criteria. MHI and other major participants associated with the ITP (including equipment suppliers, as applicable), provide plant system information specific enough to prepare the test procedures. The test procedures are reviewed by the startup organization and receive final approval by the designated plant management personnel.

14.2.3.2 Test Procedure Content

The test procedures contain safety precautions and limitations, objectives, prerequisites, initial conditions, methods to direct and control test performance (including the sequencing of testing), acceptance criteria, and the format by which data or observations are recorded, and the data analysis methods. Administrative procedures control the test procedures content and format. Subsection 14.2.3.5 specifies the format of the test procedures.

14.2.3.3 System Designer Participation in Development of Test Procedures

A method is developed for the utilization of system designers to provide objectives and acceptance criteria in developing detailed test procedures. The system designers include MHI, the architect engineer and other major contractors, subcontractors, and vendors, (see Subsection 14.2.3.1 for additional details).

14.2.3.4 Qualification of Test Procedure Developers and Reviewers

The test procedures are developed and reviewed by personnel with the appropriate technical backgrounds and experience. These qualifications are defined in administrative procedures. The test procedures receive final approval by the designated plant management personnel. The administrative procedures define the position titles for review and approval.

14.2.3.5 Test Procedure Format

Administrative procedures define the specific format of preoperational and startup test procedures. Checklists and signature blocks are included to control the testing sequence. The format of the test procedures developed for the ITP reflects the guidance provided in RG 1.68 (Reference 14.2-10), Appendix C, Section 1. The exceptions to this guidance are:

- Item g, “Data Collection,” is replaced by “Data Sheets”
- Item i, “Documentation of Test Results,” is included in “Detailed Procedures”
- Sections titled “References,” “Test Equipment,” “System Restoration,” and “Attachments” are added.

The format consists of the following sections:

a. Prerequisites

Prerequisites are those items which must be completed prior to the performance of the test or subsection of the test.

b. Objectives

This section identifies the objectives of the test. They are clear and concise, but not quantitative. Example contents of this section are as follows:

- Verification of normal equipment starting and stopping, both manual and automatic
- Verification of normal operation

- Verification of control, both local and remote
- Verification of loss of motive or control power alarms
- System parameter verification
- System capacity verification

c. Special Precautions

This section contains any special precautions applicable to the performance of the test. Items pertinent to the entire test are included in this section. Specific precautions are included in the text of the test immediately prior to the step to which they apply.

d. Initial System Conditions

Conditions that must exist prior to starting the test such as valve alignment, equipment status, temporary modifications, and required support systems are considered initial system conditions and are listed in this section. This section assures that temporary instrument cables and test leads are routed in a manner that does not compromise electrical separation.

e. Environmental Conditions

When tests are run at conditions other than ambient, the procedures include provisions to test the system under environmental conditions as close as possible to those experienced during normal and accident conditions.

f. Acceptance Criteria

The acceptance criteria section identifies the criteria that must be met to verify that the system performance is acceptable. Numerical values and tolerances are specified for quantitative criteria. Some acceptance criteria may be qualitative in nature.

Quantitative acceptance criteria are consistent with the setpoints and accuracies derived from uncertainty analysis and setpoint determinations as described in Chapter 7, Instrumentation and Controls, and the acceptance criteria included in the Technical Specifications surveillance requirements. Acceptance criteria that are demonstrated using portable measuring and test equipment are adjusted conservatively to account for instrument uncertainty.

g. Data Sheets

Where test data is too extensive to be recorded in the body of the procedure, the test results are entered onto data sheets contained in this section. Each data sheet is numbered sequentially. Data entries are in a permanent form with a means for correcting an entry.

h. Detailed Procedures

This section provides the detailed step-by-step instructions required to demonstrate that test acceptance criteria are satisfied and to obtain the baseline operating data. This section includes activities to demonstrate that the system and component performances meet the acceptance criteria. This section is subdivided for the purpose of procedure organization and clarity. Each subdivision consists of a continuous series of operations prepared under the assumption that performance of a subsection, once started, is carried to completion without interruption. Test data are normally recorded in the body of the procedure immediately following the steps that set up the required test conditions and adjacent to the acceptance criteria, where practicable. However, where extensive or repetitive lists of data are required, data sheets are used (see Subsection 14.2.3.5. Data Sheets).

Records identify each observer and data recorder participating in the test, the type of observation, test or measuring equipment identification numbers, results, acceptability, and action taken to correct any deficiencies. The retention periods for test records are defined in accordance with the guidance in RG 1.28 (Reference 14.2-11).

i. References

Reference documents, including drawings, used in the preparation of the test procedure are listed in this section with the revision of the document.

j. Test Equipment

This section lists the test equipment, other than installed plant equipment, required to perform the test and collect data. The specifications for each piece of equipment include the required range and accuracy. The test equipment used is determined by the test requirements and vendor information.

k. System Restoration

This section provides, if necessary, instructions beyond those in the test instructions section for restoring the systems to a desired status. Jumper removal, signal-inhibit device removal, and the disconnection of temporary instruments and other equipment are examples of the contents of this section.

l. Attachments

This section contains any attachments necessary to fully document the test results. Examples include, recorder traces, computer printouts, pump curves, etc.

14.2.4 Conduct of Test Program

ITP administrative procedures are developed that control the conduct of testing. They contain requirements to control the activities of the startup organization. They include the following:

- Format and content of test procedures
- Initial test procedure issue and revisions

- Process to review test results
- Process to resolve failure to meet test acceptance criteria and design deficiencies
- Description of the ITP phases and requirements for transitioning between phases
- Description of requirements for satisfying hold point requirements within a phase
- Method to track as-tested system status
- Method to track system modifications for systems already tested
- Method to track retest requirements required by system modifications and the failure to meet test acceptance criteria
- Startup organization personnel qualifications and responsibilities

The function of ITP administrative procedures is to provide controls for the relatively temporary requirements of the ITP. Plant administrative procedures provide controls for permanent plant requirements and are in effect during the ITP.

A description of the administrative controls that govern the conduct of the test program is provided in US-APWR Test Program Description Technical Report, MUAP-08009 (Reference 14.2-29). These controls include requirements that govern the activities of the startup organization and their interface with other organizations.

14.2.4.1 Administrative Controls for Test Prerequisites

Prerequisites are those items that must be completed prior to performance of the test or a subsection of the test. ITP administrative procedures describe the use of test prerequisites. The controls include inspections, checks, and other applicable controls, the identification of test personnel completing the data forms or checklists, and the dates of completion. Individual test procedures and each major phase of the test program adhere to these controls.

14.2.4.2 Use of Plant Modifications and Maintenance During Testing

Methods are developed for initiating plant modifications or the maintenance necessary to conduct the test program. The methods are documented in ITP administrative procedures. Temporary plant modifications may be used to test a system and are treated as initial conditions for test conduct. Temporary plant modifications are returned to normal upon the test completion. This is documented in the system restoration section of the test procedure. Permanent plant modifications may be needed to resolve deficiencies discovered during test conduct. Permanent plant modifications are controlled and documented in accordance with plant administrative controls. Maintenance activities may be required prior to a system test to facilitate testing. Maintenance activities may also be required to resolve deficiencies discovered during test conduct.

14.2.4.3 Post-Modification and Post-Maintenance Testing

Methods are developed to control post-modification (either permanent or temporary) and post-maintenance testing and to define the involvement of design organizations in the review and approval of plant modifications. The methods are documented in ITP administrative procedures.

Post-modification tests are required to be performed on modified systems or components to assure that the modified system or component operates in accordance with the design requirements. If the modification is required to resolve a test deficiency discovered during the ITP, the post-modification testing documents that the test procedure meets its objectives and is noted as the resolution of a test deficiency. Post-maintenance tests are performed on a system or component following a maintenance activity. If the maintenance is required to resolve a test deficiency discovered during the ITP, the post-maintenance testing documents that the test procedure meets its objectives and is noted as the resolution of a test deficiency.

Administrative procedures describe the controls in place that assure that the as-tested status of each system is known and that track modifications, including retest requirements, deemed necessary for systems undergoing or already having completed specified testing.

14.2.4.3.1 Compliance with ITAAC

ITP administrative controls assure that retesting required for modifications and maintenance remain in compliance with ITAAC requirements.

14.2.4.4 Test Procedure Compliance

ITP administrative controls are developed to assure adherence to approved test procedures during the conduct of the test program. If compliance with the test procedure, as approved, is not possible, the procedure is revised in accordance with change controls.

14.2.4.5 Changes to Approved Test Procedures

ITP administrative procedures define the specific format and content of preoperational and startup test procedures, as well as the review and approval process for both initial procedures, changes to test procedures, and subsequent revisions. Test procedure revisions are reviewed and approved in the same manner as the initial test procedure.

14.2.5 Review, Evaluation, and Approval of Test Results

Specific controls are developed for the review, evaluation, and approval of test results of the program by appropriate personnel and/or organizations.

Individual test results are evaluated and reviewed by members of the startup organization. Test exceptions or failure to meet acceptance criteria are documented and communicated to the affected and responsible organizations that help resolve the issues by suggesting corrective actions, design modifications, and retests. MHI and others, outside the plant operating organization, as appropriate, have the opportunity to review the test results for conformance to expectations. Test results, including the resolutions of test deficiencies, are reviewed and initially approved by the designated startup organization personnel. The final approval is obtained from the designated level of plant management.

The final review of the individual tests is the responsibility of the plant management, which is also responsible for the final review of the overall test results and for the review of selected milestones or hold points within the test phases.

A description of the specific controls for the review, evaluation, and approval of the test results of the program by appropriate personnel and/or organizations, including the methods and sequence for approval of test data for each major phase, is provided in US-APWR Test Program Description Technical Report, MUAP-08009 (Reference 14.2-29).

14.2.5.1 Review, Evaluation, and Approval of Test Results for each Major Test Phase

A method is developed for the approval of the test results for each major test phase before proceeding to the next test phase.

ITP administrative controls specify the process for the review and approval of test results for each major test phase. The startup organization initially approves the overall test phase results and the test results of the major test phases. The designated level of the plant management has the responsibility for the final review and approval. Steps taken when the test data does not meet the defined acceptance criteria are delineated in Subsections 14.2.5.3 and 14.2.5.4.

14.2.5.2 Review, Evaluation, and Approval of Test Results at each Power Test Plateau

A method is developed for the approval of the test results at each power test plateau before increasing the power level.

ITP administrative controls specify the process for the review, evaluation and approval of test results prior to transitioning to the next power test plateau. The startup organization initially approves the test results of each power test plateau. The designated level of the plant management has the responsibility for the final review and approval. Steps taken when the test data does not meet the defined acceptance criteria are delineated in Subsections 14.2.5.3 and 14.2.5.4.

14.2.5.3 Notification when Acceptance Criteria Not Met

ITP administrative controls specify the process for the review of the test results. Individual test results are evaluated and reviewed by members of the startup organization. Test exceptions or the failure to meet acceptance criteria are communicated to the affected and responsible organizations.

14.2.5.4 Resolution of Failed Acceptance Criteria

ITP administrative controls specify the method for resolution of a failure to meet acceptance criteria and other operational problems or design deficiencies discovered during the testing process. Test exceptions or the failure to meet acceptance criteria are communicated to the affected and responsible organizations that help resolve the issues with suggested corrective actions, design modifications, retests, or other remedies, as appropriate. The evaluation of the test results may result in accepting the system as tested or may require modification and/or maintenance and retest to verify that the steps taken to correct the deficiency are adequate. All resolutions are documented in accordance with approved administrative controls.

14.2.5.5 Test Data Approval

ITP administrative controls specify the process for the review and approval of test data, versus test results. The individual test data may require engineering review and/or analysis prior to the approval of the test results. The startup organization performs the initial approval and the designated level of the plant management has the responsibility for the final review and approval of the test results.

14.2.6 Test Records

The ITP results are compiled and maintained according to ITP administrative procedures that comply with applicable regulatory requirements. A summary of the startup testing is included in a startup report prepared in accordance with the guidance in RG 1.16 (Reference 14.2-12). The summary includes a description of the method and objectives for each test, a comparison of applicable test data with the related acceptance criteria, including the systems' responses to major plant transients (such as reactor trip and turbine trip), design- and construction-related deficiencies discovered during testing, system modifications and corrective actions required to correct those deficiencies, the schedule for implementing these modifications and the corrective actions unless previously reported to the NRC, the justification for the acceptance of systems or components that are not in conformance with the design predictions or the performance requirements, and the conclusions regarding the system or component adequacy.

Controls are in place for the disposition of test procedures and test data following the completion of the test program.

Test records, including test procedures and results, that demonstrate the adequacy of safety-related SSCs are retained for the life of the plant. The retention periods for other test records are based on the consideration of their usefulness in documenting the initial plant performance characteristics. The test records are retained in accordance with the guidance in RG 1.28 (Reference 14.2-11).

A description of the specific controls for the preparation and retention of test records is provided in US-APWR Test Program Description Technical Report, MUAP-08009 (Reference 14.2-29).

14.2.7 Conformance of Test Program with RGs

The development of the preoperational and startup test program adheres to the guidance of the NRC RGs associated with the ITP. These RGs are listed in Table 14.2-2. Conformance with the guidance of RGs are defined in Table 1.9.1-1, US-APWR Conformance with Division 1 RGs.

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

Because the US-APWR plant is based on the development of previous pressurized-water reactor (PWR) plants, the US-APWR plants have the benefit of experience acquired with the successful and safe startup of many previous PWR plants in Japan. The operational experience and knowledge gained from these plants and other reactor types are factored into the design and test system information of US-APWR equipment and systems that are demonstrated during the preoperational and startup test programs. Additionally, reactor operating and testing experience of similar nuclear power plants obtained from NRC Licensee Event Reports, Institute of Nuclear Operations correspondence, Significant Operating Event Reports, and through other industry sources is utilized to the extent practicable in developing and carrying out the ITP. Special importance is attached to repeat reportable occurrences experienced involving safety concerns and other operating experiences that could potentially impact the performance of the test program.

14.2.8.1 Preoperational and/or Startup Testing for Unique or First-of-a-Kind Principal Design Features

First-of-a-kind tests are special tests performed to verify unique performance parameters for new design features. Since these design features are new, the tests have not been performed for the design certification of previous plants. Because of the standardization of the US-APWR design, the parameters will not change from plant to plant and thus the tests are performed only on the first plant containing the unique design.

These first-plant-only tests are identified in the individual test descriptions in Subsection 14.2.12. The following is a listing of the first plant only tests, and the corresponding subsection in which they appear. The COL holder for the first plant is to perform these tests. For subsequent plants, either these tests are performed, or the COL Applicant provides a justification that the results of the first-plant only tests are applicable to the subsequent plant and are not required to be repeated.

First-Plant-Only Test	Subsection
Reactor Internals Vibration Test	14.2.12.1.7
Rod Cluster Control Assembly (RCCA) Misalignment Measurement and Radial Power Distribution Oscillation Test	14.2.12.2.4.5

There could be other special tests that further establish a unique performance parameter of the US-APWR design features beyond the testing performed for the design certification for previous plants and, which will not change from plant to plant, that are performed for the first three plants. There are no first-three-plants tests required.

The justifications for the first-plant-only tests and the justifications for there being no first-three-plant tests required are provided below:

14.2.8.1.1 Reactor Internals Vibration Test (14.2.12.1.7)

Preoperational vibration test of reactor internals is performed in accordance with RG 1.20 (Reference 14.2-13). This program is discussed in Subsection 3.9.2.

This test is conducted only during the hot functional test prior to fuel loading because the vibration responses under normal operating conditions with core are predicted to be almost the same or slightly lower than those under hot functional tests without the core loaded.

Justification for performing this on the first plant only is provided in Subsections 3.9.2.3 and 3.9.2.4.

14.2.8.1.2 Deleted

14.2.8.1.3 RCCA Misalignment Measurement and Radial Power Distribution Oscillation Test (14.2.12.2.4.5)

RCCA misalignment measurements and radial power distribution oscillation tests are performed in the power ascension test phase for the first US-APWR. The test is required only for the first plant because the stability of the radial power distribution is dependent upon the core diameter only. This test validates the calculation tools and instrument responses.

14.2.8.2 Prototype Test Results

14.2.8.2.1 Natural Circulation Testing

Natural circulation testing for the first plant is performed in accordance with Subsection 14.2.12.2.3.9. For subsequent plants, the COL Applicant either performs the test or provides a justification for not performing the test based on an evaluation of the results of previous natural circulation tests and comparison of RCS hydraulic resistance coefficients applicable to normal flow conditions provided that

- Test results from the US-APWR reference prototype plant indicate that natural circulation flow rates are adequate to ensure that core decay heat removal, boron mixing, plant cooldown/depressurization, and stable natural circulation conditions are maintained throughout the test.
- The as-built plant and US-APWR 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.

- The 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 Test in Subsection 14.2.12.2.4.12 and during the RCS Flow Coastdown Test in Subsection 14.2.12.2.1.13) are comparable with the US-APWR reference prototype plant.

- The results of the natural circulation test from the US-APWR 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 off-normal events for each operating shift.

14.2.9 Trial Testing of Plant Operating and Emergency Procedures

Plant operating and emergency procedures are, to the extent practical, developed, trial-tested, and corrected during the ITP prior to fuel loading to establish their adequacy. Preoperational and startup test procedures utilize plant operating, surveillance, emergency, and abnormal procedures either by reference or verbatim incorporation in the performance of tests. This verifies the plant procedures by actual use and provides experience to the plant personnel.

The COL Applicant provides a schedule for the development of plant procedures that assures that required procedures are available for use during the preparation, review and performance of preoperational and startup testing.

14.2.9.1 Operator Training during Special Low-Power Testing

At approval to load fuel, by virtue of being licensed by the NRC to operate the plant, the ROs/SROs have a responsibility for the operation of the plant. Therefore, at this point, the plant operations organization assumes responsibility for the plant. This period is used to further the training of licensed operators and provide training for operator trainees. This includes identifying the specific operator training to be conducted as a part of the use-testing during the special low power testing program required by the resolution of NUREG-0737 (Reference 14.2-7) TMI action plan item I.G.1. Meeting this requirement includes identifying proposed tests to be conducted, submitting analysis to support the test, submitting the test procedure, training to the test procedure and evaluating and documenting the results of the training.

14.2.10 Initial Fuel Loading and Initial Criticality

Fuel loading and initial criticality is conducted in accordance with the guidance of RG 1.68 (Reference 14.2-10). This phase of the ITP is performed in a controlled manner as prescribed in approved detailed written procedures. These procedures specify the following:

- System test prerequisites

- System status

- Detailed step-by-step test instructions

- Precautions
- Responses to unexpected conditions

14.2.10.1 Initial Fuel Loading

When the plant is declared ready to load fuel, a predetermined set of specific checks is made prior to beginning the fuel loading. A review is conducted of the appropriate preoperational test results and the status of design changes, and any retests that were performed due to preoperational test deficiencies or exceptions. All other ongoing activities are checked to assure that there are no adverse impacts on safe fuel loading. Technical specification surveillances are implemented to assure the operability of systems required for fuel loading. Immediately before fuel loading, proper reactor vessel water level and reactor coolant chemistry are verified and nuclear instruments are checked.

The 15 prerequisites for fuel loading listed in Section 2.a. of RG 1.68 (Reference 14.2-10), Appendix C are included as described in Subsection 14.2.12.2.1.3.

RG, 1.206, Section C.I.14.3, ITAAC (Reference 14.2-14), states that the successful completion of all ITAAC is a prerequisite for fuel load and a condition of the license. Therefore, the ITAAC is verified to be completed prior to the fuel loading.

The initial fuel loading is supervised by a licensed SRO with no concurrent duties. For the initial fuel loading a full core of fuel assemblies is transferred from the fuel pit to the reactor core. Each fuel assembly is identified by a unique serial number. The fuel loading procedure identifies which fuel assembly is placed into each core position. In conjunction with the fuel assemblies, control rods, burnable poison assemblies, and primary and secondary neutron sources are installed in the reactor vessel. The procedure specifies predetermined checks of shutdown margin and subcriticality. In-vessel neutron detectors provide continuous indication of the core flux as each fuel assembly is placed into the reactor. A complete check is made of the fully loaded reactor core to assure that all fuel assemblies are properly installed, oriented, and in the pre-designated positions.

The predictions of core reactivity are prepared in advance to evaluate the measured response to specified loading increments. During and following the insertion of each fuel assembly, the response of the neutron detectors is observed and compared with predictions to verify that changes in core reactivity are as expected. Procedures are prepared and approved in advance to respond to unpredicted reactivity changes. Temporary neutron detectors may be used in the reactor vessel to provide additional reactivity monitoring.

14.2.10.2 Initial Criticality

When the initial fuel loading is completed, the reactor upper internals and the reactor vessel head are installed.

Mechanical and electrical test are performed in preparation for criticality and power operations.

The following conditions exist prior to initial criticality:

- The reactor coolant system (RCS) is filled and vented.
- The operation of the control rod drive mechanism (CRDM) is verified.
- Rod control and position indication systems are operational.
- Rod drop time under hot full flow and no flow conditions meet design requirements.
- The protection and safety monitoring system and plant control and monitoring system are operable.
- Reactor trip breakers are operable.
- The RCS is at hot no-load temperature and pressure.
- The reactor coolant boron concentration is adequate for the shutdown margin requirements of the Technical Specifications to be satisfied for the hot standby condition.
- Core conditions including rod position and boron concentration at criticality are predicted.
- RCS system leak rates are verified within the specified limits.
- All systems required for startup or protection of the plant are operable and in a state of readiness.

Initial criticality is achieved in an orderly, controlled fashion by the combination of shutdown and control bank withdrawal and RCS boron concentration reduction during the ITP.

When approaching initial criticality, the rate of reactivity addition and proximity to a critical condition is determined using source range nuclear instruments to assure that criticality is reached in a deliberate and orderly manner.

Rates for rod withdrawal and boron reduction is prescribed to prevent passing through criticality in a period shorter than approximately 30 seconds (less than one decade per minute).

14.2.10.3 Low Power and Power Ascension

Low power testing and power ascension testing to full licensed power are conducted in a controlled manner in accordance with specific written procedures as part of the startup test phase.

14.2.10.3.1 Low Power Testing

Physics tests are performed after the initial criticality but before reaching 5% of rated power.

Physics tests verify that characteristics of the reactor core meet the design predictions and determine the zero power testing range. Low power testing is conducted at less than 5% of rated power. Procedures are prepared that specify the test sequence and measurements to be taken, and the conditions required to perform each test. If the test results deviate significantly from the design specifications, if unacceptable reactor characteristics are noted, or if unexplained anomalies occur, the plant is put in a safe stable condition and the data analyzed to determine subsequent plant operations.

Low power tests determine the reactivity worth of control and shutdown rod banks, isothermal temperature coefficient, and critical boron concentration for selected rod bank configurations. The response of the nuclear instrumentation system is determined and radiation surveys are performed. In addition, 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, are confirmed. These include the dynamic automatic turbine bypass control test, the pressurizer heater and spray capability and continuous spray verification test, the natural circulation test and the automatic low power steam generator water level control test.

14.2.10.3.2 Power Ascension Testing

Power ascension tests are performed once the operating characteristics of the reactor are verified during low power tests. During power ascension, the power level is increased to full licensed power in prescribed stages defined in approved procedures. At each stage, hold points are defined at which test results are evaluated and approved prior to transitioning to the next stage. The requirements for each stage of the power ascension are prescribed in the startup test procedures. Power ascension tests are performed at prescribed power levels as follows:

- Secondary system heat balance data is collected at prescribed power levels up to full licensed power. The data is used to predict the plant performance during power ascension, to provide calibration data for the plant control and protection systems, and to provide the bases for the plant trip setpoints.

- At predetermined reactor power levels, the primary and secondary systems are evaluated. Data for system response is collected for step load changes, rapid load reductions, and plant trips.

- Radiation shielding requirements is verified by gamma and neutron radiation surveys. Periodic sampling is performed to determine the chemical and radiochemical analysis of the reactor coolant and to verify agreement with predictions.

- Incore instrumentation is used to determine the power distribution of the reactor core to verify that design predictions and technical specifications limits on peaking factors are met.

14.2.11 Test Program Schedule

An event-based schedule is provided for conducting the ITP. This schedule uses the beginning of the initial fuel loading as a base point. Other activities are placed in the schedule in advance of, in parallel with, or after that base point. Estimated time periods are included for each activity in the schedule. Activities include the preparation of procedures, testing, and the evaluation of the test results

At least nine months are scheduled for the preoperational testing. A detailed description of initial fuel loading and initial criticality is contained in Subsections 14.2.10.1 and 14.2.10.2. At least three months are scheduled for startup and power ascension testing. A detailed description of low power and power ascension testing is contained in Subsection 14.2.10.3. Test procedure preparation is scheduled to provide test specifications and approved test procedures to the NRC at least 60 days before their intended use and 60 days before the fuel load for power ascension test procedures. Timely notification is made to the NRC of any test procedure changes prior to performance.

The ITP schedule assures that the test requirements are met for those plant SSCs credited to prevent, limit, or mitigate the consequences of postulated accidents prior to the beginning of the initial fuel load. Tests or portions of tests required to be completed prior to the fuel load which are designed to satisfy the requirements for completing the ITAAC are identified and cross-referenced to the ITAAC requirements. The test schedule is established so that a system required to support another system test is tested prior to its need to assure that plant safety does not rely on untested systems, components, or features. This is a prime factor in the determination of the required sequence of testing.

As construction is completed on systems, the systems are turned over to the startup organization for preoperational testing. Most process systems rely on common support systems, such as electrical power systems, cooling water systems, and compressed gas systems for operation. The common support systems are tested prior to the process systems they support as much as possible.

Sequencing of testing during the startup phase depends primarily on specified power conditions and intersystem prerequisites. To the extent practicable, the schedule establishes that, prior to exceeding 25% power, the test requirements are met for those plant SSCs that are relied on to prevent, limit, or mitigate the consequences of postulated accidents.

The schedule for individual startup tests establishes that test requirements are completed in accordance with plant technical specification requirements for system, structure and component (SSC) operability before changing plant modes.

The COL Applicant provides an event-based schedule, relative to fuel loading, for conducting each major phase of the test program. For multiunit sites, the COL Applicant discusses the effects of overlapping initial test program schedules on organizations and personnel participating in each ITP. The COL Applicant identifies and cross-references each test or portion of a test required to be completed prior to fuel load which satisfies ITAAC requirements.

14.2.11.1 Major Phases of the Test Program

The major phases of the ITP are the preoperational testing, initial fuel loading, initial criticality, low power testing, and power ascension testing.

The definitions of the major phases of the ITP and the controls for progressing from one phase to the next, as well as the requirements for moving beyond the selected hold points or milestones within a given phase, are contained in ITP administrative procedures.

The power ascension testing plateaus consist of low power testing at less than 5% power, 30% power, 50% power, 75% power, and 100% power. Test abstracts are provided for the startup tests in Subsection 14.2.12.2.

14.2.11.2 Completion of Tests for Initial Fuel Loading

It may not be possible to complete one or more preoperational tests, the review of test results, or the final approval of test results prior to fuel loading. If the test completion is not required for fuel loading, it may be possible to delay the test. If this occurs, the NRC must approve the delay. To request permission, the NRC is notified and provided with a list of the tests, a list of sections of the tests for which the delay is being requested, and technical justification for the delay.

14.2.12 Individual Test Descriptions

A test abstract is a brief statement of the content of the test. Test abstracts are provided for preoperational tests and startup tests. Test abstracts listed in Table 14.2-1 are described in Subsection 14.2.12 and the conformance with RG 1.68 appendix A (Reference 14.2-10) is shown in the appendix 14A.

The COL Applicant is responsible for the testing outside scope of the certified design in accordance with the test criteria described in Subsection 14.2.1. And testing of the following is required under the operational radiation protection program as described in Section 12.5.

- Personnel monitors and radiation survey instruments
- Laboratory equipment used to analyze or measure radiation levels and radioactivity concentrations

Table 14.2-1 Comprehensive Listing of Tests (Sheet 1 of 5)

Section	Test
14.2.12.1.1	RCS Hot Functional Preoperational Test
14.2.12.1.2	Pressurizer Pressure and Water Level Control Preoperational Test
14.2.12.1.3	RCP Initial Operation Preoperational Test
14.2.12.1.4	Pressurizer Safety Depressurization Valve (SDV) Preoperational Test
14.2.12.1.5	Pressurizer Relief Tank Preoperational Test
14.2.12.1.6	RCS Preoperational Test
14.2.12.1.7	Reactor Internals Vibration Test
14.2.12.1.8	RCS Cold Hydrostatic Preoperational Test
14.2.12.1.9	Reactor Control, Rod Control, and Rod Position Indication Preoperational Test
14.2.12.1.10	CRDM Motor-Generator Set Preoperational Test
14.2.12.1.11	CRDM Initial Timing Preoperational Test
14.2.12.1.12	Chemical and Volume Control System (CVCS) Preoperational Test - Boric Acid Blending
14.2.12.1.13	CVCS Preoperational Test - Charging and Seal Water
14.2.12.1.14	CVCS Preoperational Test - Letdown
14.2.12.1.15	RCS Lithium Addition and Distribution Test
14.2.12.1.16	Primary Makeup Water System (PMWS) Preoperational Test
14.2.12.1.17	Reactor Trip System and ESF System Response Time Test
14.2.12.1.18	Reactor Trip System and ESF System Logic Preoperational Test
14.2.12.1.19	Resistance Temperature Detectors (RTDs)/Thermocouple Cross-Calibration Preoperational Test
14.2.12.1.20	Diverse Actuation System (DAS) Actuation Test
14.2.12.1.21	Main Steam Supply System Preoperational Test
14.2.12.1.22	Residual Heat Removal System (RHRS) Preoperational Test
14.2.12.1.23	Main Steam Isolation Valve (MSIV), Main Feedwater Isolation Valve (MFIV), and Main Steam Check Valve Preoperational Test
14.2.12.1.24	Motor-Driven Emergency Feedwater System Preoperational Test
14.2.12.1.25	Turbine-Driven Emergency Feedwater System Preoperational Test
14.2.12.1.26	Extraction Steam Preoperational Test
14.2.12.1.27	Turbine-Generator (T/G) Preoperational Test
14.2.12.1.28	Condensate System Preoperational Test
14.2.12.1.29	Feedwater System Preoperational Test
14.2.12.1.30	Feedwater Heater and Drain Systems Preoperational Test
14.2.12.1.31	Condensate Polishing System Preoperational Test
14.2.12.1.32	Main Condenser Evacuation System Preoperational Test
14.2.12.1.33	Circulating Water System Preoperational Test
14.2.12.1.34	Essential Service Water System (ESWS) Preoperational Test
14.2.12.1.35	Main and Unit Auxiliary Transformers Preoperational Test
14.2.12.1.36	Reserve Auxiliary Transformers Preoperational Test
14.2.12.1.37	Non-Class 1E Alternating Current (ac) Distribution Preoperational Test
14.2.12.1.38	6.9 kV Class 1E System Preoperational Test

Table 14.2-1 Comprehensive Listing of Tests (Sheet 2 of 5)

Section	Test
14.2.12.1.39	480 V Class 1E Switchgear Preoperational Test
14.2.12.1.40	480 V Class 1E Motor Control Center Preoperational Test
14.2.12.1.41	120 V ac Class 1E Preoperational Test
14.2.12.1.42	Emergency Lighting System Preoperational Test
14.2.12.1.43	Normal Lighting System Preoperational Test
14.2.12.1.44	Class 1E Gas Turbine Generator Preoperational Test
14.2.12.1.45	Class 1E Bus Load Sequence Preoperational Test
14.2.12.1.46	Alternate ac Power Sources for Station Black Out Preoperational Test
14.2.12.1.47	125 V DC Class 1E Preoperational Test
14.2.12.1.48	125 V DC Class 1E Minimum Load Voltage Verification
14.2.12.1.49	125 V DC non-Class 1E Preoperational Test
14.2.12.1.50	Dynamic State Vibration Monitoring of Safety Related and High-Energy Piping
14.2.12.1.51	Steady State Vibration Monitoring of Safety Related and High-Energy Piping
14.2.12.1.52	Thermal Expansion Testing
14.2.12.1.53	Class 1E Gas Turbine Generator Sequence Preoperational Test - Loss of Offsite Power (LOOP) Sequence and LOOP Sequence with ECCS Actuation Signal
14.2.12.1.54	Safety Injection System (SIS) Preoperational Test
14.2.12.1.55	ECCS Actuation and Containment Isolation Logic Preoperational Test
14.2.12.1.56	Safety Injection Check Valve Preoperational Test
14.2.12.1.57	Safety Injection Accumulator Test
14.2.12.1.58	Containment Spray System Preoperational Test
14.2.12.1.59	Refueling Water Storage System Preoperational Test
14.2.12.1.60	Essential Chilled Water System Preoperational Test
14.2.12.1.61	Containment Structural Integrity Test
14.2.12.1.62	Containment Local Leak Rate Preoperational Test
14.2.12.1.63	Containment Integrated Leak Rate Test (ILRT) Preoperational Test
14.2.12.1.64	Containment Hydrogen Monitoring and Control System Preoperational Test
14.2.12.1.65	CRDM Cooling System Preoperational Test
14.2.12.1.66	Reactor Cavity Cooling System Preoperational Test
14.2.12.1.67	Containment High Volume Purge System Preoperational Test
14.2.12.1.68	Containment Low Volume Purge System Preoperational Test
14.2.12.1.69	Containment Fan Cooler System Preoperational Test
14.2.12.1.70	Annulus Emergency Exhaust System Preoperational Test
14.2.12.1.71	RCS Leak Rate Preoperational Test
14.2.12.1.72	Loose Parts Monitoring System Preoperational Test
14.2.12.1.73	Seismic Monitoring System Preoperational Test
14.2.12.1.74	Incore Instrumentation System Preoperational Test
14.2.12.1.75	Nuclear Instrumentation System Preoperational Test
14.2.12.1.76	Remote Shutdown Preoperational Test
14.2.12.1.77	Miscellaneous Leakage Detection System Preoperational Test

Table 14.2-1 Comprehensive Listing of Tests (Sheet 3 of 5)

Section	Test
14.2.12.1.78	Process and Effluent Radiological Monitoring System, Area Radiation Monitoring System and Airborne Radioactivity Monitoring System Preoperational Test
14.2.12.1.79	High-Efficiency Particulate Air Filters and Charcoal Adsorbers Preoperational Test
14.2.12.1.80	Liquid Waste Management System Preoperational Test
14.2.12.1.81	Gaseous Waste Management System Preoperational Test
14.2.12.1.82	Solid Waste Management System Preoperational Test
14.2.12.1.83	Steam Generator Blowdown System Preoperational Test
14.2.12.1.84	Sampling System Preoperational Test
14.2.12.1.85	Spent Fuel Pit Cooling and Purification System (SFPCS) Preoperational Test
14.2.12.1.86	Fuel Handling System Preoperational Test
14.2.12.1.87	Component Cooling Water System Preoperational Test
14.2.12.1.88	Turbine Component Cooling Water System Preoperational Test
14.2.12.1.89	Secondary Side Chemical Injection System Preoperational Test
14.2.12.1.90	Fire Protection System Preoperational Test
14.2.12.1.91	Instrument Air System Preoperational Test
14.2.12.1.92	Station Service Air System Preoperational Test
14.2.12.1.93	Boron Recycle System Preoperational Test
14.2.12.1.94	Offsite Communication System Preoperational Test
14.2.12.1.95	Inplant Communication System Preoperational Test
14.2.12.1.96	Safeguard Component Area Heating, Ventilation, and Air Conditioning (HVAC) System Preoperational Test
14.2.12.1.97	Emergency Feedwater Pump Area HVAC System Preoperational Test
14.2.12.1.98	Class 1E Electrical Room HVAC System Preoperational Test
14.2.12.1.99	Auxiliary Building HVAC System Preoperational Test
14.2.12.1.100	Main Steam/Feedwater Piping Area HVAC System Preoperational Test
14.2.12.1.101	Main Control Room (MCR) HVAC System Preoperational Test (including MCR Habitability)
14.2.12.1.102	Non-Class 1E Electrical Room HVAC System Preoperational Test
14.2.12.1.103	Technical Support Center HVAC System Preoperational Test
14.2.12.1.104	Non-Essential Chilled Water System Preoperational Test
14.2.12.1.105	Vessel Servicing Preoperational Test
14.2.12.1.106	Safety-Related Component Area HVAC System Preoperational Test
14.2.12.1.107	Pressurizer Heater and Spray Capability and Continuous Spray Flow Verification Test
14.2.12.1.108	Non-Essential Service Water (non-ESW) System Preoperational Test
14.2.12.1.109	Condensate Storage Facilities System Preoperational Test
14.2.12.1.110	Turbine Building Area Ventilation System (General Mechanical Area) Preoperational Test
14.2.12.1.111	Turbine Building Area Ventilation System (Electric Equipment Area) Preoperational Test
14.2.12.1.112	Reserved
14.2.12.1.113	Reserved
14.2.12.1.114	Reserved
14.2.12.1.115	RCPB Leak Detection Systems Preoperational Test
14.2.12.1.116	Equipment and Floor Drainage System Preoperational Test

Table 14.2-1 Comprehensive Listing of Tests (Sheet 4 of 5)

Section	Test
14.2.12.1.117	Compressed Gas System Preoperational Test
14.2.12.1.118	Equipment Hatch Hoist Preoperational Test
14.2.12.2.1.1	RCS Sampling for Fuel Loading
14.2.12.2.1.2	Fuel Loading Instrumentation and Neutron Source Requirements Test
14.2.12.2.1.3	Initial Fuel Loading
14.2.12.2.1.4	Inverse Count Rate Ratio Monitoring for Fuel Loading
14.2.12.2.1.5	Precritical Test Sequence
14.2.12.2.1.6	Rod Drop Time Measurement Test
14.2.12.2.1.7	CRDM Operational Test
14.2.12.2.1.8	Rod Position Indication Test
14.2.12.2.1.9	Rod Control System Test
14.2.12.2.1.10	Reactor Protection System Test
14.2.12.2.1.11	RCS Final Leak Test
14.2.12.2.1.12	Incore Detector Test
14.2.12.2.1.13	RCS Flow Coastdown Test
14.2.12.2.1.14	Operational Alignment of Process Temperature Instrumentation Test
14.2.12.2.2.1	Initial Criticality Test Sequence
14.2.12.2.2.2	Initial Criticality
14.2.12.2.2.3	Determination of Core Power Range for Physics Testing
14.2.12.2.3.1	Low Power Test Sequence
14.2.12.2.3.2	Boron Endpoint Determination Test
14.2.12.2.3.3	Isothermal Temperature Coefficient Measurement Test
14.2.12.2.3.4	RCCA Bank Worth Measurement at Zero Power Test
14.2.12.2.3.5	Pseudo Rod Ejection Test
14.2.12.2.3.6	Operational Alignment of Nuclear Instrumentation Test
14.2.12.2.3.7	Dynamic Automatic Turbine Bypass Control Test
14.2.12.2.3.8	Pressurizer Heater and Spray Capability and Continuous Spray Flow Verification Test
14.2.12.2.3.9	Natural Circulation Test
14.2.12.2.3.10	Automatic Low Power SG Water Level Control Test
14.2.12.2.4.1	Power Ascension Test Sequence
14.2.12.2.4.2	Power Coefficient Determination Test
14.2.12.2.4.3	Axial Flux Difference Instrumentation Calibration Test and Axial Distribution Oscillation Test
14.2.12.2.4.4	Flux Map Test
14.2.12.2.4.5	RCCA Misalignment Measurement and Radial Power Distribution Oscillation Test
14.2.12.2.4.6	Remote Shutdown Test
14.2.12.2.4.7	Loose Parts Monitoring System Test (Continuation of 14.2.12.1.72)
14.2.12.2.4.8	Automatic Rod Control System Test
14.2.12.2.4.9	Operational Alignment of Process Temperature Instrumentation at Power Test
14.2.12.2.4.10	Thermal Power Measurement and Statepoint Data Collection Test

Table 14.2-1 Comprehensive Listing of Tests (Sheet 5 of 5)

Section	Test
14.2.12.2.4.11	Ventilation Capability Test
14.2.12.2.4.12	RCS Flow Measurement Test
14.2.12.2.4.13	Process and Effluent Radiation Monitoring System Test
14.2.12.2.4.14	Primary and Secondary Chemistry Test
14.2.12.2.4.15	Biological Shield Survey Test
14.2.12.2.4.16	Load Swing Test
14.2.12.2.4.17	Loss of Offsite Power (LOOP) at Greater Than 10 % Power Test
14.2.12.2.4.18	Plant Trip from 100 % Power Test
14.2.12.2.4.19	100% Load Rejection Test
14.2.12.2.4.20	Dynamic Response Test
14.2.12.2.4.21	Ultimate Heat Sink Heat Rejection Capability Test
14.2.12.2.4.22	Automatic High Power SG Water Level Control Test

14.2.12.1 Preoperational Tests

Test abstracts are provided for preoperational tests of system and function testing in accordance with the guidance in RG 1.68 (Reference 14.2-10). Test abstracts include first-of–a-kind system tests. The first-of-a-kind tests establish the performance parameters of the US-APWR design features that will not change from plant to plant. Since the US-APWR plant design is standardized, these tests need to be performed only on the first US-APWR plant. The test abstracts for these are specifically identified.

The test abstracts in the following subsections contain the objectives of each preoperational test. During the final construction phase, it might be necessary to modify the preoperational test methods as operating and preoperational test procedures are developed. Consequently, the methods in the following descriptions are general, not specific. Specific testing performed and the applicable acceptance criteria for each preoperational test are documented in test procedures. Preoperational tests are prepared in accordance with the system and associated component specifications for the equipment in those systems provided by MHI and other major participants associated with the ITP. The tests demonstrate that the installed equipment and systems perform within the limits of the system and component specifications. To assure that the tests are conducted in accordance with established methods and appropriate acceptance criteria, the plant and system preoperational test information are made available to the NRC at least 60 days before their intended use.

14.2.12.1.1 RCS Hot Functional Preoperational Test

A. Objectives

1. To operate the RCS at full-flow conditions long enough to provide the necessary vibration cycles on the reactor vessel’s internal components prior to their final inspection before fuel loading. A portion of this operating time sufficient to verify proper operation must occur with the reactor coolant temperature at or above the required operating temperature.

2. To provide the coordination and establishment of initial conditions necessary for the conduct of those preoperational tests to be performed during heatup, normal operating temperature and pressure, and cooldown of the RCS.

3. To provide the plant operators an opportunity to actually control the plant from an operations viewpoint and put into practice the plant operation procedures for the RCS, auxiliary systems, and principal secondary systems prior to nuclear operation.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. The reactor internals and head are installed.

6. All systems and components required to support heatup, operation at normal operational temperature and pressure, and cooldown of the RCS are available.

7. The Class 1E gas turbine generators are operable and are ready for emergency power requirements.

8. Cold functional testing of all systems to be operated is complete.

9. RCS and secondary water chemistry are kept in compliance with Table 9.3.4-1 and Table10.3.5-3.

10. RCS temperature is maintained at 557°F.

    Note: The maximum heatup rate and cooldown rate of RCS are 100°F per hour.

C. Test Method

1. The plant is taken from cold shutdown conditions to hot standby for the first time prior to placing nuclear fuel in the reactor core.

2. The required energy input for this operation is from operating reactor coolant pumps (RCPs) and the pressurizer heaters. The preoperational tests that require these hot and/or dynamic conditions are conducted during hot functional testing as coordinated by this procedure.

3. The capability to control the RCS under solid conditions (no pressurizer bubble) during both heatup and cooldown is demonstrated.

4. The temperature and pressure plateaus are used.

5. Provisions are in place to perform trial applications of plant operating procedures and to track recommended changes.

6. This test is used to coordinate the following preoperational tests:

14.2.12.1.2	Pressurizer Pressure and Water Level Control Preoperational Test
14.2.12.1.3	RCP Initial Operation Preoperational Test
14.2.12.1.4	Pressurizer Safety Depressurization Valve (SDV) Preoperational Test
14.2.12.1.5	Pressurizer Relief Tank Preoperational Test
14.2.12.1.7	Reactor Internals Vibration Test
14.2.12.1.13	CVCS Preoperational Test - Charging and Seal Water
14.2.12.1.14	CVCS Preoperational Test - Letdown
14.2.12.1.15	RCS Lithium Addition and Distribution Test
14.2.12.1.19	Resistance Temperature Detectors (RTDs)/Thermocouple Cross-Calibration Preoperational Test
14.2.12.1.21	Main Steam Supply System Preoperational Test
14.2.12.1.22	Residual Heat Removal System (RHRS) Preoperational Test
14.2.12.1.23	Main Steam Isolation Valve (MSIV), Main Feedwater Isolation Valve (MFIV) and Main Steam Check Valve Preoperational Test
14.2.12.1.25	Turbine-Driven Emergency Feedwater System Preoperational Test
14.2.12.1.50	Dynamic State Vibration Monitoring of Safety Related and High-Energy Piping
14.2.12.1.51	Steady State Vibration Monitoring of Safety Related and High-Energy Piping
14.2.12.1.52	Thermal Expansion Test
14.2.12.1.54	Safety Injection System (SIS) Preoperational Test
14.2.12.1.56	Safety Injection Check Valve Preoperational Test
14.2.12.1.66	Reactor Cavity Cooling System Preoperational Test
14.2.12.1.69	Containment Fan Cooler System Preoperational Test

14.2.12.1.71 RCS Leak Rate Preoperational Test

14.2.12.1.72 Loose Parts Monitoring System Preoperational Test

14.2.12.1.76 Remote Shutdown Preoperational Test

14.2.12.1.83 Steam Generator Blowdown System Preoperational Test

14.2.12.1.84 Sampling System Preoperational Test

14.2.12.1.87 Component Cooling Water System Preoperational Test

14.2.12.1.107 Pressurizer Heater and Spray Capability and Continuous Spray Flow Verification Test

7. The leakage control program plant procedures which implement Technical Specifications program 5.5.2, Primary Coolant Sources Outside Containment, are performed while the plant is in hot standby.

D. Acceptance Criteria

1. The RCS is operated at full-flow conditions above the required operating temperature for a period sufficiently long to identify run-in type failures.

2. The acceptance criteria for individual systems are a part of the individual test procedures sequenced by this procedure.

14.2.12.1.2 Pressurizer Pressure and Water Level Control Preoperational Test

A. Objectives

1. To demonstrate the stability and response of the pressurizer pressure control system, including the verification of alarm and control functions.

2. To demonstrate the stability and response of the pressurizer water level control system, including the verification of alarm and control functions.

3. To perform preliminary adjustment of the pressurizer continuous spray flow valves. The final adjustment of the continuous spray flow valves is performed during startup testing.

4. To demonstrate the proper operation for the pressurizer proportional heaters, backup heaters, and the pressurizer heater cutoff for low-low pressurizer water level.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.
4. Required support systems are available.
5. Required electrical power supplies and control circuits are operational.
6. The plant is at normal operating temperature and pressure with RCPs running, and hot functional testing in progress.
7. The letdown and charging portions of the CVCS are available to vary pressurizer water level.
8. The CVCS is available to provide seal water to the RCPs.

C. Test Method

1. Pressurizer pressure and water level are varied separately, and the ability of the control system to automatically control and stabilize pressurizer pressure and water level is verified.
2. Pressurizer pressure and water level are varied separately, and the pressure and water level alarm and control setpoints are verified.
3. Pressurizer continuous spray flow valve initial setting determination is made, and proper spray line temperatures are verified.
4. Pressurizer proportional heaters and backup heaters are operated and their interlocks demonstrated.

D. Acceptance Criteria

1. The pressurizer pressure and water level control systems automatically respond to an increase or decrease in pressurizer pressure and water level, and the pressure and water levels are stabilized (see Subsections 5.4.10.3.1 and 5.4.10.3.2, Subsections 7.7.1.1.5 and 7.7.1.1.7)
2. Pressurizer pressure and water level control system alarm and control functions are operational.
3. Pressurizer continuous spray flow valve initial settings are determined, and spray line temperatures are maintained within design specifications.
4. Pressurizer proportional heaters and backup heaters respond properly to an increase or decrease in pressurizer pressure and their control functions are operationally verified, including the heater cutoff circuit due to low-low pressurizer water level.

14.2.12.1.3 RCP Initial Operation Preoperational Test

A. Objectives

1. To measure and record system and operating parameters of the RCPs, including seal parameters in the cold condition.

2. To measure and record pump operating parameters, including seal parameters, during hot functional testing.

3. To verify the operation of the associated oil lift pumps.

B. Prerequisites

1. Required construction testing including oil spillage protection system and the seal leakoff is completed.

2. Component testing and instrument calibration including RCP frame vibration, RTD, seal injection flow and CCW flow is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. The CVCS is available to provide seal water to the RCPs.

6. The component cooling water (CCW) system is available for cooling.

7. The RCS is filled, vented, and pressurized.

C. Test Method

1. The RCPs and associated oil lift pumps are operated in the cold condition, and operating data is recorded.

2. The RCPs and associated oil lift pumps are operated during hot functional testing, and operating data, including seal parameters and temperatures at the thermal barrier, motor, motor air cooler and oil coolers, are recorded at various temperature plateaus.

3. Alarms and Interlocks are verified.

D. Acceptance Criteria

1. Alarms and interlocks function as designed.

2. The RCP and pump seals operating characteristics are within design specifications as described in Subsection 5.4.1.

14.2.12.1.4 Pressurizer Safety Depressurization Valve (SDV) Preoperational Test

A. Objectives

1. To demonstrate operation and valve response times for both pressurizer SDVs.
2. To demonstrate operation of the SDV isolation valves.
3. To demonstrate operation of the function to provide the RCS depressurization.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.

C. Test Method

1. Each SDV is operated and the response time is determined.
2. SDV isolation valves are operated and their interlocks demonstrated.
3. The function to provide system depressurization is demonstrated properly. The operation of the SDVs is demonstrated in both cold and hot conditions.

D. Acceptance Criteria

1. SDV operating time is within design specifications for both SDVs.
2. SDV isolation valves operate in accordance with the design specification.

14.2.12.1.5 Pressurizer Relief Tank Preoperational Test

A. Objectives

1. To demonstrate that design pressurizer relief tank spray flow can be obtained against design backpressure in the tank.
2. To demonstrate the filling and draining operation of the pressurizer relief tank.
3. To demonstrate the operation of system valve control circuitry.
4. To demonstrate that the pressurizer relief tank is capable of receiving a steam discharge.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. The containment vessel (C/V) reactor coolant drain tank part of the liquid waste management system is available to the pressurizer relief tank drain.

6. PMWS is available to supply water to the pressurizer relief tank.

7. The nitrogen gas subsystem in the gaseous waste management system is available to supply the pressurizer relief tank.

C. Test Method

1. With design backpressure in the pressurizer relief tank, the required spray flow is pumped to the pressurizer relief tank.

2. While draining the pressurizer relief tank, the nitrogen pressurization system operation is observed.

3. The control circuitry for system valves is verified.

4. Verify indications and alarms.

5. Verify the ability of the pressurizer relief tank to condense a steam discharge from the pressurizer. This test is performed in conjunction with Subsection 14.2.12.1.4, Pressurizer Safety Depressurization Valve (SDV) Preoperational Test.

D. Acceptance Criteria

1. The required spray flow is obtained as designed (see Subsection 5.4.11),

2. The pressurizer system properly pressurizes the pressurizer relief tank.

3. The system valves operate as designed.

4. Indications and alarms operate as described in Subsection 5.4.11.4.

5. The pressurizer relief tank functions per design.

14.2.12.1.6 RCS Preoperational Test

A. Objectives

1. To verify the control circuitry and operation of the head vent subsystem.

2. To verify the operability of all 4 pressurizer safety valves at approximately operating temperature and pressure.

B. Prerequisite

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

C. Test Method

1. The control circuitry and operation of system valves are verified.

2. During a fill and vent of the RCS, the head vent is operated.

3. The operability of all 4 pressurizer safety valves is demonstrated at approximately operating temperature and pressure or using applicable in –situ testing.

D. Acceptance Criteria

1. The valves respond to control signals (see Subsections 5.4.10 and 5.4.12.5).

2. All four pressurizer safety valves actuate at the required pressure (See Table 5.4.10-3).

14.2.12.1.7 Reactor Internals Vibration Test

A. Objectives (1-3 is for first-plant-only testing)

1. To verify the structural integrity of reactor internals for flow-induced vibration.

2. To determine the margin of safety associated with steady-state and anticipated transient conditions for normal operation.

3. To confirm the results of the vibration analysis.

4. To confirm the sign of neither abnormal wear nor structural changes are observed.

B. Prerequisites (1 is for first-plant-only testing)

1. Special test instrumentation for vibration monitoring system and transducers are installed at the required locations.

2. RCS hot functional testing is in progress.

3. Test instrumentation is available and calibrated.

C. Test Method (1-3 is for first-plant-only testing)

1. Vibration measurements are made to verify the structural integrity of reactor internals for flow-induced vibration.

2. Vibration measurements are made to determine the margin of safety associated with steady-state and anticipated transient conditions for normal operation.

3. Comparison between test results and the predicting analyses results is performed.

4. Prior to the hot functional tests and after cooldown from the hot functional tests, the reactor vessel and internals are inspected and the results documented.

NOTE:Reactor internal vibration tests are coordinated with the reactor internals comprehensive vibration assessment program described in Subsection 3.9.2.4 and consistent with the requirements of RG 1.20 (Reference 14.2-13).

D. Acceptance Criteria (1 is for first-plant-only testing)

1. Alternating stress levels are acceptably low in comparison with the limit for high cycle fatigue in the ASME code.

2. No structural damage or change is observed in post-test inspections (see Subsection 3.9.2.6).

Note: Reactor internals test is performed as a part of the reactor internals comprehensive vibration assessment program required by RG 1.20 (Reference 14.2-13)

14.2.12.1.8 RCS Cold Hydrostatic Preoperational Test

A. Objective

1. To verify the integrity and leak-tightness of the RCS and the high-pressure portions of associated systems by performing a hydrostatic pressure test in accordance with Section III, Division 1, NB of the ASME Code (Reference 14.2-15) (NB-6220, Hydrostatic Test Requirements).

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. The RCPs are available to support this test.

6. A test pump is available.

7. The reactor lower and upper internals and the closure head are installed. The studs are tensioned to the design value for the associated hydrostatic test pressure [Section III, Division 1, NB of the ASME Code (Reference 14.2-15), NB-3226, Testing Limits].

8. All instrumentation required to support the test is installed and calibrated.

9. System relief valves and instrumentation that are within the test boundaries are either recalibrated or are verified to be able to withstand the hydrostatic test pressure.

10. Welds that are within the test boundaries are verified as ready for hydrostatic testing.

11. The system is filled using the CVCS and RHRS.

12. The RCPs are operated, as required, to vent the system and to establish the required hydro temperature.

C. Test Method

1. The system is then pressurized to test pressure in stages; system welds, piping, and components are monitored for leaks at each stage.

D. Acceptance Criterion

1. There are no leaks at welds or piping within the test boundaries during the final inspection. If there is any leakage at a weld or piping, the leak must be terminated prior to the final inspection, or the source of leak may be isolated, repaired, and retested at a later date [Section III, Division 1, NB of the ASME Code (Reference 14.2-15), NB-6224, Examination for Leakage-After-Application of Pressure] (see Subsection 3.9.1.1.5.1 and Subsection 5.2.4.1.5).

14.2.12.1.9 Reactor Control, Rod Control, and Rod Position Indication Preoperational Test

A. Objectives

1. To demonstrate the functioning of the rod control system.

2. To demonstrate operation of the rod control system in response to interlock signals.

3. To demonstrate the functioning of the rod position indication system.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.
5. Required electrical power supplies and control circuits are operational.

C. Test Method

1. The rod control system is initially operated, and functioning of the system is verified.
2. Rod control interlock actuation signals are simulated and response of the rod control system is verified.
3. The rod position indication system is initially operated, and the functioning of the system is verified through the use of status indications, annunciations, and a test fixture.

D. Acceptance Criteria

1. The rod control system operates as designed (Subsections 7.7.1.1.1 through 7.7.1.1.3).
2. The rod control system operates as designed in response to interlock signals (Subsection 7.7.1.1.2 and Table 7.7-3).
3. The rod position indication system operates as designed to provide rod position indication and alarms (Subsection 7.7.1.1.4).

14.2.12.1.10 CRDM Motor-Generator Set Preoperational Test

A. Objectives

1. To demonstrate the operation of the CRDM motor-generator sets and system components, including the proper generator phasing for parallel operation.
2. To demonstrate the operation of the motor-generator set control system during motor-generator starting, running, and parallel operation including verification of interlock and alarm functions.

B. Prerequisites

1. Required construction testing is completed. The construction testing includes installation inspection, generator and motor inspection, control panel inspection, and insulation resistance measurement.

2. Component testing and instrument calibration is completed. This includes power incoming circuit inspection, excitation relays test, protection relays test, resistance measurement of relays, automatic voltage regulator test, timer relays test, automatic synchronization device test, and instruments test.

3. Test instrumentation is available and calibrated.

4. Required electrical power supplies are operational.

5. A three-phase load bank is available for motor-generator set testing under loaded conditions.

C. Test Method

1. CRDM motor-generator set and system component control circuits, including the interlock and alarm functions, are verified. This test includes the demonstration of the operation on simulated loss of power.

2. Generator phasing for parallel generator operation is verified.

3. Operation of the CRDM motor-generator sets and control system is verified during starting, running, and parallel operation.

D. Acceptance Criteria

1. Generator phasing is proper for parallel and synchronized motor-generator set operation.

2. The CRDM motor-generator sets and control system operate in accordance with the design requirements during starting, running, and parallel operation.

3. The motor-generator and control system alarms and interlocks function as designed.

14.2.12.1.11 CRDM Initial Timing Preoperational Test

A. Objective

1. To demonstrate CRDM current command timing, rod speed, and bank overlap logic operation.

B. Prerequisites

1. Required construction testing is completed. The construction testing includes installation inspection and wiring continuity check.

2. Component testing and instrument calibration is completed. This includes initial energization check of CRDM control system.

3. Test instrumentation is available and calibrated.

4. Required electrical power supplies and control circuits are energized and operational.

5. The CRDM cooling system is in its normal operational alignment.

C. Test Method

1. CRDM withdrawal and insertion are simulated; and proper current command sequence, timing, and rod speed signals are verified.

2. Proper operation of the bank overlap logic to control rod bank sequence is verified.

D. Acceptance Criteria

1. The CRDMs operate as verified by current traces, to include digital data acquisition, showing current command sequence and timing and measurement of rod speed digital data (see Subsection 7.7.1.3).

2. The bank overlap logic operates to control rod movement and sequence.

14.2.12.1.12 Chemical and Volume Control System (CVCS) Preoperational Test - Boric Acid Blending

A. Objectives

1. To verify the operation of the boric acid transfer pumps and the ability of the boric acid blender to make up at design flowrates and boric acid concentrations to the CVCS in each mode of operation.

2. To verify the operation of system valves and control circuitry.

3. To verify the operability of heat tracing or area heating for portions of the system which normally contain 4 wt. % of boric acid solution.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Auxiliary steam is available to heat the boric acid batching tank as required.

6. The PMWS is available to supply water to the boric acid blender.

7. Water with boron concentrations of approximately 7,000 ppm is available, when required.

C. Test Method

1. The boric acid transfer pumps and primary water pumps are operated, and performance characteristics are verified.

2. The control circuitry for system valves and motors is verified.

3. The makeup and blending system controls are demonstrated in auto makeup, dilute, alternate dilute, borate, and manual modes of operation.

4. Verify indications and alarms.

5. Demonstrate the operability of heat tracing or area heating for portions of the system which normally contain 4 wt. % of boric acid solution.

D. Acceptance Criteria

1. The boric acid transfer pump and primary makeup water pumps operating characteristics are within the design specifications (Subsection 9.3.4).

2. System valves and interlocks operate as designed.

3. The flowrates and boric acid concentrations associated with the blender are within the design specifications for each operating mode, auto makeup, dilute, alternate dilute, borate, and manual.

4. Indications and alarms operate as described in Subsection 9.3.4.5.

5. Heat tracing or area heating for portions of the system which normally contain 4 wt. % of boric acid solution operate as described in Subsection 9.3.4.2.3.1.

14.2.12.1.13 CVCS Preoperational Test - Charging and Seal Water

A. Objectives

1. To demonstrate the operation and verify the operating characteristics of the charging pumps.

2. To demonstrate the ability of the CVCS to supply adequate seal water injection flow to the RCPs.

3. To verify operation of the control circuitry of the charging pumps and system valves.

4. To demonstrate that the volume control tank water level and pressure control system operate as designed.

5. To demonstrate that the auxiliary spray cools the pressurizer during cooldown of the RCS.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. CCW is available to the centrifugal charging pump,

6. CCW is available for the RCP seal water heat exchanger.

7. Systems required to adequately supply cover gas and water to the volume control tank are operated.

8. Reactor head is removed for the initial charging pump testing

9. Auxiliary spray cooldown of the pressurizer is performed at the end of cooldown from hot functional testing.

C. Test Method

1. Charging pumps are operated and the performance characteristics of the charging pumps are verified.

2. The seal injection flow is measured to demonstrate proper operation.

3. The control circuitry of the charging pumps and system valves are verified.

4. Water levels and pressures in the volume control tank are varied and system response verified.

5. Verify indications and alarms.

D. Acceptance Criteria

1. The charging pumps operating characteristics are within design specifications as described in Subsection 9.3.4.

2. Seal water injection flow to each RCP is established in accordance with design specifications.

3. System valve and charging pump control circuits and interlocks operate as designed.

4. Auxiliary spray cooling of the pressurizer operates as designed during cooldown of the RCS.

5. The volume control tank water level and pressure control system operates as designed.

6. Indications and alarms operate as described in Subsection 9.3.4.5.

14.2.12.1.14 CVCS Preoperational Test - Letdown

A. Objectives

1. To verify the operation of the normal and excess letdown systems, including the branch line orifice sizing in the normal letdown system.

2. To verify the operation of the system valves and control circuitry.

3. To demonstrate the ability of the charging and letdown system to maintain RCS pressure control.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. The system test with the solid RCS is performed during cold conditions.

C. Test Methods

1. Control circuitry for system valves is verified in the cold conditions.

2. The charging and letdown system pressure control is demonstrated with the system solid by varying the charging and letdown flowrates and observing the system response in the cold condition.

3. The charging and letdown system pressure control is demonstrated by varying the charging and letdown flowrates and observing the system response in the hot condition.

4. The system performance characteristics are recorded, and the branch line orifice sizing (branch line flowrates) are verified.

5. Verify indications and alarms.

D. Acceptance Criteria

1. System valves and interlocks operate as designed.

2. System operating characteristics are within design specifications as described in Subsection 9.3.4.

3. The normal letdown branch line orifice sizing and branch line flowrates are within design specifications.

4. Indications and alarms operate as described in Subsection 9.3.4.5.

14.2.12.1.15 RCS Lithium Addition and Distribution Test

A. Objective

1. To verify correct and uniform lithium concentration of the RCS by addition of lithium, and confirm uniform concentration at each sampling point during hot functional test.

B. Prerequisites

1. Component testing and instrument calibration is completed.

2. Test instrumentation is available and calibrated.

3. Required support systems are available.

4. Charging pump and chemical mixing tank are available.

5. Hot functional test is in progress.

C. Test Method

NOTE: Boron addition is not required during hot functional testing.

1. Lithium ($^{7}LiOH$) is added in chemical mixing tank. The amount of lithium is to be added corresponds to the primary water chemical concentration. The increased lithium concentration will be approximately 1.0 ppm. The lithium is charged into the RCS by the charging pump.

2. At several sampling points (e.g., RCS loops, pressurizer liquid, and demineralizer inlet), each lithium concentration is measured until the lithium concentration is almost equal at each sampling point.

3. The RCS volume without fuel assembles is calculated from the amount of lithium to be added and its lithium concentration. The quantity and concentration of injected lithium divided by increased concentration of lithium is used to estimate the RCS volume. This volume is reference data.

4. Following completion of hot functional testing, lithium is removed until it is approximately equal to the initial concentration (example: almost 0.5 ppm).

D. Acceptance Criteria

1. The lithium concentrations from all sample points are within +/-0.05 ppm following analytical measurement with an accuracy of +/- 0.05 ppm or better.

2. Lithium mixing, charging to the RCS, and removal performs as described in Subsections 9.3.4.

14.2.12.1.16 Primary Makeup Water System (PMWS) Preoperational Test

A. Objective

1. To demonstrate the operation of the PMWS.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available, including the Demineralized Water Storage Tank (DWST) and the Demineralized Water Transfer Pumps.

C. Test Method

1. Verify manual and automatic system controls.

2. Verify system flowrates.

3. Verify indications and alarms.

D. Acceptance Criteria

1. The PMWS operates as described in Subsection 9.2.6.

2. Indications and alarms operate as described in Subsections 9.2.6.5 and 9.3.4.5.5.6.

14.2.12.1.17 Reactor Trip System and ESF System Response Time Test

A. Objective

1. To demonstrate that the reactor trip system and ESF system response times are less than the maximum allowable response times as specified in the accident analysis.

B. Prerequisites

1. Required reactor protection system alignments, calibration, and testing are completed.

2. Required electrical power supplies and control circuits are energized and operational.

3. Special test circuitry test equipment and test instrumentation required for test performance are available.

4. The type test data for each primary sensor is obtained.

C. Test Method

1. The response times of each primary sensor associated with the reactor trip system and the ESF system will be obtained from either (1) historical records based on acceptable response time tests (hydraulic, noise, or power interrupt tests), (2) in place, onsite, or offsite (e.g., vendor) test measurements, or (3) utilizing vendor engineering specifications, as described in section B 3.3.1 of DCD Chapter 16 for SR 3.3.1.13 and SR 3.3.2.8.

2. Reactor trip signal and ESF actuation signals are applied at the process sensor output, and the time interval is measured until loss of stationary gripper coil voltage and until the ESF equipment is capable of performing its safety function.

3. Total reactor trip system and ESF system response time is computed by summing the results of the previous test method.

4. Individual components and valve response times are accomplished in the system preoperational test procedures.

D. Acceptance Criterion

1. The total reactor trip system and total ESF system response times do not exceed the allowable response times calculated using the methodology described in MUAP-07004-P, “Safety I&C System Description and Design Process,” Subsection 6.5.3 (Reference 14.2-16), (see Section 7.2.2.7.2).

14.2.12.1.18 Reactor Trip System and ESF System Logic Preoperational Test

A. Objectives

1. To demonstrate the integrity of the software installed in the reactor trip system and the ESF actuation system using the latest verified software.

2. To demonstrate the operation of the ESF system and reactor trip system and their ability to initiate the appropriate reactor trip and ESF actuation signals on the receipt of simulated input signals.

3. To demonstrate the operation of the reactor trip system block and permissive interlocks.

4. To demonstrate the functioning of the interlock and alarm functions in the reactor trip system and ESF system.

5. To demonstrate the operation of the reactor trip breakers, alarm, and tripping functions.

6. To demonstrate that the undervoltage coil and the shunt trip coil function independently to trip the reactor trip breakers following initiation of a manual reactor trip.

7. To demonstrate that the reactor trip functions occur at design setpoints using the latest verified software.

B. Prerequisites

1. Required component testing, operability check of bypass switches and instrument calibrations are completed.

2. Required electrical power supplies and control circuits are energized and operational.

3. Required output signals from the ESF system are bypassed to prevent the operation of components not required by this test.

4. Plant system and components to be operated during testing are aligned prior to the actuation of the particular system or component.

5. Factory testing is completed with a similar interface condition at the site and the test record is available.

C. Test Method

1. The basic software data and application software data in the ESF system and reactor trip system are compared with those stored in the engineering tool, a portable personal computer used for diagnosing module failures in the protection

and safety monitoring system (PSMS) and for software maintenance and periodic testing, bit by bit.

2. Appropriate input signals are simulated and the proper operation of the representative reactor protection logic matrix is verified by observing the operation of the reactor trip breakers and/or undervoltage coils. The integrity of the entire reactor protection logic matrix is verified in C.1.

3. Appropriate input signals are simulated and the proper operation of the representative ESF system logic matrix is verified by observing the operation of the output signal in the ESF system. The integrity of the entire reactor protection logic matrix is verified in C.1.

4. Integrity of the reactor trip system block and permissive interlocks is verified in C.1.

5. Integrity of the setpoint, interlock, and alarm functions of the reactor trip system and the ESF system is verified in C.1.

6. Operation of the reactor trip breakers alarms is verified.

D. Acceptance Criteria

1. The results of Test Method C.1 for the reactor trip system and the ESF system are completely “Good”, which means there is no change to the internal PSMS software that would impact its functional operation or the continuous self-test function.

2. The reactor trip system and the ESF system operate as designed to initiate the appropriate reactor trip and ESF actuation signal.

3. The reactor trip breakers operate as designed to provide normal trip and alarm functions.

14.2.12.1.19 Resistance Temperature Detectors (RTDs)/Thermocouple Cross-Calibration Preoperational Test

A. Objectives

1. To collect data to verify expected resistance-versus-temperature characteristics of installed RTDs and millivolt-versus-temperature characteristics of thermocouples.

2. To determine RTD deviation from RCS average temperature for individual RTDs and isothermal corrections for individual thermocouples.

3. To demonstrate that temperature instrumentation is reading correctly after disconnecting special test instrumentation and reconnecting RTDs to normal plant terminations.

B. Prerequisites

1. The reactor upper internals are installed and thermocouple wiring is completed.

2. The temperature instruments are aligned in accordance with manufacturer's calibration data.

3. Hot functional testing is in progress.

4. The special test instrumentation required for test performance is available and calibrated.

5. The plant computer is operational to obtain thermocouple data in the trend mode while taking RTD readings.

C. Test Method

1. RTD resistance data is taken at specified temperatures during hot functional testing, and the RTD resistance versus temperature characteristics is verified.

2. Thermocouple data is taken at the same temperature points used for recording RTD data, and the thermocouple millivolt-versus-temperature characteristics is verified to be within design tolerances.

3. RTD deviation from RCS average temperature and isothermal corrections for individual thermocouples are determined from the recorded data. NOTE: Any individual RTD reading that differs from the calculated average temperature by the specified amount determined using the methodology referenced in Section 7.1 (which conforms to Branch Technical Position 7-13) is not used for average temperature calculations (see Subsection 7.7.1.1). This methodology conforms to Branch Technical Position 7-13.

4. After disconnecting special test instrumentation and reconnecting RTDs to normal plant terminations, temperature data are taken to verify that all temperature instruments are reading correctly and indicate approximately RCS average temperature, as a functional check.

D. Acceptance Criterion

1. Test data are recorded for future alignment purposes only, and specific acceptance criteria are not provided.

14.2.12.1.20 Diverse Actuation System (DAS) Actuation Test

A. Objectives

1. To demonstrate the capability of the DAS to perform the required logic and timing functions.

2. To demonstrate that the DAS produces the required output signals in response to specific input signals.

B. Prerequisite

1. The plant control and monitoring system and protection and safety monitoring system are available to the extent necessary to provide the required input signals to the DAS.

C. Test Method

1. Internal DAS testing is accomplished to verify input, output, setpoint, timer, and logic functions.

2. Overall tests are accomplished to verify correct DAS output trip, and actuation signals are generated in response to specified input signal levels.

3. Verify indications and alarms.

D. Acceptance Criteria

1. The DAS processing system performed the required logic and timing functions.

2. The DAS produced the required output signals in response to specified input signals.

3. The DAS operates as described in Section 7.8.

4. Indications and alarms operate as described in Subsection 7.8.1.1.2.

14.2.12.1.21 Main Steam Supply System Preoperational Test

A. Objectives

1. To demonstrate the operability of the main steam depressurization valves, main steam relief valves and main steam relief valve block valves with steam lines at normal operating temperature and pressure.

2. To demonstrate the operability of the turbine bypass valves with steam lines at normal operating temperature and pressure.

3. To verify the setpoints of the main steam safety valves at temperature and pressure.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.
4. Required support systems are available.
5. Water quality is in required condition.
6. Main steam pressure is at required pressure.
7. SG water level is at required level.

C. Test Method

1. Verify manual and automatic system controls.
2. Verify alarms and status indications are functional.
3. Demonstrate dynamic operation of steam bypass to condenser during hot functional testing.
4. Demonstrate the operability of the main steam depressurization valves, the main steam relief valves and the main steam relief valve block valves during hot functional testing.
5. Verify setpoints of the main steam safety valves at operating temperature and pressure or using applicable in-situ testing.

D. Acceptance Criteria

1. The opening and closing times of the relief valves are within the design specifications.
2. The main steam supply system operates as described in Subsection 10.3.2
3. Setpoints of main steam are within required limits as specified in Subsection 10.3.2.

14.2.12.1.22 Residual Heat Removal System (RHRS) Preoperational Test

A. Objectives

1. To demonstrate operation of the containment spray (CS)/RHRS pumps and RHRS valves and their associated control and interlock circuitry.
2. To demonstrate CS/RHRS pump and RHRS performance during discharge to the reactor coolant cold legs and to the minimum flow line and to verify the head/flow characteristics of each installed pump.
3. To demonstrate the RHRS operation during the RCS heatup with letdown through RHRS.

4. To demonstrate RHRS operation during RCS cooldown and reactor coolant cooling by only two of four subsystems.

5. To demonstrate proper operation of the RHRS during low RCS water level (e.g., mid-nozzle level) and to verify sufficient margins exist to prevent vortexing or air entrainment in the suction lines.

6. To provide the RHRS relief valve in order to protect low temperature overpressure for the RCS.

7. To demonstrate proper operation of the SFP gravity drain injection to the RCS.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support system are available.

5. Required system flushing/cleaning is completed.

6. Required electrical power supplies and control circuits are energized and operational.

7. The CCW system is available to supply water to the CS/RHRS heat exchangers, pump seal coolers, and CS/RHRS pump motors.

C. Test Method

1. System component control and interlock circuits and alarms are verified, including the operation of the CS/RHRS pumps and RHRS valves.

2. CS/RHRS pump and RHRS performance characteristics are verified during RCS circulation.

3. RHRS operation is verified during RCS heatup and cooldown in conjunction with the hot functional test. This includes operation of reactor coolant cooling with only two of four subsystems.

4. Operation of the RHRS during RCS mid-loop hot leg water level is verified.

5. Operation of the SFP gravity injection to the RCS during mid-loop operation is verified.

D. Acceptance Criteria

1. RHRS components respond properly to normal control and interlock signals (see Subsection 5.4.7).

2. CS/RHRS pump and RHRS performance characteristics are within design specifications.

3. RHRS functions as designed during RCS heatup and cooldown.

4. Reactor coolant temperature can be cooled down with only two of four subsystems.

5. The RHRS functions as designed during RCS mid-loop hot leg water level.

6. The RHRS relief valve operation to provide low temperature overpressure protection for RCS is verified by in-service testing specified in subsection 3.9.6.

7. Indications and alarms operate as described in Subsection 5.4.7.2.5.

8. The SFP water can be injected to the RCS by gravity during mid-loop operation.

14.2.12.1.23 Main Steam Isolation Valve (MSIV), Main Feedwater Isolation Valve (MFIV) and Main Steam Check Valve Preoperational Test

A. Objectives

1. To demonstrate acceptable closing times of the MSIVs and the MSIV bypass valves.

2. To demonstrate acceptable closing times for the MFIVs.

3. To demonstrate failure position of MSIVs and MFIVs upon loss of valve motive force.

4. To demonstrate that the main steam check valve prevents blowdown by steam backflow for intact steam generator in the event of breaking the upstream of main steam check valve.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support system are available.

C. Test Method

1. The MSIV system's manual and automatic operation and MSIV and MSIV bypass valve closure times are demonstrated.

2. The MFIV system's manual and automatic operation and MFIV valve closure times are demonstrated.

3. Verify alarms and status indications are functional.

D. Acceptance Criteria

1. The response times are within the design specification as specified in Chapter 16, Surveillance Requirements 3.7.2.1 and 3.7.3.1.

2. The main steam supply system and the feedwater system operate as described in Section 10.3 and Subsection 10.4.7.

3. MSIVs and MFIVs fail closed upon loss of motive power.

4. The main steam check valve operation to prevent blowdown by steam backflow is verified by in-service testing specified in Subsection 3.9.6. The acceptance criterion is based on the safety evaluation specified in Subsection 10.3.

14.2.12.1.24 Motor-Driven Emergency Feedwater System Preoperational Test

A. Objectives

1. To demonstrate the ability of the motor-driven emergency feedwater system to supply feedwater to the SGs.

2. To verify the operation of system valves and components.

3. To verify the emergency feedwater pit alarm.

4. To verify electrical redundancy and independence.

5. To verify endurance of the motor-driven emergency feedwater pump.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Emergency feedwater pits are available.

6. Alternating current (ac) and direct current (dc) power sources are available.

C. Test Method

1. Verify manual and automatic system controls, including the operability of system pumps, valves, controls, and instrumentation and, to assure that flow instabilities (e.g., “water hammer”) does not occur in system components or piping, or inside the SGs, during normal system startup and operation.

2. Verify that system flowpaths, flowrates, and operating parameters are within limits.

3. Verify pump and valve operating parameters.

4. Verify instruments, indications and alarms.

5. Verify electrical redundancy and independence requirements are met.

D. Acceptance Criteria

1. The motor-driven emergency feedwater system operates within design limits, as described in Subsection 10.4.9.

2. Electrical redundancy and independence are provided.

3. 48-hour endurance test is performed on motor-driven emergency feedwater pumps. Following the 48-hour pump run, the pumps are shut down and cooled down and then restarted for one hour. After that the soundness of the pumps is confirmed.

14.2.12.1.25 Turbine-Driven Emergency Feedwater System Preoperational Test

A. Objective

1. To demonstrate the ability of the turbine-driven emergency feedwater system to supply feedwater to the SGs.

2. To verify endurance of the turbine-driven emergency feedwater pump.

B. Prerequisites

1. Construction acceptance testing is completed.

2. Component testing, setpoint verification, and instrument calibration are completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Emergency feedwater pits are available.

6. Related ac and dc power sources are available.

7. Steam is available for the emergency turbine.

8. RCS pressure and temperature are established near the no-load operating values.

C. Test Method

1. Verify manual and automatic system controls, including operability of system pumps, valves, controls, and instrumentation and, to assure that flow instabilities (e.g., “water hammer”) does not occur in system components or piping, or inside the SGs, during normal system startup and operation.

2. Verify system flowpaths, including from the main steam supply systems, flowrates, and operating parameters are within limits.

3. Verify turbine, pump, and valve operating parameters.

4. Verify instruments, indications and alarms.

5. Verify that the pump starts on simulated loss of ac power.

6. Verify electrical redundancy and independency requirements are met.

D. Acceptance Criteria

1. The turbine-driven emergency feedwater system operates within design limits, as described in Subsection 10.4.9.

2. 48-hour endurance test is performed on turbine-driven emergency feedwater pumps. Following the 48-hour pump run, the pumps are shut down and cooled down and then restarted for one hour. After that the soundness of the pumps is confirmed.

14.2.12.1.26 Extraction Steam Preoperational Test

A. Objectives

1. To verify the proper operation and control of each extraction line isolation and drain valve.

2. To verify the proper operation of each non-return valve.

B. Prerequisites

1. Construction acceptance testing is completed, including turbine-generator and auxiliaries.

2. Component testing and instrument calibration is completed, including turbinegenerator and auxiliaries.

3. Test instrumentation is available and calibrated.

4. Required support system are available.

C. Test Method

1. Extraction line isolation and drain valves are tested to verify that the valves function in accordance with the control logic.

2. Each non-return valve is observed to verify that the valve shuts following a turbine trip signal.

3. Turbine trip logic combinations are tested to verify that the appropriate valve control signals are generated for each turbine trip path (mechanical overspeed, electrical overspeed, reactor trip, manual from MCR and local control).

D. Acceptance Criteria

1. The extraction line isolation valves close and drain valves open following a turbine trip signal.

2. Each non-return valve closes following a turbine trip signal within the allowable valve closure time in Table 10.2-4.

14.2.12.1.27 Turbine-Generator (T/G) Preoperational Test

A. Objective

1. To demonstrate proper operation of the T/G and auxiliaries.

2. To demonstrate the functional performance of the main turbine stop valves, main turbine control valves, reheat stop valves, and intercept valves, including the actuation times from a turbine trip signal.

B. Prerequisites

1. Construction acceptance testing is completed.

2. Component testing and instrument calibration are completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

C. Test Method

1. T/G and auxiliary system performance data are recorded during a series of tests to verify acceptable performance of the following:

   a. the T/G set consisting of the high-pressure turbine (HPT), three low-pressure turbines (LPTs) and generator

   b. moisture separator/reheaters (MS/Rs)

   c. main turbine stop valves, main turbine control valves, reheat stop valves, and intercept valves

   d. turbine gland seal system

   e. turbine turning gear

   f. digital electrohydraulic (DEH) control system with supervisory instrumentation

   g. turbine overspeed protection

   h. T/G bearing lubrication oil system

   i. Generator stator cooling

   j. Generator rotor cooling and seal oil

   k. Hydrogen and carbon dioxide gas control

   l. exciter

2. Simulate control and trip signals to verify alarms and valve operation.

3. Verify operation, status indications, and alarms of system valves.

4. Turbine trip logic combinations are tested to verify that the appropriate valve control signals are generated for each turbine trip path (mechanical overspeed, electrical overspeed, reactor trip, manual from MCR and local control).

D. Acceptance Criterion

1. The T/G and auxiliaries operate as described in Section 10.2 and Subsection 10.4.3.

2. Each main turbine stop valve, main turbine control valve, reheat stop valve and intercept valve closes following a turbine trip signal within the allowable valve closure time in Table 10.2-4.

14.2.12.1.28 Condensate System Preoperational Test

A. Objectives

1. To demonstrate that the condensate pumps operate in a stable condition without alarms.

2. To demonstrate the automatic operation of system valves, status indications and alarms.

3. To demonstrate the operation of the hotwell level control system.

B. Prerequisites

1. Required construction acceptance testing is completed.

2. Required electrical power supplies and control circuits are operational.

3. The condensate storage facilities are available.

C. Test Method

1. Simulate pump overloads and discharge pressure signals to verify alarms and pump operation.

2. Operate pumps and verify pump performance characteristics at the operating point.

3. Verify the operation, status indications, and alarms of system valves and switches.

D. Acceptance Criteria

1. Condensate pumps, control valves, and isolation valves operate as described in Subsection 10.4.7.

2. The hotwell level control system operates as described in Subsection 10.4.7.

14.2.12.1.29 Feedwater System Preoperational Test

A. Objective

1. To demonstrate the proper operations of the SG water level control (i.e., the feedwater control system valves) and the manual and automatic function indications, and alarms.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Required electrical power is available.

6. Instrument air is available to air-operated valves.

7. Main feedwater pumps are available for testing.

8. Cooling water is available to be provided cooling water to the lube oil coolers.

C. Test Method

1. Manual and automatic operations of the feedwater system control valves are performed to demonstrate the modes of operation and response.

2. SG water levels are measured, and alarms and interlocks are verified.

D. Acceptance Criteria

1. The feedwater system operates as discussed in Subsection 10.4.7.

2. Normal SG water level is restored from low water level without causing unacceptable water hammer.

14.2.12.1.30 Feedwater Heater and Drain Systems Preoperational Test

A. Objectives

1. To demonstrate proper operation of controls and interlocks in the feedwater heater system.

2. To demonstrate that the drain pumps provide designed performance, that the control and interlocks operate as designed, and to verify alarms of each drain tank.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Required electrical power supplies and control circuits are operational.

6. The cooling water system and the condensate storage facilities are available.

C. Test Method

1. Simulate temperature signals and each operational condition to verify system operation, including status indications, alarms, and valves.

2. Simulate water level signals to verify drain tank alarms and pump operation.

3. Operate drain pumps and verify the drain pump performance characteristics.

D. Acceptance Criteria

1. System valves, instrumentation, controls, and interlocks operate as described in Subsection 10.4.7.

2. Drain pumps and alarms perform as described in Subsection 10.4.7.

14.2.12.1.31 Condensate Polishing System Preoperational Test

A. Objective

1. To verify that the as-installed components properly perform the functions of removing corrosion products, dissolved solids, and other impurities from the condensate system.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Electrical power supplies and control circuits are operational.

6. The circulating water system is available.

7. The condensate system is operational.

C. Test Method

1. Condensate polishing system performance is observed and recorded during individual component and integrated system testing.

2. Calibration and operation of the system instrumentation, controls, actuation signals, and interlocks are verified.

3. Verify indications and alarms.

D. Acceptance Criteria

1. System valves, instrumentation, controls, actuation signals, and interlocks operate as described in Subsections 10.3.5.3 and 10.4.6.

2. Indications and alarms operate as described in Subsection 10.4.6.

14.2.12.1.32 Main Condenser Evacuation System Preoperational Test

A. Objective

1. To verify that the system components perform the functions to establish and maintain the required vacuum in the main condenser.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. The condensate system, instrument air system, circulating water, vacuum pump seal water cooler, gland sealing system, auxiliary steam supply system and turbine component cooling water system are available.

6. Turbine is on turning gear.

C. Test Method

1. Verify operation of the vacuum pumps and system valves.

2. Verify calibration and operation of the system instrumentation, controls, actuation signals, and interlocks.

3. Verify capability of the vacuum pumps to establish the required vacuum in the main condenser.

4. Verify indications and alarms.

D. Acceptance Criteria

1. The main condenser evacuation system performs as described in Subsection 10.4.2.

2. Indications and alarms operate as described in Subsection 10.4.2.

14.2.12.1.33 Circulating Water System Preoperational Test

A. Objective

1. To demonstrate the operation of the circulating water pumps, [[the cooling tower fans]] and associated automatic operated valves.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. [[The cooling tower fans are available.]]

6. The following systems are available:

   a. Instrument and service air systems.

   b. [[Makeup water pump system.]]

   c. [[Blowdown water system.]]

   d. Demineralized water system.

C. Test Method

1. Verify controls and functions of circulating water pump [[and cooling tower fans]].

2. Verify strokes and functions of motor-operated valves and control valves.

3. Operate circulating water pumps and verify operating condition.

4. Verify indications and alarms.

D. Acceptance Criteria

1. The circulating water system performs as described in Subsection 10.4.5.

2. Indications and alarms operate as described in Subsection 10.4.5.

14.2.12.1.34 Essential Service Water System (ESWS) Preoperational Test

A. Objective

1. To demonstrate the operation of the ESWS.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.

C. Test Method

1. Verify manual and automatic system controls.
2. Verify system flowrates and performance of ESWS pumps.
3. Verify alarms and status indications are functional.
4. Verify the absence of indications of water hammer by re-activating the ESW pump after a simulated LOOP as specified in Subsection 14.2.12.1.45, Class 1E Bus Load Sequence Preoperational Test.

D. Acceptance Criterion

1. The ESWS operates within design limits, as described in Subsection 9.2.1.

14.2.12.1.35 Main and Unit Auxiliary Transformers Preoperational Test

A. Objectives

1. To demonstrate operation of protective relaying, alarms, and control devices of the main and unit auxiliary transformers.
2. To demonstrate the energization of the unit auxiliary transformers.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Related ac and dc power sources are available.

6. Actual service conditions of loads are simulated as closely as practical.

C. Test Method

1. Simulate fault conditions to verify alarms and operation of protective relaying circuits.

2. The unit auxiliary transformers are energized. Voltage and phase rotation are verified and recorded.

D. Acceptance Criterion

1. The performance of the main and unit auxiliary transformers is in accordance with the design criteria as described in Section 8.2.

14.2.12.1.36 Reserve Auxiliary Transformers Preoperational Test

A. Objectives

1. To demonstrate the operation of protective relaying, alarms, and control devices associated with the reserve auxiliary transformers.

2. To demonstrate the energization of the reserve auxiliary transformers.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Related ac and dc power sources are available.

6. Actual service conditions of loads are simulated as closely as practical.

C. Test Method

1. Simulate fault conditions to verify alarms and operation of protective relaying circuits.

2. The reserve auxiliary transformers are energized. Voltage and phase rotation are verified and recorded.

D. Acceptance Criterion

1. The performance of the reserve auxiliary transformers is in accordance with the design criteria as described in Section 8.2.

14.2.12.1.37 Non-Class 1E ac Distribution Preoperational Test

A. Objectives

1. To demonstrate operability of bus supply breaker control logic and interlocks.

2. To demonstrate automatic fast and slow transfers from the unit auxiliary transformer are within design specifications in each condition (including loss of offsite power).

3. To demonstrate the operation of system instrumentation and controls (including trip, load shedding, permissive and prohibit interlocks).

4. To demonstrate the energization of buses, distribution panels, station service transformers and cables.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Required electrical power supplies and control circuits are operational.

6. Actual service conditions of loads are simulated as closely as practical.

C. Test Method

1. Operability of bus supply breakers is demonstrated with the bus de-energized.

2. Simulation of automatic fast transfer initiation signals is utilized to demonstrate automatic fast transfer scheme operability as applicable.

3. Buses are energized from their alternate supplies. Voltage, phase rotation, and phase angles are measured and recorded.

4. Verify indications and alarms.

D. Acceptance Criteria

1. The 13.8 kV, 6.9 kV and 480 V ac systems (non-Class 1E) perform as described in Subsection 8.3.1.1.1 and the non-Class 1E 120V AC I&C power system performs as described in Subsection 8.3.1.1.7.

2. Indications and alarms operate as described.

14.2.12.1.38 6.9 kV Class 1E System Preoperational Test

A. Objectives

1. To demonstrate the operation of normal (reserve auxiliary transformers) and alternate (unit auxiliary transformer) incoming supply breakers of 6.9 kV Class 1E buses.

2. To demonstrate that the buses and cables can be energized by the normal and alternate sources via these breakers.

3. To verify operation of interlocks (including trip, permissive, initiating), protective relaying, and the PSMS.

B. Prerequisites

1. Required construction acceptance testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Required electrical power supplies and control circuits are operational.

6. Actual service conditions of loads are simulated as closely as practical.

C. Test Method

1. Operate breaker from control points and verify operation of switches, indications, interlocks, and alarms

2. Simulate abnormal conditions and verify responses and alarms.

3. The 6.9 kV Class 1E buses are energized via their normal and alternate sources; bus voltage and phase rotation are recorded.

D. Acceptance Criterion

1. The 6.9 kV Class 1E system performs as described in Subsection 8.3.1.1.2

14.2.12.1.39 480 V Class 1E Switchgear Preoperational Test

A. Objective

1. To perform the initial operation of the 480 V, Class 1E, load centers and to demonstrate that they can be energized and operated.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.
5. Required electrical power supplies and control circuits are operational.
6. Actual service conditions of loads are simulated as closely as practical.

C. Test Method

1. The manual controls, annunciation, and instrumentation for the 480 V, Class 1E, load centers and their 6.9 kV feeder breakers are checked for correct operation.
2. The 480 V, Class 1E, load centers are energized. Voltage and phase rotation are verified and recorded.

D. Acceptance Criteria

1. The manual controls, automatic loading controls, annunciation, and instrumentation for the 480 V, Class 1E, load centers and their 6.9 kV feeder breakers operate correctly.
2. The voltage and phase rotation of each 480 V, Class 1E, load center are within design specifications.
3. All 480 V, Class 1E, load centers perform as described in Subsection 8.3.1.1.2.

14.2.12.1.40 480 V Class 1E Motor Control Center Preoperational Test

A. Objectives

1. To demonstrate the operation of associated controls, interlocks, alarms, and solid-state trip devices.
2. To demonstrate energization of the applicable motor control centers (MCCs).

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.
5. Required ac and dc power sources are available.
6. Actual service conditions of loads are simulated as closely as practical.

C. Test Method

1. Operability of all MCC supply breakers is demonstrated.
2. Fault conditions that verify alarms and operation of solid-state trip devices and protective relaying are simulated.
3. The MCCs are energized, with voltage and phase rotation recorded and verified.

D. Acceptance Criterion

1. The performance of the 480 V MCC (Class 1E) system is in accordance with the design criteria and Subsection 8.3.1.1.2

14.2.12.1.41 120 V ac Class 1E Preoperational Test

A. Objectives

1. To demonstrate that the 120 V, Class 1E, ac distribution panels can be fed from their normal source inverters and from their backup source transformers by auto and manual transfer.
2. To verify operation of system instrumentation and controls, including breaker protective interlocks.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.

5. Appropriate ac and dc power sources are available.

C. Test Method

1. Normal source inverters are energized from 125 V dc switchgear, and inverter input and output voltages are recorded.

   The 120 V, Class 1E, ac distribution panels are energized from normal source inverters, and ac distribution panel voltages are recorded.

2. Normal source inverters are energized from a 480 V MCC, and inverter input and output voltages are recorded.

   The 120 V, Class 1E, ac distribution panels are energized from normal source inverters, and ac distribution panel voltages are recorded.

3. The 120 V, Class 1E, ac distribution panels are energized from their backup source transformer by automatic and manual transfer and distribution panel voltages are recorded.

4. The system breakers are operated, and breaker interlocks are verified.

5. Verify indications and alarms.

D. Acceptance Criteria

1. The 120 V, Class 1E, ac distribution panels perform as described in Subsections 8.3.1.1.2 and 8.3.1.1.6, and their operation is in conformance with the Chapter 16, Technical Specifications, SR 3.8.8.1 and SR 3.8.9.1.

2. Indications and alarms operate as described in Subsections 8.3.1.1.2 and 8.3.1.1.6.

14.2.12.1.42 Emergency Lighting System Preoperational Test

A. Objectives

1. To demonstrate the capability of the emergency lighting system to provide adequate illumination levels.

2. To verify operation of system instrumentation and controls.

B. Prerequisites

1. Required construction testing is completed.

2. Required electrical power supplies and control circuits are available.

3. The emergency lighting system is energized.

C. Test Method

1. The ability of the emergency lighting system is verified by simulating a loss of the normal lighting and observing that the emergency system automatically activates.

2. Illumination levels and operation times are verified.

D. Acceptance Criterion

1. The performance of the emergency lighting tested is in accordance with the design criteria and Subsection 9.5.3. Emergency lighting provides 10 foot-candles of illumination at the safety panel, workstations in the control room and the remote shutdown console areas (Subsection 9.5.3.2.2.1).

14.2.12.1.43 Normal Lighting System Preoperational Test

A. Objectives

1. To demonstrate the capability of the normal lighting system to provide adequate illumination levels.

2. To verify operation of system instrumentation and controls.

B. Prerequisites

1. Required construction testing is completed.

2. Required electrical power supplies and control circuits are available.

3. The normal lighting system is energized.

C. Test Method

1. System function, correct electrical feeds, and correct fixture location is verified to be in accordance with the design.

D. Acceptance Criterion

1. The normal lighting system functions as described in Subsection 9.5.3 to provide illumination to required areas of the plant.

14.2.12.1.44 Class 1E Gas Turbine Generator Preoperational Test

A. Objectives

1. To demonstrate the operability of each Class 1E gas turbine generator breaker and associated interlocks.

2. To demonstrate the operation of the air starting system, fuel oil storage and transfer system, lubrication system, combustion air intake and exhaust system for each Class 1E gas turbine generator.

3. To demonstrate emergency generator reliability by performing 25 consecutive starts with no failures on each Class 1E gas turbine generator.

4. To demonstrate that the Class 1E gas turbine generator starts and verify that the required voltage and frequency are attained.

5. To demonstrate maximum expected load-carrying capability for an interval of not less than 1 hour by synchronizing each Class 1E gas turbine generator with the offsite power system.

6. To determine the fuel oil consumption of each Class 1E gas turbine generator while operating under continuous rating load conditions.

7. To demonstrate proper operation during Class 1E gas turbine generator load shedding, including a test of the loss of the largest single load and of complete loss of load. To verify that the overspeed limit is not exceeded.

8. To demonstrate full load carrying capability of each Class 1E gas turbine generator for 24 hours.

9. To demonstrate functional capability at full load temperature conditions by verifying each Class 1E gas turbine generator starts and to verify the generator voltage and frequency are attained within the required time limits.

10. To demonstrate the ability of each Class 1E gas turbine generator to synchronize with the offsite power system.

11. To verify that specified automatic Class 1E gas turbine generator trips are automatically bypassed with an emergency core cooling system (ECCS) actuation signal.

12. To verify that, with each Class 1E gas turbine generator operating in the test mode connected to its bus, a simulated ECCS actuation signal overrides the test mode by returning the Class 1E gas turbine generator to standby operation.

13. To demonstrate that by starting and running (unloaded) redundant Class 1E gas turbine generator units simultaneously, common failure modes that may be undetected with a single Class 1E gas turbine generator test do not occur.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Required electrical power supplies and control circuits are available.

6. The starting system, fuel oil storage and transfer system, lubrication system and combustion air intake and exhaust system are available.

C. Test Method

1. Fuel oil is transferred from the fuel oil storage tank to the fuel oil day tanks by means of the transfer pumps. The appropriate flow parameters are recorded.

2. The control logic of the Class 1E gas turbine generator breakers, Class 1E gas turbine generator circuit, and support pumps and valves are verified.

3. The operability of the starting system, lubrication system and combustion air intake and exhaust system is verified.

4. A demonstration of 25 consecutive starts of each Class 1E gas turbine generator is performed.

5. The Class 1E gas turbine generator is started and attaining required voltage and frequency is verified.

6. The Class 1E gas turbine generator is operated with maximum expected load-carrying capability for an interval of not less than 1 hour by synchronizing the Class 1E gas turbine generator with the offsite power system.

7. During the testing, fuel oil consumption is monitored with each Class 1E gas turbine generator operating at the continuous load rating.

8. The largest single load and complete load are shed and no tripping on overspeed is verified.

9. Demonstrate full load carrying capability for 24 hours, of which 22 hours are at a load equivalent to the continuous rating of the Class 1E gas turbine generator and 2 hours at a load equivalent to the two hour rating of the emergency generator. Obtain ventilation air flow rate and ambient room temperature measurements during this test. Record outside air ambient environmental temperature.

10. Demonstrate functional capability at full load temperature conditions by verifying each Class 1E gas turbine generator starts upon receipt of a manual or auto-start signal, and the generator voltage and frequency are attained within the required time limits.

11. Demonstrate the ability to:

- Synchronize the Class 1E gas turbine generator unit with the offsite system while the unit is connected to the emergency load.
- Transfer the emergency load to the offsite system.
- Restore the Class 1E GTG to standby status.

12. Demonstrate that the specified automatic trip signals for the Class 1E gas turbine generator are bypassed automatically as designed.
13. With each Class 1E gas turbine generator operating in the test mode connected to its bus, a simulated ECCS actuation signal is initiated to override the test mode and return the Class 1E gas turbine generator to standby operation.
14. Demonstrate that by starting and running (unloaded) redundant units simultaneously, common failure modes that may be undetected with a single Class 1E gas turbine generator testing do not occur.

D. Acceptance Criteria

1. The controls, alarms, interlocks, and operation of the emergency generator breakers and support systems are as designed (see Subsection 8.3.1.1.3).
2. Each Class 1E gas turbine generator completes 25 consecutive starts within the required time without a failure.
3. Each Class 1E gas turbine generator attains the required voltage and frequency upon starting.
4. Each Class 1E gas turbine generator is capable of being synchronized with offsite power and supplies the maximum expected load-carrying capability for an interval of not less than 1 hour.
5. The fuel oil consumption of each Class 1E gas turbine generator while operating under continuous rating load conditions does not exceed the design requirements, including fuel oil storage capacity as described in Subsection 9.5.4.1.
6. Upon the loss of the largest single load and complete loss of load, each Class 1E gas turbine generator continues to operate without exceeding the overspeed limit.
7. Each Class 1E gas turbine generator satisfactorily completes the full-load test for 24 hours with 22 hours at a load equivalent to the continuous rating of the Class 1E gas turbine generator and 2 hours at a load equivalent to the 2 hour rating of the Class 1E gas turbine generator. Ventilation air flow rate is shown to meet design flow rate, and ambient room temperature is maintained within limits during the 24 hour run. It has been demonstrated through testing and analyses that the temperatures for the GTG room are being maintained at or around the design temperatures based on outside air ambient design conditions.

8. Each Class 1E gas turbine generator starts and attains required voltage and frequency within the required time limits at full load temperature.

9. Each Class 1E gas turbine generator is synchronized with offsite power and restored to standby status.

10. On an ECCS actuation signal, specified automatic Class 1E gas turbine generator trips are automatically bypassed.

11. On a simulated ECCS actuation signal, with each Class 1E gas turbine generator operating in the test mode connected to its bus, the test mode is overridden and the Class 1E gas turbine generator returns to standby operation.

12. Each electrical division operates independently of other divisions.

13. The Fuel Oil System operates as described in Subsection 9.5.4.

14.2.12.1.45 Class 1E Bus Load Sequence Preoperational Test

A. Objectives

1. Verify the control logic and operation of bus undervoltage and degraded voltage relays.

2. Verify the control logic of the load shed, prohibit interlock and load control.

3. To demonstrate above functions in offsite power available condition.

4. Verify each electrical division operates independently of other divisions.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Required electrical power supplies are available.

C. Test Method

1. The load control logic is verified by simulating a LOOP and by simulating an ESF initiation and recording the response.

2. The logic for the bus undervoltage and degraded voltage relays is verified.

3. In offsite source available condition, load sequence is tested by initiating an ECCS actuation signal.

4. Each electrical division is operated independently of other divisions and division separation is verified in accordance with RG 1.41.

5. Verify all associated indications and alarms during test sequences.

D. Acceptance Criteria

1. The PSMS, the bus undervoltage relays, and the degraded voltage relays operate in accordance with design (see Subsection 8.3.1.1.3).

2. The loading intervals for supplying from Class 1E gas turbine generator are within the design limits.

3. Each train loads are sequenced on the bus by initiating of an ECCS actuation signal.

4. Each electrical division operates independently of other divisions.

5. All associated indications and alarms operate per design.

14.2.12.1.46 Alternate ac Power Sources for Station Black Out Preoperational Test

A. Objectives

1. Demonstrate the operability of each alternate ac power source breaker and associated interlocks.

2. Demonstrate the operation of air start and fuel systems.

3. Demonstrate the ability of the alternate ac power source to synchronize with the offsite power system.

4. Determine the fuel oil consumption of each alternate ac power source while operating under continuous rating load conditions.

5. Verify that, with the alternate ac power source operating in the test mode connected to its bus, an automatic start signal overrides the test mode by returning the alternate ac power source to standby operation.

B. Prerequisites

1. Required construction acceptance tests are completed.

2. Required electrical power supplies and control circuits are operational.

3. The alternate ac power source fuel oil system is available.

4. Adequate ventilation for the alternate ac power source area is available.

5. A report exists that demonstrates the reliability of the alternate ac power sources meets or exceeds 95% as determined in accordance with NSAC-108 (Reference 8.4-2) or equivalent methodology to meet the Criterion 5 of Section C.3.3.5, RG 1.155, based on historical data of the similar type of the ac alternate power sources.

C. Test Method

1. Fuel oil is transferred from the fuel oil storage tank to the fuel oil day tanks by means of the transfer pumps. Appropriate flow parameters are recorded.

2. The control logic of the alternate ac power source breaker, alternate ac power source start circuit, and support pumps and valves are verified.

3. The operability of the alternate ac power source starter is verified.

4. The alternate ac power source is started, voltage and frequency control demonstrated, phase rotation verified, and the backup generator synchronized to offsite power and loads.

5. During the testing, fuel oil consumption is monitored with the alternate ac power source operating at the continuous load rating.

6. With a simulated LOOP signal, the proper alternate ac power source trips is verified.

7. With the alternate ac power source connected to its bus, an automatic start signal causes it to return to standby operation.

8. Verify all associated indications and alarms during test sequences.

D. Acceptance Criteria

1. The controls, interlocks, and operation of the alternate ac power source breakers and support systems operate as designed (see Subsection 8.3.1.1.1).

2. Each alternate ac power source can be synchronized with offsite power.

3. Upon the receipt of automatic start signals, the alternate ac power sources operate as designed.

4. The alternate ac power source fuel oil consumption does not exceed the design requirements.

5. All associated indications and alarms operate per design.

14.2.12.1.47 125 V dc Class 1E Preoperational Test

A. Objectives

1. To demonstrate the battery capacity and to verify actual total load current is within the load assumed in the system design.

2. To demonstrate the capability of the batteries to supply the required loads via breakers, cables and inverters for the required period of time.

3. To demonstrate the ability of the battery chargers to carry the load via breakers, cables and inverters.

4. To demonstrate the ability of the battery chargers to recharge the battery in the required time period, while carrying the largest combined continuous steady state load expected on the dc system.

5. To demonstrate proper calibration and trip setting of protective relays and proper transfer function (including permissive and prohibit interlocks).

6. Verify each electrical division operates independently of other divisions.

7. Verify each battery voltage following discharge test at full load and for design duration.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Required electrical power supplies and control circuits are operational.

6. Required battery room ventilation is available.

7. Required resistive load devices are available.

8. Actual service conditions of loads are simulated as closely as practical.

C. Test Method

1. To determine capacity, each battery is discharged, using the eight hour rate, to its minimum design voltage limit.

2. The battery is charged to its fully charged condition, while the battery charger is simultaneously carrying the largest combined continuous steady-state load expected on that dc system.

3. Each battery is discharged using the required discharge rates and time periods.

4. The battery charger is subjected to its rated load for the required 8 hour period.

5. Each individual battery cell voltage is measured following the discharge test.

6. Simulate abnormal conditions and verify responses.

7. Each electrical division is operated independently of other divisions and division separation is verified in accordance with RG 1.41.

8. Verify all associated indications and alarms.

D. Acceptance Criteria

1. Battery capacity is at least 90% of the manufacturer's rating (see Subsection 8.3.2).

2. The battery charger can charge the battery to a fully charged condition following a design basis discharge within 24 hours while carrying the largest combined continuous steady state load expected on that dc system.

3. Each battery can carry the required load for eight hours without reaching its minimum discharged state.

4. The battery charger can carry nameplate rated load.

5. The battery voltage remains the above minimum voltage.

6. Class 1E 125 V dc system performs as described in Subsection 8.3.2.

7. Each electrical division operates independently of other divisions.

8. Indications and alarms operate as described in Subsection 8.3.2.1.1.

14.2.12.1.48 125 V dc Class 1E Minimum Load Voltage Verification

A. Objectives

1. To measure the voltage drops, at nominal battery voltage, to 125 V dc Class 1E inverters and power operated valves.

2. To determine the voltage which would be available at the 125 V dc Class 1E inverters and power operated valves if the batteries were discharged to the minimum voltage limit.

3. To verify that the voltage available to 125 V dc Class 1E inverters and power operated valves exceed the design minimum.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. The 125 V dc Class 1E inverters and power operated valves are operable.

6. Required load test devices are available.

C. Test Method

1. Each 125 V dc Class 1E inverter is loaded to its design capacity and the voltage drop from the battery to the inverter input measured.

2. Each 125 V dc Class 1E power-operated valve is operated and the voltage drop from the battery to the motor or solenoid measured.

3. The minimum available voltage at each 125 V dc Class 1E inverter and power operated valve is determined from the measured voltage drops and the battery minimum voltage limit.

D. Acceptance Criteria

1. The minimum available input voltage for the 125 V dc Class 1E inverters equals or exceeds 100 V dc.

2. The minimum available input voltage for the 125 V dc Class 1E power operated valves equals or exceeds 100 V dc or the equipment minimum rated operating voltage, whichever is lower.

14.2.12.1.49 125 V dc non-Class 1E Preoperational Test

A. Objectives

1. To demonstrate the capacity of each battery.

2. To demonstrate the capability of the batteries to supply the required loads for the required period of time.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.
5. Required electrical power supplies and control circuits are operational.
6. Battery room ventilation is available.
7. Required resistive load devices are available.

C. Test Method

1. To determine capacity, each battery is discharged, using the design-specified rate, to its minimum design voltage limit.
2. Each battery is discharged using the required discharge rates and time periods.
3. Each individual battery cell is measured following the discharge test.

D. Acceptance Criteria

1. Battery capacity is at least 90 percent of the manufacturer's rating (see Subsection 8.3.2).
2. Each battery can carry the required load for the required time period.
3. Each battery cell is within the minimum design voltage limit at the end of the service test.

14.2.12.1.50 Dynamic State Vibration Monitoring of Safety Related and High-Energy Piping

A. Objective

1. To demonstrate during preoperational test transients that the systems' monitored parts respond in accordance with design calculations.

B. Prerequisites

1. Reference points for measurement of the systems are established, and required temporary instrumentation is installed and calibrated.
2. Hot functional testing is in progress for those portions of testing requiring elevated temperatures and pressure.

3. All subject systems are available for the specified dynamic operations.

C. Test Method

1. The dynamic response of the specified safety-related and high-energy piping is recorded during both steady flow and flow-induced transients.

2. Specified-safety-related and high-energy piping are screened qualitatively for perceptible vibration by visual inspection during the transient events. Where excessive vibration is observed, deflection amplitudes are recorded for evaluation.

3. Dynamic response monitoring is performed in conjunction with preoperational test 14.2.12.1.24 and during hot functional testing per Subsection 14.2.12.1.1 and the tests coordinated by Subsection 14.2.12.1.1.

D. Acceptance Criteria

1. The movements due to flow-induced loads do not exceed design limits (Subsection 3.9.2).

2. Flow-induced movements and loads do not cause malfunctions of plant equipment or instrumentation.

14.2.12.1.51 Steady State Vibration Monitoring of Safety Related and High-Energy Piping

A. Objective

1. Demonstrate that the steady state vibrations of safety-related and high-energy piping are within acceptable limits.

B. Prerequisites

1. The subject systems are available for operation at the specified conditions.

2. Portable instrumentation is available and calibrated.

C. Test Method

1. Specified safety-related and high-energy piping runs are screened qualitatively for perceptible vibration by visual inspection.

2. All piping observed to be vibrating is monitored with portable instrumentation. The results are assessed versus quantitative screening criteria or, if necessary, using standard stress evaluation techniques.

D. Acceptance Criterion

1. Steady state vibrations of safety-related and high energy piping are within the allowable stress limits defined in Subsection 3.9.2.

14.2.12.1.52 Thermal Expansion Test

A. Objectives

1. To verify that essential nuclear steam supply system and balance of plant components, piping, support, and restraint deflections are unobstructed and within design specifications.

2. To verify that thermal movements for safety-related snubbers, as delineated in the Technical Specifications and whose system operation temperature exceeds the design temperature, are within design specifications.

B. Prerequisites

1. This test is conducted simultaneously with hot functional testing. Objectives that cannot be verified during hot functional testing are completed during startup testing.

2. Supports, restraints, and hangers are installed, and reference points and predicted movements are established.

3. Temporary instrumentation is installed as required to monitor the expansion of the components under test.

4. A preservice examination is performed on snubbers.

C. Test Method

1. During the RCS heatup and cooldown, deflection data are recorded.

2. Snubber thermal movements are verified by recording positions during initial system heatup and cooldown. Local and/or remote displacement measurements are recorded to determine thermal growth rates for snubbers utilized in safety-related systems or components that experience high thermal growth rates.

3. Snubber swing clearance is verified at specified heatup and cooldown intervals.

4. Thermal expansion is observed during power ascension.

D. Acceptance Criteria

1. No evidence of blocking of the thermal expansion of any piping or components, other than by installed supports, restraints, and hangers (Subsection 3.9.2).

2. Spring hanger movements remain within the hot and cold setpoints, and snubbers do not become fully retracted or extended.

3. Piping and components return to their approximate baseline cold position.

4. For snubbers utilized in safety-related systems or components that experience high thermal growth rates, the overall thermal growth rates are verified not to exceed the snubber lock-up velocity.

14.2.12.1.53 Class 1E Gas Turbine Generator Sequence Preoperational Test - LOOP Sequence and LOOP Sequence with ECCS Actuation Signal

A. Objectives

1. To demonstrate that the operation of the Class 1E gas turbine generators and the emergency loads supplied are in agreement with design assumptions.

2. To demonstrate proper automatic alignment and operation of ESF and other safety components using Class 1E gas turbine generators with voltage and frequency within acceptable limits. (LOOP sequence)

3. To demonstrate that the starting of Class 1E gas turbine generator by an ECCS actuation signal.

4. To demonstrate proper automatic alignment and operation of ESF and other safety components upon an ECCS actuation signal using Class 1E gas turbine generators with voltage and frequency within acceptable limits. (LOOP sequence with ECCS actuation signal.)

(Note) The ECCS actuation of the isolation valves and non-safety components and system valves in the SIS is verified in the ECCS Actuation and Containment Isolation Logic Preoperational Test (Subsection 14.2.12.1.55) and the Main Steam Isolation Valve (MSIV) and Main Feedwater Isolation Valve (MFIV) System Preoperational Test (Subsection 14.2.12.1.23).

B. Prerequisites

1. Required preoperational testing, component testing, and instrument calibrations are completed.

2. Required electrical power supplies and control circuits are energized and operational.

3. The refueling water storage pit (RWSP) contains an adequate supply of demineralized water.

4. The CS pump discharge lines are isolated to prevent spraying into the containment.

5. Plant systems and components to be operated during testing are aligned.

C. Test Method

1. A LOOP is simulated, loads are shed from the safety bus, and the Class 1E gas turbine generator starting and safety bus loading are verified.

2. Following initiation of a simulated LOOP, Class 1E gas turbine generator loading is checked to assure that the Class 1E gas turbine generator continuous operation ratings are not exceeded.

3. Initiate an ECCS actuation signal and verify each Class 1E gas turbine generator starts, attains the required voltage and frequency within acceptable limits and time, and operates on standby.

4. Following an ESF actuation signal coincident with a simulated LOOP, Class 1E gas turbine generator loading is checked to assure that the Class 1E gas turbine generator continuous operation ratings are not exceeded.

D. Acceptance Criteria

1. Operation of the Class 1E gas turbine generators and emergency loads supplied are in agreement with design assumptions.

2. On a LOOP, proper automatic alignment and operation of ESF and other safety components using Class 1E gas turbine generators is demonstrated, with voltage and frequency within acceptable limits. (LOOP sequence)

3. The Class 1E gas turbine generators start on an ECCS actuation signal.

4. On an ECCS actuation signal coincident with a simulated LOOP, proper automatic alignment and operation of ESF and other safety components using Class 1E gas turbine generators is demonstrated, with voltage and frequency within acceptable limits. (LOOP sequence with ECCS actuation signal)

14.2.12.1.54 Safety Injection System (SIS) Preoperational Test

A. Objectives

1. To verify the proper operation of the safety injection pumps and system valves and controls.

2. To verify that the performance characteristics of each safety injection pump is within design specifications.

3. To verify proper direct vessel injection and hot leg injection and conformity of test line with design requirements.

4. To verify flow test and valve operability for the SIS injection line at operating pressure and temperature conditions.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.
5. The RWSP contains an adequate supply of demineralized water for test performance.
6. The reactor vessel head is removed and provisions are provided to remove water from the vessel.

C. Test Method

1. System component control and interlocks are verified.
2. The safety injection pump injection line and minimum flows and pump operation are verified.
3. During hot operating conditions, small amounts of water are injected into the reactor coolant system by the SIS (in accordance with RG 1.79).
4. Alarms which indicate SI pump operation are verified.

D. Acceptance Criteria

1. SIS components respond properly to normal control and interlock signals as described in (Section 6.3 and Sections 7.3 and 7.6)
2. The performance characteristics of safety injection pumps are within design specifications.
3. Flowrates for safety injection test lines are within design specifications.
4. The safety injection flow rates are within design specifications and the available net positive suction head meets design requirements.
5. The times for safety injection pumps to reach rated flow rates are within design specifications.
6. Alarms which indicate SI pump operation perform as described in Subsection 6.3.5.3.

14.2.12.1.55 ECCS Actuation and Containment Isolation Logic Preoperational Test

A. Objectives

1. To verify that equipment, (including valves and dampers) interlocks related to the ECCS actuation and alarms or repositions operate properly upon actuation of appropriate ESF signals and that response is obtained upon reset of the signals.

   The ECCS actuation of ESF is verified as specified in Subsection 14.2.12.1.53, Class 1E Gas Turbine Generator Sequence Preoperational Test.

2. To verify that containment isolation valves are closed properly upon receipt of a containment isolation signal.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.
5. Demineralized water is available.
6. Accumulator is blown out completely and not pressurized by gas.
7. Plant systems and components to be operated during testing are aligned prior to actuation of the ECCS actuation signal.

C. Test Method

1. Appropriate ECCS actuation signals are initiated and the operation of valves, dampers, and equipment are verified.
2. Appropriate containment isolation signals are initiated and the operation of valves and dampers are verified.

D. Acceptance Criteria

1. Valves and dampers are actuated and non safety-related equipment is tripped as designed upon initiation of safety signals and receipt of proper alarms as described in Subsections 6.2.4 and 6.3.5.1.
2. Valves and dampers close as designed upon actuation of containment isolation signals.
3. Valves and dampers close as specified in the design specifications.

14.2.12.1.56 Safety Injection Check Valve Preoperational Test

A. Objectives

1. To verify proper operation of safety injection line check valves.

2. To verify the integrity of accumulator discharge check valves and safety injection pump discharge line check valves.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Required electrical power sources and controls are energized and operational.

6. RCS pressure and temperature are established near the no-load operating values.

C. Test Method

1. RCS pressure is reduced and safety injection pump flow is routed through the reactor vessel or hot leg and the correct accumulator discharge check valve and injection line check valve operation to confirm delivery of the water are verified.

2. Accumulator motor-operated isolation valves are opened and RCS pressure and temperature are reduced to the accumulator discharge conditions to verify the operability of each accumulator discharge check valve as indicated by a decrease in the fluid level of each accumulator.

3. SIS test line valves are aligned to provide a leakoff path from the accumulator discharge check valves and the safety injection pump injection line check valves (downstream of the applicable check valve) to verify proper operation of the check valves.

D. Acceptance Criteria

1. The accumulator discharge and safety injection line check valves operate as demonstrated by verification of flow through the check valves as described Subsections 6.3.2.2.1 and 6.3.2.2.2.

2. Check valve integrity test results conform to Chapter 16 Technical Specification requirements, Surveillance Test SR 3.4.14.1.

14.2.12.1.57 Safety Injection Accumulator Test

A. Objectives

1. To demonstrate operation of the safety injection accumulators and system valves and their associated control circuitry.

2. To demonstrate accumulator injection and obtain flow rate data during a low-pressure injection for each accumulator.

3. To verify flow and verify valve operability for the accumulator injection line at operating pressure and temperature conditions.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Required electrical power supplies and control circuits are energized and operational.

6. The reactor vessel head and reactor internals are removed, and provisions are provided to remove water from the vessel during the low pressure injection test.

7. The high pressure nitrogen supply is available to supply nitrogen to the accumulators.

8. The RWSP contains an adequate supply of demineralized water for the performance of this test.

9. The SIS is available for filling the accumulators.

C. Test Method

1. Accumulator system component pressure control circuits are verified.

2. Each accumulator is filled and partially pressurized with the discharge valves closed. The discharge valves are opened, discharging the accumulators to the reactor vessel, and accumulator flow rate data are determined.

3. Each accumulator discharge valve is operated under maximum differential pressure conditions of normal accumulator precharge pressure and zero reactor coolant pressure with normal and emergency power conditions.

4. During hot operating conditions, small amounts of water are injected into the reactor coolant system by the accumulator (in accordance with RG 1.79).

5. Accumulator instrumentation for level (volume) and pressure, and associated alarms, are verified.

D. Acceptance Criteria

1. The nitrogen pressure of each accumulator is controlled by the accumulator nitrogen supply pressure control valve within design limits.

2. The discharge performance is as specified in design specifications (Subsection 6.3.2.2.2).

3. The valve operation initiated by the safety injection and containment isolation signal is verified as specified in ECCS Actuation and Containment Isolation Logic Preoperational Test, Subsection 14.2.12.1.55.

4. Accumulator instrumentation for level (volume) and pressure, and associated alarms perform as described in Subsection 6.3.5.2.

14.2.12.1.58 Containment Spray System Preoperational Test

A. Objectives

1. To demonstrate that the spray nozzles in the CS headers are free from obstructions.

2. To demonstrate operation of the CS/RHRS pumps, CS system valves and their associated control circuitry.

3. To demonstrate CS/RHRS pumps and CS system performance during operation in the test mode.

4. To demonstrate proper operation of the CS header check valve.

5. To demonstrate an unobstructed path of the sodium tetraborate decahydrate (NaTB) solution transfer piping from the NaTB basket container to the RWSP.

6. To verify proper operation of the CS/RHR pump hot leg isolation valve open permissive interlocks and the CS/RHR valve open block interlocks.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Required electrical power supplies and control circuits are energized and operational.

6. The RWSP contains an adequate supply of demineralized water for the performance of this test.

7. Temporary piping is installed from the spray header test connections.

8. A source of compressed air is available to pressurize the spray headers.

9. The CCW system is available to supply cooling water to the CS pump motors.

C. Test Method

1. System component control circuits are verified.

2. CS/RHRS pumps and CS system performance characteristics are verified during operation in the test mode.

3. Airflow is initiated through the CS headers, and unobstructed flow is verified through each nozzle.

4. Use visual or alternate means to demonstrate unobstructed flow from each container to the RWSP.

5. The CS/RHR pump hot leg isolation valve open permissive interlocks described in Subsection 7.6.1.1 and the CS/RHR valve open block interlocks described in Subsection 7.6.1.2 are demonstrated.

D. Acceptance Criteria

1. CS system components respond to normal control signals and to simulated CS actuation load, load shed, and load sequencing signals as described in Subsection 6.2.2.2.

2. CS/RHRS pumps and CS system performance characteristics are within design specifications as described in Subsection 6.2.2.2.

3. All CS nozzles are unobstructed, as evidenced by air passing through each nozzle.

4. The CS header discharge check valves operate as designed.

5. The flow path from each container to the RWSP is unobstructed.

6. The CS/RHR pump hot leg isolation valve open permissive interlocks perform as described in Subsection 7.6.1.1, and the CS/RHR valve open block interlocks perform as described in Subsection 7.6.1.2.

14.2.12.1.59 Refueling Water Storage System Preoperational Test

A. Objective

1. To demonstrate the operation of the refueling water storage system and its associated control circuitry.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.
5. Required electrical power supplies and control circuitry are energized and operational.
6. The demineralized water system is available for filling the RWSP.

C. Test Method

1. System component control circuits and alarms are verified.

D. Acceptance Criterion

1. The RWSP system components and controls, including alarms operate as designed (see Subsections 6.2.2.2.5, 6.3.2.2.4, 6.3.2.2.3, and 6.3.5.4).

14.2.12.1.60 Essential Chilled Water System Preoperational Test

A. Objective

1. To demonstrate the operation of the essential chilled water system during normal operations and upon receipt of an ECCS actuation signal.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.
5. ESWS are available.

C. Test Method

1. Verify manual and automatic system controls.

2. Verify alarms and status indications are functional.

3. Verify system flowrates.

4. Verify system flow rates, pressures, and performance of all pumps.

5. Verify that essential chillers supply 40° F chilled water to the HVAC systems cooling coils.

6. Verify that operating essential chillers and pumps continue to run and the standby essential chillers and pumps start upon receipt of an ECCS actuation signal.

D. Acceptance Criteria

1. The essential chilled water system operates as described in Subsection 9.2.7.

2. Controls, alarms and status indications perform as described in Subsection 9.2.7.5.1.

3. System flow rates, pressures, and performance of all pumps are within design specifications.

4. Essential chillers supply 40° F chilled water to the HVAC systems cooling coils.

5. Operating essential chillers and pumps continue to run and the standby essential chillers and pumps start upon receipt of an ECCS actuation signal.

14.2.12.1.61 Containment Structural Integrity Test

A. Objective

1. To demonstrate the structural integrity of the containment.

B. Prerequisites

1. Containment penetrations are installed, and penetration leak tests are completed.

2. Containment penetrations, including equipment and personnel airlocks, are closed.

C. Test Method

1. The containment is pressurized to the test pressure of 78.2 psig as described in Subsection 3.8.1.3.1, using the test methods described in Subsection 3.8.1.7, and the deflection measurements, and concrete crack inspections are made to

determine that the actual structural response is within the limits predicted by the design analyses.

D. Acceptance Criterion

1. The containment structural response is within the limits predicted by design analyses (Subsection 3.8.1).

14.2.12.1.62 Containment Local Leak Rate Preoperational Test

A. Objective

1. To determine the leakage rate of the containment penetrations and isolation valves.

B. Prerequisites

1. Safety-related air-operated containment isolation valves are tested for the proper response (i.e., fail-open, fail-closed) upon loss of instrument air (RG 1.68.3, Reference 14.2-17).

2. Containment isolation valves are closed by normal activation methods.

3. Associated piping is drained, and vent paths for leakage are established as required.

4. Test instrumentation is available and calibrated.

C. Test Method

1. The containment penetrations and isolation valves are leak tested using the containment leakage rate testing program defined in Chapter 16 Subsection 5.5.16 by performing type B and type C tests, in accordance with 10 CFR 50, Appendix J, Option B (Reference 14.2-4), RG 1.163 (Reference 14.2-32) and NEI 94-01 (Reference 14.2-33).

D. Acceptance Criteria

1. The combined leakage from containment penetrations and isolation valves meet requirements for the “first unit startup following testing” defined in Chapter 16, Technical Specifications, Surveillance Requirement SR 3.6.1.1 and B 3.6.1 Containment, Bases and Chapter 16 Subsection 5.5.16.

2. Air lock testing leakage meets the requirements specified in Chapter 16 Subsection 5.5.16.

14.2.12.1.63 Containment Integrated Leak Rate Test (ILRT) Preoperational Test

A. Objective

1. To demonstrate that the total leakage from the containment does not exceed the maximum allowable leakage rate at the calculated peak containment internal pressure.

B. Prerequisites

1. The containment local leak rate tests are completed.

2. Containment isolation valves are closed by normal actuation methods.

3. Portions of fluid systems, which are part of the containment boundary that may be opened directly to the containment or outside atmosphere under post-accident conditions, are opened or vented to the appropriate atmosphere to place the containment in conditions as close to post-accident conditions as possible.

4. Containment penetration, including equipment and personnel airlocks, are closed.

5. Test instrumentation is available and calibrated.

C. Test Method

1. The ILRT is conducted by performing the type A test, in accordance with 10 CFR 50, Appendix J, Option B (Reference 14.2-4), which describes the primary reactor containment overall integrated leakage testing, RG 1.163 (Reference 14.2-32) and NEI 94-01 (Reference 14.2-33), using the containment leakage rate testing program defined in Chapter 16 Subsection 5.5.16.

D. Acceptance Criterion

1. The containment integrated leakage does meet requirements for the "first unit startup following testing" Type A test defined in Chapter 16, Technical Specifications, Surveillance Requirement SR 3.6.1.1 and B 3.6.1, Containment, Bases and Chapter 16 Subsection 5.5.16. Test results meet the guidance for acceptance provided in RG 1.163 (Reference 14.2-32), NEI 94-01 (Reference 14.2-33) and ANSI/ANS-56.8-1994 (Reference 14.2-34).

14.2.12.1.64 Containment Hydrogen Monitoring and Control System Preoperational Test

A. Objective

1. To demonstrate operation of the hydrogen monitor and igniters.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

C. Test Method

1. Verify manual and automatic controls.

2. Verify alarms and status indications are functional.

D. Acceptance Criterion

1. The hydrogen monitor and igniters operate as described in Subsection 6.2.5.

14.2.12.1.65 CRDM Cooling System Preoperational Test

A. Objective

1. To demonstrate operation of the CRDM cooling system.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. For the CRDM cooling checkout, the plant is at or near normal operating temperature, and pressure and hot functional testing is in progress.

C. Test Method

1. Simulate start and interlock signals for each cooling fan and cooling unit and verify operation and annunciation.

2. Simulate high temperature signals and high vibration signals and verify alarm annunciation.

3. Verify design airflow.

4. Verify CRDM cooling during hot functional testing.

D. Acceptance Criteria

1. CRDM cooling fans operate on the proper signals (see Subsection 9.4.6).

2. All high alarms annunciate to MCR properly.

3. The CRDM cooling system performs in accordance with design specifications during hot functional testing.

14.2.12.1.66 Reactor Cavity Cooling System Preoperational Test

A. Objective

1. To demonstrate operation of the reactor cavity cooling system.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

C. Test Method

1. Simulate start and interlock signals for each cooling fan and verify operation and annunciation.

2. Simulate high vibration signals and verify alarm annunciation.

3. Verify design airflow.

4. During hot functional testing, monitor temperature between the reactor vessel support base plates and the concrete, and temperature of the primary shield wall.

D. Acceptance Criteria

1. Reactor cavity air cooling fans operate on the proper signals (see Subsection 9.4.6).

2. All high alarms annunciate to MCR properly.

3. During hot functional testing, the temperature between the reactor vessel support base plates and the concrete is maintained at or below 200° F.

4. During hot functional testing, the temperature of the primary shield wall is maintained at or below 150° F.

14.2.12.1.67 Containment High Volume Purge System Preoperational Test

A. Objective

1. To demonstrate operation of the containment high volume purge system.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Replacement of HEPA filters and prefilters used during system construction is completed.

C. Test Method

1. Verify manual and automatic controls.

2. Verify alarms and indications are functional.

3. Verify design airflow.

D. Acceptance Criterion

1. The containment high volume purge system operates as described in Subsection 9.4.6.

14.2.12.1.68 Containment Low Volume Purge System Preoperational Test

A. Objective

1. To demonstrate operation of the containment low volume purge system.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Replacement of HEPA filters, prefilters, and adsorber material used during system construction is completed.

C. Test Method

1. Verify manual and automatic controls.
2. Verify alarms and indications are functional.
3. Verify design airflow.

D. Acceptance Criterion

1. The containment low volume purge system operates as described in Subsection 9.4.6.

14.2.12.1.69 Containment Fan Cooler System Preoperational Test

A. Objective

1. To demonstrate operation of the containment fan coolers system.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.

C. Test Method

1. Verify manual and automatic controls.
2. Verify alarms and indications are functional.
3. Verify design airflow.
4. With the Containment Fan Cooler in operation, monitor containment air temperature during normal plant operation (three units in operation) and simulated LOOP conditions (two units in operation) during Hot Functional testing.

D. Acceptance Criteria

1. The containment fan cooler system operates as described in Subsection 9.4.6.
2. Containment air temperature remains below 120° F during normal plant operation (three units in operation) and below 150° F during simulated LOOP conditions (two units in operation) during Hot Functional testing.

14.2.12.1.70 Annulus Emergency Exhaust System Preoperational Test

A. Objective

1. To demonstrate the capability to maintain a negative pressure in the annulus and safeguard component areas with respect to the surrounding area when the annulus emergency exhaust system operates upon an ECCS actuation signal.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing, including tests of the system dampers’ loss of motive power position, and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

C. Test Method

1. Verify manual and automatic controls.

2. Verify operation of fans and dampers.

3. Verify alarms and status indications are functional.

4. Verify design airflow.

5. Demonstrate the capability of the annulus emergency exhaust system to maintain a negative pressure in the annulus and safeguard component area with respect to the surrounding areas.

D. Acceptance Criteria

1. The annulus emergency exhaust system operates as described in Subsection 6.5.1 and Subsection 9.4.5.

2. The system air flow meets design criteria.

3. The system can establish a -1/4 inch water gauge pressure in the penetration areas and safeguard component areas with respect to the surrounding areas within 240 sec and maintain that pressure (Subsection 6.5.1).

14.2.12.1.71 RCS Leak Rate Preoperational Test

A. Objective

1. To determine during hot functional testing the leakage from the RCS and verify that the leakage is within allowable limits.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. RCS pressure and temperature are established near the no-load operating values for the determination of the amount of leakage.

C. Test Method

The RCS leakage rates are determined by monitoring the following parameters in conjunction with quantitative leakage detection methods described in Subsection 5.2.5.4.1.1 through 5.2.5.4.1.4 over a specified period of time:

1. RCS pressure and temperature.

2. Pressurizer water level, pressure, and temperature.

3. Volume control tank water level, pressure, and temperature.

4. Pressurizer relief tank and containment vessel C/V drain tank water level, pressure, and temperature.

5. Primary makeup water flow and RCP seal water flow.

D. Acceptance Criteria

1. The amount of leakage from the RCS is within the limits specified in LCO 3.4.13 of Chapter16.

14.2.12.1.72 Loose Parts Monitoring System Preoperational Test

A. Objectives

1. To perform initial calibration of the loose parts monitoring system.

2. To demonstrate operation of the loose parts monitoring system and establish the alarm signal level for use during preoperational testing.

B. Prerequisites

1. Loose parts monitoring system accelerometers are mechanically fastened to the RCS.

2. Required electrical power supplies and control circuits are energized and operational.

3. For system operation demonstration portions of the test, RCS pressure and temperature are established near the no-load operating values.

C. Test Method

1. The response of the loose parts monitoring system (including the installed accelerometer) is verified with the simulated signals.

2. During RCS hot functional testing, the loose parts monitoring system is set up for initial operation, and system operation is verified. The alert signal level for use during hot functional testing is established.

D. Acceptance Criteria

1. Loose parts monitoring system calibration is acceptable and in accordance with the manufacturer's instructions.

2. System operates as designed for RCS monitoring (see Subsection 4.4.6.3).

14.2.12.1.73 Seismic Monitoring System Preoperational Test

A. Objective

1. To demonstrate operation of the seismic monitoring system including but not limited to the tri-axial acceleration sensor units, triggers, and time-history recorder and analyzer for each tri-axial time-history accelerograph, and the alarm system.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

C. Test Method

1. Verify the operability of the internal calibration devices by recording calibration records on all applicable sensors.

2. Verify system response to a simulated seismic event by actuating the trigger(s) of each of the tri-axial acceleration sensor units, recording the outputs, and playing back the time-history recorder/analyzer records for analysis.

3. Verify proper operation of the battery charging system by charging battery in accordance with equipment manual.

4. Verify all alarms and indications, including annunciation of audible and visual alarms and indications in the MCR.

D. Acceptance Criterion

1. The seismic monitoring system operates as described in Section 3.7. When triggered by a simulated seismic event, recorded and reproducible accelerograph records are produced and annunciation, including annunciation in the MCR, is observed.

14.2.12.1.74 Incore Instrumentation System Preoperational Test

A. Objective

1. To demonstrate the operation of the incore movable detector system control equipment, drive assemblies, and transfer devices, including proper rotation, position indication, and limit switch actuation.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. The incore movable detector system installation is completed except for installation of the retractable guide thimbles.

6. Required electrical power supplies and control circuits are energized and operational.

7. A dummy cable is available for test performance.

C. Test Method

1. The functioning of the incore movable detector system control equipment drive assemblies and transfer devices is verified during operation in the various modes using a dummy cable.

2. Position indication and limit switch actuations are verified during test performance.

3. Verify indications and alarms.

D. Acceptance Criteria

1. The drive assemblies insert and withdraw the detectors in the proper paths and operate in the high and low speeds in the manual mode.

2. The drive assemblies operate in accordance with the design.

3. The safety and withdraw limit switches operate properly.

4. The leak detection system is capable of detecting a leak.

5. System limit switch setpoints are acceptable and in accordance with the manufacturer's instructions.

6. Indications and alarms operate as designed.

14.2.12.1.75 Nuclear Instrumentation System Preoperational Test

A. Objective

1. To demonstrate the operability of the nuclear instrumentation source, intermediate, and power range channels, including their ability to supply signals for operating the appropriate alarm and trip signals and indicating reactor power levels.

B. Prerequisites

1. The software installed in the nuclear instrumentation system is verified by the software verify check test and the results are completely "Good."

2. Nuclear instrumentation system installation, calibration, and alignments are completed.

3. Required electrical power supplies are energized and operational.

4. The nuclear instrumentation system has been energized long enough to stabilize.

C. Test Method

1. The ability of the source, intermediate, and power range nuclear instrumentation circuitry to respond to test signals is verified (see Sections 7.2 and 7.7.1.2).

2. The source, intermediate, and power range instrumentation setpoints are reviewed using the engineering tool.

3. Operation of the source range nuclear instrumentation audible count rate circuitry is verified.

4. Alarms and indications are verified.

D. Acceptance Criteria

1. The source, intermediate, and power range nuclear instrumentation circuitry responds properly to test signals.

2. The source, intermediate, and power range are within design specifications.

3. Alarms, indications and trip signals operate as designed.

14.2.12.1.76 Remote Shutdown Preoperational Test

A. Objective

1. To demonstrate the capability to cool down the plant from the hot standby condition to the cold shutdown condition using controls and instrumentation located outside the control room.

Note: Testing is conducted in accordance with RG 1.68.2.

B. Prerequisites

1. The controls and instrumentation associated with the remote shutdown console are available.

2. The RCS temperature above the RHRS cut-in temperature is maintained.

3. Approved operating procedures for performing a remote shutdown are available.

4. Construction Acceptance Testing of plant instrumentation, controls, and systems to be used at remote shutdown locations is completed. This testing includes verification that

   a. All systems to be used during shutdown operation from outside the control room are functional in the manner in which they would be used during the operation (i.e., control from remote stations, manual operation, use of available power supplies, etc.)

   b. Communication is established and maintained among the personnel who are performing the shutdown operation and

   c. Control of transferred components from the main control room is not possible after control of these components from the remote shutdown stations is established

5. The authority and responsibility of the control room observers are established and documented in the test procedure. Provisions are made for the following actions:

   a. Assumption of control of the plant if an emergency or unsafe condition develops during the testing that cannot be managed by the shutdown crew.

b. Performance of non safety-related activities that would not be required during an actual remote shutdown. These could include protection of non safety-related equipment from mechanical damage during the transient and the placement of equipment into standby status when no longer required. Such activities have been previously defined and evaluated to ensure that, if they were not performed during an actual remote shutdown, safe shutdown of the plant can still be achieved.

C. Test Method

1. Transfer control from the control room to the remote shutdown console.

2. Check the functioning of instrumentation, controls, alarms, and interlocks.

3. Establish a heat transfer path to the ultimate heat sink.

Note: Before RHRS cut-in, heat is transferred to the environment through emergency feedwater system, steam generator and main steam depressurization valve. After RHRS cut-in, heat is transferred to environment through residual heat removal system, component cooling water system, essential service water system and ultimate heat sink system.

4. Remotely cool the plant down to the point of establishing RHRS, as defined in Subsection 5.4.7.

Note:This cooldown demonstration may be accomplished using additional personnel who could be made available to the unit prior to the time that cooldown would have to be initiated. The number and level of such personnel are established in the remote shutdown procedure.

5. Remotely establish RHRS, and reduce reactor coolant temperature by approximately 50° F at a rate that does not exceed Technical Specification limits.

6. Transfer control back to the control room.

7. During the demonstration, use only the equipment for which credit is taken to perform an actual remote shutdown.

D. Acceptance Criteria

1. Transfer of control from the control room to the remote shutdown console is achieved in accordance with design requirements (Subsection 7.4.1.5).

2. The ability to cool down the plant from hot standby to cold shutdown is demonstrated.

14.2.12.1.77 Miscellaneous Leakage Detection System Preoperational Test

A. Objective

1. To demonstrate the operation of the miscellaneous leakage detection system installed for each ESF equipment room (Subsection 9.3.3.5).

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

C. Test Method

1. Verify alarms and indications.

D. Acceptance Criterion

1. The miscellaneous leakage detection system operates as described in Subsection 9.3.3.

14.2.12.1.78 Process and Effluent Radiological Monitoring System, Area Radiation Monitoring System and Airborne Radioactivity Monitoring System Preoperational Test

A. Objective

1. To demonstrate operation of the process and effluent radiological monitoring system as shown in Section 11.5, area radiation monitoring system and airborne radioactivity monitoring system as shown in Subsection 12.3.4.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated. Type testing of the instrumentation used to detect primary-to-secondary leakage in the steam generators (see subsection 5.2.5.3) includes demonstrating that these instruments have the required sensitivity per NEI 97-06.

4. Suitable check sources are available.

C. Test Method

1. The operation of each monitor is verified.

2. Setpoint, control logic, annunciation (e.g. high alarm of SFP area radiation monitor), and power failure alarms of each monitor is verified.

3. The uncertainty and determination of setpoint of each monitor is verified.

D. Acceptance Criterion

1. The process and effluent radiological monitoring system, area radiation monitoring system and airborne radioactivity monitoring system operate as described in Section 11.5 and Subsection 12.3.4.

14.2.12.1.79 High-Efficiency Particulate Air Filters and Charcoal Adsorbers Preoperational Test

A. Objective

1. To demonstrate operation of the high-efficiency particulate air (HEPA) filters and charcoal adsorbers. This includes the MCR HVAC system, technical support center (TSC) HVAC system, annulus emergency exhaust system and containment purge system.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. The ventilation systems containing HEPA filters and charcoal adsorbers are air balanced and are operational and available to support this test.

6. Replacement of HEPA filters and adsorber material used during system construction is completed.

C. Test Method

1. HEPA filters and charcoal adsorbers are tested in place.

2. Verify design airflow.

3. Verify alarms and indications.

4. Testing is performed in accordance with RG 1.52 (Reference 14.2-26), RG 1.140 (Reference 14.2-25), ASME N510 (Reference 14.2-20) and ASME AG-1-1997 (Reference 14.2-27).

D. Acceptance Criteria

1. The HEPA filters and charcoal adsorbers perform and operate in accordance with RG 1.52 (Reference 14.2-26), RG 1.140 (Reference 14.2-25), ASME AG-1-1997 (Reference 14.2-27), ASME N509 (Reference 14.2-19) and ASME N510 (Reference 14.2-20) as described in Section 9.4.

2. System air flows meet the design specifications.

14.2.12.1.80 Liquid Waste Management System Preoperational Test

A. Objectives

1. To demonstrate the operation of the waste holdup tanks, waste holdup tank pumps, waste monitor tanks, waste monitor tank pump, detergent drain tank, detergent drain monitor tank and pump, chemical drain tank and pump, C/V reactor coolant drain tank (RCDT), and C/V RCDT pump.

2. To demonstrate the operation and verify the operating characteristics of the liquid waste management system, including pumps, valves, and tanks.

3. To demonstrate the operation of each building sump drains (i.e., containment, reactor, and auxiliary buildings) including sump tanks, pumps, and valves.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. The instrument air system is available to provide instrument air to the liquid waste management system instruments and control valves.

6. Required electrical power supplies and control circuits are energized and operational.

7. Demineralized water is available.

C. Test Method

1. The control circuitry and operation of system pumps and valves is verified.

2. The system is operated and performance characteristics verified.

3. Verify manual and automatic system controls, interlocks, alarms and indications as described in Section 11.2.

D. Acceptance Criteria

1. The performance characteristics of the system pumps are as designed (Section 11.2)

2. The pump and valve controls and interlocks operate as designed.

3. The containment and reactor and auxiliary buildings drain subsystems function as designed.

4. The Liquid Waste Management System operates as described in Section 11.2.

14.2.12.1.81 Gaseous Waste Management System Preoperational Test

A. Objectives

1. To demonstrate operation of the waste gas compressors, charcoal bed, waste gas dryer, and waste gas management system components and associated control and interlock circuitry.

2. To demonstrate waste gas compressor, charcoal delay bed, waste gas dryer, and waste gas management system performance.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Required electrical power supplies and control circuits are energized and available.

6. The compressed gas system is available to supply nitrogen to the waste gas system and the waste gas dryer.

7. The CCW system is available to supply cooling water to the waste gas compressors and the waste gas dryer.

8. The PMWS is available to provide water to the waste gas compressors.

9. The instrument air system is available to provide instrument air to waste gas system instruments and control valves.

10. A temporary test gas source is available for checking the operation of the charcoal beds.

C. Test Method

1. System component control circuits are verified, including response to normal control, interlock, and alarm signals.

2. The waste gas compressors and waste gas dryer are operated and their performance characteristics are verified.

3. The test source gas is routed through the charcoal beds to verify performance.

D. Acceptance Criteria

1. The waste gas compressors, waste gas dryer, and waste gas system components respond to normal control, interlock, and alarm signals.

2. The waste gas compressors, waste gas dryer, and waste gas system are operable and their controls operate as described in Section 11.3.

3. The charcoal beds perform as designed (see Section 11.3).

14.2.12.1.82 Solid Waste Management System Preoperational Test

A. Objective

1. To demonstrate the operation and verify the operating characteristics of the solid waste management system, valves, and spent resin storage tanks.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

C. Test Method

1. Verify manual and automatic system controls, interlocks, alarms and indications.

2. Demonstrate the ability of the spent resin storage tanks (SRSTs) to receive spent resin from the LWMS, CVCS, SFPCS, SG blowdown system, and the condensate polisher ion exchange columns.

3. Demonstrate the ability of the SWMS to handle the following waste types, consistent with system operations described in Subsection 11.4.2: dry active waste, spent filter elements, spent resin, spent activated carbon, and oil and sludge.

4. The test source gas is routed through the SWMS to verify performance.

D. Acceptance Criteria

1. The operation of the system meets design specifications (Section 11.4) including the capability to assure that the volume of free liquids in packaged wastes is within acceptable limits.

2. The nitrogen supply gas demonstrates conformance with design flows and process capabilities.

14.2.12.1.83 Steam Generator Blowdown System Preoperational Test

A. Objectives

1. To demonstrate that the SG blowdown system (SGBDS) accepts water from each SG blowdown line, processes the blowdown as required, and delivers the processed water to the condensate system.

2. To demonstrate the capability of the SG blowdown sampling system to collect blowdown liquid sample from each SG and the operation of the SG blowdown sampling system including monitors, system valve and control circuits.

3. To demonstrate of the performance of laboratory equipment.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. CCW is available for cooling the sample stream and hot functional test is in progress.

6. The SGBDS to be sampled is at normal pressure and temperature.

7. The condenser or waste water system [[(WWS)]] or LWMS is available to receive discharge from the SG blowdown sampling system.

C. Test Method

1. Verify manual and automatic system controls.

2. Verify flowrates and temperatures.

3. Verify indications (flow, temperature and status), and alarms.

4. Verify system isolation using simulated signals.

5. Verify flowpaths.

6. Verify the flow rate and temperature during SG blowdown liquid samples are taken from each SG.

7. Verify the operation of control circuit and operability of the SG blowdown sampling system.

8. Verify the operation of laboratory equipment used to analyze or monitor SG blowdown water quality and radioactivity concentrations.

D. Acceptance Criteria

1. The SGBDS operates as described in Subsection 10.4.8 and Table 10.3.5-1.

2. The SG blowdown sampling system operates as described in Subsection 9.3.2.2 and Table 9.3.2-5.

14.2.12.1.84 Sampling System Preoperational Test

A. Objectives

1. To demonstrate the capability of the sampling system to collect liquid samples from the RCS and auxiliary systems and gaseous samples (including post-accident monitoring system) of the containment atmosphere.

2. To verify the operation of system valves and control circuitry.

3. To demonstrate the performance of laboratory equipment.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. CCW is available for cooling the sample streams.

6. The systems to be sampled are at their normal pressure and temperature (i.e., hot functional for RCS).

7. The CVCS or LWMS is available to receive discharge from the sampling system.

C. Test Method

1. Samples are taken from each of the sample points and flows; pressures, and temperatures are recorded.

2. Control circuit operation and operability of the system valves are verified.

3. To verify the operation of laboratory equipment used to analyze or measure radiation levels and radioactivity concentrations.

D. Acceptance Criteria

1. The sample system flows, pressures, and temperatures are within specifications such that normal samples can be taken and analyzed.

2. The system valves operate as designed (Subsection 9.3.2)

3. The laboratory equipment operates as manufacture’s specification.

14.2.12.1.85 Spent Fuel Pit Cooling and Purification System (SFPCS) Preoperational Test

A. Objectives

1. To demonstrate operation of the SFPCS components and their associated control circuitry.

2. To demonstrate spent fuel pit pump and system performance during various operational modes.

3. To demonstrate that the siphon breaker design prevents gravity drainage of the spent fuel pit.

4. To demonstrate the operability of the low water level alarm.

5. To demonstrate that the spent fuel pit can be filled from the RWSP or primary makeup water and retain its leak-tightness.

6. To verify the operability of sectionalizing devices and drains and to perform the leak test of sectionalizing devices and gaskets or bellows in the refueling canal and fuel storage pit.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.
5. Required electrical power supplies and control circuits are energized and operational.
6. The RWSP or PMWS is available to provide fill water to the spent fuel pit.
7. The spent fuel pits gates are installed to keep the fuel transfer canal dry, the fuel transfer tube valve is closed, and construction tests are completed.
8. The spent fuel pits are filled to the normal water level with demineralized water.

C. Test Method

1. System component control circuits are verified.
2. The spent fuel pit pumps are operated in their various modes, and the pump and system performance characteristics are verified.
3. The ability to partially fill the spent fuel pit from the RWSP and PMWS and retain its leak-tightness is verified.
4. The SFPCS piping is altered to allow gravity draining of the spent fuel pit by siphon effect. Verify that the spent fuel pits can be drained until the minimum water level.
5. The sectionalizing devices and gaskets or bellows in the refueling canal and fuel storage pit are inspected.
6. Alarms and indications are verified.

D. Acceptance Criteria

1. The SFPCS components respond properly to control signals.
2. The spent fuel pit pumps and system performance characteristics are within design specifications (Subsection 9.1.3).
3. The spent fuel pit can be filled from either the RWSP or the PMWS. The level of water necessary to perform its design basis functions is maintained and demonstrated by the instrumentation described in Subsection 9.1.3.1.

4. The SFPCS siphon breaker design prevents draining the spent fuel pit below an acceptable minimum level.

5. Alarms and indications perform as designed.

14.2.12.1.86 Fuel Handling System Preoperational Test

A. Objectives

1. To demonstrate operation of the fuel handling system control circuits and associated interlocks.

2. To verify the ability of the refueling machine, new fuel elevator, fuel transfer system, fuel handling machine, spent fuel cask handling crane, and associated fuel handling tools to transfer a dummy fuel assembly.

3. To perform static load testing at 125% of rated load and operational (dynamic) load testing at 100% of rated load on the refueling machine, new fuel elevator, fuel handling machine, and spent fuel cask handling crane.

4. To perform operational load testing using the dummy fuel assembly.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. A dummy fuel assembly and sufficient test weights are available.

C. Test Method

1. The refueling machine, new fuel elevator, fuel handling machine, and spent fuel cask handling building crane are static load tested at 125% of rated load, followed by an inspection.

2. A dummy fuel assembly is transferred from the new fuel pit to the refueling machine in the containment and back to the spent fuel pit to verify the operation of the fuel handling system.

3. Verify indications and alarms.

4. The refueling machine, new fuel elevator, fuel handling machine, and spent fuel cask handling building crane are dynamically load tested at 100% of rated load, followed by an inspection.

5. Spent fuel cask handling crane testing for handling of heavy loads includes test requirements specified by NUREG-0554 (Reference 14.2-24) and NUREG-0612 (Reference 14.2-21) as applicable.

6. The use and operation of fuel handling tools identified in Subsection 9.1.4.2.1 are demonstrated.

D. Acceptance Criteria

1. The fuel handling system interlocks and interlock bypasses perform in accordance with design specifications.

2. The fuel handling system is able to transfer a dummy fuel assembly in and out of containment in accordance with design specifications.

3.a The refueling machine, new fuel elevator, and fuel handling machine can lift 125% of rated load and satisfactorily pass an inspection, and can transfer the dummy fuel assembly (Subsection 9.1.4).

3.b The spent fuel cask handling crane can lift 125% of rated load and satisfactorily pass an inspection, and can raise the new fuel shipping container from the receipt truck (the only potentially heavy load handling for new fuel receipt described in Subsection 9.1.4).

3.c The spent fuel cask handling crane main hoist can lift, transport, lower, stop and hold a test load of at least 100% of rated load. Each spent fuel cask handling crane main hoist holding brake stops and holds the test load.

4. Indications and alarms operate as described in Subsection 9.1.4.5.

5. Refueling machine, new fuel elevator, and fuel handling machine testing demonstrates compliance with test requirements specified by ASME NOG-1 (Reference 14.2-30) and ASME B30.20-2006 (Reference 14.2-31) as applicable.

6. Spent fuel cask handling building crane testing demonstrates compliance with test requirements specified by NUREG-0554 (Reference 14.2-24), ASME NOG-1 (Reference 14.2-30) and NUREG-0612 (Reference 14.2-21) as applicable.

7. Fuel handling tools perform their intended design function as identified in Subsection 9.1.4.2.1.

14.2.12.1.87 Component Cooling Water System Preoperational Test

A. Objectives

1. To verify the operation, interlock and alarm of CCW surge tank.

2. To demonstrate the capability of the CCW system to provide cooling water during normal operation, normal cooldown, and postulated loss-of-coolant accident (LOCA) modes of operation.

3. To verify operation of system valves and control circuitry.

4. To demonstrate the operation and verify the operating characteristics of the CCW pumps.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Demineralized water is available for system makeup.

6. The CCW is aligned to cool the CCW motors.

7. The ESWS is available to CCW heat exchangers.

C. Test Method

1. The control circuitry of the CCW pumps, surge tanks, and valves is verified.

2. The CCW system pumps are operated, and performance characteristics verified.

3. System flows are balanced, as required, and then verified in each mode of operation. Cavitation is not present in the area of butterfly throttle valves. Testing includes verification of coolant flow to the thermal barrier via cross-tie.

4. The cooling ability of the CCW system is verified during RCS heatup and cooldown in conjunction with the RHRS during the hot functional test.

5. CCW surge tank vent valve closure logic is verified using a simulated high CCW radiation monitor condition.

6. The thermal barrier heat exchanger cooling water return line isolation valve logic is verified using a simulated reactor coolant pump thermal barrier heat exchanger cooling water high flow condition.

7. The CCW header tie line isolation valves' closure logic is verified to be consistent with Subsection 9.2.2.2.1.5 using simulated signals. Valve response to ESF actuation signals may be verified via other tests (e.g., Subsection 14.2.12.1.55, ECCS Actuation and Containment Isolation Logic Preoperational Test).

8. The CCW header tie line isolation valves' closure time is verified to be consistent with Subsection 9.2.2.2.1.5.

9. Demonstrate the ability to provide makeup water and verify flow to each pressurized CCW surge tank using DWS, PMWS and RWS supplies.

D. Acceptance Criteria

1. The tank alarms and interlocks operate as designed.

2. The performance characteristics of the CCW pumps are within design specifications (Subsection 9.2.2)

3. Components that are supplied with CCW receive flows that are within the design specifications in each of the operating modes including the supply of coolant flow to the thermal barrier via cross-tie.

4. The pump control and interlocks operate as designed.

5. CCW system performance characteristics are within design specifications.

6. CCW surge tank vent valve high radiation logic operates as described in Subsection 9.2.2.5.2.

7. The thermal barrier heat exchanger cooling water return line isolation valve logic operates as described in Subsection 9.2.2.5.5.

8. The CCW header tie line isolation valves' closure logic and closure time are consistent with Subsection 9.2.2.2.1.5.

9. The ability to provide makeup water to each pressurized CCW surge tank using DWS, PMWS and RWS supplies is demonstrated.

14.2.12.1.88 Turbine Component Cooling Water System Preoperational Test

A. Objective

1. To verify that the system components perform their function of supplying adequate cooling water to the designated turbine building components, as described in Subsection 9.2.8.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Electrical power supplies and control circuits are operational.

6. Components cooled by the system are operational and operating for verifying the heat exchanger capability.

C. Test Method

1. Turbine component cooling water system performance is observed and recorded during individual component and integrated system testing.

2. Operation of the system pumps and valves is verified.

3. Operation of the system instrumentation, controls, actuation signals, and interlocks is verified.

4. Verify indications and alarms.

D. Acceptance Criteria

1. System pumps and valves operate as described in Subsection 9.2.8.

2. Indications and alarms operate as described in Subsection 9.2.8.

14.2.12.1.89 Secondary Side Chemical Injection System Preoperational Test

A. Objective

1. To verify the operability of the secondary side chemical injection systems.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Required electrical power supplies and control circuits are operational.

6. The condensate and feedwater systems are available.

C. Test Method

1. The operating parameters of the chemical injection pumps are measured.

2. The mixing capability of the mixing pump is verified.

3. Verify indications and alarms.

D. Acceptance Criteria

1. Automatic valves operate as described in Subsection 10.4.10.

2. The automatic functions required to add chemicals perform as described in Subsection 10.4.10.

3. The mixing pump meets its design requirements.

4. Indications and alarms operate as described in Subsection 10.4.10.

14.2.12.1.90 Fire Protection System Preoperational Test

A. Objective

1. To demonstrate operation of the fire protection system, (water system and gaseous systems) in the turbine building, access control building, auxiliary building, C/V, reactor building, and power source buildings.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

C. Test Method

1. Demonstrate operation of the fire detection system.

2. Demonstrate the head and flow characteristics of the fire protection water supply system pumps and the operation of all auxiliaries.

3. Verify control logic of the fire protection water supply system pumps and auxiliaries.

4. Demonstrate flow paths of the fire protection water supply system.

5. Demonstrate operation of the fire alarm system.

6. Verify installation of fire extinguishers.

7. Verify operation of the gaseous fire protection systems.

D. Acceptance Criterion

1. The fire protection system operates as described in Subsection 9.5.1 and Appendix 9A.

14.2.12.1.91 Instrument Air System Preoperational Test

A. Objectives

1. To demonstrate operation of the instrument air system, including compressors, coolers, reservoirs, and dryers and associated controls.

2. To assure that the air supply equipment is able to maintain the quality of air supplied within design requirements.

3. To verify that the system responds appropriately to both normal operation of the plant and upset, faulted, or emergency conditions including increases in pressure due to component malfunction or failure, and to verify appropriate response of air-operated valves and other components during and following such upset, faulted or emergency conditions (e.g., fail open, fail closed, fail-as-is).

4. To demonstrate that operation of components requiring large quantities of air does not cause excessive instrument air system pressure transients.

Tests are in accordance with RG 1.68.3 except for C.7.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Required ac and dc power sources are available.

C. Test Method

1. Simulate pressure signals to verify alarms.

2. Operate instrument air system to verify operation while recording flow, pressure, and temperature.

a. Air dryer units are tested for proper functioning, and the units are operated through at least one regeneration cycle. Air dryer testing includes verification of acceptable operation at maximum flow rates.

b. The appropriate differential pressures and the proper operation of pressure switches, high and low-pressure alarms, safety and relief valves, bypass valves, and alarms and resets are verified.

c. The operation of compressor unloaders, automatic and manual start and stop circuits of standby compressors, high, and low pressure alarms, pressure indications, and temperature indications are checked. Relief valve settings are verified.

d. Compressors, aftercoolers, oil separator units, air receivers, and pressure-reducing stations are tested to verify proper operation according to system design.

3. Sample and analyze the air at the end of each feeder line using continuous flow techniques or by analyzing a discrete sample.

4. Simultaneously operate large users of instrument air and monitor the instrument air system pressures.

5. Loads that are a part of (or support the operation of) portions of the facility important to safety, which are identified as susceptible to changes in state or loss of operability upon increases in pressure due to component malfunction or failure are evaluated and tested as determined appropriate, without exceeding allowable component pressure ratings.

6. Those air-operated components that are a part of (or support the operation of) portions of the facility important-to-safety are tested to verify the fail-safe position for sudden loss of instrument air or gradual loss of pressure as described in Table 9.3.1-1 for safety-related air-operated valves, and in accordance with the intended design function of components not included in Table 9.3.1-1.

D. Acceptance Criteria

1. The instrument air system performs as described in Subsection 9.3.1.

2. The Instrument air systems meets system design specifications relating to flow, pressure, and temperature of the product air. The total air demand at normal steady-state conditions, including leakage from the system, is in accordance with design.

3. Air quality meets the requirements of American National Standards Institute (ANSI) / Instrumentation, Systems, and Automation Society (ISA) S73-1975, “Quality Standard for Instrument Air,” (Reference 14.2-22) with respect to oil, water, and particulate matter contained in the product air.

4. Loads that are a part of (or support the operation of).portions of the facility important to safety respond to pressure transients in accordance with design.

5. Plant equipment designated by design to be supplied by the instrument air system is not being supplied by other compressed air supplies (such as station air) that may have less restrictive air quality requirements without meeting the air quality requirements of ANSI/ISA S7.3-1975 (Reference 14.2-22).

6. Operation of supplied loads is continued in response to credible failures that result in an increase in the supply system pressure.

7. The fail-safe positions of safety-related air-operated components are same as shown in Table 9.3.1-1 for sudden loss of instrument air or gradual loss of pressure.

14.2.12.1.92 Station Service Air System Preoperational Test

A. Objective

1. To demonstrate operation of air compressors, air receivers and air dryers and associated controls.

2. To assure that the air supply equipment is able to maintain the quality of air supplied within design requirements.

3. To verify that the system responds appropriately to both normal operation of the plant and upset, faulted, or emergency conditions including increases in pressure due to component malfunction or failure; and to verify appropriate response of various loads that are important to safety during and following such upset, faulted or emergency conditions (e.g., fail open, fail closed, or fail-as-is).

4. To demonstrate that operation of components requiring large quantities of air does not cause excessive station service air system pressure transients.

Tests are in accordance with RG 1.68.3 except for C.7.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Turbine component cooling water system is available.

6. Appropriate ac and dc power sources are available.

C. Test Method

1. Simulate temperature and pressure signals to verify alarms.

2. Operate station service air system to verify operation while recording flow, pressure, and temperature.

   a. Air dryer units are tested for proper functioning. Air dryer testing includes verification of acceptable operation at maximum flow rates.

   b. The automatic and manual start and stop circuits of standby compressors are checked. Relief valve settings are verified.

   c. Proper operation of inlet/air filter/silencer, compressors, intercoolers, aftercoolers and moisture separators are verified according to system design.

3. Sample and analyze the air at the end of each feeder line using continuous flow techniques or by analyzing a discrete sample.

4. Simultaneously operate large users of station service air and monitor the station service air system pressures.

5. Loads that are a part of (or support the operation of) portions of various loads that are important to safety, which are identified as susceptible to changes in state or loss of operability upon increases in pressure due to component malfunction or failure are evaluated and tested, as determined appropriate, without exceeding allowable component pressure ratings.

D. Acceptance Criteria

1. Compressors and air dryers perform as described in Subsection 9.3.1.

2. The station service air systems meets system design specifications relating to flow, pressure, and temperature of the product air.

3. Air quality meets the design specification of the station service air system.

4. Loads that are a part of (or support the operation of) portions of various loads that are important to safety respond to pressure transients in accordance with design.

5. Operation of supplied loads is continued in response to credible failures that result in an increase in the supply system pressure.

14.2.12.1.93 Boron Recycle System Preoperational Test

A. Objectives

1. To demonstrate the operability of the boron recycle system, including the recycle evaporator and its associated pumps, valves, tanks, and control circuits.

2. To verify the capability of the recycle evaporator to produce the required distillate output.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. The CCW system is available to supply cooling water.

6. The auxiliary steam system is available to supply steam to the system when required.

7. The gaseous waste management system (i.e., the portion of the nitrogen supply system) and PMWS are available to supply nitrogen gas and demineralized water.

8. Water is available with sufficient boron concentration in holdup tanks to produce a batch of approximately 7,000 ppm boric acid in the evaporator when required.

C. Test Method

1. The control circuitry and operation of system pumps and valves are verified.

2. The system is operated using demineralized water, and performance characteristics are measured.

3. The recycle evaporator is operated using borated water, and the evaporator output is verified.

D. Acceptance Criteria

1. System valves, pumps, and interlocks operate as designed.

2. The system operating characteristics are within design limit (Subsection 9.3.4).

14.2.12.1.94 Offsite Communication System Preoperational Test

A. Objective

1. To demonstrate operation of the offsite communication system.

B. Prerequisites

1. Required construction testing is completed.

2. Required support systems are available.

C. Test Method

1. Verify operation of the plant telephone system, private automatic branch exchange, to provide adequate communication between onsite stations.

2. Verify operation of the plant telephone system to the required offsite communication systems.

D. Acceptance Criterion

1. The offsite communication system operates as described in Subsection 9.5.2.

14.2.12.1.95 Inplant Communication System Preoperational Test

A. Objective

1. To demonstrate the adequacy of the inplant communication system to provide reliable communications between plant areas and to verify the operability of the emergency alarm system.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Plant equipment that contributes to the ambient noise level is in operation if possible.

C. Test Methods

1. Verify operation of the telephones.

2. Verify the operation of the page system.

3. Verify the operation of the emergency alarm system.

4. Verify the operation of the sound-powered system is operability.

5. Verify the operation of the standard notification system.

6. Verify the operation of the station radio system.

D. Acceptance Criterion

1. The inplant communication system operates as described in Subsection 9.5.2.

14.2.12.1.96 Safeguard Component Area HVAC System Preoperational Test

A. Objective

1. To demonstrate operation of the safeguard component area HVAC system.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing, including tests of the system dampers' loss of motive power position, and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.

C. Test Method

1. Simulate interlock signals for each air handling unit (AHU) and verify operation and annunciation.
2. Verify alarms and status indications are functional.
3. Verify design airflow.
4. Operate dampers under simulated normal and emergency conditions and verify operation and indication.

D. Acceptance Criteria

1. Safeguard component area HVAC system operates on the proper signals (see Subsection 9.4.5),
2. All alarms annunciate properly.
3. The automatic dampers operate properly in normal and emergency operation.

14.2.12.1.97 Emergency Feedwater Pump Area HVAC System Preoperational Test

A. Objective

1. To demonstrate operation of the emergency feedwater pump area HVAC system.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing, including tests of the system dampers' loss of motive power position, and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.

C. Test Method

1. Interlock signals for each AHUs is simulated and verify operation and annunciation.
2. Verify alarms, and status indications are functional.
3. Verify design airflow.
4. Operate dampers under simulated normal and emergency condition and verify operation and indication.

D. Acceptance Criterion

1. The emergency feedwater pump area HVAC system operates as described in Subsections 9.4.5.

14.2.12.1.98 Class 1E Electrical Room HVAC System Preoperational Test

A. Objective

1. To demonstrate operation of the Class 1E electrical room HVAC system.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing, including tests of the system dampers' loss of motive power position, and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.

C. Test Method

1. Simulate interlock signals for each AHU and exhaust fan and verify operation and annunciation.

2. Verify alarms and status indications are functional.

3. Verify design airflow.

4. Operate dampers under simulated normal and emergency conditions and verify operation and indication.

D. Acceptance Criteria

1. Class 1E electrical room AHUs and battery room exhaust fans operate on the proper signals (see Subsection 9.4.5),

2. All alarms annunciate properly.

3. The automatic dampers operate properly in normal and emergency operation.

4. Battery room exhaust fan operation maintains the hydrogen concentration below 1% by volume in the battery room per Subsection 9.4.5.1.1.2.

14.2.12.1.99 Auxiliary Building HVAC System Preoperational Test

A. Objective

1. To demonstrate operation of the auxiliary building HVAC system.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

C. Test Method

1. Verify manual and automatic controls in the normal and shutdown modes.

2. Verify alarms and status indications are functional.

3. Verify design airflow.

4. Verify penetration and safeguard component area and discharge duct of auxiliary building HVAC system isolation on a simulated ECCS actuation signal.

D. Acceptance Criteria

1. The auxiliary building HVAC system operates as described in Subsection 9.4.3.

2. The auxiliary building HVAC system maintains the exhaust airflow rates from radiological controlled areas described in Table 12.2-60.

3. Ventilation flow balancing of the auxiliary building HVAC system is performed as described in Subsection 9.4.3.

14.2.12.1.100 Main Steam/Feedwater Piping Area HVAC System Preoperational Test

A. Objective

1. To demonstrate operation of the main steam/feedwater piping area HVAC system.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

C. Test Method

1. Verify manual and automatic controls in the normal operating mode.

2. Verify alarms and indications are functional.

3. Verify design airflow.

D. Acceptance Criterion

1. The main steam/feedwater piping area HVAC system operates as described in Subsection 9.4.3.

14.2.12.1.101 MCR HVAC System Preoperational Test (including MCR Habitability)

A. Objectives

1. To demonstrate operation of the MCR HVAC system in normal, isolation and emergency pressurization modes.

2. To verify that the system components perform their safety-related functions, including:

   a. Providing sufficient breathable quality air to the MCR

   b. Maintaining the MCR at positive pressure

3. To perform integrated control room envelope leak testing.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.
5. The ventilation systems containing HEPA filters and charcoal absorbers are air balanced and are operational and available to support this test.
6. Class 1E electrical power and uninterruptible power supply systems are available.
7. MCR construction is completed and leak-tight barriers are in place.
8. Tornado depressurization protection dampers are calibrated.

C. Test Method

1. Verify manual and automatic controls.
2. Verify that alarms and indications are functional.
3. Performance of the MCR HVAC and habitability systems are observed and recorded during component and integrated system testing.
4. Verify design air flow.
5. The ability of the emergency air supply to maintain the MCR at the proper positive pressure is demonstrated.
6. Air inleakage to the MCR is verified in accordance with RG 1.196 (Reference 14.2-28) and ASTM E-741-00 (Reference 14.2-23).
7. Demonstrate automatic switching to isolation mode upon the receipt of the initiation signal.
8. Demonstrate automatic switching to pressurization mode upon the receipt of the MCR isolation signal.
9. Demonstrate Smoke Purge Operation mode.
10. Perform system and component testing in accordance with RG 1.52 (Reference 14.2-26).

11. Testing of high-efficiency particulate air filters and charcoal adsorbers performed per Subsection 14.2.12.1.79 is coordinated with this test.

12. Testing of prefilters, fans and fan motors, heaters, dampers, and ductwork is performed in accordance with RG 1.52 (Reference 14.2-26), and standards referenced by RG 1.52.

13. Ventilation zones adjacent to the control room envelope (CRE) are configured and balanced to preclude airflow toward CRE.

14. Verify loss of motive power function position of the isolation dampers.

D. Acceptance Criteria

1. The AHUs, fans and dampers perform as described in Subsections 6.4.2 and 9.4.1.

2. All indications and alarms operate as described in Subsection 9.4.1.5.

3. The MCR HVAC system automatically switches to pressurization mode and establishes pressurization mode conditions upon the receipt of the MCR isolation signal in accordance with Subsections 6.4.2 and 9.4.1.2.2.1.

4. The system maintains proper control room air quality.

5. The MCR tornado depressurization protection dampers operate as designed.

6. The ASTM E741 tests confirm total system leakage in the pressurization mode and air exchange rate in the pressurization mode in accordance with Subsection 6.4.2.3.

7. The MCR HVAC system automatically switches to isolation mode and establishes isolation mode conditions upon the receipt of the initiation signal in accordance with Subsections 6.4.2 and 9.4.1.2.2.2.

8. Based on a positive pressures inside the CRE relative to adjacent areas, the direction of airflow is away from the CRE during a DBAs, when the MCR HVAC system is in the pressurization mode of operation.

9. Upon loss of motive power, the isolation dampers assume their fail positions as specified in Section 6.4.

14.2.12.1.102 Non-Class 1E Electrical Room HVAC System Preoperational Test

A. Objectives

1. To demonstrate operation of the non-Class 1E electrical room HVAC system.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.

C. Test Method

1. Verify manual and automatic controls in the normal and emergency operating modes.
2. Verify alarms and indications are functional.
3. Verify design airflow.
4. Demonstrate smoke purge operation mode.

D. Acceptance Criteria

1. The non-Class 1E electrical room HVAC system operates as described in Subsection 9.4.3.
2. Battery Room Exhaust Fan operation maintains the hydrogen concentration below 1% by volume in the battery room per Subsection 9.4.3.1.2.2.

14.2.12.1.103 Technical Support Center HVAC System Preoperational Test

A. Objectives

1. To demonstrate operation of the TSC HVAC system.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.

C. Test Method

1. Verify manual and automatic controls in the normal and emergency operating modes.
2. Verify alarms and indications are functional.

3. Verify design airflow.

4. Testing of high-efficiency particulate air filters and charcoal adsorbers performed per Subsection 14.2.12.1.79 is coordinated with this test.

5. Testing of the TSC HVAC system is performed in accordance with RG 1.140 (Reference 14.2-25), and standards referenced by RG 1.140.

D. Acceptance Criterion

1. The TSC HVAC system operates as described in Subsection 9.4.3.

14.2.12.1.104 Non-Essential Chilled Water System Preoperational Test

A. Objectives

1. To demonstrate operation of the non-essential chilled water system.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

C. Test Method

1. Verify manual and automatic system controls.

2. Verify alarms and indications are functional.

3. Verify system flowrates.

D. Acceptance Criterion

1. The non-essential chilled water system operates as described in Subsection 9.2.7.

14.2.12.1.105 Vessel Servicing Preoperational Test

A. Objectives

1. To demonstrate operation of the polar crane, including the control circuits, limit devices, safety devices and interlocks, and the reactor vessel head and internals lifting rigs, associated equipment and accessories (e.g., slings and hooks, etc.).

2. To verify the polar crane and the reactor head and internals lifting rigs, and associated equipment and accessories, have completed static testing at 125% and operational testing (dynamic load testing) at 100% of rated load.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. The vessel servicing system is available to support testing.

C. Test Method

1. Verify control circuitry, limit devices, safety devices, and interlocks for the polar crane as described in Subsection 9.1.5.5.

2. Perform static load testing at 125% of rated load for the polar crane, reactor vessel head and internals lifting rigs, and associated equipment and accessories, followed by appropriate inspections.

3. Perform operational (dynamic load) testing at 100% of rated load of the polar crane, reactor vessel head and internals lifting rigs, and associated equipment and accessories followed by appropriate inspections. The polar crane lifts, transports, lowers, stops and holds the test load. Each polar crane hoist holding brake's ability to stop and hold the test load is individually tested.

4. Testing and inspection includes testing and inspection requirements specified by NUREG-0554 (Reference 14.2-24), ASME NOG-1 (Reference 14.2-30), and NUREG-0612 (Reference 14.2-21) as applicable.

D. Acceptance Criteria

1. The polar crane and its associated interlocks, limit devices, safety devices and control circuits perform as specified in Subsection 9.1.5.

2. The polar crane static testing at 125% of rated load and operational (dynamic load) testing at 100% of rated load is completed and the crane satisfactorily passes inspections in accordance with NUREG-0554 (Reference 14.2-24), ASME NOG-1 (Reference 14.2-30), and NUREG-0612, (Reference 14.2-21).

3. The reactor vessel head and internals lifting rigs and associated equipment and accessories satisfactorily pass an inspection following static and operational (dynamic load) testing in accordance with NUREG-0612 (Reference 14.2-21) and NUREG-0554 (Reference 14.2-24).

4. Testing and inspection demonstrates compliance with testing and inspection requirements specified by NUREG-0554 (Reference 14.2-24), ASME NOG-1 (Reference 14.2-30) and NUREG-0612 (Reference 14.2-21) as applicable.

14.2.12.1.106 Safety-Related Component Area HVAC System Preoperational Test

A. Objective

1. To demonstrate operation of the safety-related component area HVAC system.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing, including tests of the system dampers' loss of motive power position, and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.

C. Test Method

1. Simulate interlock signals for each AHU and verify operation and annunciation.
2. Verify alarms and status indications are functional.
3. Verify design airflow.

D. Acceptance Criteria

1. Safety related component area HVAC system operates on the proper signals (see Subsection 9.4.5),
2. All alarms annunciate properly.

14.2.12.1.107 Pressurizer Heater and Spray Capability and Continuous Spray Flow Verification Test

A. Objectives

1. To establish the optimum continuous spray flowrate.
2. To determine the effectiveness of the pressurizer heaters and normal control spray.
3. To demonstrate the depressurization rate by turning off pressurizer heaters and by using auxiliary spray.

B. Prerequisites

1. The RCS is at no-load operating temperature and pressure.

2. RCPs are operating.

3. Pressurizer heaters are operable.

4. Preoperational test 14.2.12.1.2 is complete.

C. Test Method

1. While maintaining constant pressurizer water level, spray bypass valves are adjusted until a minimum flow is achieved which maintains the temperature difference between the spray line and the pressurizer within acceptable limits.

2. With the pressurizer spray valves closed, pressurizer heaters are energized, and the time to raise the pressurizer pressure a specified amount is recorded.

3. With the pressurizer heaters deenergized, both spray valves are fully closed, and the time to lower the pressurizer pressure a specified amount is recorded.

4. All RCPs except one are turned off, and the pressurizer heaters are turned off. The depressurization rate is observed with its effect on margin to saturation temperature.

5. The pressurizer heaters are reestablished and auxiliary spray is initiated; charging and steam flow are then varied to observe the effects on RCS depressurization.

6. Verify indications and alarms.

D. Acceptance Criteria

1. The spray bypass valves are throttled so that the minimum flow necessary to keep the spray line warm is achieved.

2. The pressurizer pressure response to the opening of the pressurizer spray valves and to the actuation of all pressurizer heaters is within the limits described in Subsection 5.4.10.3.

3. Indications and alarms operate as described in Subsection 5.4.10.3.

14.2.12.1.108 Non-Essential Service Water (non-ESW) System Preoperational Test

A. Objective

1. To demonstrate the operation of the non-ESW system.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.
5. Motor-operated valve adjustment and operation check are completed.
6. Makeup for non-ESW system is completed prior to non-ESW pump operation.

C. Test Method

1. Verify manual and automatic system controls.
2. Verify system flowrates and performance of non-ESW pumps.
3. Verify alarms and status indications are functional.
4. Verify automatic self-cleaning for strainers.

D. Acceptance Criteria

1. The non-ESW system operates as described in Subsection 9.2.9.
2. Isolation valves and backwash valves perform as described in Subsection 9.2.9.

14.2.12.1.109 Condensate Storage Facilities System Preoperational Test

A. Objective

1. To demonstrate operation of the condensate storage facilities system.

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.

C. Test Method

1. Verify movement of automatic valves.
2. Verify manual and automatic controls and functions.

3. Operate demineralized water pump on recirculation line and verify operating condition.

4. Operate condensate transfer pump on recirculation line and verify operating condition.

5. Verify indications and alarms.

D. Acceptance Criteria

1. The condensate storage facilities system operates as described in Subsection 9.2.6.

2. Indications and alarms operate as described in Subsection 9.2.6.

14.2.12.1.110 Turbine Building Area Ventilation System (General Mechanical Area) Preoperational Test

A. Objective

1. To demonstrate operation of the turbine building area ventilation system (general mechanical area).

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

C. Test Method

1. Verify manual and automatic controls and functions in the normal power operation, normal shutdown and smoke purge modes.

2. Verify movement of louvers.

3. Verify alarms and status indications are functional.

4. Operate fans and verify operating condition.

D. Acceptance Criterion

1. Turbine building area ventilation system (general mechanical area) operates as described in Subsection 9.4.4.

14.2.12.1.111 Turbine Building Area Ventilation System (Electric Equipment Area) Preoperational Test

A. Objective

1. To demonstrate operation of the turbine building area ventilation system (electric equipment area).

B. Prerequisites

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.
3. Test instrumentation is available and calibrated.
4. Required support systems are available.

C. Test Method

1. Verify controls and functions in the normal and abnormal operating modes.
2. Verify status indications and alarms are functional.
3. Verify operating conditions of air handling unit.
4. Operate exhaust fans in battery room and verify operating condition.

D. Acceptance Criteria

1. Turbine building area ventilation system (electric equipment area) operates as described in Subsection 9.4.4.
2. Indications and alarms operate as described in Subsection 9.4.4.
3. Battery room exhaust fan operation maintains the hydrogen concentration below 1% by volume in the battery room per Subsection 9.4.4.1.2.

14.2.12.1.112 Reserved

14.2.12.1.113 Reserved

14.2.12.1.114 Reserved

14.2.12.1.115 RCPB Leak Detection Systems Preoperational Test

A. Objective

1. To verify operability of RCPB leak detection systems and adjust the alarm setpoints.

2. To demonstrate the function described in Subsection 5.2.5 with reference to RG 1.45.

3. To determine quantitative conversion data from measured quantities that correspond to RCS leak rate.

Note: This test may be performed in conjunction with subsection 14.2.12.1.80, ”Liquid Waste Management System Preoperational Test.”

B. Prerequisites

1. Component testing and instrument calibration is completed.

2. Test instrumentation is available and calibrated.

C. Test Method

1. Verify the calibration, alarm setpoints and alarm functions to each channel of RCPB leak detection systems and associated systems used to determine RCS leakage identified below.

Note: Instrument channel verification should be performed in conjunction with the associated tests identified below.

a. Intersystem leakage, SG tube leakage and unidentified leakage detection design features:

Feature	Instrument	Associated Test
Containment sump level	Containment sump level instrument in Figure 11.2-1	14.2.12.1.115
Containment airborne particulate radioactivity	RMS-RE-040 in Figure11.5-1a and Subsection 11.5.2	14.2.12.1.78
Containment airborne gaseous radioactivity monitor	RMS-RE-041 in Figure11.5-1b and Subsection 11.5.2	14.2.12.1.78
Containment air cooler condensate standpipe level	Containment air cooler condensate standpipe level instrument in Figure 11.2-1	14.2.12.1.115
Steam generator blowdown water radiation monitor	RMS-RE-055 in Figure11.5-1d and Subsection 11.5.2	14.2.12.1.78
High sensitivity main steam line monitor	RMS-RE-065A, 065B, 066A, 066B, 067A, 067B, 068A, 068B in Figure11.5-1c and Subsection 11.5.2	14.2.12.1.78
Condenser vacuum pump exhaust line radiation monitor	RMS-RE-043A, 043B, 081A, 081B in Figure11.5-1i and Subsection 11.5.2	14.2.12.1.78
RHRS suction RTD	RHS-TE-015, 025, 035, 045 in Figure 5.4.7.2	14.2.12.1.22
SIS/accumulator level	SIS-LT-010, 011, 020, 021, 030, 031, 040, 041 in Figure 6.3-2	14.2.12.1.56
Safety Injection pumps discharge lines RTD	SIS-TE-084, 085, 086, 087 in Figure 6.3-2	14.2.12.1.56

Feature	Instrument	Associated Test
SI Direct vessel Injection line RTD	SIS-TE-080, 081, 082, 083 in Figure 6.3-2	14.2.12.1.56
RHR Emergency letdown lines RTD	SIS-TE-088, 089 in Figure 6.3-2	14.2.12.1.22
Reactor head seal leakage RTD	RCS-TE-010 in Figure 5.1-2	14.2.12.1.8
CCW radiation monitors	RMS-RE-056A, 056B in Figure 11.5-1f	14.2.12.1.78
CCW surge tank level	NCS-LT-010, 011, 020, 021 in Figure 9.2.2-1	14.2.12.1.87
Containment humidity, temperature and pressure monitoring	Humidity instrument in subsection 5.2.4.2 and 5.2.5.6 CSS-TE-200, 201 in Figure 6.2.2-1 CSS-PT-010, 011, 012, 013, 014 in Figure 6.2.2-1	14.2.12.1.115 14.2.12.1.58
Charging flow rate	CVS-FT-048 in Figure 9.3.4-1	14.2.12.1.13
Liquid inventory balance	Related instruments(See b below)	-
Liquid samples taken from the SG blowdown sampling line	(Verify ability to obtain samples)	14.2.12.1.83

b. Design features for calculating leakage rate from RCS (liquid inventory balance):

Feature	Instrument	Associated Test
RCS pressure and temperature	RCS-PT-020, 030, 040, 050 RCS-TE-020, 025, 030, 035, 040, 045, 050, 055 in Figure 5.1-2	14.2.12.1.71
Pressurizer water level, pressure and temperature	RCS-LT-061, 062, 063, 064 RCS-PT-061, 062, 063, 064 RCS-TE-061, 062 in Figure 5.1.2	14.2.12.1.71 14.2.12.1.2
Volume control tank water level, pressure and temperature	CVS-LT-030, 031 CVS-PT-032 CVS-TE-033 in Figure 9.3.4-1	14.2.12.1.71 14.2.12.1.13
Letdown flow rate	CVS-FT-014 in Figure 9.3.4-1	14.2.12.1.14
Pressurizer relief tank	RCS-LT-170, RCS-PT-170 RCS-TE-170 in Figure 5.1-2	14.2.12.1.71 14.2.12.1.5
C/V reactor coolant drain tank water level, pressure and temperature	C/V reactor coolant drain tank water level, pressure and temperature instruments in Figure 11.2-1	14.2.12.1.80
Primary makeup water flow	CVS-FT-133 in Figure 9.3.4-1	14.2.12.1.16
RCP seal water flow	CVS-FT-060, 070, 080, 090 in Figure9.3.4-1 CVS-FT-064A, 064B, 074A, 074B, 084A, 084B, 094A, 094B, CVS-FT-068, 078, 088, 098 & CVS-LT-069, 079, 089, 099 in Figure 9.3.4-1	14.2.12.1.71 14.2.12.1.13

2. Verify the automatic functions.

3. By addition of measured amounts of water to (1) the containment sump and (2) the containment air cooler condensate standpipe, quantify the conversion of each level indication to volume, determine the sensitivity of the leak detection capability and verify the leak rate alarm setpoints in the MCR.

4. Obtain quantitative conversion data for RCS leakage equivalent (level to volume) for the following features (as identified in item C.1 above) by measured addition of liquid volumes correlated to level indication, pressure and temperature over the full operating range (level) of these vessels:

Note: RCS pressure and temperature measurements include the instruments identified in C.1.b above.

a. SIS/accumulator level

b. CCW surge tank level

c. Pressurizer level

d. Volume control tank level

e. Pressurizer relief tank level

f. C/V reactor coolant drain tank level

Note: The results of this preoperational test are provided for development of the operating leakage conversion procedure as described in Subsection 5.2.5.8.

D. Acceptance Criteria

1. The RCPB Leak Detection systems operate as described in Sections 5.2.5.

2. The alarm setpoints are established.

3. Containment sump level indication is capable of detecting the leak rate specified in Subsection 5.2.5.4.1.1 and actuating an alarm in the MCR.

4. The Containment Air Cooler Condensate Flow Rate Monitoring System is capable of detecting the leak rate specified in Subsection 5.2.5.4.1.4 and actuating an alarm in the MCR.

5. The instrument channel calibrations and alarm functions to each channel of RCPB leak detection systems, as identified in item C.1 above, are verified.

14.2.12.1.116 Equipment and Floor Drainage System Test

A. Objective

1. To demonstrate the correct routing of the drain lines.

2. To demonstrate the operation of the sump level instrumentation including alarms and indications.

Note: This test may be performed in conjunction with subsection 14.2.12.1.80, ”Liquid Waste Management System Preoperational Test.”

B. Prerequisites

1. Required construction testing is completed.

2. Test instrumentation is available and calibrated.

3. Required support systems are available.

4. Water is available for flow paths to be checked.

C. Test Method

1. The control circuitry and operation of system pumps and valves is verified.

2. The system is operated and performance characteristics are verified.

3. Reactor building floor drain and sump systems operation is demonstrated by water addition or pressurized air (where appropriate) to show system functionality that prevents backflow in order to prevent cross-divisional flooding between areas.

D. Acceptance Criteria

1. The equipment and floor drainage system operates as described in Subsection 9.3.3.

2. The pump and valve controls and interlocks operate as designed.

3. The containment and reactor and auxiliary buildings drain subsystems function as described in subsection 9.3.3 and as designed.

4. Reactor building floor drain and sump systems operation demonstrates that the system piping and valves prevent backflow to prevent cross-divisional flooding between areas as described in subsection 3.4.1.5.2.

14.2.12.1.117 Compressed Gas System Preoperational Test

A. Objective

1. To demonstrate operation of the compressed gas system (nitrogen gas subsystems and hydrogen gas subsystem only) to supply compressed gases to various loads that are important to safety.

2. To demonstrate that operation of components requiring large quantities of compressed gases does not cause excessive gas system pressure transients.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

5. Required ac and dc power sources are available.

C. Test Method

1. Simulate pressure signals to verify alarms.

2. Operate the compressed gas system to verify operation while recording pressure.

3. Loads that are a part of (or support the operation of) portions of loads identified below, which are identified as susceptible to changes in state or loss of operability upon increases in pressure due to component malfunction or failure, are evaluated and tested, as determined appropriate, without exceeding allowable design pressure ratings:

   Nitrogen supplied to the following:

   - SIS Accumulators,
   - CCW Surge Tanks,
   - CVCS Volume Control Tanks,

   Hydrogen supplied to the following:

   - CVCS Volume Control Tanks

D. Acceptance Criteria

1. The compressed gas system (nitrogen gas subsystems and hydrogen gas subsystem only) meets design requirements relating to the supply gas pressure.

2. Loads that are a part of (or support the operation of) portions of loads identified in item C.3 above respond to pressure transients in accordance with design.

14.2.12.1.118 Equipment Hatch Hoist Preoperational Test

A. Objective

1. To demonstrate operation of the equipment hatch hoist, associated equipment and accessories.

2. To verify the equipment hatch hoist, associated equipment and accessories have completed static testing at 125% and operational testing (dynamic load testing) at 100% of rated load.

B. Prerequisites

1. Required construction testing is completed.

2. Component testing and instrument calibration is completed.

3. Test instrumentation is available and calibrated.

4. Required support systems are available.

C. Test Method

1. Verify control circuitry, limit devices, safety devices, and interlocks for the equipment hatch hoist as described in Subsection 9.1.5.5.

2. Perform static load testing at 125% of rated load for the equipment hatch hoist, associated equipment and accessories, followed by appropriate inspections.

3. Perform operational (dynamic load) testing at 100% of rated load of the equipment hatch hoist, associated equipment and accessories followed by appropriate inspections.

4. Testing and inspection includes testing and inspection requirements specified by NUREG-0554 (Reference 14.2-24), ASME NOG-1 (Reference 14.2-30), and NUREG-0612 (Reference 14.2-21) as applicable.

D. Acceptance Criteria

1. The equipment hatch hoist and its associated interlocks, limit devices, safety devices and control circuits perform as specified in Subsection 9.1.5.

2. The equipment hatch hoist static testing at 125% of rated load and operational (dynamic load) testing at 100% of rated load is completed and the hoist satisfactorily passes inspections in accordance with NUREG-0554 (Reference 14.2-24), ASME NOG-1 (Reference 14.2-30), and NUREG-0612, (Reference 14.2-21).

3. The associated equipment and accessories satisfactorily pass an inspection following static and operational (dynamic load) testing in accordance with NUREG-0612 (Reference 14.2-21) and NUREG-0554 (Reference 14.2-24).

4. Testing and inspection demonstrates compliance with testing and inspection requirements specified by NUREG-0554 (Reference 14.2-24), ASME NOG-1 (Reference 14.2-30) and NUREG-0612 (Reference 14.2-21) as applicable.

14.2.12.2 Startup Tests

Startup testing is conducted in four phases:

1. Initial fuel loading and precritical testing
2. Initial criticality tests
3. Low power tests (less than 5% power)
4. Power ascension tests (from 5% to 100% of rated power)

14.2.12.2.1 Initial Fuel Loading and Pre-critical Tests

This subsection addresses the test abstracts during or following initial fuel loading.

14.2.12.2.1.1 RCS Sampling for Fuel Loading

A. Objective

1. To verify correct and uniform boron concentration in the RCS and directly connected auxiliary systems prior to fuel loading.

B. Prerequisites

1. Boric acid storage tanks, transfer pumps, and associated piping and equipment are available.
2. The RCS is filled with reactor grade water which is borated to the concentration specified in the initial fuel loading procedure.

C. Test Method

1. The RCS is filled and on recirculation to maintain a uniform boron concentration.
2. A sample is obtained at a depth of 15 feet from the reactor vessel flange surface. Also, samples are taken from the operating RHR loop, RWSP, boric acid tank, boric acid charging line and CVCS charging line.
3. These samples are analyzed to verify that there is a uniform boron concentration in the RCS.

D. Acceptance Criterion

1. The samples obtained from the designated sample points have a minimum boron concentration in accordance with Chapter 16 Technical Specifications.

14.2.12.2.1.2 Fuel Loading Instrumentation and Neutron Source Requirements Test

A. Objectives

1. To verify alignment, calibration, and neutron response of the temporary fuel loading instrumentation prior to the start of fuel loading.

2. To verify the neutron response of the nuclear instrumentation system (NIS) source range channels prior to the start of fuel loading.

3. To verify the neutron response of the temporary and NIS source range instrumentation prior to resumption of fuel loading following any delay of 12 hours or more.

B. Prerequisites

1. Temporary fuel loading instrumentation package is available.

2. Preoperational testing of source range of NIS that is to be performed prior to fuel loading is completed.

3. Plant and temporary instrumentation are calibrated, and calibration data are available.

C. Test Method

1. A portable neutron source and pre-shipment equipment checkout data are used to verify proper alignment, calibration, and neutron response of the temporary fuel loading instrumentation and the NIS source range instrumentation.

2. A portable neutron source or movement of a source-bearing fuel element is used to produce the desired change in neutron level to verify the neutron response of the temporary fuel loading instrumentation and the NIS source range instrumentation prior to resumption of fuel loading, following any delay of eight hours or more.

3. A statistical evaluation of 10 observations for each channel may be performed to verify operability of the equipment in lieu of C.2 above.

D. Acceptance Criterion

1. Neutron instrumentation is operational and calibrated and indicates the appropriate change in count rate as the neutron level is varied.

14.2.12.2.1.3 Initial Fuel Loading

A. Objectives

1. To establish the conditions under which the initial fuel loading is to be accomplished.

2. To accomplish initial fuel loading in a safe and orderly manner.

B. Prerequisites

1. A fuel handling crew qualified on alarm response and emergency procedures is established to perform initial core loading in accordance with approved procedures. A senior reactor operator is exclusively assigned to supervise the overall process of initial fuel loading.

2. Continuous area radiation monitoring by portable area radiation monitoring system is established prior to and during fuel handling and fuel loading operations. The containment evacuation alarm and the containment purge system are operable.

3. The status of systems required for the fuel loading is established and verified.

4. Inspections of fuel and control rods are complete.

5. Nuclear instruments have been calibrated, are operable and properly located. One operating channel has an audible indication or annunciation in the main control room.

6. A response check of the source range neutron flux monitors to a neutron source shall be performed within 12 hours prior to loading of the core or upon resumption of loading if delay is for more than 12 hours.

7. The containment structure is complete and containment integrity is demonstrated according to Technical Specifications.

8. The reactor vessel and associated components are ready to receive fuel. Components are verified either in place or out of the vessel, as required, to make it ready to receive fuel.

9. Water level in the reactor vessel is maintained to a level approximately equal to the center of the vessel outlet nozzles.

10. At least one RHR loop is operable to provide coolant circulation for adequate boron mixing and temperature control, consistent with Technical Specifications. Unborated water sources are isolated and controlled in accordance with Technical Specifications.

11. The Refueling Water Storage Pit (RWSP) is operable in accordance with Technical Specifications as an emergency boron addition system.

12. Fuel handling tools and equipment have been successfully tested, calibrated (including indexing of the manipulator crane with a dummy fuel element) and are operational. Operators are familiar with the use and operation of the equipment.

13. The status of protection systems, interlocks, mode switch, alarms, and radiation protection equipment is specified and verified.

14. Reactor coolant water quality requirements are established and verified within limits.

15. The reactor coolant boron concentration is verified to be within the limits specified by the Technical Specifications.

16. Predictions of core reactivity are prepared in advance to aid in evaluating the measured responses to specified loading increments and shutdown margin.

C. Test Method

1. Fuel assemblies and other core inserted components (control rods, burnable poisons, and neutron sources) are inserted into the reactor vessel in accordance with the pre-specified and approved loading sequence.

2. Neutron count rate is monitored on temporary and permanent source range detectors throughout the fuel loading.

3. Check sheets are filled at pre-specified intervals in order to verify that the required conditions are met.

4. These actions are directly supervised by a senior licensed operator having no other concurrent duties, and the loading operation is conducted in strict accordance with detailed approved procedures.

5. Conditions that require the immediate suspension of fuel loading activities include the following:

- An unexplained increase of neutron multiplication factor during each subsequent fuel addition.

- A loss of communication between the control room and the fuel loading station.

- Conditions in Section 3.9 of the Technical Specifications with required actions to suspend core alterations (which includes requirements for operable source range detectors).

- Loss of RCS recirculation using at least one CS/RHR pump.

- Failure to maintain at least one path for boron addition to the RCS.

D. Acceptance Criterion

1. The core is loaded with assemblies in accordance with the pre-specified configuration which establishes the required shutdown margin without achieving criticality.

14.2.12.2.1.4 Inverse Count Rate Ratio Monitoring for Fuel Loading

A. Objective

1. To verify sub-criticality during fuel loading. (This monitoring is performed in conjunction with the initial fuel loading.)

B. Prerequisites

1. Temporary and plant source range nuclear instrumentation has been operational for a minimum of 60 minutes to allow instruments to attain stable operating conditions.

2. The plant is prepared for initial fuel loading.

C. Test Method

1. Data from the temporary and permanent nuclear monitoring channels are used to assess the neutron multiplication factor during fuel loading operations.

D. Acceptance Criterion

1. No unexplained increase of neutron multiplication factor during each subsequent fuel addition.

14.2.12.2.1.5 Precritical Test Sequence

A. Objective

1. To specify the sequence of events which constitute the pre-critical test program.

B. Prerequisite

1. Plant system conditions are established as required by the individual test instructions within this sequence.

2. SSCs required by Technical Specifications to support a specified operational mode shall be operational prior to the initiation of precritical testing.

C. Test Method

1. This instruction establishes the sequence for required testing after fuel loading, until the plant has completed all pre-critical testing and reached the hot standby condition.

D. Acceptance Criterion

1. Acceptance criteria are contained in the various individual tests conducted during this time.

14.2.12.2.1.6 Rod Drop Time Measurement Test

A. Objective

1. To determine the rod drop time of each RCCA with the reactor under full-flow conditions and no-flow conditions during cold shutdown and hot standby (at normal operating temperature and pressure).

B. Prerequisites

1. Initial fuel loading is completed.

2. The NIS source range channels are in operation.

3. All rods are fully inserted.

4. This test is performed prior to initial criticality.

5. Reactor coolant boron concentration is not less than specified in the Technical Specifications.

C. Test Method

1. Withdraw each RCCA, interrupt the electrical power to the associated CRDM, measure, and record the rod drop time.

2. Perform a minimum of three additional drops for each control rod whose drop time falls outside the two-sigma limit, as determined from the drop times obtained for the hot test condition.

3. This test is performed for the full-flow and no-flow conditions in the RCS at cold shutdown and hot standby

D. Acceptance Criterion

1. The rod drop times are acceptable in accordance with Chapter 16, plant Technical Specifications, SR 3.1.4.3.

14.2.12.2.1.7 CRDM Operational Test

A. Objective

1. To demonstrate the operation of the CRDM under both cold and hot plant conditions.

B. Prerequisites

1. The RCS is filled and vented at cold shutdown.
2. All rods are fully inserted.
3. The NIS source range channels are aligned and operable.

C. Test Method

1. With the reactor core installed and the reactor in the cold shutdown condition, confirm that the CRDMs supply operating signals to the CRDM stepping magnet coils.
2. Verify operation of all CRDMs under both cold and hot standby conditions. The CRDM magnet coil currents are recorded.

D. Acceptance Criterion

1. CRDM mis-stepping is not observed.

14.2.12.2.1.8 Rod Position Indication Test

A. Objective

1. To verify that the rod position indication system satisfactorily performs required indication and alarm functions for each individual rod and that each rod operates satisfactorily over its entire range of travel.

B. Prerequisites

1. Initial fuel loading is completed (this test is performed prior to initial criticality).
2. Source range channels are in operation.
3. The RCS is at no-load operating temperature and pressure.
4. At least one RCP in service with reactor coolant boron concentration not less than specified in the Technical Specifications for refueling shutdown.

C. Test Method

1. Rod banks are individually withdrawn from and reinserted into the core while recording control room position readout, and the group step counters.

D. Acceptance Criterion

1. The rod position indication system performs the required indication and alarm functions, as described in Subsections 7.7.1.1.4 and 7.7.1.4, and each rod operates over its entire range of travel.

14.2.12.2.1.9 Rod Control System Test

A. Objective

1. To demonstrate that the rod control system performs the required control and indication functions just prior to initial criticality.

B. Prerequisites

1. Initial fuel loading is completed.

2. RCS is at no-load operating temperature and pressure under full-flow conditions.

3. The NIS source range channels are aligned and operable.

4. Rod position indication system is in operation.

5. Reactor coolant boron concentration is not less than specified in the Technical Specifications.

C. Test Method

1. With the reactor at no-load temperature and pressure, immediately prior to initial criticality, the operation of the rod control system in various modes is verified.

2. The operation of status indications is verified.

D. Acceptance Criteria

1. The rod control system withdraws and inserts each rod bank (see Subsection 7.7.1.3).

2. The rod position and indication system tracks each rod bank as it is being moved.

3. The control banks overlap system starts and stops rod movement at the designated bank positions.

14.2.12.2.1.10 Reactor Protection System Test

A. Objectives

1. To verify that initial trip setpoint adjustments are made prior to initial unit startup and to specify which trip setpoint adjustments require readjustment during startup.

2. To obtain a record of all trip setpoints.

B. Prerequisites

1. Reactor trip instrumentation is aligned and calibrated.
2. Reactor trip instrumentation has been energized for a time sufficient to achieve stability.

C. Test Method

1. Trip setpoints are reviewed and documented prior to criticality.
2. During startup and test operations, specific setpoints noted for readjustment on the data sheets are readjusted and final setpoint values recorded.

D. Acceptance Criteria

1. Initial reactor trip setpoints are verified to be within design criteria and in conformance with or more conservative than values in Chapter 16 Technical Specifications, Section 3.3.1 and Table 3.3.1-1 (also see Section 7.2).
2. Setpoints readjusted during startup and testing are noted, and a final record of all setpoints is obtained.

14.2.12.2.1.11 RCS Final Leak Test

A. Objective

1. To determine the leakage from the RCS and verify that the leakage is within allowable limits.

B. Prerequisite

1. Fuel loading is completed.

C. Test Method

The RCS leakage rates are determined by monitoring the following parameters in conjunction with quantitative leakage detection methods described in Subsection 5.2.5.4.1.1 through 5.2.5.4.1.4 over a specified period of time:

1. RCS pressure and temperature.
2. Pressurizer water level, pressure, and temperature.
3. Volume control tank water level, pressure, and temperature.
4. Pressurizer relief tank and C/V reactor coolant drain tank water level, pressure, and temperature.

5. Primary makeup water flow and RCP seal water flow.

D. Acceptance Criteria

1. The amount of leakage from the RCS is within the limits specified in LCO 3.4.13 of Chapter 16.

14.2.12.2.1.12 Incore Detector Test

A. Objectives

1. To set up and demonstrate the operation of the incore instrumentation system.

2. To verify its adequacy for incore flux mapping.

B. Prerequisites

1. Reactor upper internals are installed, and the reactor vessel head is installed with the studs tensioned.

2. The initial fuel loading is completed.

3. Rotation and limit switch operation of the incore detector system are verified.

4. Hot standby conditions exist.

C. Test Method

1. A dummy cable is inserted into each thimble to demonstrate system operation.

2. Detectors are inserted into the thimbles to demonstrate system operation.

D. Acceptance Criterion

1. The system operates in agreement with technical requirements and is capable of taking a flux map (see Subsection 7.7.1.5).

14.2.12.2.1.13 RCS Flow Coastdown Test

A. Objectives

1. To measure the rate at which reactor coolant flow changes, subsequent to tripping all RCPs.

2. To measure various delay times associated with the loss of flow.

B. Prerequisites

1. Required component testing and instrument calibration are completed.

2. Required electrical power supplies and control circuits are operational.

3. The reactor core is installed, and the plant is at normal operating temperature and pressure with all RCPs running.

C. Test Method

1. Flow coastdown stabilization and loss of coolant flow delay-time data are recorded while tripping all RCPs.

D. Acceptance Criteria

1. The rate of change of reactor coolant flow for all RCPs tripped is less than that assumed in accordance with design specifications.

2. The RCS low-flow delay times are less than or equal to those assumed in the safety analysis for loss of flow.

14.2.12.2.1.14 Operational Alignment of Process Temperature Instrumentation Test

A. Objective

1. To align ΔT and T_{avg} process instrumentation under isothermal conditions prior to criticality.

B. Prerequisites

1. All RCPs are operating.

2. The RCS average temperature is within ±2° F of the hot no-load average temperature.

C. Test Method

1. Align ΔT and T_{avg} according to test instructions at isothermal conditions.

D. Acceptance Criteria

1. The T_{avg} is within 0.5° F of the value calculated from the hot leg temperature (T_{hot}) and cold leg temperature (T_{cold}) converter outputs.

2. The measured ΔT for each channel is within 0.5% at isothermal conditions.

14.2.12.2.2 Initial Criticality

Test abstracts for initial criticality testing are provided in this subsection. Following the completion of the fuel loading and pre-criticality testing, the plant is brought to initial criticality, according to the test procedures described in the following test abstracts.

14.2.12.2.2.1 Initial Criticality Test Sequence

A. Objective

1. To define the sequence of tests and operations for initial criticality.

B. Prerequisite

1. Plant system conditions are established as required by the individual test instruction within this sequence.

C. Test Method

1. Individual test instructions establish the plant conditions required for initial criticality and during the low power testing program following initial criticality.

D. Acceptance Criterion

1. Relevant acceptance criteria are provided in each of the test procedures.

14.2.12.2.2.2 Initial Criticality

A. Objective

1. To achieve initial criticality in a controlled manner.

B. Prerequisites

1. Plant system conditions are established as required in the plant Technical Specifications.

2. The nuclear instrumentation is verified to be operating properly.

3. A neutron count rate at least 1/2 count per second will be confirmed to register on the source range channels, and the signal-to-noise ratio is known to be greater than two.

4. Both source range and intermediate range nuclear channels alarms, trip functions, and indicating devices are confirmed to be operable and calibrated.

5. Both source range and intermediate range nuclear channels are energized a minimum of 60 minutes to assure stable operation.

6. The reactivity addition sequence during the initial startup and subsequent startups is prescribed in detailed procedures approved by personnel or groups designated by the licensee.

7. Rod withdrawal sequences and patterns during the initial approach to criticality are the same as those during subsequent startups.

8. Hi-flux trip set points are established at the lowest value prior to initial criticality.

C. Test Method

1. Baseline count rates are obtained prior to rod withdrawal and boron dilution.

2. The RCCAs are withdrawn to maintain minimum shutdown margin at hot zero power conditions.

3. Initial criticality may be achieved by boron dilution and final rod withdrawal using detailed procedures which describe rates for boron dilution and rod withdrawal to prevent passing through criticality in a period shorter than approximately 30 sec (< 1 decade per minute).

4. At pre-selected points during rod withdrawal and boron dilution, data are taken and the inverse count rate ratio is plotted to enable an extrapolation to be carried out to predict the expected critical point.

D. Acceptance Criterion

1. The reactor is critical within Technical Specifications limits (Comparison between prediction and measurement will be within ±1%Δk/k.).

14.2.12.2.2.3 Determination of Core Power Range for Physics Tests

A. Objectives

1. To determine the reactor power level at which effects from fuel heating is detectable.

2. To establish the range of neutron flux in which zero power reactivity measurements are to be performed.

B. Prerequisites

1. The reactor is critical.

2. The neutron flux level is stable and below the expected level of nuclear heating.

3. The boron concentration is stable.

4. Control rods are sufficiently deep in the core to allow positive reactivity insertion by rod withdrawal.

5. The reactivity computer is installed and calibrated.

C. Test Method

1. Control rod bank is withdrawn allowing the neutron flux level to increase until nuclear heating effects are indicated by the reactivity computer.

2. The reactivity computer picoammeter flux level and, if possible, the corresponding intermediate range channel currents at which nuclear heating occurs are recorded to obtain zero power testing range.

D. Acceptance Criterion

1. This procedure is provided to collect data and to determine the power range at which zero power testing is conducted.

14.2.12.2.3 Low Power Tests (See Subsection 14.2.12.2.2)

Test abstracts for low power testing are provided in this subsection. Following the successful completion of the initial criticality tests, low power tests are conducted, typically at power levels less than 5%, to measure physics characteristics of the reactor system and to verify the operability of the plant systems at low power levels.

14.2.12.2.3.1 Low Power Test Sequence

A. Objective

1. Establish test sequence for low power tests.

B. Prerequisite

1. Tests required prior to low power testing are satisfactorily completed.

C. Test Method

1. Low power test abstracts contained in this subsection are performed in the test sequence established herein.

D. Acceptance Criterion

1. Acceptance criteria are included in each low power test procedure abstract contained in this subsection.

14.2.12.2.3.2 Boron Endpoint Determination Test

A. Objective

1. To determine the critical RCS boron concentration appropriate to an endpoint configuration (rod cluster control configuration).

B. Prerequisites

1. The reactor is critical at zero power, with stable no-load temperature and pressure.

2. The reactivity computer is installed and calibrated.

C. Test Method

1. The control rods are positioned close to the desired endpoint configuration, with the RCS boron concentration stabilized.

2. The rods are quickly moved to the desired endpoint configuration without boron concentration adjustment.

3. The change in reactivity is measured, and this is converted to an equivalent change in boron concentration which yields the endpoint for the given rod configuration.

D. Acceptance Criterion

1. The results of the boron endpoint calculations agree with the acceptance criteria of the design documentation.

14.2.12.2.3.3 Isothermal Temperature Coefficient Measurement Test

A. Objective

1. To determine isothermal temperature coefficient and then derive the moderator temperature coefficient from the isothermal data.

B. Prerequisites

1. The reactor is critical at zero power, with stable pressure and no-load temperature.

2. The neutron flux level and the boron concentration are stable,

3. The reactivity computer is installed and calibrated.

C. Test Method

1. The isothermal temperature coefficient is determined by heating/cooling the RCS at a constant rate and plotting temperature versus reactivity. The moderator temperature coefficient may be derived from isothermal data.

D. Acceptance Criterion

1. The average of the measured values of the isothermal and the derived moderator temperature coefficient agrees with the acceptance criteria in the design documentation.

14.2.12.2.3.4 RCCA Bank Worth Measurement at Zero Power Test

A. Objective

1. To determine the differential and integral reactivity worth of RCCA banks.

B. Prerequisites

1. The reactor is critical at zero power, with no-load temperature and pressure stable.

2. The reactivity computer is installed and calibrated.

C. Test Method

1. RCCA bank worth is determined by constant addition and/or dilution of boron in the RCS, causing rod movement to compensate for the boron concentration changes. This rod movement causes step changes in reactivity which are used to compute the bank worth.

D. Acceptance Criteria

1. The measured values of the individual rod bank are consistent with the design value within specified limits contained in Section 4.3.

2. The RCCAs bank worth is in accordance with the design requirements with the assumed uncertainty used in the shutdown margin calculation.

14.2.12.2.3.5 Pseudo Rod Ejection Test

A. Objective

1. To verify that the power distribution and ejected rod worth resulting from a simulated ejected RCCA is within acceptable limits.

B. Prerequisites

1. Excore and incore nuclear instrumentation and incore thermocouples are operable and are calibrated.

2. The test is performed with the reactor critical at zero power.

C. Test Method

1. Rod ejection accident at the required power levels is simulated by withdrawing an RCCA.

2. The selected rod cluster assembly is withdrawn to the fully withdrawn position. Reactivity change is compensated for by boration as required.

3. Excore instrumental signal is recorded and the power distribution is measured by incore instrumentation.

D. Acceptance Criterion

1. The power distribution resulting from the withdrawn RCCA agrees with the acceptance criteria of the design document.

14.2.12.2.3.6 Operational Alignment of Nuclear Instrumentation Test

A. Objective

1. To establish and determine voltage settings, trip settings, operational settings, alarm settings, and overlap of channels on source range, intermediate range, and power range instrumentation from prior to initial criticality to at or near full reactor power.

B. Prerequisite

1. The NIS is aligned in accordance with the nuclear instrumentation system technical requirements.

C. Test Method

1. Instrumentation is calibrated, tested, and verified, utilizing permanently installed controls and adjustment mechanisms.

2. Operational modes of the source range, intermediate range, and power range channels are set for their proper functions, in accordance with the test instructions.

D. Acceptance Criteria

1. The NIS demonstrates the ability to achieve the operational adjustments according to its design (see Subsections 7.2 and 7.7.1.2).

2. The NIS demonstrates an overlap of indication between the source and intermediate ranges and the intermediate and power range instrumentation.

14.2.12.2.3.7 Dynamic Automatic Turbine Bypass Control Test

A. Objective

1. To verify automatic operation of the average temperature (T_{avg}), turbine bypass control system, demonstrate controller setpoint adequacy, and obtain final settings from steam pressure control of the turbine bypass valves.

B. Prerequisites

1. The turbine bypass control system is aligned and calibrated to initial settings.
2. The plant is at no-load temperature and pressure.
3. The condenser vacuum is established.
4. The reactor is critical.

C. Test Method

1. Reactor power is increased to less than 10% by rod withdrawal and steam bypass to condenser to demonstrate setpoint adequacy.
2. Pressure controller setpoint is increased prior to switching to T_{avg} control, which rapidly modulates opening of the turbine bypass valves.
3. Simulate turbine operating conditions with reactor at power, then simulate a turbine trip resulting in the rapid opening of the turbine bypass valves.

D. Acceptance Criteria

1. The plant trip controller responds to maintain a stable T_{avg}. After steady state power is achieved, no divergent oscillations in temperature occur (see Subsection 7.7.1.1.11.4).
2. The loss of load controller responds properly to maintain a specified stable T_{avg}. After steady state power is achieved, no divergent oscillations in temperature occur (see Subsection 7.7.1.1.11.3).
3. The steam header pressure controller responds to maintain a stable pressure at normal no-load pressure.

14.2.12.2.3.8 Pressurizer Heater and Spray Capability and Continuous Spray Flow Verification Test

A. Objectives

1. To establish the optimum continuous spray flowrate.
2. To determine the effectiveness of the pressurizer heaters and normal control spray.

3. To demonstrate the depressurization rate by turning off pressurizer heaters.

B. Prerequisites

1. The RCS is at no-load operating temperature and pressure.

2. RCPs are operating.

3. Pressurizer heaters are operable.

C. Test Method

1. While maintaining constant pressurizer water level, spray bypass valves are adjusted until a minimum flow is achieved to maintain the temperature difference between the spray line and the pressurizer within acceptable limits.

2. With the pressurizer spray valves closed, pressurizer heaters are energized, and the time to raise the pressurizer pressure a specified amount is recorded.

3. With the pressurizer heaters de-energized, both spray valves are fully closed, and the time to lower the pressurizer pressure a specified amount is recorded.

4. All RCPs except one are turned off, and the pressurizer heaters are turned off. The depressurization rate is observed with its effect on margin to saturation temperature.

5. The pressurizer heaters are reestablished, charging and steam flow are then varied to observe the effects on RCS depressurization.

D. Acceptance Criteria

1. The spray bypass valves are throttled so that the minimum flow necessary to keep the spray line warm is achieved.

2. The pressurizer pressure responses to the opening of the pressurizer spray valves and to the actuation of all pressurizer heaters are within the limits described in Subsection 5.4.10.

14.2.12.2.3.9 Natural Circulation Test

(Perform on first plant. For subsequent plants, see discussion in Subsection 14.2.8.2.)

A. Objectives

1. To demonstrate the capability to remove decay heat by natural circulation.

2. To demonstrate boron mixing occurs during natural circulation.

B. Prerequisites

1. RCPs are operating.

2. Primary system is at normal operating temperature and pressure.

3. The feedwater system is available for decay heat removal.

4. RCS boron concentration has been determined via multiple primary liquid sampling points.

C. Test Method

1. The test is initiated by tripping all RCPs.

2. Heat removal is achieved via feedwater system operation and natural circulation.

3. Natural circulation is verified by observing the response of the hot leg and cold leg temperature instrumentation in each loop for natural circulation stabilization period and the ability to maintain the cooling mode.

4. RCS boration is performed during the test, with samples taken from multiple primary liquid sampling points.

D. Acceptance Criteria

1. Decay heat removal capability is demonstrated by maintaining natural circulation conditions.

14.2.12.2.3.10 Automatic Low Power SG Water Level Control Test

A. Objective

1. To verify the stability of the automatic low power SG water level control system following simulated transients at low power conditions.

B. Prerequisites

1. The reactor is critical, and in the low power level.

2. The SG water level control system is checked and calibrated.

3. SG alarm setpoints are set for each SG.

C. Test Method

1. Induce simulated SG water level transients to verify SG water level control response.

D. Acceptance Criteria

1. The low power SG water level controller responds to maintain a stable SG water level at setpoint (see Subsection 7.7.1.1.9).

2. The main feedwater bypass control valves open or close and stabilize in level setpoint changes.

14.2.12.2.4 Power Ascension Tests

Power ascension testing includes testing from 5% to 100% of rated power.

Although the order of testing within a given plateau is somewhat flexible, the normal recommended sequence of tests would be as follows:

1. Core performance analysis

2. Steady-state tests

3. Control system tuning

4. System transient tests

5. Major plant transients (including trips)

For a given testing plateau, testing at lower power levels is generally performed prior to that of higher power levels. The detailed testing schedule is generated by the startup organization and made available to the NRC prior to implementation. The schedule may be updated and continually optimized to reflect progress and subsequent revised projections.

After low power testing is completed, testing is performed at specified power levels to demonstrate that the facility operates in accordance with design during normal steady-state operations, and to the extent practical, during and following anticipated transients. During power ascension, tests are performed to obtain operational data and to demonstrate the operational capabilities of the plant.

14.2.12.2.4.1 Power Ascension Test Sequence

A. Objective

   1. To define the sequence of operations, beginning at approximately 5% power, which constitutes the power ascension testing program.

B. Prerequisite

   1. Plant system conditions are established, as required, by the individual test instruction within this sequence.

C. Test Method

1. The sequence of operations and tests are presented along with detailed instructions, specific plant conditions, and test procedures.

D. Acceptance Criterion

1. Relevant acceptance criteria are provided in each of the test procedures.

14.2.12.2.4.2 Power Coefficient Determination Test

A. Objective

1. To verify nuclear design predictions of the power coefficient.

B. Prerequisites

1. Reactor power is at the specified testing levels (30%, 50%, 75%, and greater than 90% power). Reactor coolant temperature and pressure, and rod cluster control bank configurations are at normal operating conditions and are stable.

2. All subsystems which affect overall plant transient response, except the rod control system, are in automatic control, whenever possible.

3. The reactivity computer is installed and calibrated.

C. Test Method

1. Plant conditions are stabilized at selected power levels (30%, 50%, 75%, and greater than 90%). The plant load is varied, using the turbine-generator controller, in a manner approximating step changes of about 2% to 4% power.

2. The power coefficient verification factor is determined from correlative measurements of core reactivity and core thermal power output.

D. Acceptance Criterion

1. The power coefficient verification factor agrees with the value given in the nuclear fuel design report within the assumed uncertainty of calculation.

14.2.12.2.4.3 Axial Flux Difference Instrumentation Calibration Test and Axial Distribution Oscillation Test

A. Objectives

1. To derive calibration factors for the power range nuclear instrumentation signals used as input to overpower and over temperature T set-points.

2. To calibrate instruments to display and monitor axial flux difference.

3. To verify that the axial power distribution is stable or controllable.

B. Prerequisites

1. The NIS power range isolation amplifiers are aligned.
2. The core average axial offset from the incore data is available from flux maps.
3. Average core thermal power from calorimetric, performed during the flux mapping, is available.

C. Test Method

1. Data is collected as required by test instruction, at 50%, 75% and 100% power.
2. The calibration factors of the power range nuclear instrumentation signal are derived from correlative datasets of incore axial power offsets and detector current during axial power distribution oscillation.
3. The stability index of axial power distribution is evaluated with incore and excore instrumentation signals during axial power distribution oscillation.

D. Acceptance Criteria

1. Calibration factors agree with Chapter 16 Technical Specifications.
2. The stability index of axial power distributions is negative or the axial power oscillation is restrained.

14.2.12.2.4.4 Flux Map Test

A. Objective

1. To determine the reactor core power distributions for various control rod configurations at 0%, 30%, 50%, 75%, and 100% rated power.

B. Prerequisites

1. Incore instrumentation is operable.
2. Reactor is critical, and power level is established as necessary.

C. Test Method

1. Use data collected from incore detectors to generate a flux map.

D. Acceptance Criterion

1. The power distribution indicated by the flux maps are acceptable and in accordance Chapter 16 Technical Specifications.

14.2.12.2.4.5 RCCA Misalignment Measurement and Radial Power Distribution Oscillation Test

(first-plant-only test)

A. Objectives

1. To verify the ability of the incore and excore nuclear instrumentation systems to detect RCCA misalignment.

2. To verify the conservatism for prediction of power distribution according to RCCA misalignment.

3. To verify that the radial power distribution oscillation is stable.

B. Prerequisites

1. The reactor power is operating at selected power level (50%) and has been at that level long enough to reach xenon equilibrium.

2. The RCS boron concentration and temperature are stable.

3. The control and shutdown banks are positioned as follows for the specific measurement:

   a. For RCCA insertion: Nearly fully withdrawn.

   b. For RCCA withdrawal: At insertion limits.

C. Test Method

1. For RCCA withdrawal, power distribution and excore instrumentation signals are recorded to verify proper response and to determine power distribution and power peaking factors prior to misalignment.

2. The selected rod cluster assembly is withdrawn to the fully withdrawn position. Power distribution and excore instrumentation signals are recorded, to verify proper response and to determine power distribution and power peaking factors at full misalignment position held for one hour.

3. The selected rod cluster assembly is restored to bank position.

4. Reactivity changes are compensated for by dilution or boration as required.

5. For RCCA insertion, the selected rod cluster assembly is inserted to the limit of misalignment specified in Chapter 16 Technical Specifications. Power distribution and excore instrumentation signals are recorded to verify proper responses of them at partial misalignment.

6. The selected rod cluster assembly is fully inserted. Power distribution and excore instrumentation signals are recorded, to verify proper response and to determine power distribution and power peaking factors at full misalignment position held for one hour.

7. The selected rod cluster assembly is restored to the bank position.

8. Reactivity changes are compensated for by dilution or boration as required.

9. The stability index of radial power distribution is evaluated periodically after restoration to normal rod position.

D. Acceptance Criteria

1. Measured power distribution and peaking factors are consistent with prediction.

2. The sensitivity of the incore and excore instrumentation signals to the RCCA misalignment is demonstrated by the results of power distribution measurements.

3. The stability index of radial power distribution is negative.

14.2.12.2.4.6 Remote Shutdown Test

A. Objectives

1. To demonstrate the capability of performing a controlled reactor shutdown to the hot standby condition.

2. To maintain the plant in a hot standby condition from outside the control room.

3. To demonstrate the potential for safely cooling down the plant from hot standby to cold shutdown conditions from outside the control room.

Note: Testing is conducted in accordance with RG 1.68.2.

B. Prerequisites

1. Reactor power is greater than or equal to 10%.

2. The controls and instrumentation associated with the remote shutdown console are available.

3. Plant systems are in the normal operating mode with the turbine generator in operation.

4. Approved operating procedures for performing a remote shutdown are available.

5. Preoperational testing of plant instrumentation, controls, and systems to be used at remote shutdown locations is completed. This preoperational testing includes

verification that all systems to be used during shutdown operation from outside the control room are operable in the manner in which they would be used during the operation (i.e., control from remote stations, manual operation, use of available power supplies, etc.) and that communication is established and maintained among the personnel who is performing the shutdown operation.

6. The authority and responsibility of the control room observers are established and documented in the test procedure. Provisions are made for the following actions:

   a. Assumption of control of the plant if an emergency or unsafe condition develops during the testing that cannot be managed by the shutdown crew.

   b. Performance of non safety-related activities that would not be required during an actual remote shutdown. These could include protection of non safety-related equipment from mechanical damage during the transient and the placement of equipment into standby status when no longer required. Such activities have been previously defined and evaluated to ensure that, if they were not performed during an actual remote shutdown, safe shutdown of the plant can still be achieved.

C. Test Method

1. Transfer control from the control room to the remote shutdown console.

2. Perform a controlled reactor shutdown to the hot standby condition from the remote shutdown console.

3. Demonstrate the capability to achieve and maintain the plant in a hot standby condition from the remote shutdown console for a minimum of 30 minutes.

4. During the demonstration, use only the equipment for which credit is taken to perform an actual remote shutdown.

5. Perform the test with the minimum of personnel required to be at the reactor unit at any one time (minimum shift crew).

6. Obtain the data at locations outside the control room.

7. Following the hot standby demonstration, starting from approximately 350°F, reduce the reactor coolant temperature by at least 50 °F from outside the control room using the RHRS.

D. Acceptance Criteria

1. Transfer of control from the control room to the remote shutdown console is achieved.

2. The ability to perform a controlled reactor shutdown to the hot standby condition and to maintain hot standby conditions from the remote shutdown console is demonstrated.

3. The potential ability to cool down from hot standby to cold shutdown conditions from outside the control room is demonstrated by reducing the reactor coolant temperature by at least 50 °F using the RHRS from outside the control room.

14.2.12.2.4.7 Loose Parts Monitoring System Test (Continuation of 14.2.12.1.72)

A. Objectives

1. To perform final calibration of the loose parts monitoring system.

2. To establish alarm signal level for startup testing and operations.

B. Prerequisites

1. Required electrical power supplies and control circuits are energized and operational.

2. Loose parts monitoring system accelerometers are installed at the proper locations.

C. Test Method

1. The loose parts monitoring system calibration is performed in accordance with the manufacturer's instructions including verification of accelerometer calibration.

2. The RCS loose parts monitoring system operation is verified. The alert signal level is established.

D. Acceptance Criteria

1. A loose parts monitoring system calibration is acceptable and in accordance with the manufacturer's instructions.

2. The system operates for RCS monitoring during startup testing and power operations.

14.2.12.2.4.8 Automatic Rod Control System Test

A. Objective

1. To demonstrate the capability of the rod control system to respond to input signals.

B. Prerequisites

1. The reactor is at equilibrium at the power level specified by the startup test program.

2. Setpoints and controls for the pressurizer, SG, turbine bypass, and main feedwater pump are checked and set to proper values.

C. Test Method

1. T_{avg} is varied from the reference temperature (T_{ref}) setpoint to verify the transient recovery capabilities of the rod control system.

D. Acceptance Criterion

1. T_{avg} returns to within the control dead-band of the T_{ref} setpoint (see Subsection 7.7.1.1.1).

14.2.12.2.4.9 Operational Alignment of Process Temperature Instrumentation at Power Test (Continuation of 14.2.12.2.1.14)

A. Objective

1. To align ΔT and T_{avg} process instrumentation at power conditions.

B. Prerequisites

1. All RCPs are operating.

2. The RCS average temperature is within ±2° F of the hot no-load average temperature.

C. Test Method

1. Align ΔT and T_{avg} according to test instructions at approximately 75% power. Extrapolate the 75% data to determine ΔT and T_{avg} values for the 100% plateau.

2. At or near 100% power, check the alignment of the ΔT and T_{avg} channels for agreement with the results of the thermal power measurement.

D. Acceptance Criteria

1. The T_{avg} is within 0.5° F of the value calculated from the hot leg temperature (T_{hot}) and cold leg temperature (T_{cold}) converter outputs.

2. The measured ΔT for each channel is within 1% of the calorimetric power.

14.2.12.2.4.10 Thermal Power Measurement and Statepoint Data Collection Test

A. Objectives

1. To determine reactor power by performing a calorimetric power measurements at 30%, 50%, 75%, and 100% power.

2. To identify instrumentation for statepoint data collection.

3. To calibrate nuclear instruments, turbine inlet pressure instruments, ΔT instruments and main steam flow instruments.

B. Prerequisites

1. The following equipment is installed and checked out and is operational: sensor for measuring SG feedwater temperature, differential pressure measuring devices for determining feedwater flow to each SG, and pressure gauges to measure steam pressure at SG outlets.

2. The following control systems are in automatic: pressurizer pressure control, pressurizer level control, SG water level control and rod control.

C. Test Method

1. Collect data and calculate thermal power by calorimetric power measurements.

2. Obtain statepoint data, compute the average for each parameter measured, convert to the appropriate units, and summarize the data for each RCS loop.

3. Calibrate nuclear instruments, ΔT instruments and turbine inlet pressure instruments to the thermal power determined by the calorimetric power measurements.

4. Calibrate the main steam flow instruments to the main feedwater measurements.

D. Acceptance Criterion

1. The nuclear instruments, ΔT instruments, turbine inlet pressure instruments and main steam flow instruments are calibrated based on the collected data.

14.2.12.2.4.11 Ventilation Capability Test

A. Objective

1. To verify that various HVAC systems for the containment and areas housing ESF continue to maintain design temperatures.

B. Prerequisite

1. The plant is operating at or near the desired power (0%, 50%, and 100%).

C. Test Method

1. Record temperature readings in specified areas while operating with normal ventilation lineups.

2. Record temperature readings in specified areas while operating the designed minimum number of HVAC components consistent with existing plant conditions.

3. Record surface concrete temperatures adjacent to the high temperature piping penetrations and at selected locations on the concrete shielding primary shield wall, and at selected locations between the reactor vessel support base plates and concrete (at 100% power only).

4. Record outside air ambient environmental conditions.

D. Acceptance Criteria

1. Temperature conditions are maintained in the containment and ESF areas in accordance with Subsections 9.4.5, 9.4.6, and Table 9.4-1. It has been demonstrated through testing and analyses that the temperatures for these areas are being maintained within the design temperatures based on the design basis environmental conditions and design basis heat loads.

2. Concrete surface temperatures are maintained in accordance with Subsection 9.4.6.1.2.3.

14.2.12.2.4.12 RCS Flow Measurement Test

A. Objectives

1. As for RCS flow rate measurement, RCS flow rate is determined based on the correlation between data obtained by measuring RCP motor input power and the differential pressure across the reactor coolant line elbow tap, for the purpose of confirming reactor coolant flow is equal to or greater than the design flow specified in Section 5.1.

2. To perform calorimetric flow measurements at 50%, 75%, and 100% power, for the purpose of confirming RCS flow is equal to or greater than the design flow in Section 5.1.

B. Prerequisites

1. Required instrument calibration is completed.

2. Required support systems are operational.

3. The reactor core is installed, and the plant is at normal operating temperature and pressure prior to initial criticality.

C. Test Method

1. Prior to criticality, operating all RCPs and any combination of them including a single operation, input power of each operating RCP motor and relating RCS line elbow tap differential pressure is measured. RCS flow rate is calculated using the correlation between obtained RCP motor input power and RCS line elbow tap differential pressure.

2. Calorimetric flow measurements are performed at the 50%, 75%, and 100% power plateau and RCS flow is calculated.

3. RCS hydraulic resistance coefficients are calculated and recorded based on the RCS flow measurement data and temperature data of RCS is recorded.

D. Acceptance Criterion

1. Reactor coolant flowrate in each loop is equal to or greater than the design flow specified in Section 5.1.

14.2.12.2.4.13 Process and Effluent Radiation Monitoring System Test

A. Objectives

1. To verify the operation of the process and effluent radiation monitor against an acceptable standard.

2. To adjust control systems, if necessary, prior to proceeding to the next power plateau.

3. To establish baseline activity.

4. To demonstrate that process and effluent radiation monitoring systems are responding correctly by performing independent laboratory or other analyses.

This test abstract applies to monitors which:

- Are used for establishing conformance with Chapter 16 Technical Specifications.

- Are classified as ESF or are relied on to support or assure operation of the ESF within design limits.

- Are assumed to function or for which credit is taken in the accident analysis.

- Are used to in the processing, storage, control, or limiting the release of radioactive materials.

B. Prerequisites

1. The plant is stable at the desired power level.

2. The sampling systems for the process and effluent systems are operable.

3. Process and effluent monitors are calibrated.

C. Test Method

1. Operations are performed with the use of radioactive sources to verify proper operation of the monitors and detectors.

2. Baseline activity levels determined by sampling are established at 100% power to monitor the buildup of activity.

D. Acceptance Criteria

1. Process and effluent radiation monitors respond properly to radioactive standards (see Section 11.5).

2. Baseline activities are established.

14.2.12.2.4.14 Primary and Secondary Chemistry Test

A. Objective

1. To verify proper water quality in the RCS and secondary coolant system.

B. Prerequisite

1. The plant is at steady state condition at approximately 0%, 30%, 50%, 75%, and 100% power.

C. Test Method

1. Samples are taken and analyzed to determine the chemical and radiochemical concentrations.

D. Acceptance Criterion

1. The chemical and radiochemical control systems are capable of maintaining the water chemistry within limits specified by the manufacturer and described in Subsection 5.2.3.2 and Subsection 10.3.5.

14.2.12.2.4.15 Biological Shield Survey Test

A. Objectives

1. To document the radiation levels in accessible locations of the plant outside of the biological shield while at power.

2. To obtain baseline radiation levels for comparison with future measurements of level buildup with operation.

B. Prerequisites

1. Radiation survey instruments are calibrated.

2. Background radiation levels are measured in designated locations prior to initial criticality.

3. The plant is stable at the applicable power level.

C. Test Method

1. Gamma and neutron radiation dose rates at designated locations are measured at low power (normally at less than 5%), 50% and 100% power.

D. Acceptance Criterion

1. Radiation levels are demonstrated acceptable for full-power operation and are within the limits described in the design requirements.

14.2.12.2.4.16 Load Swing Test

A. Objective

1. To verify nuclear plant transient response, including automatic control system performance, when step-load changes are introduced to the turbine generator at 30%, 50%, 75%, and 100% power levels.

B. Prerequisite

1. The plant is operating in a steady state condition at the desired power level.

2. Control systems are in control mode in accordance with the desired power level.

C. Test Method

1. The turbine-generator output is changed as rapidly as possible to achieve a step load increase or decrease. Selected plant parameters are monitored and recorded during the load transients.

D. Acceptance Criterion

1. The primary and secondary control systems, with no manual intervention, maintain reactor power, RCS temperature, pressurizer pressure and level, SG levels and pressures within acceptable ranges during steady-state and transient operation.

14.2.12.2.4.17 LOOP at Greater Than 10 % Power Test

A. Objective

1. To demonstrate plant response following a plant trip with no offsite power available.

B. Prerequisites

1. The reactor is operated at approximately 30% power with the offsite power (i.e., reserve auxiliary transformers and unit auxiliary transformers) supplying station electrical load.

C. Test Method

1. Manually start equipment, as required, for protection of non safety-related secondary equipment.

2. Isolate the offsite power.

3. Verify reactor trip.

4. Verify automatic starting and automatic loading of Class 1E gas turbine generators.

5. Verify that natural circulation conditions are established.

6. Verify that the RCS can be maintained in a stable shutdown condition utilizing the power-operated atmospheric relief valves to remove decay heat.

7. Certain non safety-related, secondary plant equipment may be immediately restarted.

D. Acceptance Criteria

1. The automatic transfer from offsite power to the onsite Class 1E gas turbine generator is demonstrated.

2. The primary plant can be maintained in a stable condition on natural circulation using the battery and Class 1E gas turbine generators for 30 minutes.

14.2.12.2.4.18 Plant Trip from 100 % Power Test

A. Objective

1. To verify the ability of the plant automatic control systems to sustain a trip from 100% power and to bring the plant to stable conditions following the transient.

B. Prerequisite

1. The plant is operating in a steady-state condition at full power.

C. Test Method

1. The turbine-generator is tripped by manual turbine trip switch.

2. Selected plant parameters are monitored and recorded.

3. If necessary, the control systems setpoints are adjusted to obtain optimal response.

D. Acceptance Criteria

1. Following a reactor trip from 100% power, primary and secondary control systems and operator actions can stabilize RCS temperature, pressurizer pressure and level, and SG levels to no-load operating conditions.

2. The turbine bypass control system operates to prevent opening of primary and secondary safety valves.

14.2.12.2.4.19 100% Load Rejection Test

A. Objectives

1. To demonstrate satisfactory plant transient response to a 100% load rejection.

2. To monitor the RCS during these transients.

3. To optimize the RCS setpoints, if necessary.

B. Prerequisite

1. The plant is operating in a steady-state condition at full power.

2. Control systems are in control mode for full power operation.

3. Manual main turbine trip capability is available.

C. Test Method

1. With the plant at nominal full-power steady-state conditions, manually place the generator load break switch in the trip position to cause a 100% load rejection.

2. Selected plant parameters are monitored and recorded during the load transients.

3. If necessary, RCS setpoints are adjusted until optimal response is obtained.

D. Acceptance Criterion

1. The control systems maintain turbine speed, reactor power, RCS temperature, pressurizer level and pressure, and SG levels and pressures without causing a reactor or turbine trip, or lift primary or secondary safety valves during, or following, the transient operation.

14.2.12.2.4.20 Dynamic Response Test

A. Objectives

1. To verify during power range testing that stress analysis of essential NSSS and balance of plant components under transient conditions is in accordance with design.

2. Points are tested to resolve discrepancies from hot functional testing, to test modifications made since hot functional testing, and to test systems not tested during hot functional testing.

B. Prerequisites

1. Temporary instrumentation is installed, as required, to monitor the deflections of components under test.

2. Points are monitored and baseline data are established.

C. Test Method

1. Deflection measurements are recorded during various plant transients.

D. Acceptance Criteria

1. The movements due to flow-induced loads do not exceed the stress analysis of the monitored points.

2. Flow-induced movements and loads do not cause malfunctions of plant equipment or instrumentation.

14.2.12.2.4.21 Ultimate Heat Sink Heat Rejection Capability Test

A. Objectives

1. To determine the heat rejection capabilities of the ESWS to the ultimate heat sink while operating under partial heat load conditions.

2. To evaluate the heat rejection capabilities of the ESWS to the ultimate heat sink determined under test conditions and demonstrate that they meet the design requirements.

B. Prerequisites

1. The ESWS is operable.

2. The plant is operated in a manner to provide the ESWS with a heat load.

C. Test Method

1. Heat rejection capability of ESWS to the ultimate heat sink is measured in accordance with design requirements.

D. Acceptance Criteria

1. The heat rejection capability of the ESWS to the ultimate heat sink meets design requirements.

2. The heat rejection capability of two operating and four operating ESWS trains are verified.

14.2.12.2.4.22 Automatic High Power SG Water Level Control Test

A. Objective

1. To verify the stability of the automatic high power SG water level control system following simulated transients at 30% power conditions and the operation of the variable speed feature of the feedwater pumps.

B. Prerequisites

1. The reactor is critical, and in the 30% power level.

2. The high power SG water level control system is checked and calibrated.

3. Steam generator alarm setpoints are set for each SG.

C. Test Method

1. Induce simulated SG level transients to verify high power SG water level control response.

2. Verify the variable speed features of the main feedwater pumps by manipulation of controllers and test input signals.

D. Acceptance Criteria

1. The high power SG water level controller responds to maintain a stable SG level at setpoint (see Subsection 7.7.1.1.9).

2. The feedwater pump speed controller responds to maintain a stable feedwater pump discharge pressure at setpoint.

3. The main feedwater control valves open or close and stabilize in response to level setpoint changes.

14.2.13 Combined License Information

COL 14.2(1) Deleted

COL 14.2(2)	*The COL Applicant reconciles the site-specific organization, organizational titles, organizational responsibilities, and reporting relationships to be consistent with US-APWR Test Program Description Technical Report, MUAP-08009 (Reference 14.2-29) [14.2.2].*
COL 14.2(3)	*Deleted*
COL 14.2(4)	*Deleted*
COL 14.2(5)	*Deleted*
COL 14.2(6)	*Deleted*
COL 14.2(7)	*The COL Applicant provides an event-based schedule, relative to fuel loading, for conducting each major phase of the test program, and a schedule for the development of plant procedures that assures required procedures are available for use during the preparation, review and performance of preoperational and startup testing. For multiunit sites, the COL Applicant discusses the effects of overlapping initial test program schedules on organizations and personnel participating in each ITP. The COL Applicant identifies and cross-references each test or portion of a test required to be completed prior to fuel load which satisfies ITAAC requirements. [14.2.9] [14.2.11]*
COL 14.2(8)	*Deleted*
COL 14.2(9)	*Deleted*
COL 14.2(10)	*The COL Applicant is responsible for the testing outside scope of the certified design in accordance with the test criteria described in subsection 14.2.1. [14.2.12]*
COL 14.2(11)	*The COL holder for the first plant is to perform the first plant only tests and prototype test. For subsequent plants, either these tests are performed, or the COL Applicant provides a justification that the results of the first-plant only tests are applicable to the subsequent plant and are not required to be repeated. [14.2.8]*
COL 14.2(12)	*The COL holder makes available approved test procedures for satisfying testing requirements described in Section 14.2 to the NRC approximately 60 days prior to their intended use. [14.2.3, 14.2.11, 14.2.12.1]*

14.2.14 References

14.2-1 'Tests,' "Rules of General Applicability to domestic Licensing of Byproduct Material," Energy, Title 10, Code of Federal Regulations, Part 30.53, U.S. Nuclear Regulatory Commission, Washington, DC.

14.2-2 'Contents of Applications; Technical Information.' "Domestic Licensing of Production and Utilization Facilities," Energy, Title 10, Code of Federal Regulations, Part 50.34, U.S. Nuclear Regulatory Commission, Washington, DC.

14.2-3 'Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,' "Domestic Licensing of Production and Utilization Facilities," Energy, Title 10, Code of Federal Regulations, Part 50, Appendix B, U.S. Nuclear Regulatory Commission, Washington, DC.

14.2-4 'Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors,' "Domestic Licensing of Production and Utilization Facilities," Energy, Title 10, Code of Federal Regulations, Part 50, Appendix J, U.S. Nuclear Regulatory Commission, Washington, DC.

14.2-5 'Contents of Applications; Technical Information,' "Licenses, Certifications, and Approvals for Nuclear Power Plants," Energy, Title 10, Code of Federal Regulations, Part 52.79, U.S. Nuclear Regulatory Commission, Washington, DC.

14.2-6 "Licenses, Certifications, and Approvals for Nuclear Power Plants," Energy, Title 10, Code of Federal Regulations, Part 52, U.S. Nuclear Regulatory Commission, Washington, DC.

14.2-7 NUREG-0737, Clarification of TMI Action Plan Requirements, U.S. Nuclear Regulatory Commission, Washington, DC, November 1980.

14.2-8 'Contents of Applications,' "Licenses, Certifications, and Approvals for Nuclear Power Plants," Energy, Title 10, Code of Federal Regulations, Part 52.47(b)(1), U.S. Nuclear Regulatory Commission, Washington, DC.

14.2-9 Boiler and Pressure Vessel Code, American Society of Mechanical Engineers.

14.2-10 Initial Test Programs for Water-Cooled Nuclear Power Plants, Regulatory Guide 1.68, Rev. 3, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.2-11 Quality Assurance Program Requirements (Design and Construction), Regulatory Guide 1.28, Rev. 3, U.S. Nuclear Regulatory Commission, Washington, DC August 1985.

14.2-12 Reporting of Operating Information – Appendix A, Technical Specifications, Regulatory Guide 1.16, Rev. 4, U.S. Nuclear Regulatory Commission, Washington, DC, August 1975.

14.2-13 Comprehensive Vibration Assessment Program for Reactor Internals during Pre-operational and Initial Startup Testing, Regulatory Guide 1.20, Rev. 3, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.2-14 Combined License Applications for Nuclear Power Plants (LWR Edition), Regulatory Guide 1.206, U.S. Nuclear Regulatory Commission, Washington, DC, June 2007.

14.2-15 Boiler and Pressure Vessel Code, Section III, Division 1, NB of the ASME Code (NB-6220, Hydrostatic Test Requirements), American Society of Mechanical Engineers.

14.2-16 Safety I&C System Description and Design Process, TR MUAP-07004-P, Section 6.5.3.

14.2-17 Preoperational Testing of Instrument and Control Air Systems, Regulatory Guide 1.68.3, Rev. 3, U.S. Nuclear Regulatory Commission, Washington, DC, April 1982.

14.2-18 Deleted.

14.2-19 Nuclear Power Plant Air Cleaning Units and Components, ASME N509, American Society of Mechanical Engineers.

14.2-20 Cleanrooms and Associated Controlled Environments - Part 3: Test Methods, ASME N510, American Society of Mechanical Engineers.

14.2-21 Control of Heavy Loads at Nuclear Power Plants, NUREG-0612, Nuclear Regulatory Commission, Washington, DC July 1980.

14.2-22 Quality Standard for Instrument Air, ANSI/ISA S73-1975, American National Standards Institute/ISA.

14.2-23 Standard Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution, ASTM E 741-00 (Reapproved 2006), American Society for Testing and Materials International, West Conshohocken, PA.

14.2-24 Single Failure Proof Cranes for Nuclear Power Plants, NUREG-0554, Nuclear Regulatory Commission, Washington, DC May 1979

14.2-25 Design, Inspection and Testing Criteria for Normal Ventilation Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants, Regulatory Guide 1.140, Rev. 2, U.S. Nuclear Regulatory Commission, Washington, DC June 2001

14.2-26 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, Regulatory Guide 1.52, Rev. 3, U.S. Nuclear Regulatory Commission, Washington, DC June 2001

14.2-27 Code on Nuclear Air and Gas Treatment, ASME/ANSI AG-1-1997, American Society of Mechanical Engineers

14.2-28 Control Room Habitability at Light-Water Nuclear Power Reactors, Regulatory Guide 1.196, Rev. 1, U.S. Nuclear Regulatory Commission, Washington, DC January 2007

14.2-29 US-APWR Test Program Description Technical Report, MUAP-08009, Revision 1, October, 2009

14.2-30 Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder), ASME NOG-1-2004, American Society of Mechanical Engineers.

14.2-31 Below-the-Hook Lifting Devices, ASME B30.20-2006, American Society of Mechanical Engineers.

14.2-32 Performance-Based Containment Leak-Test Program, Regulatory Guide 1.163, Rev. 0, U.S. Nuclear Regulatory Commission, Washington, DC September 1995

14.2-33 Industry Guideline for Implementing Performance-Based Option of 10 CFR 50 Appendix J, NEI 94-01, Rev. 0, Nuclear Energy Institute, July 1995

14.2-34 Containment System Leakage Testing Requirements, ANSI/ANS-56.8-1994, American National Standard Institute, January 1994

Table 14.2-2 Regulatory Guides Associated with the ITP (Sheet 1 of 2)

1	Regulatory Guide 1.9, "Application and Testing of Safety-related Diesel-Generators in Nuclear Power Plants." Rev. 4, March 2007
2	RG 1.16, "Reporting of Operating Information – Appendix A Technical Specifications," Rev. 4, August 1975
3	RG 1.20, "Comprehensive Vibration Assessment Program for Reactor Internals during Pre-operational and Initial Startup Testing," Rev. 3, March 2007
4	RG 1.28, "Quality Assurance Program Requirements (Design and Construction)," Rev. 3, August 1985
5	RG 1.30, "Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electrical Equipment," August 1972
6	RG 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants," Rev. 1, March 2007
7	RG 1.41, "Preoperational Testing of Redundant Onsite Electric Power Systems to Verify Proper Load Group Assignments," Rev. 0, March 1973
8	RG 1.52, "Design, Inspection and Testing, Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered-Safety-Feature Atmospheric Cleanup Systems in Light-Water- Cooled Nuclear Power Plants," Rev. 3, June 2001
9	RG 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants," Rev. 3, March 2007
10	RG 1.68.2, "Initial Startup Test Program to Demonstrate Remote Shutdown Capability for Water-Cooled Nuclear Power Plants," Rev. 1, July 1978
11	RG 1.68.3, "Preoperational Testing of Instrument and Control Air Systems," Rev. 0, April 1982
12	RG 1.79, "Preoperational Testing of Emergency Core Cooling Systems for Pressurized Water Reactors," Rev. 1, September, 1975
13	RG 1.116, "Quality Assurance Requirements for Installation, Inspection, and Testing of Mechanical Equipment and Systems," Rev. 0, June 1976
14	RG 1.118, "Periodic Testing of Electric Power and Protection Systems," Rev. 3, April 1995
15	RG 1.128, "Installation Design and Installation of Vented Lead-Acid Storage Batteries for Nuclear Power Plants," Rev. 2, February 2007
16	RG 1.136, "Design Limits, Loading Combinations, Materials, Construction, and Testing of Concrete Containments," Rev. 3, March 2007
17	RG 1.140, "Design, Inspection and Testing Criteria for Air Filtration and Adsorption Units of Normal Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants," Rev. 2, June 2001
18	RG 1.206, "Combined License Applications for Nuclear Power Plants" (LWR Edition), June 2007
19	Regulatory Guide 1.163, "Performance-Based Containment Leak-Test Program," September 1995
20	RG 1.45, "Guidance on Monitoring and Responding to Reactor Coolant System Leakage," Rev.1, May 2008

Table 14.2-2 Regulatory Guides Associated with the ITP (Sheet 2 of 2)

21	RG 1.196, “Control Room Habitability at Light-Water Nuclear Power Reactors,” Rev. 1, January 2007
22	RG 1.35, “Inservice Inspection Of Ungrouted Tendons In Prestressed Concrete Containments,” Rev 3, July 1990
23	RG 1.35.1, “Determining Prestressing Forces For Inspection Of Prestressed Concrete Containments,” July 1990

Table 14.2-3 Power Ascension Test Metrix

	Power Level				
Test Number	**0%**	**30%**	**50%**	**75%**	**100%**
14.2.12.2.4.1	x	X	X	X	X
14.2.12.2.4.2		x	x	x	x
14.2.12.2.4.3			x	x	X
14.2.12.2.4.4	X	X	X	X	X
14.2.12.2.4.5			X		
14.2.12.2.4.6		≥10%			
14.2.12.2.4.7	To be determined in accordance with the manufacture's instructions.				
14.2.12.2.4.8	Not specified.				
14.2.12.2.4.9				x	x
14.2.12.2.4.10		X	X	X	X
14.2.12.2.4.11	X		x		x
14.2.12.2.4.12	Prior to criticality		X	X	X
14.2.12.2.4.13	Low power				x
14.2.12.2.4.14	X	X	X	X	x
14.2.12.2.4.15	Low power		X		X
14.2.12.2.4.16		X	X	X	x
14.2.12.2.4.17		X			
14.2.12.2.4.18					x
14.2.12.2.4.19					X
14.2.12.2.4.20	Not specified.				
14.2.12.2.4.21	Not specified.				
14.2.12.2.4.22		X			

14.3 Inspections, Tests, Analyses, and Acceptance Criteria

This purpose of section is to describe the bases, processes, and selection criteria used to develop the Tier 1 material (i.e., information), with emphasis on the level of detail provided in Tier 1. To this end, this section describes each section of the Tier 1 document and discusses its development.

This section provides the following information:

- Subsection 14.3.1 provides introductory information to help place the information that follows into context, including definitions of key terms used in the Tier 1 material
- Subsection 14.3.2 describes the content of Tier 1, Chapter 1, the introduction to the Tier 1 material
- Subsection 14.3.3 provides general information about how design descriptions and ITAAC are presented in Tier 1, Chapter 2
- Subsection 14.3.4 describes selection criteria used to develop ITAAC for specific aspects of the US-APWR design that appear in Tier 1, Chapter 2
- Subsection 14.3.5 discusses how interface requirements are presented in Tier 1, Chapter 3
- Subsection 14.3.6 identifies references cited in the text

Information provided in this section is in accordance with the NRC guidance contained in RG 1.206 (Reference 14.3-1) and NUREG-0800, “Standard Review Plan” (SRP) 14.3 (Reference 14.3-2).

This section contains no technical information not already presented in other sections of the Tier 2 material.

14.3.1 Introduction

This subsection describes the basis for the content of the Tier 1 material, defines terms used in design descriptions and related ITAAC, and briefly explains how the Tier 1 material is organized.

14.3.1.1 Basis for the Content of the Tier 1 Material

Information in this DCD is divided into two parts. Tier 1 contains information to be certified by the NRC in its approval of the US-APWR standard design. Tier 2 contains more detailed information that is approved but not certified by the NRC, which is similar to and in some cases identical with information to be included in the FSAR. The terms Tier 1 and Tier 2 are precisely defined in Subsection 14.3.1.2.

The type of information and the level of detail in Tier 1 are based on a graded approach commensurate with the safety significance of the SSCs for the design. Top-level design features of safety-related SSCs are addressed in Tier 1 with consideration of performance capabilities required to perform their safety functions. Non-safety related SSCs are evaluated on a case-by-case basis to ascertain the level of detail considered appropriate for Tier 1 based on their safety significance. Design-specific and unique features of the facility are included in Tier 1, as appropriate. The Tier 1 material is derived from the Tier 2 material.

The top-level information selected for Tier 1 includes the principal performance characteristics and safety functions of the SSCs, which are to be verified appropriately by ITAAC. ITAAC for non-safety related SSCs are developed based on their importance to safety, considering such factors as internal and external hazards analysis, fire protection, PRA insights and severe accident prevention and mitigation. The successful completion of all ITAAC is a prerequisite for fuel load and a condition of the license.

The ITAAC included in the Tier 1 material support the requirement in 10 CFR 52.97(b) (Reference 14.3-3) that ITAAC be used to verify the complete facility. To this end, the Tier 1 portion of the DCD provides ITAAC for all structures and systems within the scope of the certified design.

The primary basis for ITAAC appears in 10 CFR 52.80(a) (Reference 14.3-4). These requirements specify that a Combined License Application (COLA) must include the proposed inspections, tests, and analyses (including those that apply to emergency planning) that the licensee shall perform and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria are met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and applicable NRC regulations.

14.3.1.2 Definitions

The following definitions are used in the design descriptions and the related ITAAC to assure precision and consistency. Most are based on RG 1.206 (Reference 14.3-1) and SRP 14.3 (Reference 14.3-2).

- **Acceptance Criteria** means the performance, physical condition, or analysis result for a structure, system, or component that demonstrates that the Design Commitment is met.

- **Analysis** means a calculation, mathematical computation, or engineering/technical evaluation. Engineering or technical evaluations could include, but are not limited to, comparisons with operating experience or design of similar SSCs.

- **As-built** means the physical properties of a structure, system, or component following completion of its installation or construction activities at its final location at the plant site. In cases where it is technically justifiable, determination of physical properties of the as-built structure, system, or component may be based on measurements, inspections, or tests that occur prior to installation, provided that subsequent fabrication, handling, installation, and testing do not alter the properties.

- **ASME Code** means Section III of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code
- **ASME Code Report** means a report required by the ASME Code and whose content requirements are stipulated by the ASME Code. Each such ASME Code Report is final, and, when required, is certified in accordance with the Code.
- **Column line** is the designation applied to a plant reference grid used to define the locations of building walls and columns. Column lines may not represent the centerline of walls and columns.
- **Containment**, when this term is used as “the containment,” means the containment vessel or, as it is sometimes referred to, the prestressed concrete containment vessel.
- **Design commitment** means that portion of the design description that is verified by ITAAC.
- **Design description** means that portion of the design that is certified.
- **Design plant grade** means the elevation of the soil around the nuclear island assumed in the design (i.e., “plant grade” or “finished grade level”) in relation to plant structures to which other plant elevations are correlated and which is set at 2’-7”.
- **Division (for electrical systems)** is the designation applied to each portion of a given safety-related system (i.e., the set of connected electrical components) that is physically, electrically, and functionally independent from other redundant sets of components.
- **Division (for mechanical systems)** is the designation applied to a specific set of safety-related components that perform redundant, identical mechanical functions within a system.
- **Exists**, when this term is used in the acceptance criteria, means that the item is present and consistent with the design description.
- **Functional arrangement (for a system)** means that the physical arrangement of components in a system to provide the function for which the system is intended is as described in the Design Description.
- **Harsh environment** means the limiting environmental conditions resulting from a design basis accident.
- **Inspect or Inspection** means visual observations, physical examinations, or reviews of records based on visual observation or physical examination that compare the SSC condition to one or more Design Commitments. Examples include, but are not limited to, walkdowns, configuration checks, measurements of dimensions, and nondestructive examinations. Inspections may also include

review of design and construction documents including drawings, calculations, analyses, test procedures and results, certificates of compliance, purchase records, and other documents that verify that the Acceptance Criteria of a particular ITAAC are met.

- **Inspect for retrievability** of a display or alarm means to visually observe that the specified information appears on a monitor when summoned by the operator.
- **Operate** means the actuation, control, running, or shutting down (e.g., closing, turning off) of the equipment.
- **Physical arrangement or functional arrangement (for a structure)** means the arrangement of the building features (e.g., floors, ceilings, walls, doorways, and basemat) as described in the Design Description.
- **PSMS Control** means a safety-related control signal to a component or equipment from the protection and safety monitoring system. The signals may include automatic and remote-manual signals.
- **Qualified for a harsh environment** means that the subject equipment can withstand environmental conditions that would exist before, during, and after a design basis accident and still perform its safety function.
- **Raceway system** consists of the raceway (cable conduits and cable trays) and raceway supports including anchorages.
- **Reports** means, as used in the Acceptance Criteria, a document created by or for the licensee that verifies that the Acceptance Criteria of the subject ITAAC have been met and references the supporting documentation. Reports typically include, but are not limited to: results of walkdowns, results of visual inspections, field measurements, calculations, analyses, certificates of compliance, test results, or design and construction documents.
- **Tag number** means the identifying number associated with hardware. Tag numbers in Tier 1 provide unique identification of the items and include system designation.
- **Test or Testing** means actuation or operation, or establishment of specified conditions to evaluate the performance or integrity of as-built SSCs, unless explicitly stated otherwise.
- **Transfer open (or transfer closed)** means to move from a closed position to an open position (or vice versa).
- **Type test** means a test performed on one or more sample components to qualify other components of the same type and manufacturer. A type test is not necessarily a test of the as-built SSC.

14.3.1.3 General Organization of the Tier 1 Material

Tier 1 material is divided into three chapters, as follows:

- Chapter 1, Introduction
- Chapter 2, Design Descriptions and ITAAC
- Chapter 3, Interface Requirements

The contents of each chapter are described in the following subsections.

14.3.2 Chapter 1 of Tier 1, Introduction

This subsection summarizes the content of the first chapter of Tier 1 and its basis.

Chapter 1 of Tier 1 provides the following information:

- Definitions of key terms used in the Tier 1 document
- General provisions
- An explanation of how ITAAC are presented
- An explanation of how figures are used in connection with the design descriptions and ITAAC
- A legend identifying the meanings of symbols used in the Tier 1 figures

The material contained in Chapter 1 of Tier 1 is selected to help assure clarity in the Tier 1 information that follows. The definitions of key terms in Chapter 1 of Tier 1 are similar to those in this section, as is the explanation of how ITAAC are presented.

14.3.3 Chapter 2 of Tier 1, Design Descriptions and ITAAC

This subsection (1) describes how Chapter 2 is organized, (2) discusses the selection of top-level requirements for Tier 1, (3) outlines the general approach to design descriptions, (4) summarizes how tables are used, (5) discusses figures used in support of design descriptions, (6) summarizes measures taken to present information in the design descriptions in a consistent manner, and (7) discusses the tabular format and general content of ITAAC.

Chapter 2 of Tier 1, by providing the design descriptions and the related ITAAC, describes the scope of the certified design. It also describes the site parameters selected, which are not considered to be ITAAC as discussed in Subsection 14.3.4.1.

14.3.3.1 Chapter 2 Organization

To facilitate NRC staff review, the design descriptions and associated ITAAC in Chapter 2 of Tier 1 are organized like SRP 14.3 (Reference 14.3-2) as follows:

SRP Section	Tier 1 Section	Subject
14.3.1 – Relocated to SRP 2.0 (Reference 14.3-5)	2.1	Site Parameters
14.3.2 (Reference 14.3-6)	2.2	Structural and Systems Engineering
14.3.3 (Reference 14.3-7)	2.3	Piping Systems and Components
14.3.4 (Reference 14.3-8)	2.4	Reactor Systems
14.3.5 (Reference 14.3-9)	2.5	Instrumentation and Controls
14.3.6 (Reference 14.3-10)	2.6	Electrical Systems
14.3.7 (Reference 14.3-11)	2.7	Plant Systems
14.3.8 (Reference 14.3-12)	2.8	Radiation Protection
14.3.9 (Reference 14.3-13)	2.9	Human Factors Engineering
14.3.10 (Reference 14.3-14)	2.10	Emergency Planning
14.3.11 (Reference 14.3-15)	2.11	Containment Systems
14.3.12 (Reference 14.3-16)	2.12	Physical Security Hardware

Guidance contained in SRP Sections 14.3.1 through 14.3.12 – which are generally considered to be individual SRPs – is followed in preparation of the Tier 1 document.

The sections of Chapter 2 of Tier 1 that address these matters are numbered 2.1 through 2.12 to correspond with the SRP section numbers. Chapter 2 of Tier 1 also addresses two other matters that are not covered by sections of SRP 14.3: the design reliability assurance program and the initial test program.

Section 2.13 of Tier 1 addresses the design reliability assurance program and Section 2.14 addresses the initial test program. The SRP section upon which information in each of these sections of Tier 1 is based is identified in Subsections 14.3.4.13 and 14.3.4.14, respectively.

A Tier 1 design description is, as the name implies, a written description of a certain aspect of the US-APWR design that appears in the Tier 1 document as described in the next subsection.

14.3.3.2 General Approach to Design Descriptions

The Tier 1 design descriptions are prepared using information in the appropriate sections of Tier 2. In some cases, information in a Tier 1 section comes from sections in different Tier 2 chapters.

The Tier 1 design descriptions contain technical information expressed in narrative form, which is supplemented by tables and figures, with the following considerations:

- The design descriptions are derived from the Tier 2 document, as indicated previously.
- The Tier 1 design descriptions address the most safety-significant aspects of each of the systems of the design, describing the top-level design features and performance characteristics most significant to safety.
- The level of detail is governed by a graded approach related to the SSCs of the design, based on the safety significance of the functions they perform (i.e., the amount of design information provided is proportional to the safety significance of the structure or system).
- Some non-safety aspects of SSCs are not discussed in Tier 1.
- Figures are provided as described in Subsection 14.3.3.4 except in cases where the narrative is sufficient to describe a simple non safety-significant system.
- Regulations, codes, and standards are generally not cited or referenced in Tier 1; instead the applicable requirements from the regulations, codes, or standards are stated. (The Tier 2 information identifies regulations, codes, and standards.)
- Exceptions to this practice are made in certain cases involving reference to various parts of Section III of the ASME Boiler and Pressure Vessel Code (Reference 14.3-17) (generally referred to as the ASME Code) for verification of issues such as pressure boundaries, references to Section XI (Reference 14.3-18) of the ASME Code for pre-service inspection requirements, and references to 10 CFR 20 (Reference 14.3-19) for in relation to radiation protection. In such references to the ASME Code, details such as the specific code edition, volume, version, and date are not specified.
- The tables and figures identify the components, equipment, system piping, building walls, etc. that are verified by ITAAC. Additional information on tables as well as figures appears in Subsection 14.3.3.4.

Although there are some variations for different types of systems, the design description narratives generally provide the following information, as applicable:

- System purpose
- Significant performance characteristics and safety functions
- Whether the system is safety-related or not
- System location
- Key design features
- Seismic and ASME code classifications

- Description of system operation
- Major controls and displays related to the system that are available in the control room
- Logic circuits (i.e., system or component action in response to automatic signals)
- Interlocks needed for direct safety functions
- Class 1E power sources and divisions
- Equipment to be qualified for harsh environments (and other than harsh environment for certain instrumentation and control (I&C) equipment)
- Interface requirements
- Selected numeric performance values
- Key parameters in safety analyses

Numeric performance values and key parameters in safety analyses are specified in the design descriptions based on their safety significance when there is a specific reason to include them (e.g., it is important that they be maintained for the life of the facility).

While the design descriptions address these matters as applicable, they contain only the information necessary to define the scope of the certified design. Additional details appear in the Tier 2 material. However, because the Tier 1 material is self-contained in that it completely defines the top-tier requirements, it does not refer to Tier 2 information for additional details.

While the level of detail of design descriptions for non-safety systems will be less than for safety-related systems following the graded approach, each applicable topic in the bulleted list above will be briefly addressed for non-safety systems, as well as safety-related systems, to facilitate regulatory review.

14.3.3.3 Tables

Tables are used to supplement the text of the design descriptions in cases where information can be more concisely presented in tabular form. The ITAAC tables are discussed in Subsection 14.3.3.7.

14.3.3.4 Figures

Figures provided in support of design description are simplified schematic drawings. They provide the following information, as applicable:

- The figures depict the functional arrangement of the significant SSCs of the standard design

- The amount of information depicted is based on the safety significance of the SSCs, with figures for non safety-related systems having less detail than figures for safety-related systems

- The figures show components discussed in the design description

- The figures clearly delineate system boundaries with other systems

- Symbols used on the figures are similar to those used for Tier 2 figures, with any symbols unique to Tier 1 being consistent with industry practice or NRC usage

The Tier 1 introductory material includes a legend for the symbols used, as noted previously.

14.3.3.5 Safety Analyses and Probabilistic Risk Assessment Insights and Assumptions

The top-level requirements included in Tier 1 are selected based on risk insights regarding the safety significance of the SSCs, their importance in safety analyses, and their functions with respect to defense-in-depth considerations. Among the selection factors considered are the following:

- The presence of features or functions necessary to satisfy the NRC's regulations in 10 CFR 20 (Reference 14.3-19), 10 CFR 50 (Reference 14.3-20), 10 CFR 52 (Reference 14.3-21), 10 CFR 73 (Reference 14.3-22), or 10 CFR 100 (Reference 14.3-23)

- Whether the SSC is safety-related

- Whether the SSC includes one or more severe accident design features

- Whether there are important insights or assumptions from the probabilistic risk assessment (PRA) related to the SSC

- Relevant operating experience, including that documented in unresolved safety issues, generic safety issues, and TMI items, as well as that documented in NRC generic correspondence such as bulletins, circulars, and generic letters

- Assumptions and insights from key safety and integrated plant safety analyses in Tier 2, where plant performance is dependent on contributions from multiple systems of the design;

The guidance of RG 1.206 and individual SRP14.3 subsections cover the above selection criteria so that the significant parameters are addressed in the US-APWR Tier1. Tables 14.3-1a through 14.3-1f in this section summarizes information particularly significant to selection of top-level requirements for Tier 1. They cross reference the important design information and parameters used in key safety and integrated plant safety analyses to their treatment in Tier 1, and are divided into the following categories:

Table 14.3-1a Design Basis Accident Analysis Key Design Features

Table 14.3-1b Internal and External Hazards Analysis Key Design Features

Table 14.3-1c Fire Protection Key Design Features

Table 14.3-1d PRA and Severe Accident Analysis Key Design Features

Table 14.3-1e ATWS Key Design Features

Table 14.3-1f Radiological Analysis Key design features

The information in these tables is sufficiently detailed to assist a COL Applicant or licensee in determining whether a proposed design change impacts the treatment of these parameters in Tier 1. These tables, especially Table 14.3-1d, also contain key insights and key assumptions identified through the PRA (i.e. major risk significant SSCs).

Certain design features included in the tables for their importance to DBA analysis, hazards analysis, fire protection, ATWS or radiological analysis, are also identified as features considered in severe accident prevention or mitigation, or PRA insights. These features are presented in the appropriate tables, with reference to the Chapter 19 information for PRA (Section 19.1) or severe accident (Section 19.2) information. These key designs features are derived from appropriate Tier 2 chapters such as Chapters 2 through 10, 15, 16 and 19.

Because Tables 14.3-1a through 14.3-1f provide DCD Tier 1 to Tier 2 cross-references, their focus is on design features. Programmatic, operational aspects of the SSCs, such as system lineup during normal operation or maintenance requirements, are generally not the subject of Tier 1 information and are likewise excluded from Table 14.3-1a through 14.3-1f.

14.3.3.6 Consistency in Design Description Style

Consistency in style in design descriptions and the associated tables and figures is important and the following general guidelines are followed:

- Standard terminology as used in NRC RGs and the NUREG-0800 SRPs is used, consistent with Tier 2 terminology, and new terminology is avoided
- The term “associated” is generally not used to avoid possible confusion with the use of this term in control systems, where it has a particular meaning
- The present tense is consistently used, rather than the future tense
- The term “division” is consistently used instead of train
- Systems are described as safety-related (including Class 1E) or non safety-related (including non-Class 1E), instead of as essential and non-essential in general

- Numbers are expressed in English units
- Pressures are expressed in units that indicate whether the value is absolute, gauge, or differential

14.3.3.7 ITAAC Tabular Format and General Content

Table 14.3-2 provides examples of the arrangement of the ITAAC tables in Tier 1 and of typical content. All ITAAC are numbered similar to those shown in the table.

The first column of the ITAAC table identifies the proposed design requirement and/or commitment to be verified. This column contains the specific text of the design commitment, which is extracted from the design description. In cases where the specific design commitment is summarized, the statement in the first column retains the principal performance characteristics and safety functions of the design feature to be verified.

The second column of the ITAAC table identifies the proposed method – inspection, testing, analysis, or some combination of the three – by which the licensee will verify the design requirement/commitment described in first column.

The third column of the ITAAC table identifies the proposed specific acceptance criteria for the inspections, tests, and/or analyses described in second column that, if met, demonstrate that the licensee has met the design requirements/commitments in first column. These criteria are intended to be objective and unambiguous to prevent misinterpretation. When numeric performance values for SSCs are specified, these values are those assumed in the safety analyses, rather than the design values.

Criteria used for determining the most appropriate inspection, test, or analysis (or the appropriate combination of the three) for different types of SSCs are discussed in Subsections 14.3.4.2 through 14.3.4.13.

14.3.4 Chapter 2 of Tier 1, Development of Specific ITAAC

This subsection summarizes how ITAAC are developed for the various sections of Chapter 2. To completely define the US-APWR design as it is to be certified by the NRC, it is necessary to address major plant systems. Tables 14.3-3 through 14.3-7 identify the systems considered for ITAAC purposes by category, with the categories as follows:

- Reactor systems
- Instrumentation and control systems
- Electrical systems
- Plant systems
- Containment systems

System ITAAC differ depending on the type of system, with differences among fluid systems, I&C systems, and electrical systems. In some cases, ITAAC are provided for key parameters for accident analyses using information summarized in Tables 14.3-1a through 14.3-1f. Examples of typical ITAAC are provided in Table 14.3-2.

The ITAAC design commitments are developed from the Tier 1 design descriptions and are subject to a similar approach to determining level of detail, as described in Subsection 14.3.3.2:

- ITAAC address the most safety-significant aspects of each of the systems of the design, describing the top-level design features and performance characteristics most significant to safety.

- Numeric performance values are included for in the ITAAC acceptance criteria for selected performance characteristics consistent with safety analysis assumptions

- ITAAC level of detail is governed by a graded approach related to the SSCs of the design, based on the safety significance of the functions they perform.

Some non-safety aspects of SSCs are not subject to ITAAC. ITAAC for non-safety related SSCs in the certified design may be limited to inspection of the functional arrangement to verify conformance with the design description. Non-safety SSCs that are risk-significant, or that have a severe accident mitigation or prevention function, are verified to exist in the as-built plant by ITAAC. The existence of risk-significant, non-safety related design features may be verified by specific ITAAC or included in the functional arrangement ITAAC of its related system.

14.3.4.1 ITAAC for Site Parameters

Section 2.1 of Tier 1, which addresses site parameters, is prepared in accordance with the guidance in RG 1.206 (Reference 14.3-1), SRP 14.3 (Reference 14.3-2), and SRP 2.0 (Reference 14.3-5). No ITAAC are provided for site parameters. Instead key site design parameters associated with the US-APWR standard design are identified and their values specified; these values are selected to accommodate a wide range of potential sites. An actual site for construction of a US-APWR plant will be acceptable if its characteristics fall within the specified design parameter values.

14.3.4.2 ITAAC for Structural and Systems Engineering

Section 2.2 of Tier 1, which addresses structural and systems engineering, is prepared in accordance with the guidance in RG 1.206 (Reference 14.3-1), SRP 14.3 (Reference 14.3-2), and SRP 14.3.2 (Reference 14.3-6). ITAAC for structural and systems engineering focus on building structures. The design for the structural aspects of major components, such as the reactor vessel, pressurizer, and steam generator is addressed in Sections 2.3 and 2.4 of Tier 1. The different matters are addressed for each building as applicable. These matters and the associated General Design Criteria (GDC) of Appendix A to 10 CFR 50 (Reference 14.3-24) are as follows:

- Pressure boundary integrity (GDC 14, “Reactor Coolant Pressure Boundary, GDC 16, “Containment Design,” and GDC 50, “Containment Design Basis”)

- Normal loads (GDC 2, “Design Bases for Protection Against Natural Phenomena”)

- Seismic loads (GDC 2)
- Flood, wind, and tornado (GDC 2)
- Rain and snow (GDC 2)
- Pipe rupture (GDC 4)
- Codes and standards (GDC 1, "Quality Standards and Records")
- Containment integrity (GDC 16, "Containment Design")
- As-built reconciliation

14.3.4.3 ITAAC for Piping Systems and Components

Section 2.3 of Tier 1, which addresses piping systems and components, is prepared in accordance with the guidance in RG 1.206 (Reference 14.3-1), SRP 14.3 (Reference 14.3-2), and SRP 14.3.3 (Reference 14.3-7). The ITAAC in this section address piping system design and components, along with dynamic qualification, welding, fasteners, and safety classification of SSCs, covering matters such as the following:

- Piping design criteria, structural integrity, and functional capability of safety-related and risk-significant piping
- ASME Code Class 1, 2, and 3 piping and supports
- Buried piping and instrumentation lines
- Interaction of non-seismic piping with seismic Category I piping
- Any safety-related and risk-significant piping designed to industry standards other than the ASME Code
- Analysis methods, modeling techniques, pipe stress analysis criteria, pipe support design criteria, high-energy line break criteria, and the leak before break (LBB) approach, as applicable

Generic ITAAC – which apply to all ASME Class 1, 2, and 3 piping systems and high-energy piping systems – provide for as follows:

- Requiring the existence of a design report to assure that the ASME Code Class 1 piping system and components are designed to retain their pressure boundary integrity and functional capability under internal design and operating pressures and design-basis loads.
- Requiring the existence of an ASME Code-certified stress report to assure that the as-built ASME Code Class 1, 2, and 3 piping systems and components are

designed to retain their pressure boundary integrity and functional capability under internal design and operating pressures and design-basis loads.

- Requiring the existence of a pipe break analysis report that documents that the as-built SSCs that are required to be functional during and following a safe-shutdown earthquake have adequate high-energy pipe break mitigation features.

- Requiring the existence of an LBB evaluation report that documents that the as-built piping and piping materials comply with the LBB acceptance criteria for the systems to which LBB is applied.

- Requiring the existence of a report that documents the results of an as-built reconciliation confirming that the piping systems are built in accordance with the ASME Code certified stress report.

ITAAC for specific systems typically verify the following:

- Requirements such as piping and component safety classification

- Fabrication, especially pressure-boundary weld quality

- Hydrostatic testing

- Equipment seismic and dynamic qualification

- Design qualification of valves

Such ITAAC also address the verification of applicable dynamic qualification records and vendor test records, as well as performance of appropriate in-situ tests. All of these matters are addressed for safety-related systems, and appropriate ones are addressed for non-safety systems.

These ITAAC for the individual systems are covered in each plant system ITAAC such as Sections 2.4, 2.7 and 2.11 of Tier 1.

14.3.4.4 ITAAC for Reactor Systems

Section 2.4 of Tier 1, which addresses reactor systems identified in Table 14.3-3, is prepared in accordance with the guidance in RG 1.206 (Reference 14.3-1), SRP 14.3 (Reference 14.3-2), and SRP 14.3.4 (Reference 14.3-8). ITAAC for reactor systems are provided to verify the following:

- Important input parameters used in the transient and accident analyses for the facility design

- Net positive suction head for key pumps

- The design pressures of the piping systems that interface with the reactor coolant boundary to validate intersystem LOCA analyses

ITAAC are also specified to verify the following top-level design aspects of reactor systems:

- Functional arrangement
- Seismic and ASME Code classification
- Weld quality and pressure boundary integrity
- Valve qualification and operation
- Controls, alarms, and displays
- Logic and interlocks
- Equipment qualification for harsh environments
- Interface requirements with other systems
- Numeric performance values
- Class 1E electrical power sources and divisions, if applicable
- System operation in various modes

ITAAC for the reactor system fluid systems follow NRC guidelines for fluid systems ITAAC in Appendix C.II.1-A of RG 1.206 (Reference 14.3-1), including those for figure content and ITAAC style.

All of these matters are addressed for safety-related systems, and appropriate ones are addressed for non-safety systems. Table 14.3-3 shows the selected system as reactor systems in Tier 1.

14.3.4.5 ITAAC for Instrumentation and Controls

Section 2.5 of Tier 1, which addresses instrumentation and controls, is prepared in accordance with the guidance in RG 1.206 (Reference 14.3-1), SRP 14.3 (Reference 14.3-2), and SRP 14.3.5 (Reference 14.3-9). ITAAC for I&C equipment address compliance with 10 CFR 50.55a(h) (Reference 14.3-26) and applicable sections of Institute of Electrical and Electronics Engineers (IEEE) Standard 603-1991 (and the correction sheet dated January 30, 1995) (Ref 14.3-27), as they pertain to safety systems. These ITAAC also address compliance with the following GDC set forth in Appendix A of 10 CFR 50 (Reference 14.3-24):

- GDC 1, “Quality Standards and Records,” as it pertains to quality standards for design, fabrication, erection, and testing

- GDC 2, “Design Bases for Protection Against Natural Phenomena,” as it pertains to protection against natural phenomenon
- GDC 4, “Environmental and Dynamic Effects Design Bases,” as it pertains to environmental and dynamic effects
- GDC 13, “Instrumentation and Control,” as it pertains to I&C requirements
- GDC 19, “Control Room,” as it pertains to control room requirements
- GDC 20, “Protection System Functions,” as it pertains to protection system design requirements
- GDC 21, “Protection System Reliability and Testability,” as it pertains to protection system reliability and testability requirements
- GDC 22, “Protection System Independence,” as it pertains to protection system independence requirements
- GDC 23, “Protection System Failure Modes,” as it pertains to protection system failure modes requirements
- GDC 24, “Separation of Protection and Control Systems,” as it pertains to separation of protection systems from control systems
- GDC 25, “Protection System Requirements for Reactivity Control Malfunctions,” as it pertains to protection system requirements for reactivity control malfunctions
- GDC 29, “Protection Against Anticipated Operational Occurrences,” as it pertains to protection against anticipated operational occurrences (AOOs).

ITAAC are also provided for documentation of a high-quality software design process consistent with each of the management, implementation, and resource characteristics shown in branch technical position (BTP) 7-14, “Guidance on Software Reviews for Digital Computer-Based Instrumentation and Controls Systems,” (Ref 14.3-28) in SRP Chapter 7 (Ref 14.3-29).

Conformance of the I&C systems’ design to criteria in IEEE 603-1991, with cross references to applicable Tier 1 information including ITAAC, is provided in Table 14.3-8.

Design descriptions for I&C equipment follow guidelines of Appendix C.II.1-A of RG 1.206 (Reference 14.3-1) and address the following matters:

- Hardware architecture, describing all hardware modules, cabinet layout and wiring, seismic and environmental control requirements, and power sources
- Software architecture, describing design specifications, code listings, and build documents and providing installation configuration tables

- RGs that have specific recommendations
- Operating experience, including safety-significant problems identified by NRC
- Policy issues raised for the standard designs
- New design features, such as communications between various portions of the digital system or other systems
- Any insights or key assumptions identified through the PRA (Table 14.3-1)
- Generic safety issue resolutions that have resulted in design/operational features
- Post-TMI requirements such as post-accident monitoring

NRC style guidelines for I&C systems ITAAC in Appendix C.II.1-A of RG 1.206 (Reference 14.3-1) are also followed.

The systems specified in Table 14.3-4 are addressed in the Tier 1.

14.3.4.6 ITAAC for Electrical Systems

Section 2.6 of Tier 1, which addresses electrical systems, is prepared in accordance with the guidance in RG 1.206 (Reference 14.3-1), SRP 14.3 (Reference 14.3-2), and SRP 14.3.6 (Reference 14.3-10). ITAAC are provided for the entire station electrical system, including Class 1E portions of the system, the offsite power system (including site-specific interfaces addressed in Tier 1 Chapter 3), equipment qualification, major portions of the non-Class 1E system, and portions of the plant lighting, grounding, lighting systems, and containment electrical penetrations. ITAAC for electrical systems and equipment verify the following:

- Equipment qualification for seismic and harsh environments, verifying that Class 1E equipment is seismic Category I and that equipment located in a harsh environment is qualified
- Redundancy and independence, verifying Class 1E divisional assignments and independence of electric power by both inspections and tests
- Capacity and capability, including such attributes as adequate sizing of the electrical system equipment and its ability to respond to postulated events and its ability to power the loads
- Electrical protection features, including attributes such as analyzing the ability of the as-built electrical system equipment to withstand and clear electrical faults analyzing the protection feature coordination
- Displays, controls, and alarms, verifying by inspection the ability to retrieve the information (displays and alarms) and to control the electrical power system in the MCR and/or at locations provided for remote shutdown

- Offsite power, verifying by inspection the direct connection of offsite power sources to the Class 1E divisions as well as the adequacy of voltage, capacity, and independence/separation of the offsite sources and appropriate lightning protection and grounding features

- Containment electrical penetrations, including verifying that all electrical containment penetrations are protected against postulated currents greater than their continuous current rating

- The alternate ac power source, verifying through inspection and testing of the gas turbines and their auxiliaries the availability of the this power source for station blackout (SBO) events, as well as its independence from other ac sources

- Lighting, including the continuity of power sources for plant lighting systems to assure that portions of the plant lighting remain available during accident scenarios and power failures

- Electrical power for non-safety plant systems, including the functional arrangement of electrical power systems provided to support non-safety systems to the extent that those systems perform a significant safety function

- Physical separation and independence, verifying separation and independence of redundant electrical equipment, circuits, and cabling for post-fire safe shutdown

Design descriptions for electrical systems follow NRC guidelines for electric systems ITAAC in Appendix C.II.1-A of RG 1.206 (Reference 14.3-1). These design descriptions address electrical equipment that is involved in performing the direct safety function. Such equipment includes the complete Class 1E electrical system, including power sources (which include offsite sources even though they are not Class 1E) and dc and ac distribution equipment.

Design descriptions also address additional relevant factors related to the electrical equipment that are not part of the Class 1E system, but are included to improve the reliability of the individual Class 1E divisions. Brief design descriptions are included for the non-Class 1E portions of the electrical system that power the balance of plant loads; these generally focus on the aspects needed to support the Class 1E portion.

Consistent with these criteria, the electrical system design descriptions address the following equipment:

- The overall Class 1E electric distribution system

- Power sources

- Other electrical features, such as containment electrical penetrations and cable ampacity and derating criteria

- Lightning protection, which involves a general configuration type check

- Grounding, which also involves a configuration type check
- Lighting for the main control room and remote shutdown console room
- Requirements specified by GDC 17, "Electric Power Systems," and GDC 18, "Inspection and Testing of Electric Power Systems"
- Other specific rules and regulations that are applicable to electrical systems, such as the SBO rule (10 CFR 50.63 (Reference 14.3-30))
- RGs that have specific recommendations
- Safety-significant operating experience problems that have been identified, particularly through electrical distribution system functional inspections, generic letters, circulars, regulatory issue summaries, NRC bulletins, and in some cases, information notices
- Policy issues raised for the standard designs
- New features in the design significant enough to warrant Tier 1 treatment
- Insights or key assumptions from the PRA, which typically involves SBO, which should already receive treatment in ITAAC because of consideration given to SBO as indicated previously
- Severe accident features added to the design
- Post-TMI requirements such as power to the power-operated relief valves, block valves, and pressurizer heaters

Consistent with Appendix C.II.1-A of RG 1.206 (Reference 14.3-1), ITAAC entries for this equipment address (1) arrangement/configuration; (2) independence; (3) capacity and capability; (4) equipment protective features; (5) sensing instrumentation and logic; (6) controls, displays, and alarms; (7) test features; (8) connection of non-Class 1E loads on Class 1E busses; and (9) the location of equipment.

Based on the above criteria, the systems identified in Table 14.3-5 are selected as electrical systems in Tier 1.

14.3.4.7 ITAAC for Plant Systems

Section 2.7 of Tier 1, which addresses plant systems, is prepared in accordance with the guidance in RG 1.206 (Reference 14.3-1), SRP 14.3 (Reference 14.3-2), and SRP 14.3.7 (Reference 14.3-11). As indicated in Table 14.3-6, plant systems comprise most of the fluid systems that are not part of the reactor systems, including power generation systems; air systems; cooling water systems; radioactive waste systems; and HVAC systems, along with auxiliary systems, fire protection systems, and fuel handling systems. ITAAC are specified for these systems to provide for, as applicable:

- As-built plant reports for reconciliation with flood analyses to assure consistency with design requirements of SSCs for flood protection and mitigation
- As-built plant reports for reconciliation with post-fire safe shutdown analyses to assure consistency with design requirements of SSCs for fire protection and mitigation
- Verifying heat removal capabilities for design-basis accidents as well as tornado and missile protection
- Verifying net positive suction head for key pumps
- Verifying physical separation for appropriate systems
- Verifying that the minimum inventory of alarms, controls, and indications – as derived from emergency procedure guidelines; RG 1.97(Reference 14.3-31); and PRA insights – is provided for the MCR and remote shutdown stations
- Commensurate with the importance of the design attribute to safety, verifying the following design attributes for plant systems:
    - Functional arrangement
    - Key design features of systems
    - Seismic and ASME code classifications
    - Weld quality and pressure boundary integrity, as necessary
    - Valve qualification and operation
    - Controls, alarms, and displays
    - Logic and interlocks
    - Equipment qualification for harsh environments
    - Required interfaces with other systems
    - Numeric performance values
- Verifying the performance of the liquid waste management system (as permanently installed systems or in combination with mobile processing equipment)
- Verifying the performance of the gaseous waste management system (as permanently installed systems

- Verifying the performance of the solid waste management system (as permanently installed systems or in combination with mobile processing equipment)
- Verifying the performance of the process and effluent radiological monitoring instrumentation and sampling systems (as permanently installed systems or in combination with portable skid-mounted equipment)
- Verifying the performance of the light load handling system and overhead heavy load handling system.

ITAAC for plant piping systems follow NRC guidelines for fluid systems ITAAC in Appendix C.II.1-A of RG 1.206 (Reference 14.3-1), as summarized above.

Table 14.3-6 lists the systems which the design is addressed in Tier 1.

The COL Applicant provides the ITAAC for the site specific portion of the plant systems specified in Subsection 14.3.5, Interface Requirements.

14.3.4.8 ITAAC for Radiation Protection

Section 2.8 of Tier 1, which addresses radiation protection, is prepared in accordance with the guidance in RG 1.206 (Reference 14.3-1), SRP 14.3 (Reference 14.3-2), and SRP 14.3.8 (Reference 14.3-12). ITAAC related to radiation protection are provided for those SSCs that provide radiation shielding, confinement or containment of radioactivity, ventilation of airborne contamination, or monitoring of radiation (or radioactivity concentration) for normal operations and during accidents. These ITAAC provide for the following:

- Verifying the adequacy of as-built walls, structures, and buildings as radiation shields, as applicable
- Verifying the plant airborne concentrations of radioactive materials through adequate design of ventilation and airborne monitoring systems
- Verifying the functional arrangement of ventilation systems
- Verifying the operability of radiation detection and monitoring equipment in accordance with the requirements of 10 CFR 50.49(b)(3) (Reference 14.3-32) and guidance in RG 1.97, Rev. 4 (Reference 14.3-31) (related to Section 2.5 of Tier 1)
- Verifying radiation and airborne radioactivity levels within plant rooms and areas to assure the adequacy of plant shielding and ventilation system designs
- Verifying that radiation levels are commensurate with area access requirements and with as low as reasonably achievable (ALARA) principles during normal plant operations and maintenance

- Verifying that adequate shielding is provided to assure that radiation levels in plant areas are within the limits necessary for operator actions to aid in mitigating or recovering from an accident
- Verifying that the contribution of gamma radiation shine to the radiation dose to an offsite member of the public will be a small fraction of the dose limits of 40 CFR 190 (Reference 14.3-33).

14.3.4.9 ITAAC for Human Factors Engineering

Section 2.9 of Tier 1, which deals with human factors engineering (HFE), is prepared in accordance with the guidance in RG 1.206 (Reference 14.3-1), SRP 14.3 (Reference 14.3-2), and SRP 14.3.9 (Reference 14.3-13). ITAAC for HFE pertain to main control panels, remote shutdown panels, local control panels, the TSC, and the emergency offsite facility. They address the minimum inventory of alarms, controls, and indications appropriate for the MCR and the remote shutdown station. These ITAAC provide for verifying the HFE aspects of:

- The MCR, ensuring that the as-built design conforms with the verified and validated design that resulted from the HFE design process
- The remote shutdown station (e.g., functionality and minimum inventory of remote shutdown station controls, displays, and alarms)
- Safety-related local control stations and those local control stations associated with risk-important and credited human actions (e.g., functionality and minimum inventory of local control station controls, displays, and alarms)
- The TSC
- The emergency offsite facility

14.3.4.10 ITAAC for Emergency Planning

Section 2.10 of Tier 1, which covers emergency planning, is prepared in accordance with the guidance in RG 1.206 (Reference 14.3-1) and SRP 14.3.10 (Reference 14.3-14). ITAAC for the emergency planning are provided in accordance with the requirements of 10 CFR 52.47(b) (Ref 14.3-41). These ITAAC are consistent with the applicable generic ITAAC in Table C.II.1-B1 of Appendix C.II.1-B to RG 1.206 (Reference 14.3-1) and provide for verifying the following:

- Minimum floor space in the TSC
- A habitable environment in the TSC
- Means of communications among the MCR, the TSC, and the emergency operations facility

- A data communications system to provide plant data exchange among the MCR, the TSC, and the emergency operations facility
- The emergency response data system

The COL Applicant provides proposed ITAAC for the facility's emergency planning not addressed in the DCD in accordance with RG 1.206 (Reference 14.3-1) as appropriate.

14.3.4.11 ITAAC for Containment Systems

Section 2.11 of Tier 1 on containment systems is prepared in accordance with the guidance in RG 1.206 (Reference 14.3-1), SRP 14.3 (Reference 14.3-2), and SRP 14.3.11 (Reference 14.3-15). Table 14.3-7 lists the systems addressed in Section 2.11 of Tier1. ITAAC for containment systems focus mainly on containment design and associated issues, such as containment isolation provisions, containment leakage testing, hydrogen generation and control, containment heat removal, and subcompartment analysis. These ITAAC provide for verifying the following:

- Key parameters and insights from containment safety analyses, such as LOCA, main steam line break, main feed line break, and subcompartment analyses
- The existence of severe accident prevention and mitigation design features
- The functional arrangements of containment isolation provisions
- The design qualification of containment isolation valves
- The containment isolation functions of motor-operated valves and check valves by in-situ testing
- Containment isolation signal generation
- Containment isolation valve closure times
- Containment isolation valve leakage
- The minimum inventory of alarms, displays, and controls

14.3.4.12 ITAAC for Physical Security Hardware

Section 2.12 of Tier 1 which addresses standard plant physical security hardware, is based on the generic set of physical security hardware ITAAC (developed by the NRC in coordination with the Nuclear Energy Institute) provided in SRP 14.3.12 (Reference 14.3-16). The standard plant physical security ITAAC are consistent with the guidance provided in SRP 14.3 (Reference 14.3-2) and the applicable generic ITAAC in SRP 14.3.12 (Reference 14.3-16). They provide for verifying that:

- Vital equipment is located only within vital areas.

- The external walls, doors, ceiling and floors in the main control room and the central alarm station are bullet resistant.
- Unoccupied vital areas are locked and alarmed with activated intrusion detection systems that annunciate in the central alarm station.
- Security alarm annunciation and video assessment information are available in the central alarm station.
- The central alarm station is located inside a protected area and the interior of the alarm station is not visible from the perimeter of the protected area.
- The secondary security power supply system for alarm annunciator equipment and non-portable communications equipment is located within a vital area.
- Security alarm devices including transmission lines to annunciators are tamper indicating and self-checking (i.e., an automatic indication is provided when failure of the alarm system or a component occurs or when on standby power), and alarm annunciation indicates the type of alarm (e.g., intrusion alarms, emergency exit alarm, etc.) and location.
- Intrusion detection and assessment systems are designed to provide visual display and audible annunciation of alarms in the central alarm station.
- Intrusion detection systems equipment exists to record onsite security alarm annunciation including the location of the alarm, false alarm, alarm check, and tamper indication and the type of alarm, location, alarm circuit, date and time.
- Emergency exits through vital area boundaries are alarmed and secured by locking devices that allow prompt egress during an emergency.
- The central alarm station has conventional (land line) telephone service with local law enforcement authorities and a system for communication with the main control room and is capable of continuous communication with security personnel.

System tests of physical protection systems and related design features are performed as acceptance tests under the US-APWR Test Program Description, MUAP-08009 (Reference 14.3-39). Tests of installed physical security hardware to verify proper installation and functionality of security hardware components are performed as construction acceptance tests and installation tests as specified in MUAP-08009 (Reference 14.3-39). The organization, processes and controls for system acceptance tests, construction acceptance tests, and installation tests are as specified by MUAP-08009 (Reference 14.3-39). Descriptions of the specific inspections, tests and analyses for US-APWR physical protection systems provided in Table 2.12-1 of Tier 1 of the DCD are specified in “US-APWR Physical Security Hardware ITAAC Abstracts, “MUAP-10003”(Reference 14.3-40)

The COL Applicant provides ITAAC for the facility’s physical security hardware not addressed in the DCD, in accordance with RG 1.206 (Reference 14.3-1) as appropriate, and provides abstracts describing the specific inspections, tests and analyses for the facility's physical security hardware ITAAC not addressed in the DCD.

14.3.4.13 ITAAC for the Design Reliability Assurance Program

Section 2.13 of Tier 1, which covers the design reliability assurance program, is prepared in accordance with the guidance in RG 1.206 (Reference 14.3-1), SRP 14.3 (Reference 14.3-2), and SRP 17.4 (Reference 14.3-36).

Section 17.4 describes the design reliability assurance program, which is developed in accordance with guidance in NUREG-0800, SRP 17.4 (Ref 14.3-36). The purposes of this program are to provide reasonable assurance that: (1) the US-APWR is designed and constructed in a manner that is consistent with the assumptions and risk insights for the SSCs and (2) the risk-significant SSCs function reliably when challenged. An additional goal is to facilitate communication among the PRA, the design, and the ultimate COL activity to assure that the design is consistent and integrated with the procurement process. To this end, Table 17.4-1 identifies risk-significant SSCs for the US-APWR design.

Section 2.13 of Tier 1 contains a brief summary of the design reliability assurance program based on details provided in Section 17.4. The risk significant SSCs will be identified by introducing site-specific information to the list shown in Table 17.4-1. A single ITAAC is provided to verify that that the design reliability assurance program provides reasonable assurance that the designs of these SSCs are consistent with the assumptions used in the associated risk analyses.

14.3.4.14 ITAAC for the Initial Test Program

Section 2.14 of Tier 1, which addresses the initial test program, is prepared in accordance with the guidance in RG 1.206 (Reference 14.3-1), SRP 14.3 (Reference 14.3-2), and SRP 14.2 (Reference 14.3-37).

Section 14.2 describes the initial test program for the US-APWR plant, which is developed in accordance with guidance in RG 1.68 (Reference 14.3-38), RG 1.206 (Reference 14.3-1) and SRP 14.2 (Reference 14.3-37). Some of the activities associated with the initial test program occur as a part of the initial plant startup.

Section 2.14, of Tier 1 provides a general description of the preoperational and startup test programs and the major program documents that define how the initial test program is to be conducted and controlled. This section also describes the key elements of the initial test program.

No ITAAC are necessary for the initial test program because all ITAAC are to be completed prior to fuel load.

14.3.5 Chapter 3 of Tier 1, Interface Requirements

Chapter 3 of Tier 1 focuses on the interface requirements of the safety-significant design attributes. The interface requirements in Chapter 3 of Tier 1 define the safety-significant design attributes and performance characteristics that assure that the site-specific portion of the design is in conformance with the certified design. The site-specific portions of the design are those portions of the design that are dependent on characteristics of the site.

Chapter 3 of Tier 1 also identifies the scope of the design to be certified by specifying the systems that are completely or partially out of scope of the certified design. Thus, interface requirements are defined for: (a) systems that are entirely outside the scope of the design, and (b) the out-of-scope portions of those systems that are only partially within the scope of the standard design based on the above methodology.

14.3.6 Combined License Information

COL 14.3(1) *The COL Applicant provides the ITAAC for the site specific portion of the plant systems specified in Subsection 14.3.5, Interface Requirements. [14.3.4.6, 14.3.4.7]*

COL 14.3(2) *The COL Applicant provides ITAAC for the facility's emergency planning not addressed in the DCD in accordance with RG 1.206 (Reference 14.3-1) as appropriate. [14.3.4.10]*

COL 14.3(3) *The COL Applicant provides ITAAC for the facility's physical security hardware not addressed in the DCD, in accordance with RG 1.206 (Reference 14.3-1) as appropriate, and provides abstracts describing the specific inspections, tests and analysis for the facility's physical security hardware ITAAC not addressed in the DCD. [14.3.4.12]*

14.3.7 References

14.3-1 Combined License Applications for Nuclear Power Plants (LWR Edition). Regulatory Guide 1.206, U.S. Nuclear Regulatory Commission, Washington, DC, June 2007.

14.3-2 'Inspections, Tests, Analyses, and Acceptance Criteria,' "Initial Test Program and ITAAC – Design Certification," Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 14.3, Initial Issuance, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-3 'Issuance of Combined Licenses,' "Licenses, Certifications, and Approvals for Nuclear Power Plants," Energy. Title 10, Code of Federal Regulations, Part 52.97, U.S. Nuclear Regulatory Commission, Washington, DC.

14.3-4 'Contents of Applications; Additional Technical Information,' "Licenses, Certifications, and Approvals for Nuclear Power Plants," Energy. Title 10, Code of Federal Regulations, Part 52.80, U.S. Nuclear Regulatory Commission, Washington, DC.

14.3-5 "Sites Characteristics," Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 2.0, Initial Issuance, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-6 ‘Structural and Systems Engineering – Inspections, Tests, Analyses, and Acceptance Criteria,’ “Initial Test Program and ITAAC – Design Certification,” Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 14.3.2, Initial Issuance, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007

14.3-7 ‘Piping Systems and Components – Inspections, Tests, Analyses, and Acceptance Criteria,’ “Initial Test Program and ITAAC – Design Certification,” Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 14.3.3, Initial Issuance, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-8 ‘Reactor Systems – Inspections, Tests, Analyses, and Acceptance Criteria,’ “Initial Test Program and ITAAC – Design Certification,” Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 14.3.4, Initial Issuance, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-9 Instrumentation and Controls – Inspections, Tests, Analyses, and Acceptance Criteria,’ “Initial Test Program and ITAAC – Design Certification,” Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 14.3.5, Initial Issuance, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-10 Electrical Systems – Inspections, Tests, Analyses, and Acceptance Criteria,’ “Initial Test Program and ITAAC – Design Certification,” Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 14.3.6, Initial Issuance, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-11 ‘Plant Systems – Inspections, Tests, Analyses, and Acceptance Criteria,’ “Initial Test Program and ITAAC – Design Certification,” Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 14.3.7, Initial Issuance, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-12 ‘Radiation Protection – Inspections, Tests, Analyses, and Acceptance Criteria,’ “Initial Test Program and ITAAC – Design Certification,” Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 14.3.8, Initial Issuance, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-13 ‘Human Factors Engineering – Inspections, Tests, Analyses, and Acceptance Criteria,’ “Initial Test Program and ITAAC – Design Certification,” Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 14.3.9, Initial Issuance, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-14 ‘Emergency Planning – Inspections, Tests, Analyses, and Acceptance Criteria,’ “Initial Test Program and ITAAC – Design Certification,” Standard

Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 14.3.10, Initial Issuance, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-15 'Containment Systems – Inspections, Tests, Analyses, and Acceptance Criteria,' "Initial Test Program and ITAAC – Design Certification," Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 14.3.11, Initial Issuance, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-16 'Physical Security Hardware – Inspections, Tests, Analyses, and Acceptance Criteria,' "Initial Test Program and ITAAC – Design Certification," Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 14.3.12, Initial Issuance, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-17 "Rules for Construction of Nuclear Power Plant Components," Boiler and Pressure Vessel Code – 2007 Edition. ASME Section III, American Society of Mechanical Engineers.

14.3-18 "Rules for Inservice Inspection of Nuclear Power Plant Components," Boiler and Pressure Vessel Code – 2007 Edition. ASME Section XI, American Society of Mechanical Engineers.

14.3-19 "Standards for Protection against Radiation," Energy. Title 10, Code of Federal Regulations, Part 20, U.S. Nuclear Regulatory Commission, Washington, DC.

14.3-20 "Domestic Licensing of Production and Utilization Facilities," Energy. Title 10, Code of Federal Regulations, Part 50, U.S. Nuclear Regulatory Commission, Washington, DC.

14.3-21 "Licenses, Certifications, and Approvals for Nuclear Power Plants," Energy. Title 10, Code of Federal Regulations, Part 52, U.S. Nuclear Regulatory Commission, Washington, DC.

14.3-22 "Physical Protection of Plants and Materials," Energy. Title 10, Code of Federal Regulations, Part 73, U.S. Nuclear Regulatory Commission, Washington, DC.

14.3-23 "Reactor Site Criteria," Energy. Title 10, Code of Federal Regulations, Part 100, U.S. Nuclear Regulatory Commission, Washington, DC.

14.3-24 'General Design Criteria for Nuclear Power Plants,' "Domestic Licensing of Production and Utilization Facilities," Energy. Title 10, Code of Federal Regulations, Part 50, Appendix A, U.S. Nuclear Regulatory Commission, Washington, DC.

14.3-25 "Nondestructive Examination," Boiler and Pressure Vessel Code – 2007 Edition. ASME Section V, American Society of Mechanical Engineers.

14.3-26 'Conditions of Construction Permits, Early Site Permits, Combined Licenses, and Manufacturing Licenses,' "Domestic Licensing of Production and Utilization Facilities," Energy. Title 10, Code of Federal Regulations, Part 50.55, U.S. Nuclear Regulatory Commission, Washington, DC.

14.3-27 IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations – Description. IEEE Standard 603-1991, Institute of Electrical and Electronic Engineers.

14.3-28 Guidance on Software Reviews for digital Computer Based Instrumentation and Controls Systems. Branch Technical Position 7-14.

14.3-29 "Instrumentation and Controls-Overview of Review Process," Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 7, Rev. 5, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-30 'Loss of all Alternating Current Power,' "Domestic Licensing of Production and Utilization Facilities," Energy. Title 10, Code of Federal Regulations, Part 50.63, U.S. Nuclear Regulatory Commission, Washington, DC.

14.3-31 Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants. Regulatory Guide 1.97, Rev. 4, U.S. Nuclear Regulatory Commission, Washington, DC, June 2006.

14.3-32 'Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants,' "Domestic Licensing of Production and Utilization Facilities," Energy. Title 10, Code of Federal Regulations, Part 50.49, U.S. Nuclear Regulatory Commission, Washington, DC.

14.3-33 "Environmental Radiation Protection Standards for Nuclear Power Operations," Protection of Environment. Title 40, Code of Federal Regulations, Part 190, U.S. Nuclear Regulatory Commission, Washington, DC.

14.3-34 Deleted.

14.3-35 Deleted.

14.3-36 'Reliability Assurance Program (RAP),' "Quality Assurance," Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 17.4, Initial Issuance, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-37 'Initial Plant Test Program – Design Certification and New License Applicants,' "Initial Test Program and ITAAC – Design Certification," Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 14.2, Rev. 3, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-38 Initial Test Programs for Water-Cooled Nuclear Power Plants, Regulatory Guide 1.68, Rev. 3, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

14.3-39 US-APWR Test Program Description, MUAP-08009, Rev. 1, October 2009.

14.3-40 US-APWR Physical Security Hardware ITAAC Abstracts, MUAP-10003, Rev. 1, March 2011.

14.3-41 ‘Contents of Applications; Technical Information,’ “Licenses, Certifications, and Approvals for Nuclear Power Plants,” Energy. Title 10, Code of Federal Regulations, Part 52.47, U.S. Nuclear Regulatory Commission, Washington, DC.

Table 14.3-1a Design Basis Accident Analysis Key Design Features (Sheet 1 of 8)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
1.2.5	US-APWR rated reactor core thermal power is 4451 MWt.	1.1.4 Table 4.4-1 Table 6.2.1-4 Table 15.0-2 Table 15.6.5-1 Ch. 16, TS 1.1
Table 2.3-2 ITAAC #1.a Each ASME ITAAC in 2.4.1, 2.4.2 2.4.4, 2.4.5 2.4.6	RCPB components are designed and fabricated in accordance with 10 CFR 50.55a which requires compliance with the requirements for Class 1 components in the American Society of Mechanical Engineers (ASME) Code.	5.2 6.3 9.3.4
2.2.1.2 Table 2.2-4 ITAAC #3, #5 Table 2.11.1-1 Table 2.11.1-2 ITAAC #1	The PCCV is a prestressed concrete structure designed to endure the peak pressure and temperature for LOCA, and steamline and feedline break conditions.	3.8.1.3 Table 3.8.1-1 6.2.1.1 Table 6.2.1-2
Table 2.2-1 Table 2.2-4 ITAAC #3, #5 2.11.1.1 Table 2.11.1-2 ITAAC #1	The PCCV is designed and constructed in accordance with ASME Code, Section III, and the PCCV is classified as seismic Category I structure.	3.8.1.2 6.2.7
2.2.1.2 Table 2.11.1-2 ITAAC #3	The liner plate is not designed or analyzed as a strength structural element. The minimum concrete design compressive strength (f'c) for the PCCV is 6000 psi. The minimum concrete design compressive strength (f'c) for the basemat is 4000 psi. The ultimate capacity for the PCCV is estimated based on cumulative yield strength of steel materials such as rebars, tendons, and liner plate.	3.8.1.1.1 Table 6.2.1-2 19.2.4.1
Figure 2.11.1-1 Table 2.11.1-2 ITAAC #3	The inner height of the containment is approximately 226.5 ft and the inside diameter of the containment cylinder measures approximately 149 ft. The containment dome is 3 ft.-8 in. or 4 ft.-4 in. thick, while the containment wall thickness is 4 ft.-4 in. The inner surface of containment includes a 0.25 in. welded steel plate liner anchored to the concrete.	6.2.1.1.2

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1a Design Basis Accident Analysis Key Design Features (Sheet 2 of 8)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
Table 2.2-4 ITAAC #3,#5 Table 2.11.1-1 Table 2.11.1-2 ITAAC #3	The containment design pressure is 68 psig. The PCCV is designed for an external pressure of 3.9 psig based on conservative analysis of inadvertent CSS operation. The containment design temperature is 300°F. Free volume of containment is 2,800,000 ft^3.	Table 3.8.1-1 6.2.1.5.3 Table 6.2.1-2 Table 6.5-5 15.4.8.4 15.6.5
2.4.1 Table 2.4.1-2 ITAAC #4.b	Ferritic reactor coolant pressure boundary materials meet 10 CFR 50 Appendix G fracture toughness criteria and requirements for testing.	5.2.3.3 5.3.1
2.4.2.1 Table 2.4.2-5 ITAAC #10.a	The pressurizer safety valves provide overpressure protection in accordance with the ASME Code Section III. This overpressure protection is provided for the followingbounding events • Loss of external electrical load. • Loss of normal feedwater flow. • Reactor coolant pump shaft break. • Uncontrolled rod cluster control assembly bank withdrawal from a subcritical or low-power startup condition. • Spectrum of rod ejection accidents. The sum of the capacities of the pressurizer safety valves exceeds 1.728×10^6 lb/hr (432,000 lb/hr per valve).	5.2.2.1 Table 5.2.2-1
Table 2.4.2-5 ITAAC #10.a	Pressurizer safety valves set pressure; ≥2435 psig and ≤2485 psig	Table 5.2.2-1
Table 2.4.2-5 ITAAC #10.d	The reactor coolant flow rate per loop with 10% steam generator tube plugging is at least 112,000 gallons per minute.	Table 5.1-3
Table 2.4.2-5 ITAAC #10.c	RCPs have a rotating inertia to provide coastdown flow.	5.4.1 15.3.1.1 15.6.5.2
Table 2.4.4-5 ITAAC #7.b	The four independent ECC/CS suction strainers are designed to maintain adequate NPSH and minimize downstream effects to support ECC/CS functions, maintaining the reactor core in a long-term coolable geometry and supporting decay heat removal following a design basis accident.	6.2.2.2 Table 6.2.2-2 Table 19.1-119
Table 2.4.4-5 ITAAC #1.a	The RWSP and ECC/CS suction strainers are located at the lower elevation in containment. The coolant and associated debris from a pipe or component rupture (LOCA), and the containment spray drain into the RWSP through transfer pipes.	6.2.2.2.5 Table 19.1-119
Table 2.4.4-5 ITAAC #7.b	Insulation and coatings inside containment are consistent with the design basis evaluations of ECC/CS suction strainer performance.	6.1.2 6.1.3 6.2.2.3 Table 19.1-119

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1a Design Basis Accident Analysis Key Design Features (Sheet 3 of 8)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
2.4.4.1 Table 2.4.4-2 Table 2.4.4-5 ITAAC #1.a, #1.b, #6.b, #6.c, #10.b	The high head safety injection system consists of four independent and dedicated SI pump trains. The SI pump trains are automatically initiated by an ECCS actuation signal, and supply borated water from the RWSP to the reactor vessel via direct vessel injection line.	6.3.2.1 Table 19.1-119
Table 2.4.4-5 ITAAC #7.b	Each safety injection pump has a pump differential head of no less than 3937 ft and no more 4527 ft at the minimum flow, and injects no less than 1259 gpm and no more than 1462 gpm of RWSP water into the reactor vessel at atmospheric pressure.	Table 6.2.1-5 6.3 Figure 6.3-4 Figure 6.3-15 Figure 6.3-16
2.4.4.1 Table 2.4.4-5 ITAAC #7.b	Four (4) ECCS accumulators store borated water under pressure and automatically inject it into the RCS if the reactor coolant pressure decreases below the accumulator pressure. The volume of each accumulator is at least 3,180 ft^3, considering the total water volume and adding the volume of gas space and dead water volume.	Table 6.2.1-4 Table 6.2.1-5 6.3.2.2.2 Table 6.3-5
Table 2.4.4-5 ITAAC #7.b Table 2.4.4-6	The water volume injected from each accumulator into reactor vessel is ≥2126 ft^3. The water volume injected from each accumulator into reactor vessel during large flow is ≥1326.8 ft^3. The calculated resistance coefficient of the accumulator system (based on a cross-section area of 0.6827 ft^2) meets the requirements shown in Tier 1 Table 2.4.4-6. The accumulators provide the integrated function of low head injection in the event of a LOCA.	6.3 Table 6.3-5 Table 19.1-119
2.4.4.1 Table 2.4.4-5 ITAAC #7.b	The RWSP is the source of borated water for emergency core cooing and containment spray systems. The volume of the RWSP is at least 81,230 ft^3. taking into account ineffective pit volume and containment cavities and pits where water may be trapped and not drain to the RWSP.	6.2.2.2.5 Table 6.2.1-3 Table 6.2.1-4 Figure 6.2.2-7 6.3 Table 6.3-5
2.4.5.1 Table 2.4.5-5 ITAAC #8.a	RHRS provides long term core cooling.	5.4.7.1 Table 19.1-119
2.4.5.1 Table 2.4.5-5 ITAAC #1.a, #6.b, #6.c 2.11.3.1 Table 2.11.3-5 ITAAC #1.a, #6.b, #6.c	The CSS/RHRS consists of four independent subsystems, each of which receives electrical power from one of four safety buses. Each subsystem includes one CS/RHR pump and one CS/RHR heat exchanger, which have functions in both the CS system and the RHRS.	6.2.2 5.4.7.2.1 Table 19.1-119

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1a Design Basis Accident Analysis Key Design Features (Sheet 4 of 8)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
2.4.5.1 Table 2.4.5-5 ITAAC #1.a, #8.a 2.11.3.1 Table 2.11.3-5 ITAAC #1.a, #7.b	CSS/RHR provide long term containment and core cooling capability.	6.2.2 6.2.5 Table 19.1-119
Table 2.4.5-5 ITAAC #8.e	The CS/RHR relief valves open at a pressure not greater than the set pressure required to provide low temperature overpressure protection for the RCS, as determined by the LTOP system.	5.4.7.1
Table 2.4.5-5 ITAAC #8.a	Each CS/RHR pump is sized to deliver 3,000 gpm at a discharge head of 410 ft, and provides at least 2645 gpm to the RCS when the RCS is at atmospheric pressure.	5.4.7 Table 5.4.7-2 Figure 5.4.7-4 6.2.2 Table 6.2.1.5
Table 2.4.5-5 ITAAC #8.a	The product of the overall heat transfer coefficient and the effective heat transfer area, UA, of each as-built CS/RHR heat exchanger is greater than or equal to 1.852×10^6 Btu/hr-°F.	5.4.7 Table 5.4.7-2 6.2.2 Table 6.2.1-5
2.4.6.1 Table 2.4.6-5 ITAAC #1, #8.a	The CVCS charging pumps are arranged in parallel with common suction and discharge headers. Each pump provides full capability for normal makeup. One charging pump is capable of maintaining normal RCS inventory with small system leak if the leakage rate is less than that from a break of a pipe 3/8 inch in inside diameter.	9.3.4.2 Table 19.1-119
2.4.6.1 Table 2.4.6-5 ITAAC #1, #8.a, #8.c	The CVCS charging pumps can take suction from the VCT, the reactor makeup control system, the refueling water storage auxiliary tank and the spent fuel pit. Normally, one charging pump is operating and takes suction from the VCT, supplies charging flow to the RCS and seal water to the reactor coolant pumps.	9.3.4.2 Table 19.1-119
Table 2.4.6-5 ITAAC #8.a	Each CVCS charging pump provides a flow rate of greater than or equal to 160 gpm.	9.3.4 Table 9.3.4-2
2.5.1.1 Table 2.5.1-6 ITAAC #14.a	The PSMS initiates automatic reactor trips and ESF actuations, when the plant process signals reach a predetermined limit. (Table 2.5.1-2 and 2.5.1-3)	7.2 7.3 Table 7.2-3 Table 7.3-4

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1a Design Basis Accident Analysis Key Design Features (Sheet 5 of 8)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
2.5.1.1 Table 2.5.1-6 ITAAC #1	Reactor trip signal is provided by the reactor protection system (RPS), which consists of four redundant and independent trains. Four redundant measurements using sensors from the four separate trains are made for each variable used for reactor trip.	7.2.1 Table 19.1-119
2.5.1 Table 2.5.1-6 ITAAC #2	There are four redundant engineered safety function (ESF) trains.	7.3.1.8 Table 19.1-119
2.5.1 Table 2.5.1-6 ITAAC #29	ESF systems are automatically initiated from signals that originate in the RPS. Manual actuation of ESF systems is carried out through a diverse signal path that bypasses the RPS.	7.3.1.9 Table 19.1-119
2.5.1 Table 2.5.1-6 ITAAC #17.b	A single channel or division of the PSMS can be bypassed to allow on-line testing, maintenance or repair without impeding the safety function.	7.2.1 Table 19.1-119
2.5.4.1 Table 2.5.4-2 ITAAC #1, #2, #4	The PSMS and PCMS provide plant operators with information systems important to safety for: (1) assessing plant conditions and safety system performance, and making decisions related to plant responses to AOOs; and (2) preplanned manual operator actions related to accident mitigation.	7.5
2.5.4 Table 2.5.4-2 ITAAC #1, #3	For the monitoring of the post-accident inadequate core cooling, degree of subcooling, RV water level and core exit temperature will be measured.	4.4.6.4 7.5 7.5.1.1.3
2.9 Table 2.9-1 ITAAC #7 Each MCR/RSC ITAAC in applicable Tier 1 system sections	The minimum inventory of HSIs are · Fixed position continuously visible HSI · Class 1E HSI for control of all safety-related components and monitoring of all safety-related plant instrumentation is provided on the safety VDUs, located on the MCR operator console and the remote shutdown console (Section 7.1). · Minimum inventory for degraded HSI conditions	7.1 18.7.3.2 Table 18.7-1

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1a Design Basis Accident Analysis Key Design Features (Sheet 6 of 8)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
2.5.1.1 Table 2.5.1-6 ITAAC #4 Table 2.5.4-1 Table 2.5.4-2 ITAAC #1 2.9 Table 2.9-1 ITAAC #7	The fixed position continuously visible HSI are provided by: The fixed area of the LDP provides indications and alarms which include : · Bypassed and inoperable status indication (BISI) parameters · Type A and B post monitoring (PAM) variables (Section 7.5, Table 7.5-3) · Safety parameter displays including status of critical safety functions and performance of credited safety systems and preferred non safety systems · Prompting alarms for credited manual operator actions and risk important HAs identified in the HRA PAM displays for Type A and B variables on the safety VDUs (Subsection 7.5.1.1) Conventional switches on the MCR operator console for system level actuation of safety functions such as reactor trip, engineering safety features actuation system (ESFAS) actuation, etc. (Tables 7.2-6 and 7.3-5)	Table 7.1-1 Table 7.2-6 Table 7.3-5 7.5 Table 7.5-3 18.7.3.2
2.6.4.1 Table 2.6.4-1 ITAAC #13	The Class 1E emergency power sources (EPSs) are able to provide power at set voltage and frequency to the Class 1E 6.9kV buses within 100 seconds from the start signal.	8.3.1.1.3 Table 19.1-119
2.6.4.1 Table 2.6.4-1 ITAAC #1, #2, #13, #15.a	Each of the four divisions of the Class 1E power distribution systems is provided by a Class 1E gas turbine generator (GTG) to supply power to its dedicated safety bus as a counter measure against loss of offsite power. When loss of offsite power occurs, GTGs automatically start and would accept load in less than or equal to 100 seconds after receiving the start signal.	8.1.3.1 8.3.1.1.3
2.7.1.2.1 Table 2.7.1.2-5 ITAAC #13.a	Six main steam safety valves (MSSVs) are provided per main steam line. MSSVs with sufficient rated capacity are provided to prevent the steam pressure from exceeding 110 percent of the MSS design pressure. The sum of the rated capacities of the MSSVs exceeds 21,210,000 (lb/hr) for all 24 valves.	10.3.2.3.2
Table 2.7.1.2-5 ITAAC #13.b	The flow restrictor within the SG main steam line discharge nozzle does not exceed 1.4 sq. ft.	15.1.5.2
2.7.1.2.1 Table 2.7.1.2-5 ITAAC #14	The valves close within the following times after receipt of an actuation signal. The main steam isolation valves (MSIVs) close within 5 seconds to limit uncontrolled steam release from one SG in the event of steam line break. The main steam bypass isolation valves close within 5 seconds.	6.2.1.4.1 10.3.2.3.4

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1a Design Basis Accident Analysis Key Design Features (Sheet 7 of 8)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
2.7.1.2 Table 2.7.1.2-5 ITAAC #1.a	MSIVs are installed in each of the main steam lines to (1) limit uncontrolled steam release from one steam generator in the event of a steam line break, and to (2) isolate the faulted SG in the event of SGTR.	6.2.1 10.3 Table 19.1-119
2.7.1.9.1 Table 2.7.1.9-5 ITAAC #8.c	The main feedwater isolation valves (MFIVs), MFRVs, MFBRVs, SGWFCVs close within 5 seconds after receipt of an actuation signal, to limit the mass and energy release to containment consistent with the containment analysis.	6.2.1.4.1 10.4.7.2.2
2.7.1.11 Table 2.7.1.11-5 ITAAC #1.a	EFWS consists of two motor-driven pumps and two steam turbine-driven pumps with two emergency feedwater pits.	10.4.9.2 Table 19.1-119
2.7.1.11 Table 2.7.1.11-5 ITAAC #8.b	Upon detection of a water level increase of the SG, the EFW isolation valves and EFW control valves are automatically closed.	10.4.9.2 Table 19.1-119
2.7.1.11 Table 2.7.1.11-5 ITAAC #8.b	The motor-operated EFW isolation valves and EFW control valves are provided in each EFW pump discharge line to close automatically to terminate the flow to the affected (faulted) SG.	10.4.9.2 Table 19.1-119
2.7.1.11 Table 2.7.1.11-5 ITAAC #1.a	The common suction line from each EFW pit is connected by a tie line with two normally closed manual valves. When the two EFW pumps taking suction from the same pit are not available (OLM of one EFW pump and the single failure of other EFW pump), the tie line connections to EFW pits need to be established.	10.4.9.2 Table 19.1-119
Table 2.7.1.11-5 ITAAC #12	Two of the EFW pumps deliver at least 705 gpm to the any of two SGs against a SG pressure up to the set pressure of the first stage of main steam safety valve plus 3 percent.	10.4.9.2.1 Table 10.4.9-2
Table 2.7.1.11-5 ITAAC #13	The usable volume of each EFW pit is greater than or equal to 204,850 gallons.	10.4.9.3
2.7.3.1 Table 2.7.3.1-5 ITAAC #1.a	The ESWS is arranged into four independent trains (A, B, C, and D). Each train consists of one ESWP, two 100% strainers in the pump discharge line, one 100% strainer upstream of the CCW HX, one CCW HX, one essential chiller unit, and associated piping, valves, instrumentation and controls.	9.2.1.2.1 Table 19.1-119
2.7.3.3 Table 2.7.3.3-5 ITAAC #1.a	The CCWS consists of two independent subsystems. One subsystem consists of trains A & B, and the other subsystem consists of trains C & D, for a total of four trains.	9.2.2.2 Table 19.1-119
2.7.3.3 Table 2.7.3.3-5 ITAAC #7	The CCWS is designed to withstand leakage in one train without loss of the system's safety function.	9.2.2.1.1 Table 19.1-119

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1a Design Basis Accident Analysis Key Design Features (Sheet 8 of 8)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
2.7.3.3 Table 2.7.3.3-5 ITAAC #8.b	Two motor operated valves are located at the CCW outlet of the RCP thermal barrier Hx and close automatically upon a high flow rate signal at the outlet of this line in the event of in-leakage from the RCS through the thermal barrier Hx, and prevents this in-leakage from further contaminating the CCWS.	9.2.2.2.1.5 Table 19.1-119
2.7.5.3.1.2	The containment fan cooler system is designed to maintain containment air temperature below 120°F during the normal operation of the plant. 120°F is used as the maximum containment temperature initial condition in the safety analyses.	6.2.1.1.3.5 Table 6.2.1-4 6.3.2.1 Ch. 16 TS 3.6.5
2.7.6.2.1 Table 2.7.6.2-1 ITAAC #2	To preclude unanticipated drainage, the spent fuel pit is not connected to the equipment drain system. A weir and gate provide physical isolation of the refueling canal from each of the pits. All the gates are located above the top elevation of the fuel seated in the SFP racks: they are normally closed and only opened as required.	9.1.2.2.2
Figure 2.11.2-1 Table 2.11.2-1 Table 2.11.2-2 ITAAC #1	Containment penetration isolation features are configured as in Table 6.2.4-3 and figure 6.2.4-1.	6.2.4 Table 6.2.4-1 Table 6.2.4-3 Figure 6.2.4-1 6.2.6
2.11.3.1 Table 2.11.3-5 ITAAC #1.a, #7.b	The CSS is designed to remove containment heat, and remove fission products following an accident.	6.2.2 6.5.2 15.6.5 19.1.3.1 19.1.3.2 Table 19.1-119 19.2.3.3.3
Table 2.11.3-5 ITAAC #7.b	Two CS/RHR pumps deliver no less than 5290 gpm of RWSP water into the containment.	6.2.1 Table 6.2.1-5

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1b Internal and External Hazards Analysis Key Design Features (Sheet 1 of 2)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
Table 2.1-1	Key Site Parameters (Meteorology, Hydrologic Engineering, Geology, Seismology, and Geotechnical Engineering)	Table 2.0-1
2.2 Table 2.2-1 Table 2.2-4 ITAAC #23	Failure of buildings that are not seismic Category I (i.e., turbine building, auxiliary building and access building) does not impact SSCs designed to be seismic Category I.	3.2.1 Table 19.1-119
2.2.2.1 Table 2.2-4 ITAAC #13	The external walls of Seismic I and II structures that are below flood level are adequate thickness to protect against water seepage.	3.4.1.2
Table 2.2-4 ITAAC #14	Penetrations in the external walls below flood level are provided with flood protection features.	3.4.1.2
Table 2.2-4 ITAAC #14	Construction joints in the exterior walls and base mats are provided with water stops to prevent seepage of ground water.	3.4.1.2
Table 2.2-4 ITAAC #9, #10, #11	Elevation -26 ft, 4 in. in radiological controlled area (RCA) of the R/B is divided into two areas, by concrete walls and water-tight door. A water-tight door is provided in each Spray/RHR pump room and SIS pump room. And also water tight doors are provided in doorways between A/B and R/B.	3.4.1.5.2.1
Table 2.2-4 ITAAC #9, #10, #11	Elevation -26 ft, 4 in. in the non-radiological controlled area (NRCA) of the R/B is divided into two areas by concrete walls and water-tight door installed in the corridor. Water-tight doors are provided in doorways at ground level between T/B and R/B.	3.4.1.5.2.2
Table 2.2-4 ITAAC #9, #10, #11	Divisional walls and water tight doors provide train separation and flood barriers to prevent flood water from spreading to adjacent divisions.	3.4.1.5.2.1
Table 2.2-4 ITAAC #1, #9, #10 2.7.6.8 Table 2.7.6.8-1 ITAAC #1	R/B is divided to two divisions (e.g. east side and west side) and thus flood propagation to all four trains is prevented.	3.4.1.5.2 19.1.5.3 Table 19.1-1 Table 19.1-119
2.2.2 Table 2.2-4 ITAAC #9, #10, #11, #15, #16	Areas between the reactor building and the turbine building are physically separated by flood prevention equipment.	3.4.1.5 19.1.5.3 Table 19.1-119

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1b Internal and External Hazards Analysis Key Design Features (Sheet 2 of 2)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
2.3.1 Table 2.3-2 ITAAC #4, #5	Pipe breaks (circumferential and longitudinal) are evaluated for the entire range of effects, including dynamic effects (i.e., pipe whip, jet impingement, jet thrust forces, internal forces due to system decompression, sub-compartment pressurization), environmental conditions, spray wetting, and flooding. When LBB criteria are successfully applied, evaluation of dynamic effects is not required.	3.6 6.2.1.2
Table 2.1-1 2.2.1 Table 2.2-4 ITAAC #5, #6, #21 Table 2.5.1-6 ITAAC #8 Table 2.5.6-1 ITAAC #4	SSCs needed to achieve and maintain safe shutdown are protected or analyzed to mitigate the impacts of internal and external missile hazards	3.5
Each EQ ITAAC in applicable Tier 1 System Sections	Structures, systems, and components important to safety are designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents.	3.11
2.5.1 Table 2.5.1-6 ITAAC #5 Other seismic qualification ITAAC in applicable Tier 1 System Sections	Relay chatter does not occur or does not affect safety functions during and after seismic event.	3.10.2 Table 19.1-51 Table 19.1-119
2.7.6.8 Table 2.7.6.8-1 ITAAC #1	Flood will not propagate to other areas due to the drain systems.	3.4.1.5.2 19.1.5.3 Table 19.1-119

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1c Fire Protection Key Design Features

Tier 1 Ref.[(1)]	Key Design Features	Tier 2 Location[(2)]
Table 2.2-4 ITAAC #17	Redundant safe shutdown components and associated electrical divisions outside the containment and the control room complex are separated by 3-hour rated fire barriers to preserve the capability to safely shutdown the plant following a fire. The 3-hour rated fire barriers are placed as required by the fire hazard analysis and support prevention of severe accidents due to loss of multiple trains by fire.	9.5.1.2.1 Table 19.1-119
Table 2.2-4 ITAAC #18	All penetrations and openings through the fire barriers are protected with 3-hour rated components (i.e. fire doors in door openings, fire dampers in ventilation duct openings, and penetration seals).	9.5.1.2.1 Table 19.1-119
3.2.2	The seismic standpipe system can be supplied from a safety-related water source which capacity is at least 18,000 gallons.	9.5.1.2.4
2.7.6.9.1 Table 2.7.6.9-2 ITAAC #3 3.2.2	Two 100% capacity fire water pumps are provided: one pump is diesel-driven and one pump is electric motor-driven. Each pump provides sufficient water for the largest sprinkler system plus manual hose streams to support fire suppression activities for two hours or longer, but not less than 300,000 gallons. Redundant water supply capability is provided.	9.5.1.1
2.5.2.1 Table 2.5.2-3 ITAAC #2.a	Independent means to achieve safe shutdown of the reactor is provided a fire in the MCR result in operator evacuation.	7.4.1.5
2.7.6.9.1 Table 2.7.6.9-2 ITAAC #1, #2	Means are provided to detect and locate fires and are indicated to control room operators	9.5.1.2.6

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1d PRA and Severe Accident Analysis Key Design Features (Sheet 1 of 6)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
2.2.3.3 Table 2.2-4 ITAAC #24	SSCs that require evaluation in the seismic fragilities task of a seismic margin analysis have sufficient seismic margin.	19.1.5.1.1 Table 19.1-54 Table 19.1-119
2.4.1 Table 2.4.1-2 ITAAC #3	No penetrations through the RV are located below the top of the reactor core. This minimizes the potential for a loss of coolant accident by leakage from the reactor vessel, allowing the reactor core to be uncovered.	5.3.3.1 Table 19.1-119
2.4.2.1 Table 2.4.2-2 Figure 2.4.2-2 Table 2.4.2-5 ITAAC #2, #11.a	The reactor vessel head vent valves; the safety depressurization valve (SDV) and depressurization valves (DV) could be used for high point vents to support prevention of beyond design basis events and severe accident mitigation.	5.4.12 Table 5.4.12-3 19.1.3.1 19.1.3.2 19.2.3.3 Table 19.1-1 Table 19.1-119
2.4.2 Table 2.4.2-5 ITAAC #2, #11.a	Safety depressurization valves (SDVs) are provided at top head of the pressurizer in order to cool the reactor core by feed and bleed operation when loss of heat removal from steam generator occurs.	5.4.12.2 Table 19.1-119
2.4.2 Table 2.4.2-5 ITAAC #2, #11.a 2.4.4 Table 2.4.4-5 ITAAC #1.a, #10.a	In the event of delay in establishing RHR cooling after safety injection, the SDV and SI pump ensure long term heat removal.	Table 19.1-119
2.4.2 Table 2.4.2-5 ITAAC #2, #11.a	RCS depressurization system dedicated for severe accident is provided to prevent high pressure melt ejection.	5.4.12.2 Table 19.1-119
2.4.4 Table 2.4.4-5 ITAAC #1.a, #10.a	In the event of loss of heat removal by the RHRS and SGs, a SI pump can be manually started to maintain RCS water level.	Table 19.1-119
2.4.4 Table 2.4.4-5 ITAAC #1.a, #8	RWSP suction isolation valves can be closed to prevent leakage of RWSP water from SI, CS/RHR or RWS.	Table 19.1-119
2.4.5 Table 2.4.5-5 ITAAC #9, #11	In the case of failure of running RHRS, with RHR flow rate – low the valves on the standby RHR suction line and discharge line can be opened and the standby RHR pump started in order to maintain RHR operation.	Table 19.1-119
2.4.5.1 Table 2.4.5-5 ITAAC #1.a	Alternate core cooling/injection utilizing CSS/RHRS is available in case all safety injection fails.	Table 19.1-1 Table 19.1-119 19.2.2

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1d PRA and Severe Accident Analysis Key Design Features (Sheet 2 of 6)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
2.4.5.1 Table 2.4.5-5 ITAAC #11 2.7.1.2 Table 2.7.1.2-5 ITAAC #8.a 2.7.1.11 Table 2.7.1.11-5 ITAAC #18	In high RCS pressure sequences, a fast depressurization of the RCS by using the EFW pumps to remove heat through the SGs and by manually opening the MSRVs allows alternate core cooling injection using the CS/RHR pumps.	Table 19.1-119
2.4.5.1 Table 2.4.5-5 ITAAC #1.a	CSS/RHRS provides water to flood the reactor cavity.	Table 19.1-119
2.4.5.1 Table 2.4.5-5 ITAAC #2	Upgraded piping design pressure for the residual heat removal system (RHRS) results in a negligible frequency of occurrence of an inter-system LOCA.	19.1.3.4 Table 19.1-1 Table 19.1-119
2.4.5.1 Table 2.4.5-5 ITAAC #1.a, #2, 7.a	Two motor operated valves in series on the RHR suction line with power lockout capability during normal power operation minimize the probability of RCS pressure entering the RHR system. Even if both these valves are opened during normal power operation, the RHR system is designed to discharge the RCS inventory to the in-containment RWSP. The RHRS is designed to prevent an interfacing system LOCA by having a design rating of 900 lb.	5.4.7.1 Table 19.1-119
2.4.5 Table 2.4.5-5 ITAAC #9	RHR suction isolation valves can be manually closed to isolate a LOCA in the RHR line.	Table 19.1-119
2.4.5 Table 2.4.5-5 ITAAC #1.a	One normally closed air-operated valve is installed in each of two low-pressure letdown lines that are connected to two of four RHR trains.	Table 19.1-119
2.4.5.1 Table 2.4.5-5 ITAAC #1.a	To prevent loss of RCS inventory during mid-loop operation and support severe accident prevention, the low-pressure letdown line isolation valves are automatically closed and the CVCS is isolated from the RHRS, after receiving a RCS loop low-level signal.	5.4.7.2 19.1.3.4 Table 19.1-1 Table 19.1-119 19.2.2.2
2.4.6 Table 2.4.6-5 ITAAC #1.a 2.7.6.3 Table 2.7.6.3-5 ITAAC #1	CVCS charging pumps can provide decay heat removal in the event of loss of RHR and SG cooling. The RWSP can provide makeup to the RWSAT for charging pump suction.	Table 19.1-119

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1d PRA and Severe Accident Analysis Key Design Features (Sheet 3 of 6)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
2.5.1 Table 2.5.1-3 Table 2.5.1-6 ITAAC #4 2.5.4 Table 2.5.4-2 ITAAC #2	Containment isolation and heat removal can be manually actuated in the event of failure of the containment isolation signal.	Table 19.1-119
2.5.1 Table 2.5.1-3 Table 2.5.1-6 ITAAC #4 2.5.4 Table 2.5.4-2 ITAAC #2	ESF actuation can be performed manually in the event of failure of automatic ESF actuation.	Table 19.1-119
2.6.1 Table 2.6.1-3 ITAAC #1 2.6.5 Table 2.6.5-1 ITAAC #1	Non-Class 1E 6.9kV permanent buses P1 and P2 are also connected to the non-Class 1E A-AAC GTG and B-AAC GTG, respectively. The loads which are not safety-related but require operation during LOOP are connected to these buses.	8.3.1.1.1 Table 19.1-119
2.6.1 Table 2.6.1-3 ITAAC #24	Non-segregated busducts/cable buses to safety buses in the T/B electrical room are segregated into two groups by qualified fire barriers.	8.3.1.1.8 9.5.1 19.1.5.2 Table 19.1-1 Table 19.1-119
2.6.4 Table 2.6.4-1 ITAAC #3, #11, #32	The GTG does not need a cooling water system. Cooling of GTG is achieved by air ventilation system GTG combustion air intake and exhaust system for each of the four GTGs supply combustion air of reliable quality to the gas turbine and exhausts combustion products from the gas turbine to the atmosphere. The air intake also provides ventilation/cooling air to the GTG assembly.	9.5.5 9.5.8 Table 19.1-119
2.6.5.1 Table 2.6.5-1 ITAAC #13, #14	Common cause failure between class 1E GTG and non-class 1E GTG supply is minimized by design characteristics. The AAC power sources are of different size, have different starting system from the EPS.	8.4.1.3 Table 19.1-119
2.6.5.1 Table 2.6.5-1 ITAAC #6	In the event of SBO, power to one Class 1E 6.9kV bus can be restored manually from the AAC GTG. Power to the shutdown buses can be restored from the AAC sources within 60 minutes.	8.3.1.1.2.4 8.4.1.2 8.4.1.3 Table 19.1-119

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1d PRA and Severe Accident Analysis Key Design Features (Sheet 4 of 6)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
2.6.5.1 Table 2.6.5-1 ITAAC #1	Alternate ac power supported by two non-Class 1E GTGs is incorporated as a countermeasure against SBO. Alternate ac power sources can supply power to two of the four safety buses in case class 1E GTGs fail during loss of offsite power. AAC power sources are non-Class 1E and non-seismic. AAC power sources supply power to loads required to bring and maintain the plant in a safe shutdown condition for a station blackout (SBO) condition.	8.4.1.3 19.1.3.1 19.1.3.4 19.1.4.1 Table 19.1-1 19.2.2
2.6.5.1 Table 2.6.5-1 ITAAC #1, #5, #13, #14	AAC power sources use different rating GTGs than the Class 1E EPSs, with diverse starting system, independent and separate auxiliary and support systems to minimize common cause failure.	8.4.1.3 Table 19.1-119
2.7.1.2 Table 2.7.1.2-5 ITAAC #8.a 2.7.1.11 Table 2.7.1.11-5 ITAAC #8.a, #18	Main steam depressurization valves (MSDVs) on intact SG(s) can be opened and EFW flow established to promote heat removal and RCS depressurization.	Table 19.1-119
2.7.1.11.1 Table 2.7.1.11-5 ITAAC #1.a	Each EFW pump discharge line connects with a cross-tie line using normally closed motor-operated isolation valves to provide separation of four trains. Operation to open the EFW cross-tie valve when an EFW pump is not available is an important feature to reduce core damage frequency.	10.4.9.2 19.1.4.1 19.2.2
2.7.3.1 Table 2.7.3.1-5 ITAAC #10.a	In the case of failure of running ESWS, with ESW flow rate – low, the standby ESW pump can be started in order to maintain ESWS operation.	Table 19.1-119
2.7.3.1 Table 2.7.3.1-5 ITAAC #1.a	In the case of ESW pump discharge blockage, flow can be switched from the blocked strainer to the standby strainer.	Table 19.1-119
2.7.3.3 Table 2.7.3.3-5 ITAAC #8.a	CCW header tie line isolation valves may be manually closed to achieve header separation in the event of failure of automatic valve closure.	Table 19.1-119
2.7.3.3 Table 2.7.3.3-5 ITAAC #10.a	In the case of failure of running CCWS, with CCW flow rate – low, the standby CCW pump can be started in order to maintain CCWS operation.	Table 19.1-119
2.7.3.3 Table 2.7.3.3-5 ITAAC #1.a	If loss of seal injection should occur, CCW continues to provide flow to the thermal barrier heat exchanger; which cools the reactor coolant. The pump is able to maintain safe operating temperatures and operate safely long enough for safe shutdown of the pump.	5.4.1.1.3 Table 19.1-119

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1d PRA and Severe Accident Analysis Key Design Features (Sheet 5 of 6)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
2.7.3.3 Table 2.7.3.3-5 ITAAC #1.a Table 2.7.3.6-3 ITAAC #1	Alternate containment cooling via natural CV circulation can be established by pressurizing CCWS with nitrogen, disconnecting nonessential heat loads and connecting to the containment fan cooler units.	Table 19.1-119
2.7.3.6.1 Table 2.7.3.6-3 ITAAC #1	Non-essential chilled water system provides alternate component cooling water to charging pumps in order to maintain RCP seal water injection.	Table 19.1-1 Table 19.1-119
2.7.3.6 Table 2.7.3.6-3 ITAAC #1 2.7.5.3.1.2 Table 2.7.5.3-1	Alternate containment cooling using the containment fan cooler system is provided to prevent containment over pressure even in case of containment spray system failure. The fan cooling units are cooled by the component cooling water system. The containment fan cooler system enhances condensation of surrounding steam by natural convection and thus enhances continuous depressurization of the containment.	9.4.6.2 19.1.3.1 Table 19.1-1 19.1.3.2 Table 19.1-119 19.2.3.3.8
2.7.6.3 Table 2.7.6.3-5 ITAAC #1	As a countermeasure for loss of RHR, RCS makeup by gravity injection from spent fuel pit is available when the RCS in atmospheric pressure.	19.1.6.1 Table 19.1-1 Table 19.1-119
2.7.6.9.1 Table 2.7.6.9-2 ITAAC #6.a	The fire protection water supply system (FSS) is available as an alternative component cooling water source for severe accident prevention, including support of CVCS for RCP seal water injection.	9.5.1.2.2 19.1.3.2 19.1.5.3.2 19.2.3.3.3 Table 19.1-119
Table 2.7.6.9-2 ITAAC #6.b	The FSS is available to the containment spray system and water injection to the reactor cavity for severe accident mitigation.	9.5.1.2.2 19.1.3.2 19.2.3.3.3 Table 19.1-119
Table 2.11.1-2 ITAAC #4	A set of drain lines is provided from the steam generator compartments to the reactor cavity to flood the reactor cavity with containment spray water during severe accidents.	19.1.3.2 Table 19.1-119
2.11.1.1 Table 2.11.1-2 ITAAC #5	The core debris trap enhances capturing of ejected molten core in the reactor cavity to support severe accident mitigation. The consequences of a postulated high pressure melt ejection accident, including direct containment heating, are mitigated by the debris trap in the reactor cavity as well as no direct pathway to the upper compartment for the impingement of debris on the containment shell.	19.1.3.2 Table 19.1-1 Table 19.1-119 19.2.3.3.4
2.11.1.1 Table 2.11.1-2 ITAAC #6	The geometry of the reactor cavity is designed to assure adequate core debris coolability. Sufficient reactor cavity floor area and appropriate reactor cavity depth are provided to enhance spreading debris bed for better coolability to support severe accident mitigation.	19.1.3.2 Table 19.1-119 19.2.3.3.3

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1d PRA and Severe Accident Analysis Key Design Features (Sheet 6 of 6)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
2.11.1.1 Table 2.11.1-2 ITAAC #7	There is a liner-plate-covering concrete as the floor surface of the reactor cavity, which supports severe accident mitigation by protecting against short-term attack by relocated core debris.	Table 19.1-119 19.2.3.3.3
2.11.2.1 Table 2.11.2-2 ITAAC #14	Main containment penetrations are isolated automatically even when SBO occurs and alternative ac generators are not available.	8.3.1.1.5 Table 8.3.1-10 Table 19.1-1 Table 19.1-119
2.11.4.1 Table 2.11.4-1 ITAAC #1, #3, #4, #5, #6	The CHS includes 1. a single hydrogen monitor located outside of containment that measures hydrogen concentration in containment air extracted from the containment. 2. 20 igniters installed inside the containment, designed to burn hydrogen continuously to maintain hydrogen concentration below the low limit of global burn (approximately 10% hydrogen in air), thereby preventing further hydrogen accumulation that could become a threat to containment integrity. 3. The igniters start upon receipt of an ECCS actuation signal and are powered by two non-class 1E buses with non-class 1E GTGs.	6.2.5 Figure 6.2.5-1 19.1.3.2 19.2.3 Table 19.1-119
2.13 Table 2.13-1 ITAAC #1	US-APWR design reliability assurance program provides reasonable assurance that: 1) the US-APWR is designed and constructed in a manner that is consistent with the assumptions and risk insights for the SSCs and 2) the SSCs function reliably when challenged.	17.4 Table 17.4-1

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1e ATWS Key Design Features

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
2.5.3.1 Table 2.5.3-4 ITAAC #3, #4	The DAS is a non-safety system that is diverse from the MELTAC platform of the PSMS and PCMS, and is diverse from the hardware used in the reactor trip function of the RT system. The DAS equipment is used for the ATWS mitigation and a countermeasure to common cause failure (CCF) that disables all functions of PSMS and PCMS.	7.8 Table 19.1-119
2.5.3.1 Table 2.5.3-4 ITAAC #1.c	The DAS is electrically and physically isolated from the PSMS	7.8.2.3

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1f Radiological Analysis Key Design Features (Sheet 1 of 2)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
Table 2.1-1.	The χ/Q values used in determining the radiological consequences of postulated accidents (other than the MCR and the TSC).	Table 2.0-1 Table 15.0-13 Table 15A-17
Table 2.1-1	The MCR and the TSC χ/Q values used in determining the radiological consequences of postulated accidents as follows: - Steam system piping failure analysis - RCP rotor seizure analysis - Rod ejection accident analysis - Failure of small lines carrying primary coolant outside containment analysis - SGTR analysis - LOCA analysis - Fuel handling accident analysis	Table 2.0-1 Table 2.3.4-1 thru 2.3.4-7 Table 15A-18 Table 15A-19 Table 15A-20 Table 15A-21 Table 15A-22 Table 15A-23 Table 15A-24
Table 2.2-4 ITAAC #4.a, #4.b Table 2.11.1-1	Containment leak rate, 0-24 hr following LOCA, is 0.15 %/d.	6.2.1 Table 6.2.1-2 15.4.8.5 Table 15.4.8-3 15.6.5.5 Table 15.6.5-4
2.4.4.1 Table 2.4.4-5 ITAAC #7.c	The sodium tetraborate decahydrate (NaTB) baskets, which provide containment pH control during a LOCA, have a total calculated weight of NaTB of 44,100 pounds.	6.3.2.2.5 Table 6.3-5
2.7.5.1.1 Table 2.7.5.1-3 ITAAC #4.b	Performance values of the MCR HVAC system used in the safety analysis are: Unfiltered CRE inleakage: 120 cfm Filtered air intake flow : 1200 cfm Filtered air recirculation flow : 2400 cfm Filter efficiency Elemental iodine : 95% Filter efficiency Organic iodine : 95% Filter efficiency Particulates : 99%	6.4.2.3 Table 15.6.5-5
2.7.5.2.1.1 Table 2.7.5.2-3 ITAAC #4.a	Penetration and Safeguard Component Areas negative pressure arrival time : 240 sec Filter efficiencies for particulates: 99%	6.5.1 Table 15.6.5-4
Table 2.11.2-2 ITAAC #8.vi	The low volume containment purge isolation valves response time is within 15 seconds of accident initiation.	Table 6.2.4-3 15.6.5.5.1.1 Table 15.6.5-4 Chapter 16 Bases 3.6.3
Table 2.2-2 Table 2.2-4 ITAAC #1 Table 2.8-2	Shielding walls and floors for safety-related structures are provided to maintain the maximum radiation levels to meet the radiation zone.	3.8.3 Table 12.3-1 12.3.2.2

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-1f Radiological Analysis Key Design Features (Sheet 2 of 2)

Tier 1 Ref.(1)	Key Design Features	Tier 2 Location(2)
Table 2.8-1 ITAAC #1.b Table 2.8-2	Shielding walls and floors for the Auxiliary Building are provided to maintain the maximum radiation levels to meet the radiation zone.	Table 12.3-1 12.3.2.2
2.2.1.1 Table 2.2-2 Table 2.2-4 ITAAC #1, #3, #4, #5 2.11.1.1 Table 2.11.1-1 Table 2.11.1-2 ITAAC #1, #3	The PCCV facility is comprised of the containment vessel and the annulus enclosing the containment penetration area, and provides an efficient leak-tight barrier and environmental radiation protection under all postulated conditions, including LOCA.	3.8 6.2.1 Table 6.2.1-2

NOTES: (1) Source: Tier 1 section or table. (2) Tier 2 location or table where addressed.

Table 14.3-2 Example of ITAAC Table (Sheet 1 of 4)

Design Commitment		Inspections, Tests, Analyses		Acceptance Criteria	
1.a	The functional arrangement of the ____ system is as described in the Design Description of Subsection_____and in Table _____ and as shown on Figure _____	1.a	Inspection of the as-built ______system will be performed.	1.a	The as-built ____ system conforms to the functional arrangement as described in the Design Description of Subsection ___ and in Table _____and as shown in Figure ___.
1.b	Each mechanical division of the _____ system (Divisions A, B, C & D) is physically separated from the other divisions so as not to preclude accomplishment of the safety function.	1.b	Inspections and analysis of the as-built__ system will be performed.	1.b	A report exists and concludes that each mechanical division of the _____system is physically separated from other mechanical divisions of the system by spatial separation, barriers, or enclosures so as to assure that the functions of the safety related system are maintained.
2a.	The ASME Code Section III components of the___system identified in Table _____ are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.	2.a.	Inspection of the as-built ASME Code Section III components of the _____ system, identified in Table_____ will be performed.	2.a.	The ASME Code Section III data report(s) (certified, when required by ASME Code) and inspection reports (including N-5 Data Reports where applicable) exist and conclude that the as-built ASME Code Section III components of the ____system identified in Table ____ are fabricated, installed, and inspected in accordance with ASME Code Section III requirements.

Table 14.3-2 Example of ITAAC Table (Sheet 2 of 4)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
2.b The ASME Code Section III components of the _____ system identified in Table ______ are reconciled with the design requirements.	2.b A reconciliation analysis of the components identified in Table_____ using as-designed and as-built information and ASME Code Section III design report(s) (NCA-3550) will be performed.	2.b The ASME Code Section III design report(s) (certified, when required by ASME Code) exist and concluded that the design reconciliation has been completed in accordance with the ASME Code Section III for the as-built components of the ___ system identified in Table ___. The report documents the results of the reconciliation analysis.
3.a Pressure boundary welds in ASME Code Section III components, identified in Table ____, meet ASME Code Section III requirements for non-destructive examination of welds.	3.a Inspections of the as-built pressure boundary welds in ASME Code Section III components, identified in Table _____, will be performed in accordance with the ASME Code Section III.	3.a The ASME Code Section III code reports exist and conclude that the ASME Code Section III requirements are met for non-destructive examination of pressure boundary welds in ASME Code Section III components identified in Table ____.
4.a The ASME Code Section III components, identified in Table ____, retain their pressure boundary integrity at their design pressure.	4.a A hydrostatic test will be performed on the components, identified in Table _____, required by the ASME Code Section III to be hydrostatically tested.	4.a ASME Code Data Report(s) exist and conclude that the results of the hydrostatic test of the components identified in Table ____ as ASME Code Section III conform with the requirements of the ASME Code Section III.

Table 14.3-2 Example of ITAAC Table (Sheet 3 of 4)

Design Commitment		Inspections, Tests, Analyses		Acceptance Criteria	
5.a	The seismic Category I equipment, identified in Table _____, can withstand seismic design basis loads without loss of safety function.	5.a.i	Inspections will be performed to verify that the seismic Category I equipment identified in Table ____is located in a seismic Category I structure.	5.a.i	The seismic Category I equipment identified in Table _____is located in a seismic Category I structure.
		5.a.ii	Type tests, analyses, or a combination of type tests and analyses of seismic Category I equipment identified in Table _____ will be performed using analytical assumptions, or will be performed under conditions, which bound the seismic design basis requirements.	5.a.ii	A report exists and concludes that the seismic Category I equipment identified in Table______can withstand seismic design basis loads without loss of safety function.
		5.a.iii	Inspections and analyses will be performed to verify that the as-built seismic Category I equipment identified in Table _____ including anchorages, is seismically bounded by the tested or analyzed conditions.	5.a.iii	A report exists and concludes that the as-built seismic Category I equipment identified in Table____ ,including anchorage, is seismically bounded by the tested or analyzed conditions.
5.b	The seismic category piping, including supports, identified in Table ___can withstand seismic design basis loads without a loss of its safety function.	5.b.i	Inspections will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table ____ is supported by a seismic Category I structure(s).	5.b.i	The as-built seismic Category I piping, including supports, identified in Table___ is supported by a seismic Category I structure(s).
		5.b.ii	Inspections and analyses will be performed to verify that the as-built seismic Category I piping, including supports, identified in Table ____ can withstand seismic design basis loads without a loss of its safety function.	5.b.ii	A report exists and concludes that the as-built seismic Category I piping, including supports, identified in Table____ can withstand seismic design basis loads without a loss of its safety function.

Table 14.3-2 Example of ITAAC Table (Sheet 4 of 4)

Design Commitment		Inspections, Tests, Analyses		Acceptance Criteria	
6.a	The Class 1E equipment identified in Table ____ as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.	6.a.i	Type tests or a combination of type tests and analyses using the design environmental conditions, or under the conditions which bound the design environmental conditions, will be performed on Class 1E equipment identified in Table_____as being qualified for in a harsh environment.	6.a.i	A report exists and concludes that the Class 1E equipment identified in Table ____ as being qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis accident without loss of safety function for the time required to perform the safety function.
		6.a.ii	Inspection will be performed on the as-built Class 1E equipment identified in Table______as being qualified for a harsh environment and the associated wiring, cables, and terminations located in a harsh environment.	6.a.ii	The as-built Class 1E equipment and the associated wiring, cables, and terminations identified in Table ____as being qualified for a harsh environment are bounded by type tests or a combination of type tests and analyses.
6.b	The Class 1E equipment, identified in Table _____, is powered from its respective Class 1E division.	6.b	A test will be performed on each division of the as-built Class 1E equipment identified in Table ____ by providing a simulated test signal only in the Class 1E division under test.	6.b	The simulated test signal exists at the Class 1E equipment identified in Table ____ under test.
6.c	Separation is provided between redundant divisions of_____ system Class 1E cables, and between Class 1E cables and non-Class 1E cables.	6.c	Inspections of the as-built Class 1E divisional cables will be performed.	6.c	Physical separation or electrical isolation is provided in accordance with RG 1.75, between the as-built cables of redundant_____system Class 1E divisions and between Class 1E cables and non-Class 1E cables.

Table 14.3-3 Reactor Systems

Acronym	System
CVCS	chemical and volume control system
ECCS	emergency core cooling system
LPMS	loose parts monitoring system
RCS	reactor coolant system
RHRS	residual heat removal system
-	reactor system

Table 14.3-4 Instrumentation and Control Systems(1)

Acronym	System
DAS	diverse actuation system
DCS	data communication system
ESFAS	engineered safety features actuation system
HSIS	human-system interface system
PSMS	protection and safety monitoring system
PCMS	plant control and monitoring system
RPS	reactor protection system
RTS	reactor trip system
SLS	safety logic system
SPDS	safety parameter display system

NOTE: (1) Includes selected subsystems. ITAAC may be provided for other subsystems as well.

Table 14.3-5 Electrical Systems

Acronym	System
-	ac electric power system
-	dc electric power system
	instrumentation and control power supply system
EPS	emergency power source
AAC	alternate ac power source
-	plant lighting system
-	grounding and lightning protection system
EPA	containment electrical penetration assembly

Table 14.3-6 Plant Systems (Sheet 1 of 2)

Acronym	System
	Power Generation Systems
ASSS	auxiliary steam supply system
CWS	circulating water system
CFS	condensate and feedwater system
CPS	condensate polishing system
EFWS	emergency feedwater system
-	main condenser
MCES	main condenser evacuation system
MSS	main steam supply system
SCIS	secondary side chemical injection system
SGBDS	steam generator blowdown system
TBS	turbine bypass system
-	turbine generator
GSS	gland seal system
CAGS	Compressed Air and Gas Systems
	Cooling Water Systems
CCWS	component cooling water system
ECWS	essential chilled water system
ESWS	essential service water system
Non-ECWS	non-essential chilled water system
Non-ESWS	non-essential service water system
TCS	turbine component cooling water system
	Radwaste Systems
GWMS	gaseous waste management system
LWMS	liquid waste management system
SWMS	solid waste management system
	Heating, Ventilation, and Air Conditioning (HVAC) Systems
-	annulus emergency exhaust system
-	auxiliary building HVAC system
ABVS	auxiliary building ventilation system
-	Class 1E electrical room HVAC system
-	containment fan cooler system
-	containment purge system
CVVS	containment ventilation system

Table 14.3-6 Plant Systems (Sheet 2 of 2)

Acronym	System
-	control rod drive mechanism (CRDM) cooling system
-	emergency feedwater pump area HVAC system
ESFVS	engineered safety features ventilation system
-	main control room HVAC system
	main steam / feedwater piping area HVAC system
-	non-class 1E electrical room HVAC system
-	reactor cavity cooling system
-	safeguard component area HVAC system
-	safety related component area HVAC system
-	technical support center HVAC system
-	turbine building area ventilation system
	Auxiliary Systems and Other Plant Systems
-	area radiation and airborne radioactivity monitoring systems
ARMS	area radiation monitoring system
-	communication systems
-	condensate storage facilities
-	equipment and floor drainage system
FPS	fire protection system
LLHS	light load handling system
-	new fuel storage
OHLHS	overhead heavy load handling system
PERMS	process effluent radiation monitoring and sampling system
PSWS	potable and sanitary water systems
PSS	process and post-accident sampling system
SFPCS	spent fuel pit cooling and purification system
-	spent fuel storage

Table 14.3-7 Containment Systems

Acronym	System
-	containment vessel
CIS	containment isolation system
CSS	containment spray system
CHS	containment hydrogen monitoring and control system

Table 14.3-8 IEEE 603-1991 Compliance Matrix by DCD Tier 1 Section (Sheet 1 of 3)

IEEE Std. 603-1991		Tier 1 DCD Subsection Number					
Section Number	**Section Title or Topic**	**2.5.1 (PSMS)**	**2.5.2 (SSD)**	**2.5.3 (DAS)**	**2.5.4 (PAM/BISI/ SPDS et. al.)**	**2.5.5 (PCMS)**	**2.5.6 (DCS)**
4.4	Analytical limits, ranges and rates of change	X Table 2.5.1-6 Item # 22	(1) (5)	N/A	(1) (5)	N/A	N/A
4.6	Number and location of sensors; spatial dependence	X Table 2.5.1-6 Item # 1, 2	(1) (5)	N/A	(1) (5)	N/A	N/A
4.8	Potential for functional degradation	X Table 2.5.1-6 Item # 7, 8	(1) (5)	N/A	(1) (5)	N/A	(1) (5) Table 2.5.6-1 Item # 4
5.1	Single Failure	X Table 2.5.1-6 Item # 10, 21	(1) (5)	N/A	(1) (5)	N/A	N/A
5.2 and 7.3	Completion of Protective Action	X Table 2.5.1-6 Item # 14	(1) (5) Table 2.5.2-3 Item # 7	N/A	(1) (5)	N/A	N/A
5.3	Quality	(2)	(2)	(2)	(2)	(2)	(2)
5.4	Equipment Qualification	X Table 2.5.1-6 Item # 5, 6, 7	(1) (5)	N/A	(1) (5)	N/A	(1) (5)
5.5	System Integrity	X Table 2.5.1-6 Item # 5, 6, 7, 8, 22	(1) (5)	N/A	(1) (5)	N/A	(1) (5) Table 2.5.6-1 Item # 2
5.6	Independence	X Table 2.5.1-6 Item # 10	(1) (5)	N/A	(1) (5)	N/A	(1) (5)
5.7 and 6.5	Capability for test and Calibration	X Table 2.5.1-6 Item # 17, 27	(1) (5)	N/A	(1) (5)	N/A	(1) (5) Table 2.5.6-1 Item # 2

Table 14.3-8 IEEE 603-1991 Compliance Matrix by DCD Tier 1 Section (Sheet 2 of 3)

IEEE Std. 603-1991		Tier 1 DCD Subsection Number					
Section Number	**Section Title or Topic**	**2.5.1 (PSMS)**	**2.5.2 (SSD)**	**2.5.3 (DAS)**	**2.5.4 (PAM/BISI/ SPDS et. al.)**	**2.5.5 (PCMS)**	**2.5.6 (DCS)**
5.8	Information Displays	X Table 2.5.1-6 Item # 11, 16	(1) (5)	N/A	(1) (5)	N/A	N/A
5.9	Control of Access	X Table 2.5.1-6 Item # 12	(1) (5) Table 2.5.2-3 Item # 4	N/A	(1) (5)	N/A	N/A
5.10	Repair	X Table 2.5.1-6 Item # 17	(1) (5)	N/A	(1) (5)	N/A	N/A
5.11	Identification	X Table 2.5.1-6 Item # 13	(1) (5) Table 2.5.2-3 Item # 5	N/A	(1) (5)	N/A	N/A
5.12	Auxiliary Features	X Table 2.6.3-3 Item # 1, 8, 9, 14	(1) (5)	N/A	(1) (5)	N/A	N/A
5.13	Multi Unit Stations	(3)	(3)	(3)	(3)	(3)	(3)
5.14	Human Factors Considerations	X Tier 1, Section 2.9					
4.9 and 5.15	Reliability	(4)	(4)	(4)	(4)	(4)	(4)
6.1 and 7.1	Automatic Control	X Table 2.5.1-6 Item # 11, 14, 18, 23	(1) (5)	N/A	(1) (5)	N/A	N/A
6.2 and 7.2	Manual Control	X Table 2.5.1-6 Item # 4, 11	(1) (5)	N/A	(1) (5)	N/A	N/A
6.3	Interaction between Sense and Command Features	X Table 2.5.1-6 Item # 25, 26	(1) (5)	N/A	(1) (5)	N/A	N/A

Table 14.3-8 IEEE 603-1991 Compliance Matrix by DCD Tier 1 Section (Sheet 3 of 3)

IEEE Std. 603-1991		Tier 1 DCD Subsection Number					
Section Number	Section Title or Topic	2.5.1 (PSMS)	2.5.2 (SSD)	2.5.3 (DAS)	2.5.4 (PAM/BISI/ SPDS et. al.)	2.5.5 (PCMS)	2.5.6 (DCS)
6.4	Derivation of System Inputs	X Table 2.5.1-6 Item # 16	(1) (5)	N/A	(1) (5)	N/A	N/A
6.6 and 7.4	Operating Bypasses	X Table 2.5.1-6 Item # 17, 18	(1) (5)	N/A	(1) (5)	N/A	N/A
6.7, 7.5, and 8.3	Maintenance Bypass	X Table 2.5.1-6 Item # 17	(1) (5)	N/A	(1) (5)	N/A	N/A
6.8	Setpoints	(6)	(1) (5)	N/A	(1) (5)	N/A	N/A
8.1	Electrical Power Sources	X Table 2.5.1-6 Item # 9, 21	(1) (5)	N/A	(1) (5)	N/A	N/A

Table Notes:

X means full compliance. The applicable ITAAC Table and Item # is identified in the cell:

N/A The IEEE Std. 603-1991 Section is Not Applicable.

(1) Safety-related portions only.

(2) No ITAAC is required for this criterion. See the description of the 10 CFR 50, Appendix B, Quality Assurance Program that is applied to the design, fabrication, construction, and test of the safety-related structures, systems, and components provided as part of the preliminary Safety Evaluation Report as required by 10 CFR 50.34(a)(7).

(3) Multi Unit Stations are not applicable to the US APWR since the US APWR is a single unit.

(4) No specific ITAAC is required for this criterion. Reliability of I&C systems is considered in the PRA and addressed by D-RAP program ITAAC Item 1 in Tier 1 Table 2.13-1.

(5) The ITAAC item identified for Tier 1 Section 2.5.1 is applicable to the Safety Related portions of Tier 1 Section 2.5.2, Section 2.5.4, and Section 2.5.6.

(6) This is addressed in MUAP-09022, "US-APWR Instrument Setpoint Methodology," which will be reviewed as part of the initial design certification.

APPENDIX 14A

COMPARISON OF RG 1.68 APPENDIX A VERSUS US-APWR TEST ABSTRACTS

This appendix provides the matrix of applicable guidance of RG 1.68 Appendix A versus typical test abstracts. In general, redundancy and electrical independence tests (i.e. RG-1.41) are applicable for safety-related systems only (this test is performed in the 14.2.12.1.45 and 14.2.12.1.47). And testing specified in RG 1.68 at the 25% test power plateau is performed at 30% based on MHI's startup experience. Other exceptions are identified in this matrix with justification.

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 1 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
1.a.(1)	14.2.12.1.1 14.2.12.1.52	RCS Hot Functional Preoperational Test Thermal Expansion Testing
1.a.(2) (a)	14.2.12.1.2	Pressurizer Pressure and Water Level Control Preoperational Test
1.a.(2) (b)	14.2.12.1.3	RCP Initial Operation Preoperational Test
1.a.(2) (c)	14.2.12.1.8 14.2.12.1.29	RCS Cold Hydrostatic Preoperational Test Feedwater System Preoperational Test The above integrated hydrostatic test and shop test is applicable instead of the component test.
1.a.(2) (d)	14.2.12.1.4 14.2.12.1.5	Pressurizer Safety Depressurization Valve (SDV) Preoperational Test Pressurizer Relief Tank Preoperational Test
1.a.(2) (e)	-	Not applicable. US-APWR does not have main steam isolation valves in the reactor coolant system.
1.a.(2) (f)	14.2.12.1.6	RCS Preoperational Test
1.a.(2) (g)	14.2.12.1.2 14.2.12.1.19	Pressurizer Pressure and Water Level Control Preoperational Test Resistance Temperature Detectors (RTDs)/Thermocouple Cross-calibration Preoperational Test
1.a.(2) (h)	14.2.12.1.7	Reactor Internals Vibration Test
1.a.(2) (i)	14.2.12.1.6	RCS Preoperational Test
1.a.(2) (j)	-	Not applicable. This is not a design feature of the US-APWR.

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 2 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
1.a.(3)	14.2.12.1.7 14.2.12.1.51	Reactor Internals Vibration Test Steady State Vibration Monitoring of Safety Related and High Energy Piping
1.a.(4)	14.2.12.1.8	RCS Cold Hydrostatic Preoperational Test
1.b.(1)	14.2.12.1.9 14.2.12.1.10 14.2.12.1.11	Reactor Control, Rod Control, and Rod Position Indication Preoperational Test CRDM Motor-Generator Set Preoperational Test CRDM Initial Timing Preoperational Test The rod worth minimizers is not a design feature of US-APWR. And refueling equipment is not a part of control rod drive system.
1.b.(2)	14.2.12.1.12 14.2.12.1.13 14.2.12.1.14 14.2.12.1.15 14.2.12.1.16 14.2.12.1.45 14.2.12.1.53 14.2.12.1.84	CVCS Preoperational Test - Boric Acid Blending CVCS Preoperational Test - Charging and Seal Water CVCS Preoperational Test -Letdown RCS Lithium Addition and Distribution Test PMWS Preoperational Test Class 1E Bus Load Sequence Preoperational Test Class 1E Gas Turbine Generator Sequence Preoperational test Sampling System Preoperational Test Exception Heat tracing system test is not performed because the system is not a design feature of the US-APWR.
1.b.(3)	-	Not applicable. This is not a design feature of the US-APWR.
1.c	14.2.12.1.17 14.2.12.1.18 14.2.12.1.19 14.2.12.1.20 14.2.12.1.45 14.2.12.1.53	Reactor Trip System and ESF System Response Time Test Reactor Trip System and ESF System Logic Preoperational Test Resistance Temperature Detectors (RTDs)/Thermocouple Cross-Calibration Preoperational Test Diverse Actuation System (DAS) Actuation Test Class 1E Bus Load Sequence Preoperational Test Class 1E Gas Turbine Generator Sequence Preoperational Test
1.d.(1)	14.2.12.1.21	Main Steam Supply System Preoperational Test
1.d.(2)	14.2.12.1.21	Main Steam Supply System Preoperational Test
1.d.(3)	14.2.12.1.21	Main Steam Supply System Preoperational Test
1.d.(4)	14.2.12.1.21	Main Steam Supply System Preoperational Test
1.d.(5)	14.2.12.1.22	RHRS Preoperational Test

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 3 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
1.d.(6)	-	Not applicable. This is not a design feature of the US-APWR.
1.d.(7)	14.2.12.1.23	Main Steam Isolation Valve (MSIV), Main Feedwater Isolation Valve (MFIV) and Main Steam Check Valve Preoperational Test
1.d.(8)	14.2.12.1.24 14.2.12.1.25	Motor-Driven Emergency Feedwater System Preoperational Test Turbine-Driven Emergency Feedwater System Preoperational Test
1.d.(9)	14.2.12.1.109	Condensate Storage Facilities System Preoperational Test
1.d.(10)	-	Not applicable. This is not a design feature of the US-APWR.
1.d.(11)	14.2.12.1.33 14.2.12.1.60 14.2.12.1.87 14.2.12.1.104	Circulating Water System Preoperational Test Essential Chilled Water System Preoperational Test Component Cooling Water Preoperational Test Non-Essential Chilled Water System Preoperational Test
1.e.(1)	14.2.12.1.21	Main Steam Supply System Preoperational Test
1.e.(2)	14.2.12.1.21	Main Steam Supply System Preoperational Test
1.e.(3)	14.2.12.1.23	Main Steam Isolation Valve (MSIV), Main Feedwater Isolation Valve (MFIV) and Main Steam Check Valve Preoperational Test
1.e.(4)	14.2.12.1.21	Main Steam Supply System Preoperational Test
1.e.(5)	14.2.12.1.26	Extraction Steam Preoperational Test
1.e.(6)	14.2.12.1.27	Turbine-Generator Preoperational Test
1.e.(7)	14.2.12.1.28	Condensate System Preoperational Test
1.e.(8)	14.2.12.1.28	Condensate System Preoperational Test
1.e.(9)	14.2.12.1.29	Feedwater System Preoperational Test
1.e.(10)	14.2.12.1.30	Feedwater Heater and Drain Systems Preoperational Test
1.e.(11)	14.2.12.1.31 14.2.12.1.89 14.2.12.1.109	Condensate Polishing System Preoperational Test Secondary Side Chemical Injections System Preoperational Test Condensate Storage Facilities System Preoperational Test
1.e.(12)	14.2.12.1.32	Main Condenser Evacuation System Preoperational Test

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 4 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
1.f.(1)	14.2.12.1.33	Circulating Water System Preoperational Test
1.f.(2)	14.2.12.1.33	Circulating Water System Preoperational Test
1.f.(3)	14.2.12.1.34 14.2.12.1.108	Essential Service Water System (ESWS) System Preoperational Test Non-Essential Service Water (non-ESW) System Preoperational Test
1.g.(1)	14.2.12.1.35 14.2.12.1.36 14.2.12.1.37	Main and Unit Auxiliary Transformers Preoperational Test Reserve Auxiliary Transformers Preoperational Test Non-Class 1E ac Distribution Preoperational Test Exception Redundancy is not required to non-Class 1E distribution system. Electrical independence between Class 1E and non-Class 1E is assured in the Class 1E distribution system.
1.g.(2)	14.2.12.1.38 14.2.12.1.39 14.2.12.1.40 14.2.12.1.41 14.2.12.1.42 14.2.12.1.43 14.2.12.1.45 14.2.12.1.53	6.9 kV Class 1E System Preoperational Test 480 V Class 1E Switchgear Preoperational Test 480 V Class 1E Motor Control Center Preoperational Test 120 V ac Class 1E Preoperational Test Emergency Lighting System Preoperational Test Normal Lighting System Preoperational Test Class 1E Bus Load Sequence Preoperational Test Class 1E Gas Turbine Generator Sequence Preoperational Test
1.g.(3)	14.2.12.1.44 14.2.12.1.45 14.2.12.1.46 14.2.12.1.53	Class 1E Gas Turbine Generator Preoperational Test Class 1E Bus Load Sequence Preoperational Test Alternate ac Power Sources for Station Black Out Preoperational Test Class 1E Gas Turbine Generator Sequence Preoperational Test
1.g.(4)	14.2.12.1.42 14.2.12.1.47 14.2.12.1.48 14.2.12.1.49	Emergency Lighting System Preoperational Test 125 V dc Class 1E Preoperational Test 125 V dc Class 1E Minimum Load Voltage Verification 125 V dc Non-Class 1E Preoperational Test
1.h.(1) (a)	14.2.12.1.50 14.2.12.1.51 14.2.12.1.52	Dynamic State Vibration Monitoring of Safety Related and High-Energy Piping Steady State Vibration Monitoring of Safety Related and High-Energy Piping Thermal Expansion Test
1.h.(1) (b)	14.2.12.1.45 14.2.12.1.53	Class 1E Bus Load Sequence Preoperational Test Class 1E Gas Turbine Generator Sequence Preoperational Test

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 5 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
1.h.(1) (c)	14.2.12.1.53 14.2.12.1.54 14.2.12.1.55 14.2.12.1.57	Class 1E Gas Turbine Generator Sequence Preoperational Test Safety Injection System Preoperational Test ECCS Actuation and Containment Isolation Logic Preoperational Test Safety Injection Accumulator Test
1.h.(1) (d)	14.2.12.1.22	RHRS Preoperational Test
1.h.(1) (e)	14.2.12.1.54	Safety Injection System Preoperational Test
1.h.(2)	14.2.12.1.56 14.2.12.1.57	Safety Injection Check Valve Preoperational Test Safety Injection Accumulator Test
1.h.(3)	14.2.12.1.58	Containment Spray System Preoperational Test The containment spray system in US-APWR dose not have any chemical addition equipment.
1.h.(4)	14.2.12.1.64	Containment Hydrogen Monitoring and Control System Preoperational Test. US-APWR design does not include hydrogen recombiners.
1.h.(5)	-	Not applicable This is not a design feature of the US-APWR.
1.h.(6)	-	Not applicable This is not a design feature of the US-APWR.
1.h.(7)	14.2.12.1.96 14.2.12.1.97 14.2.12.1.98 14.2.12.1.101 14.2.12.1.70 14.2.12.1.79 14.2.12.106	Safeguard Component Area HVAC System Preoperational Test Emergency Feedwater Pump Area HVAC System Preoperational Test Class 1E Electrical Room HVAC System Preoperational Test Main Control Room (MCR) HVAC System Preoperational Test (including MCR Habitability) Annulus Emergency Exhaust System Preoperational Test High-Efficiency Particulate Air Filters and Charcoal Absorbers Preoperational Test Safety Related Component Area HVAC System Preoperational Test
1.h.(8)	14.2.12.1.57 14.2.12.1.59	Safety Injection Accumulator Testing Refueling Water Storage System Preoperational Test
1.h.(9)	-	Not applicable This system does not have an ESF function in the US-APWR.
1.h.(10)	14.2.12.2.4.21	Ultimate Heat Sink Heat Rejection Capability Test

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 6 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
1.i.(1)	14.2.12.1.61	Containment Structural Integrity Test
1.i.(2)	14.2.12.1.55	ECCS Actuation and Containment Isolation Logic Preoperational Test
1.i.(3)	14.2.12.1.62	Containment Local Leak rate Preoperational Test
1.i.(4)	14.2.12.1.62	Containment Local Leak rate Preoperational Test
1.i.(5)	14.2.12.1.62	Containment Local Leak rate Preoperational Test
1.i.(6)	14.2.12.1.63	Containment Integrated Leak Rate Test (ILRT) Preoperational Test
1.i.(7)	-	Not applicable This is not a design feature of the US-APWR.
1.i.(8)	14.2.12.1.55	ECCS Actuation and Containment Isolation Logic Preoperational Test
1.i.(9)	14.2.12.1.67 14.2.12.1.68	Containment High Volume Purge System Preoperational Test Containment Low Volume Purge System Preoperational Test
1.i.(10)	-	Not applicable This is not a design feature of the US-APWR.
1.i.(11)	-	Not applicable This is not a design feature of the US-APWR.
1.i.(12)	-	Not applicable This is not a design feature of the US-APWR.
1.i.(13)	-	Not applicable This is not a design feature of the US-APWR.
1.i.(14)	-	Not applicable This is not a design feature of the US-APWR.
1.i.(15)	-	Not applicable This is not a design feature of the US-APWR.
1.i.(16)	14.2.12.1.65 14.2.12.1.66 14.2.12.1.67 14.2.12.1.68 14.2.12.1.69	CRDM Cooling System Preoperational Test Reactor Cavity Cooling System Preoperational Test Containment High Volume Purge System Preoperational Test Containment Low Volume Purge System Preoperational Test Containment Fan Cooler System Preoperational Test
1.i.(17)	-	Not applicable This is not a design feature of the US-APWR.

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 7 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
1.i.(18)	14.2.12.1.70	Annulus Emergency Exhaust System Preoperational Test
1.i.(19)	-	Not applicable This is not a design feature of the US-APWR.
1.i.(20)	-	Not applicable This is not a design feature of the US-APWR.
1.i.(21)	-	Not applicable This is not a design feature of the US-APWR.
1.j.(1)	14.2.12.1.2	Pressurizer Pressure and Water Level Control Preoperational Test
1.j.(2)	14.2.12.1.29 14.2.12.1.24 14.2.12.1.25	Feedwater System Preoperational Test, Motor-Driven Emergency Feedwater System Preoperational Test, Turbine-Driven Emergency Feedwater System Preoperational Test
1.j.(3)	14.2.12.1.21	Main Steam Supply System Preoperational Test
1.j.(4)	-	Not applicable This is not a design feature of the US-APWR.
1.j.(5)	14.2.12.1.71 14.2.12.1.115	RCS Leak Rate Preoperational Test RCPB Leak Detection Systems Preoperational Test
1.j.(6)	14.2.12.1.72	Loose Parts Monitoring System Preoperational Test
1.j.(7)	14.2.12.1.77	Miscellaneous Leakage Detection System Preoperational Test
1.j.(8)	14.2.12.1.9	Reactor Control, Rod Control, and Rod Position Indication Preoperational Test
1.j.(9)	14.2.12.1.70	Annulus Emergency Exhaust System Preoperational Test
1.j.(10)	14.2.12.1.73	Seismic Monitoring System Preoperational Test
1.j.(11)	14.2.12.1.74	Incore Instrumentation System Preoperational Test
1.j.(12)	-	Not applicable This is not a design feature of the US-APWR.
1.j.(13)	14.2.12.1.74 14.2.12.1.75	Incore Instrumentation System Preoperational Test Nuclear Instrumentation System Preoperational Test
1.j.(14)	14.2.12.1.18	Reactor Trip System and ESF System Logic Preoperational Test
1.j.(15)	-	Not applicable This is not a design feature of the US-APWR.

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 8 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
1.j.(16)	14.2.12.1.28	Condensate System Preoperational Test
1.j.(17)	14.2.12.1.30	Feedwater Heater and Drain Systems Preoperational Test Heater bypass control system test is not performed because there is not heater bypass line in US-APWR.
1.j.(18)	-	Not applicable. This is not a design feature of the US-APWR.
1.j.(19)	14.2.12.1.76	Remote Shutdown Preoperational Test
1.j.(20)	14.2.12.1.77	Miscellaneous Leakage Detection System Preoperational Test
1.j.(21)	-	Not applicable. This is not a design feature of the US-APWR.
1.j.(22)	-	Exception The loop calibration between field instrumentation and interface module cards will be performed in the construction tests, so this test is not a part of preoperational test. Pressure-suppression level monitors applicable to BWRs only.
1.j.(23)	14.2.12.1.64 14.2.12.1.84	Containment Hydrogen Monitoring and Control System Preoperational Test Sampling System Preoperational Test
1.j.(24)	14.2.12.1.18	Reactor Trip System and ESF System Logic Preoperational Test
1.j.(25)	14.2.12.1.18	Reactor Trip System and ESF System Logic Preoperational Test Factory test and software life cycle program assure the function of the system and the quality of the software. The installation of the controlled software is to be checked in construction tests as specified in B. prerequisites so that this test is not performed as a preoperational test.
1.k.(1)	14.2.12.1.78	Process and Effluent Radiological Monitoring System, Area Radiation Monitoring System and Airborne Radioactivity Monitoring System Preoperational Test
1.k.(2)	-	Not applicable The test program will be developed under the operational radiation protection program specified in Section 12.5 by the COL licensee.

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 9 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
1.k.(3)	-	Not applicable The test program will be developed under the operational radiation protection program specified in Section 12.5 by the COL licensee.
1.k.(4)	14.2.12.1.79	High-Efficiency Particulate Air Filters and Charcoal Absorbers Preoperational Test
1.l.(1)	14.2.12.1.80	Liquid Waste Management System Preoperational Test
1.l.(2)	14.2.12.1.81	Gaseous Waste Management System Preoperational Test
1.l.(3)	14.2.12.1.82	Solid Waste Management System Preoperational Test
1.l.(4)	14.2.12.1.83	Steam Generator Blowdown System Preoperational Test
1.l.(5)	14.2.12.1.32	Main Condenser Evacuation System Preoperational Test
1.l.(6)	14.2.12.1.99 14.2.12.1.67 14.2.12.1.68	Auxiliary Building HVAC System Preoperational Test Containment High Volume Purge System Preoperational Test Containment Low Volume Purge System Preoperational Test
1.l.(7)	14.2.12.1.80	Liquid Waste Management System Preoperational Test
1.l.(8)	14.2.12.1.84 14.2.12.1.83	Sampling System Preoperational Test Steam Generator Blowdown System Preoperational Test
1.m.(1)	14.2.12.1.85 14.2.12.1.78	Spent Fuel Pit Cooling and Purification System (SFPCS) Preoperational Test Process and Effluent Radiological Monitoring System, Area Radiation Monitoring System and Airborne Radioactivity Monitoring System Preoperational Test
1.m.(2)	14.2.12.1.86	Fuel Handling System Preoperational Test
1.m.(3)	14.2.12.1.85	Spent Fuel Pit Cooling and Purification System (SFPCS) Preoperational Test
1.m.(4)	14.2.12.1.86	Fuel Handling System Preoperational Test
1.m.(5)	14.2.12.1.86	Fuel Handling System Preoperational Test
1.m.(6)	14.2.12.1.99	Auxiliary Building HVAC System Preoperational Test
1.n.(1)	14.2.12.1.34	Essential Service Water System (ESWS) System Preoperational Test

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 10 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
1.n.(2)	14.2.12.1.60 14.2.12.1.87 14.2.12.1.88 14.2.12.1.104	Essential Chilled Water System Preoperational Test Component Cooling Water System Preoperational Test Turbine Component Cooling Water System Testing Non-Essential Chilled Water System Preoperational Test
1.n.(3)	14.2.12.1.87	Component Cooling Water Preoperational Test
1.n.(4)	14.2.12.1.16	Primary Makeup Water System (PMWS) Preoperational Test
1.n.(5)	14.2.12.1.83 14.2.12.1.84	Steam Generator Blowdown System Preoperational Test Sampling System Preoperational Test
1.n.(6)	14.2.12.1.89 14.2.12.1.12 14.2.12.1.15	Secondary Side Chemical Injections System Preoperational Test CVCS Preoperational Test - Boric Acid Blending RCS Lithium Addition and Distribution Test
1.n.(7)	14.2.12.1.90	Fire Protection System Preoperational Test
1.n.(8)	14.2.12.1.13	CVCS Preoperational Test - Charging and Seal Water
1.n.(9)	14.2.12.1.116	Equipment and Floor Drainage System Preoperational Test
1.n.(10)	14.2.12.1.14	CVCS Preoperational Test -Letdown
1.n.(11)	14.2.12.1.91 14.2.12.1.92 14.2.12.1.117	Instrument Air System Preoperational Test Station Service Air System Preoperational Test Compressed Gas System Preoperational Test
1.n.(12)	14.2.12.1.93	Boron Recycle System Preoperational Test
1.n.(13)	14.2.12.1.94 14.2.12.1.95	Offsite Communication System Preoperational Test Inplant Communication System Preoperational Test
1.n.(14) (a)	14.2.12.1.96 14.2.12.1.97 14.2.12.1.98 14.2.12.1.106	Safeguard Component Area HVAC System Preoperational Test Emergency Feedwater Pump Area HVAC System Preoperational Test Class 1E Electrical Room HVAC System Preoperational Test Safety Related Component Area HVAC System Preoperational Test

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 11 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
1.n.(14) (b)	14.2.12.1.65 14.2.12.1.66 14.2.12.1.67 14.2.12.1.68 14.2.12.1.69	CRDM Cooling System Preoperational Test Reactor Cavity Cooling System Preoperational Test Containment High Volume System Preoperational Test Containment Low Volume Purge System Preoperational Test Containment Fan Coolers System Preoperational Test
1.n.(14) (c)	14.2.12.1.98 14.2.12.1.102 14.2.12.1.111	Class 1E Electrical Room HVAC System Preoperational Test Non-Class 1E Electrical Room HVAC System Preoperational Test Turbine Building Area Ventilation System (Electrical Equipment Area) Preoperational Test
1.n.(14) (d)	-	Not applicable. Class 1E Gas Turbine Generator contains the function.
1.n.(14) (e)	14.2.12.1.99 14.2.12.1.100 14.2.12.1.102 14.2.12.1.103 14.2.12.1.110	Auxiliary Building HVAC System Preoperational Test Main Steam/Feedwater Piping Area HVAC System Preoperational Test Non-Essential Electrical Room HVAC System Preoperational Test, Technical Support Center HVAC System Preoperational Test Turbine Building Area Ventilation System (General Mechanical Area) Preoperational Test
1.n.(14) (f)	14.2.12.1.101	MCR HVAC System Preoperational Test (including MCR Habitability)
1.n.(15)	14.2.12.1.66	Reactor Cavity Cooling System Preoperational Test
1.n.(16)	-	Not applicable. This is not a design feature of the US-APWR.
1.n.(17)	-	Not applicable. This is not a design feature of the US-APWR.
1.n.(18)	-	Not applicable. This is not a design feature of the US-APWR.
1.o.(1)	14.2.12.1.105 14.2.12.1.118	Vessel Servicing preoperational Test Equipment Hatch Hoist Preoperational Test
1.o.(2)	14.2.12.1.105 14.2.12.1.118	Vessel Servicing preoperational Test Equipment Hatch Hoist Preoperational Test
1.o.(3)	14.2.12.1.105 14.2.12.1.118	Vessel Servicing preoperational Test Equipment Hatch Hoist Preoperational Test
2.a	14.2.12.2.1.1	RCS Sampling for Fuel Loading

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 12 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
2.b	14.2.12.1.9 14.2.12.2.1.6 14.2.12.2.1.7 14.2.12.2.1.8 14.2.12.2.1.9	Reactor Control, Rod Control, and Rod Position Indication Preoperational Test Rod Drop Time Measurement Test CRDM Operational Test Rod Position Indication Test Rod Control System Test
2.c	14.2.12.1.18 14.2.12.2.1.6 14.2.12.2.1.10	Reactor Trip System and ESF System Logic Preoperational Test Rod Drop Time Measurement Test Reactor Protection System Test
2.d	14.2.12.2.1.11	RCS Final Leak Test
2.e	14.2.12.2.1.1 14.2.12.2.4.14	RCS Sampling for Fuel Loading Primary and Secondary Chemistry Test
2.f	14.2.12.1.7 14.2.12.1.51 14.2.12.1.50	Reactor Internals Vibration Test Exception: Vibration testing is not performed with fuel loaded. See Subsection 3.9.2 for the vibration testing of reactor internals. Steady State Vibration Monitoring of Safety Related and High Energy Piping Dynamic State Vibration Monitoring of Safety Related and High Energy Piping
2.g	14.2.12.2.1.2 14.2.12.2.3.6	Fuel Loading Instrumentation and Neutron Source Requirements test Operational Alignment of Nuclear Instrumentation Test
2.h	14.2.12.2.1.12	Incore Detector Test
3	14.2.12.2.2.1 14.2.12.2.2.2	Initial Criticality Test Sequence Initial Criticality
4.a	14.2.12.2.3.1 14.2.12.2.2.3	Low Power Test Sequence Determination of Core Power Range for Physics Testing
4.b	14.2.12.2.3.2 14.2.12.2.3.3 14.2.12.2.3.4	Boron Endpoint Determination Test Isothermal Temperature Coefficient Measurement Test RCCA Bank Worth Measurement at Zero Power Test
4.c	14.2.12.2.3.5	Pseudo Rod Ejection Test
4.d	14.2.12.2.3.6	Operational Alignment of Nuclear Instrumentation Test
4.e	14.2.12.2.4.4	Flux Map Test
4.f	14.2.12.2.4.15	Biological Shield Survey Test
4.g	14.2.12.2.4.13	Process and Effluent Radiation Monitoring System Test
4.h	14.2.12.2.4.14	Primary and Secondary Chemistry Test

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 13 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
4.i	14.2.12.1.9 14.2.12.2.1.7 14.2.12.2.1.8 14.2.12.2.1.9	Reactor Control, Rod Control, and Rod Position Indication Preoperational Test CRDM Operational Test Rod Position Indication Test Rod Control System Test
4.j	14.2.12.2.4.11	Ventilation Capability Test
4.k	14.2.12.2.4.6	Remote Shutdown Test
4.l	-	Exception The response time will not be measured because the MSIVs will be verified during hot functional and preoperational testing. In addition, the operability will be demonstrated during the startup test.
4.m	-	Not applicable. This is not a design feature of the US-APWR.
4.n	-	Exception Self-diagnostic feature assures the operability of the computer system. And the performance of the communication among computer systems is assured by the administrative control for the software and self diagnosis function. Therefore this test provides no significant results.
4.o	14.2.12.2.1.6	Rod Drop Time Measurement Test (Previously conducted.)
4.p	14.2.12.2.3.1 14.2.12.2.4.6	Low Power Test Sequence Remote Shutdown Test
4.q	14.2.12.2.3.1 14.2.12.2.4.6	Low Power Test Sequence Remote Shutdown Test
4.r	14.2.12.4.14	Primary and Secondary Chemistry Test
4.s	14.2.12.1.7	Reactor Internal Vibration Test (Previously conducted.)
4.t	14.2.12.2.3.9	Natural Circulation Test
4.u	14.2.12.2.3.7 14.2.12.2.3.8 14.2.12.2.3.10	Dynamic Automatic Turbine Bypass Control Test Pressurizer Heater and Spray Capability and Continuous Spray Flow Verification Test Automatic Low Power SG Water Level Control Test
5.a	14.2.12.2.4.2	Power Coefficient Determination Test
5.b	14.2.12.2.4.3 14.2.12.2.4.4	Axial Flux Difference Instrumentation Calibration Test and Axial Distribution Oscillation Test Flux Map Test

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 14 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
5.c	-	Not applicable. This is not a design feature of the US-APWR.
5.d	14.2.12.2.4.3	Axial Flux Difference Instrumentation Calibration Test and Axial Distribution Oscillation Test
5.e	14.2.12.2.4.5	Rod Cluster Control Assembly Misalignment Measurement and Radial Power Distribution Oscillation Test
5.f	14.2.12.2.4.5	Rod Cluster Control Assembly Misalignment Measurement and Radial Power Distribution Oscillation Test
5.g	14.2.12.1.9 14.2.12.2.1.7 14.2.12.2.1.8 14.2.12.2.1.9	Reactor Control, Rod Control, and Rod Position Indication Preoperational Test CRDM Operational Test Rod Position Indication Test (Previously Demonstrated.) Rod Control System Test
5.h	-	Exception Rod drop times are measured during pre-critical testing at hot full-flow conditions. There is no provision in the design of US-APWR to allow for determination of rod scram times following normal plant trips. These tests meet the intent of this item.
5.i	14.2.12.2.4.5	Rod Cluster Control Assembly Misalignment Measurement and Radial Power Distribution Oscillation Test
5.j	-	N/A This startup test will not be performed because US-APWR does not include partial scram or rod runback features.
5.k	14.2.12.1.54 14.2.12.1.56 14.2.12.1.57	Safety Injection System (SIS)Preoperational Test, Safety Injection Check Valve Preoperational Test, Safety Injection Accumulator Testing
5.l	14.2.12.2.4.6	Remote Shutdown Test
5.m	14.2.12.2.4.12	RCS Flow Measurement Test Reverse flow through idle RCS loops will not be measured as required by paragraph 5(m). US-APWR will not be licensed to operate with idle loops; therefore, these measurements are not applicable.

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 15 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
5.n	14.2.12.2.4.7	Loose Parts Monitoring System Test
5.o	14.2.12.2.1.11	RCS Final Leak Test (Previously demonstrated.)
5.p	14.2.12.1.7	Reactor Internal Vibration Test (Previously demonstrated.)
5.q	-	Not applicable. This system is not a design feature of the US-APWR
5.r	-	Exception Self-diagnostic feature assures the operability of the computer system. And the performance of the communication among computer systems is assured by the administrative control for the software and self diagnosis function. Therefore this test provides no significant results.
5.s	14.2.12.2.4.8 14.2.12.2.4.9 14.2.12.2.4.10 14.2.12.2.4.16	Automatic Rod Control System Test Operational Alignment of Process Temperature Instrumentation at Power Test Thermal Power Measurement and Statepoint Data Collection Test Load Swing Test Exception The verification of the boron addition systems and emergency feedwater control systems are not performed because the control of these systems is performed by manual control.
5.t	14.2.12.1.4 14.2.12.1.21 14.2.12.1.27	Pressurizer Safety Depressurization Valve (SDV) Preoperational Test Main Steam Supply System Preoperational Test Turbine-Generator Preoperational Test (Previously accomplished.)
5.u	-	Exception The operability test of main steam isolation valves (item u) and the demonstration of the dynamic response of the plant (item mm) are not performed because the similar results are obtained when the turbine trip from 100% power test is performed. The closure times for the main steam isolation valves is verified during hot functional and preoperational testing.
5.v	14.2.12.2.4.10 14.2.12.2.4.16	Thermal Power Measurement and Statepoint Date Collection Load Swing Test
5.w	14.2.12.2.4.11	Ventilation Capability Test

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 16 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
5.x	14.2.12.2.4.11	Ventilation Capability Test
5.y	14.2.12.2.4.8 14.2.12.2.4.9 14.2.12.2.4.10 14.2.12.2.4.12 14.2.12.2.4.3	Automatic Rod Control System Test Operational Alignment of Process Temperature Instrumentation at Power Test Thermal Power Measurement and Statepoint Data Collection Test RCS Flow Measurement Test Axial Flux Difference Instrumentation Calibration Test and Axial Distribution Oscillation Test
5.z	14.2.12.2.4.13	Process and Effluent Radiation Monitoring System Test
5.aa	14.2.12.2.4.14	Primary and Secondary Chemistry Test
5.bb	14.2.12.2.4.15	Biological Shield Survey Test
5.cc	-	Exception The gaseous and liquid radwaste systems will be tested as described in the gaseous waste processing system preoperational test abstract and the liquid waste processing system preoperational test abstract. Performance of these tests during the power ascension test phase would produce the same results as testing during the preoperational test phase.
5dd	14.2.12.2.4.6	Remote Shutdown Test The potential capability for cold shutdown is not demonstrated because the test is performed in preoperational test.
5.ee	14.2.12.2.4.11	Ventilation Capability Test
5.ff	14.2.12.2.4.11	Ventilation Capability Test
5.gg	14.2.12.1.20	Diverse Actuation System Actuation Test (Previously accomplished.)
5.hh	14.2.12.2.4.16	Load Swing Test

Table 14A-1 Conformance Matrix of RG 1.68 Appendix A Guidance Versus Typical Test Abstracts (Sheet 17 of 17)

RG 1.68 Appendix A	Section Number	Typical Test
5.ii	-	Exception The complete loss of flow at full-power test will not be performed. Results for reactor coolant system (RCS) flowrates obtained in the flow coastdown test will verify that the RCS flowrates assumed in safety analysis (related to chapter15) are conservative.
5.jj	14.2.12.2.4.17	Loss of Offsite Power at Greater Than 10 % Power Test
5.kk	-	Exception The loss of or bypass of feedwater heaters test will not be performed because US-APWR does not have the bypass line for feedwater heaters and feedwater temperature reduction by the loss of feedwater heater is not occurred from a credible single failure or operator error.
5.ll	14.2.12.2.4.18	Plant Trip from 100 % Power Test
5.mm	-	Exception Tests item u and mm will not be performed as the results obtained will be similar to the results obtained during a plant trip from 100 % power which will be performed. The closure times for the MSIVs will be verified during hot functional and preoperational testing.
5.nn	14.2.12.2.4.19	100 % Load Reduction Test
5.oo	14.2.12.1.52 14.2.12.2.4.20	Thermal Expansion Test Dynamic Response Test