CHAPTER 14

INITIAL TEST PROGRAM

14.1 SPECIFIC INFORMATION TO BE INCLUDED IN PSAR

Not Applicable

14.2 SPECIFIC INFORMATION TO BE INCLUDED IN USAR

14.2.1 Summary of Test Program and Objectives

The River Bend Station startup and test program is established to administratively and technically control all testing activities commencing with construction completion and ending with rated power warranty run for the River Bend Station. This test program applies to all structures, systems, and components required to conduct normal commercial operation and is in compliance with the basic intent of Regulatory Guide 1.68 (August 1978), Initial Test Program for Water Cooled Nuclear Power Plants.

The startup and test program provides properly documented assurances that the plant's structures, systems, and components will operate in compliance with their design criteria and in a manner that does not endanger the health and safety of the public, plant personnel, or plant equipment.

To the extent practicable, all plant procedures are tested and evaluated during the execution of this program. The startup and test program assists in the training of the plant operating and maintenance staff by providing them with hands-on experience in the operation and maintenance of plant equipment utilizing plant procedures.

To facilitate a systematic approach in conducting the startup and test program, the program has been divided into three major phases; preliminary test, preoperational test, and initial startup test.

14.2.1.1 Preliminary Test Phase

The preliminary test phase begins as installation and/or construction of the individual structures, systems, and components nears completion. The prime objective of this phase is to verify that construction activities associated with the respective structure, system, or components have been completed and documented. Another function is to verify that the components within the system can be put into operation safely. The testing requirements associated with this phase verify installation integrity and component and system functional characteristics, and ensure that the system, structures, and components are ready for preoperational testing. These tests, in general, include instrument calibration, electrical continuity and megger checks, pump and motor rotation and vibration checks, hydrostatic testing, cleaning, and flushing.

14.2.1.2 Preoperational Test Phase

The preoperational test phase normally commences after preliminary testing on individual components and systems or subsystems is completed. This phase includes the tests required to demonstrate that structures, systems, and components perform satisfactorily in all modes of operation and that they are ready to support fuel loading and initial startup phase testing. The preoperational test phase ends at the commencement of fuel loading; however, the possibility exists that some preoperational tests may be conducted after fuel loading has occurred. For structures, systems, and components not tested prior to fuel load, proper notification and justification will be provided before commencement of fuel load.

Preoperational tests are performed on any system that is safety related. At River Bend Station, acceptance tests are performed on all other systems. Plant operating personnel are to obtain hands-on experience during testing of these systems, thereby satisfying the training concerns of NUREG-0737, Item I.G.1. Many system tests are to be conducted as part of the preoperational and acceptance tests that lend themselves to operator training. Use of operating procedures is described in Section 14.2.9.

During the conduct of the preoperational test phase, two types of tests are performed: preoperational tests and acceptance tests. The preoperational test is a test in accordance with Section XI of Appendix B of 10CFR50. The acceptance test is a test performed on a structure, system, or component that is not classified as safety-related, but nevertheless can lead to loss or degradation of the plant's capability to produce electrical energy in a reliable manner.

14.2.1.3 Initial Startup Test Phase

The initial startup test phase of the test program commences with the preparation for fuel load and extends through 100 percent rated power and warranty demonstrations. The initial startup phase of testing is divided into five areas: fuel load, open vessel, initial heatup, power ascension, and rated power warranty run. Testing performed during this phase of the program ensures that fuel loading is accomplished in a safe manner, confirms the plant design basis, demonstrates that the plant can withstand anticipated transients and postulated accidents, and ensures that the plant can be safely brought to rated power and sustain power operation.

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14.2.2 Organization and Staffing (Historical)

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The River Bend Station startup organization is shown in Fig. 14.2-1 and is as discussed in the the following sections.

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14.2.2.1 GSU Startup and Test Department (Historical)

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The GSU Startup and Test Department has overall responsibility for control and conduct of the test program during the preliminary, preoperational, and initial startup phases. The Startup and Test Department's efforts are directed by the Superintendent-Startup and Test, who reports directly to the Plant Manager. The SWEC Preliminary Test Organization (PTO) has been delegated to perform the majority of preliminary testing. The PTO's efforts are directed by the SWEC Project Manager-Preliminary Test, who reports directly to the SWEC Project Manager. The GE Site Operations Manager, as Senior Startup Representative for GE onsite, serves on the Superintendent-Startup and Test staff to provide NSSS vendor advice and technical direction. The GSU Startup and Test Department and the SWEC Preliminary Test Organization conduct the test program in conformance with the River Bend Startup Manual and related documents associated with accomplishing the test program objectives.

The Startup and Test Department is divided into two internal groups: the Preoperational Test Group responsible for all matters relating to preliminary, preoperational, and acceptance testing, and the Startup Test Group responsible for all matters relating to initial startup testing. Both groups consist of personnel drawn from various organizations such as GSU, the River Bend Station staff, SWEC, GE, and outside consultants.

The Preoperational Test Group consists of three Preoperational Test Supervisors (NSSS, BOP, electrical) and a GSU PGCC Supervisor all reporting to the Assistant Superintendent-Startup and Test who reports directly to the Superintendent-Startup and Test. Preoperational Test Engineers are assigned to this group and report directly to one of the supervisors. The Startup Test Group consists of a Startup Supervisor who reports directly to the Superintendent-Startup and Test and four Shift Test Directors, each of whom reports directly to the Startup Supervisor. Startup Test Engineers are assigned to this group report to the Shift Test Directors. The Shift Test Directors and their assigned Startup Test Engineers comprise the shift complements necessary during initial startup testing. Commencing with fuel load, they provide, as required, 24-hr shift coverage.

The SWEC Preliminary Test Organization is divided into four major internal groups:

1. The Preliminary Test Group onsite
2. Equipment Release Group
3. Planning Support Group
4. Test Engineering Support Group at the SWEC Cherry Hill Operations Center.

The Preliminary Test Group onsite consists of the Site Advisory Manager, who reports to the Project Manager-Preliminary Test, and six lead engineers (NSSS, BOP, Electrical/Instrumentation, PGCC, Turnover, and Hydro), who report to the Site Advisory Manager.

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14.2.2.1.1 Superintendent Startup and Test (Historical)

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The Superintendent Startup and Test has been delegated by the Senior Vice President-River Bend Nuclear Group the responsibility and authority for the management, preparation, and administration of the River Bend Startup Program, including preliminary, preoperational, and initial startup testing.

His direct responsibilities are:

1. Review and approve:
    a. All staffing within the startup and test department, and
    b. All procedures associated with the preliminary, preoperational, and initial startup test phases of the test program.
2. Manage all contracts associated with the test program.
3. Act as chairman of the joint test group (JTG).
4. Report test program status and problems to the Plant Manager.

5. Act as liaison with the River Bend Station staff and other GSU departments.

6. Coordinate with station department heads in job assignments of plant staff to accomplish the test program objectives.

7. Act as startup and test department representative on the FRC.

8. Ensure startup and test department conformance to the GSU quality assurance plan.

9. Supervise the Preoperational Test Supervisors and Startup Supervisor.

10. Coordinate vendor participation in the test program.

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14.2.2.1.2 Assistant Superintendent Startup and Test (Historical)

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The responsibilities of the Assistant Superintendent include:

1. Review and approve preliminary and preoperational phase test procedures.

2. Act as alternate chairman of the Joint Test Group (JTG).

3. Report test program status and problems to the Superintendent Startup and Test.

4. Act as liaison with the River Bend Station staff and other GSU departments.

5. Coordinate plant staff job assignments with other department heads to accomplish the test program objectives.

6. Supervise the Preoperational Test Supervisors.

7. Review and approve preoperational phase test results.

8. Assume the responsibilities of the Superintendent Startup and Test in his absence.

14.2.2.1.3 Preoperational Test Supervisors

The direct responsibilities of the three Preoperational Test Supervisors are:

1. Test and place into service all equipment and related items in their respective areas of responsibility.

2. Supervise the Preoperational Test Engineers assigned to them.

3. Assist in the preparation and approval of preliminary, preoperational, and acceptance test procedures.

4. Coordinate with planning/scheduling a detailed schedule for preliminary, preoperational, and acceptance test activities in their respective areas of responsibility and monitor progress.

5. Review, analyze, and evaluate test results.

6. Act as an alternate chairman of the JTG.

7. Serve as a permanent member of the JTG.

14.2.2.1.4 Preoperational Test Engineers

Preoperational Test Engineers assigned to the preoperational test group report to an assigned Preoperational Test Supervisor. Preoperational Test Engineers are assigned specific systems or areas of responsibility for which they, as applicable:

1. Determine the nature and degree of testing required

2. Develop testing activity milestones, target dates, and manpower requirements.

3. Follow construction progress to support the startup test program requirements.

4. Prepare and ensure that the required detailed preliminary, preoperational, and acceptance test procedures are available for review and approval.

5. Identify special or temporary equipment or services needed to support testing.

6. Assure that testing identification tagging and station tagging are implemented as necessary to support testing and turnover.

7. Direct all participating groups during the preparation for and execution of assigned tests.

8. Expedite testing progress as necessary to support the project schedule.

9. Identify and assist in the resolution of deficiencies and problems found during the construction and testing of assigned systems and areas.

10. Review and evaluate test results and prepare test summaries.

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14.2.2.1.5 Startup Supervisor (Historical)

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The direct responsibilities of the Startup Supervisor are:

1. Coordinate and schedule all initial startup test activities.

2. Supervise the Shift Test Directors.

3. Assist in the preparation, review, and approval of all initial startup test procedures.

4. Review, analyze, and evaluate initial startup test results.

5. Assist in the resolution of deficiencies encountered during initial startup testing.

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14.2.2.1.6 Startup Test Group Shift Test Directors (Historical)

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The Startup Test Group Shift Test Directors are the senior startup and test department personnel on shift during the initial startup test phase of the test program. The direct responsibilities of the four Shift Test Directors are:

1. Coordinate and direct testing via the shift supervisor for the conduct of all initial startup testing scheduled for their shift.

2. Supervision of assigned Startup Test Engineers.

3. Assist in the preparation and approval of initial startup test procedures.

4. Review, analyze, and evaluate test results and data.

5. Coordinate with planning/scheduling for initial startup activities.

6. Expedite testing progress as necessary to support the project schedule.

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14.2.2.1.7 Startup Test Engineers (Historical)

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Startup Test Engineers assigned to the startup test group report to an assigned Shift Test Director. The direct responsibilities of Startup Test Engineers are:

1. Prepare and ensure that the detailed required initial startup test procedures are available for review and approval.

2. Identify special or temporary equipment or services needed to support initial startup testing.

3. Direct all participating groups during the preparation for and execution of assigned tests.

4. Identify and assist in the resolution of deficiencies and problems found during initial startup testing.

5. Review, analyze, and evaluate test results and data.

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14.2.2.1.8 Supervisor - Startup and Test, Controls (Historical)

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The direct responsibilities of the Startup and Test Controls Supervisor are:

1. Develop and manage the administration of the startup and test program.

2. Prepare and administer a training program for the qualification of startup and test engineers.

3. Supervise documentation control of startup records to ensure completeness and retrievability.

4. Technical reviews of preoperational and startup test procedures and test results and station operating manual procedures.

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14.2.2.2 River Bend Station Staff (Historical)

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The River Bend Station staff consists of those GSU employees who staff, maintain, and operate River Bend Station. Chapter 13 details their duties and general responsibilities. The station staff, while supporting the test program and maintaining all structures, systems, and components following turnover to GSU, will be under the technical direction of the GSU Startup and Test Superintendent.

The plant staff, to the maximum extent practicable, provides technical and manpower support to the startup and test department during the test program. Following successful completion of the rated power warranty run, the plant staff assumes complete control and responsibility for the total operation and maintenance of the plant.

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14.2.2.3 Stone & Webster Advisory Operations Division (Historical)

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14.2.2.3.1 Site Advisory Manager

The SWEC Site Advisory Manager is responsible to the Project Manager - Preliminary Test for technical direction during the preliminary and preoperational test phases of the test program. His specific responsibilities are:

1. Act as a permanent voting member of the JTG.

2. Report the test program status and problems to the SWEC Project Manager-Preliminary Test and the Startup and Test Department.

3. Coordinate with the SWEC construction department the turnover of structures, systems, and components to PTO for preliminary testing.

4. Coordinate with SWEC construction PTO Lead Engineers in the performance of assigned preliminary tests.

5. Coordinate with GSU startup and test department and SWEC construction the turnback of structures, systems, or components for repair/rework.

6. Provide supervision to PTO lead engineers in the performance of assigned preliminary tests.

7. Act as liaison with other SWEC-disciplines on testing matters involving SWEC-designed systems.

8. Review all preoperational and acceptance test procedures.

9. Assure that all assigned preliminary tests are performed in accordance with the River Bend Startup Manual, approved test procedures, and Project Test Program Directives and that rigid configuration control and retest control are maintained and documented.

14.2.2.3.2 SWEC Project Manager - Preliminary Test

The SWEC Project Manager-Preliminary Test is responsible to the SWEC Project Manager for all PTO administrative functions. He is responsible to the GSU Superintendent-Startup and Test for all preliminary test functions. His specific responsibilities are as follows:

1. Assure the scheduled turnover of systems from SWEC construction to PTO are in a suitable condition to begin preliminary testing.

2. Assure that all preturnover support plans, Level III network schedules, and system punch lists are prepared and that engineering and construction work contained therein is complete.

3. Assure the preparation of generic test procedures, flush procedures, and loop calibration reports.

4. Assure that assigned preliminary testing is performed in accordance with applicable program procedures and the Level II network schedule.

5. Assure that documented configuration and retest control are maintained after system turnover to PTO.

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14.2.2.4 General Electric Company (Historical)
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14.2.2.4.1 Operations Manager

The GE Operations Manager is responsible to the GSU Superintendent Startup and Test for technical direction during the preoperational and initial startup phases of the test program. His specific responsibilities are:

1. Act as liaison with GE on testing matters involving GE-supplied equipment.

2. Review preoperational and initial startup tests with emphasis on GE NSSS.

3. Assist in data reduction, analysis, and evaluation for preoperational and initial startup tests.

4. Act as permanent voting member of JTG.

5. Provide administrative support and supervision to GE onsite personnel involved in the startup and test program.

14.2.2.4.2 Operations Superintendent

The GE Operations Superintendent is responsible to the GE Operations Manager for the administrative and technical supervision of GE shift superintendents.

14.2.2.4.3 Shift Superintendents

The GE shift superintendents provide technical direction to the GSU shift operations personnel in the testing and operation of GE-supplied systems. They provide 24-hr per day shift coverage as required, beginning with fuel load. They report to the GE Operations Superintendent.

14.2.2.4.4 Startup, Test, Design, and Analysis Lead Engineer

The GE Startup, Test, Design, and Analysis Lead Engineer is responsible to the GE Operations Manager for supervising the GE startup, test, design and analysis engineers, for verifying core physics parameters and characteristics and for documenting that the performance of the NSSS and its components conform to test acceptance criteria.

14.2.2.4.5 Startup, Test, Design, and Analysis Engineers

The GE startup, test, design, and analysis engineers assist in the execution of the initial startup test phase of the test program. They participate as members of the GSU startup test group either in the capacity of startup test engineer or shift test director but administratively report to the GE Startup, Test, Design, and Analysis Lead Engineer.

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14.2.2.5 Consultants/Contractors (Historical)

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Services of consultants or contractors may be acquired to provide support relative to the test program. Such services are under the direct control of the GSU Superintendent Startup and Test.

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14.2.2.6 Joint Test Group (Historical)

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The Joint Test Group (JTG) is the primary review and approval organization during the preoperational test phase of the test program. The JTG is organized as shown in Fig. 14.2-2. Should any of the JTG members be unable to attend meetings, an appropriately qualified alternate with full capacity to act for that member may substitute. A minimum quorum consists of the chairman (or alternate) and two additional voting members, of which no more than one additional member may be an alternate. The Superintendent Startup and Test is chairman of the JTG. He and the permanent JTG members may direct participation in JTG meetings of other test personnel when required. The functions and responsibilities of the JTG are:

1. Ensure the JTG conducts itself in conformance with the River Bend Station Startup Manual.

2. Assist the Superintendent Startup and Test in coordinating with other groups in the test program.

3. Review and approve all preoperational test procedures prior to testing.

4. Review, approve, and administer all major changes or revisions to JTG approved test procedures.

5. Review the overall test schedule and sequence.

6. Review and approve the results of preoperational tests.

7. Recommend the disposition of test deficiencies.

8. Recommend retests or supplemental tests as required.

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14.2.2.7 Facility Review Committee (Historical)

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Commencing with initial fuel load, the facility review committee (FRC) assumes the responsibility for review of test results prior to recommending acceptance to the Plant Manager. During the initial startup test phase, the FRC is augmented by the Superintendent-Startup and Test and the GE Operations Manager. To aid the FRC in the review of preoperational test data for preoperational tests conducted after fuel load, the JTG reviews the data as a subcommittee of the FRC. Test data summary reports are provided to the FRC for review and concurrence prior to acceptance.

14.2.2.8 Qualification

The staffing and qualifications of the River Bend Station staff are detailed in Chapter 13. Engineers involved in Startup and Test testing activities are qualified in accordance with ANSI/ANS 3.1-1981, Selection and Training of Nuclear Power Plant Personnel, as delineated below. The minimum qualifications of engineers responsible for developing preoperational test procedures, performing preoperational tests, and generating preoperational test reports are as follows:

1. The individual possesses a Bachelor's degree in engineering or related sciences

2. The individual has 1 yr of related power plant experience.

The minimum qualifications of engineers responsible for developing startup test procedures, performing startup tests, and generating startup test reports are as follows:

1. The individual possesses a Bachelor's degree in engineering or related sciences

2. The individual has 2 yrs of related power plant experience of which 1 yr is nuclear power plant experience.

In addition to the individual responsible for developing the test procedure and performing the test, preoperational and initial startup test procedures and test results are reviewed and approved by individuals having the following minimum qualifications. One individual may fulfill more than one of the categories listed below.

1. One individual meets the following requirements:

   a. He possesses a Bachelor's degree in engineering or related sciences

   b. He has 4 yr of power plant or power generation related experience, of which 3 of the years is nuclear power plant experience. During the 3 yr, the individual has participated in the following nuclear power plant activities:

      (1) 2-month operation above 20 percent operation

      (2) Routine refueling outage

      (3) Initial plant startup testing or post refueling outage startup testing

   c. He has or has held an NRC senior operator license at an operating BWR, or has been certified at a BWR or a BWR simulator.

2. One individual meets the following requirements:

   a. He possesses a Bachelor's degree in engineering or related science

   b. He has 4 yr of power plant experience of which 2 must be nuclear power plant experience.

3. One individual is from the responsible design organization. He is knowledgeable of system and equipment design and performance requirements. For initial startup tests, this individual is also knowledgeable of plant operating and transient response characteristics.

Individuals who do not possess the specified formal educational requirements are not automatically unqualified to perform the described activities. In cases where other factors provide sufficient demonstration of their abilities, the individuals are evaluated on a case by case basis. Positive factors which are considered in making this evaluation are:

1. High school diploma or GED

2. 60 semester hr of related technical education at the college level

3. Qualified as a USNRC senior operator
4. 4 yr of additional experience in his area of responsibility
5. 4 yr of supervisory or management experience
6. A demonstrated ability to communicate clearly (verbally and in writing)
7. A certification of academic ability and knowledge by corporate management
8. Successful completion of the Engineering In Training examination
9. Professional Engineer License
10. Associate degree in Engineering or related science.

The certification of startup and test department personnel is supported by records and certification status. Every 2 yr a review is accomplished to assure the continued proficiency of every engineer.

14.2.3 Test Procedures

14.2.3.1 Preoperational Test Procedures

The River Bend Station Startup Manual establishes the method for preparing, reviewing, approving, revising, and controlling all preoperational test procedures. The Startup Manual specifies procedure content, format and style guidelines. An example of the format for preoperational test procedures is given below:

<u>TITLE PAGE</u>
<u>LIST OF EFFECTIVE PAGES</u>
<u>(LATERS) PAGE</u>
<u>SIGNATURE RECORD PAGE</u>
<u>TABLE OF CONTENTS</u>
<u>MAIN BODY SECTIONS</u>
1.0 PURPOSE
2.0 REFERENCES
3.0 PREREQUISITES
4.0 TEST EQUIPMENT
5.0 LIMITATIONS AND PRECAUTIONS
6.0 INITIAL CONDITIONS
7.0 PROCEDURE
8.0 SYSTEM RESTORATION

9.0 DATA REQUIREMENTS
10.0 ACCEPTANCE CRITERIA
MINOR MODIFICATION PAGE
TEST DEFICIENCY PAGE
ENCLOSURES
ATTACHMENTS

Preoperational test procedures are developed by the responsible preoperational test engineers. Each test procedure is prepared using pertinent reference material such as design and test specifications from GE, design documents from SWEC, safety analysis report, technical specifications, and applicable regulatory guides.

Upon completion of the initial procedure draft, the preparer forwards it to the cognizant Preoperational Test Supervisor, who reviews and comments on it. Following the resolution of comments with the preparer, an acceptable procedure draft is submitted to the following people for review: Superintendent Startup and Test, GE Operations Manager, SWEC Site Advisory Manager, Plant Staff Representative, and Supervisor of Operational Quality Assurance. The preparer resolves all comments generated by the reviewers and issues a revised procedure draft to the same people for a second review. Following the resolution of any additional comments by the author and the lead engineer, the procedure is submitted to the JTG for final review, approval, and distribution.

14.2.3.2 Initial Startup Test Procedures

The River Bend Station Startup Manual establishes the method for preparing, reviewing, approving, revising, and controlling all initial startup test procedures. The Startup Manual specifies procedure content, format, and style guidelines. An example of the format for initial startup test procedures is given below:

TITLE PAGE
LIST OF EFFECTIVE PAGES
SIGNATURE RECORD PAGE
(LATERS) PAGE
TABLE OF CONTENTS
MAIN BODY SECTIONS
1.0 GENERAL DESCRIPTION
2.0 REFERENCES
3.0 ACCEPTANCE CRITERIA
4.0 GENERAL REQUIREMENTS
5.0 TEST PERFORMANCE
6.0 SPECIAL TEST PROCEDURES

7.0 ENCLOSURES
8.0 TEST PACKAGES

Initial startup test procedures are developed by the responsible startup test engineers. Each test procedure is prepared using pertinent reference material such as test specifications provided by GE, safety analysis report, technical specifications, and applicable regulatory guides.

Upon completion of the initial procedure draft, the preparer forwards it to the Startup Supervisor and the Startup, Test, Design, and Analysis Lead Engineer, who review and comment on it. Following the resolution of comments with the preparer, an acceptable procedure draft is submitted to the following people for review: Superintendent Startup and Test, GE Operations Manager, Plant Staff Representative, and Operational Quality Assurance Director. The preparer resolves comments generated by the review and issues a revised procedure draft to the same people for a second review. Following the resolution of any additional comments, the procedure is submitted to an augmented FRC for final review, the Plant Manager's approval, and distribution. The augmented FRC is comprised of the normal FRC members, the Superintendent Startup and Test, and the GE Operations Manager.

14.2.4 Conduct of Test Program

14.2.4.1 Conduct of Preoperational Phase Testing

Preoperational phase testing commences after preliminary testing on individual components, systems, and subsystems is complete. Testing is performed by the preoperational test group under the administrative controls established in the River Bend Station Startup Manual. Testing is performed in strict adherence to approved written test procedures. Test procedures and the Startup Manual are controlled documents.

Changes to approved preoperational test procedures are in conformance with the controls established in the Startup Manual. If the functional or technical intent of the procedure is not altered by minor or obvious changes, the cognizant preoperational test engineer may make on-the-spot handwritten changes. Such changes are documented on the minor modification page of the procedure, and are approved by the responsible Preoperational Test Supervisor or his designated alternate within 1 week.

If the test procedure change results in the alteration of the functional or technical intent of the procedure, the change is made using a major change request and the test is halted pending the major change request resolution. The major change request is reviewed and approved by the JTG and the procedure is revised and reissued before testing can continue.

Each procedure includes provisions to ensure that prerequisites are met. The prerequisites for this phase of testing are consistent with the recommendations contained in Regulatory Guide 1.68 (August 1978). It is the responsibility of the preoperational test engineer assigned the specific test to ensure that all prerequisites are satisfactorily completed or any allowable exception noted.

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14.2.4.2 Conduct of Initial Startup Phase Testing (Historical)

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Initial startup phase testing begins with preparation for initial fuel load. Testing is performed by the startup test group under the administrative controls established in the River Bend Station Startup Manual. Testing is performed in strict adherence with written approved test procedures, which are controlled documents.

Approved initial startup test procedures can be revised using only minor and major change requests. If the functional or technical intent of the procedure is not altered by minor or obvious changes, the cognizant startup test engineer may make on-the-spot changes by using a minor change request. Such a change is meant for immediate implementation, thus allowing testing to continue. The minor change request must have interim approval by the following: GE Shift Superintendent, Shift Supervisor (SRO License), GE S, T, D, & A Engineer, and the Shift Test Director. It is reviewed by the FRC and submitted to the GE Operations Manager and the Superintendent of Startup and Test for approval within 14 days.

Conduct of the specific test in question stops upon initiation of a major change request. The major change request is reviewed and approved by the Startup Supervisor, the GE Lead S, T, D, & A Engineer, and the augmented FRC. The initial startup test procedure is revised and reissued before testing can continue.

A master startup checklist is used to ensure that prerequisites for initial fuel load and the beginning of initial startup testing are fulfilled. In addition, each individual initial startup test procedure specifies prerequisites that must be validated prior to test performance. It is the responsibility of shift test directors and startup test engineers to ensure that all prerequisites are satisfied prior to performance of any initial startup test.

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14.2.4.3 River Bend Station (RBS) Maintenance Work Request

The RBS work request is used to initiate maintenance or to implement modifications on systems that are under the jurisdictional control of RBS. The RBS work request assigns responsibility for performing the work, gives authorization for the work to be performed, and identifies retest requirements. Results of retests due to maintenance and/or modifications are reviewed and approved by the same organization that originated the work request. Results of the retests due to modifications are reviewed and approved by the same organization that reviewed and approved the original test results.

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14.2.5 Review, Evaluation, and Approval of Test Results

Upon completion of a test, the test engineer reviews the test data for completeness and evaluates the results to ensure they meet all acceptance criteria or notes allowable exceptions. Preoperational test results are reviewed and approved by the JTG. Initial startup test results are reviewed by the augmented FRC. Review and approval of test results are kept current with testing requirements so succeeding tests are not dependent on an untested structure, system, or component.

Prior to initial fuel load and commencement of initial startup testing, a comprehensive review of the preoperational test phase is conducted by the JTG and FRC to provide assurance that plant systems and structures are capable of supporting the initial fuel load and subsequent operational testing. Structures, systems, and components not tested prior to fuel load will be identified. Proper notification and justification will be provided and the appropriate tests rescheduled for after fuel loading.

Each area of startup testing (fuel load, open vessel testing, heatup, power ascension) is a prerequisite in itself which is completely reviewed and evaluated by the augmented FRC prior to starting tests in the succeeding area. The test results of each power ascension testing power plateau are reviewed and evaluated by the augmented FRC and approved by the Plant Manager before proceeding to the next test plateau.

14.2.6 Test Records

A single copy of each test procedure is designated as the official field copy to be used for test documentation. The official field copy of each test procedure and information specifically called for in the procedure, such as completed data sheets, tables, logs, chart recordings, etc, constitutes the completed test procedure. Completed preoperational and initial startup test procedures are made a part of the permanent plant file and are retained for the life of the plant.

14.2.7 Conformance of Test Program with Regulatory Guides

The following matrix lists regulatory guides used in the development of the Initial Test Program and the phase(s) of the program (as described in Section 14.2.1) to which they apply. The program complies with the intent of these and other regulatory guides following the interpretations, clarifications, and/or exceptions discussed in Section 1.8.

Test Phases

Reg. Guide	Preliminary	Preoperational	Initial Startup
1.8	x	x	x
1.20		x	x
1.30	x	x	x
1.33		[1]	x
1.37	x	x	x
1.41		x	x
1.52	x	x	x
1.58	[2]		
1.68		x	x
1.68.1		x	x
1.68.2		x	x
1.80		x	x
1.108		x	
1.140	x	x	x

[1] For systems in the Preoperational Test Phase, only Sections 5.2.19 and 5.3.10 of ANSI N18.7-1976 are applicable.

[2] SWEC personnel directly involved in Preliminary Test Phase testing activities are qualified in accordance with Regulatory Guide 1.58, Rev. 1 with exceptions as noted in Table 17.1.1B-1 of the RBS Construction QA Program (PSAR Section 17.1).

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

The Startup and Test Department receives and maintains GE Services Information Letters (SIL), which describe testing and operating experiences that have occurred at GE BWRS. The Superintendent Start-up and Test ensures that all SILs are reviewed for applicability to River Bend Station. Information acquired from the SIL review is used in the test program to identify potential problem areas that may require special testing, design changes, or procedure modifications.

14.2.9 Trial Use of Plant Operating and Emergency Procedures

As much as possible throughout the preoperational and initial startup phase of the test program, test procedures utilize operating, surveillance, emergency, and abnormal procedures where applicable in the performance of tests. The use of these procedures is intended to do the following:

1. Prove the specific procedure is correct or illustrate changes which may be required

2. Provide training of plant personnel in the use of these procedures

3. Increase the level of knowledge of plant personnel on the systems being tested.

Test procedures may use these operating, surveillance, emergency, and abnormal procedures in several ways: the test procedure may reference the procedure directly, the test procedure may extract a series of steps from the procedure, or the test procedure may use a combination of the first two methods. The schedule for development of plant procedures is discussed in Section 13.5.

14.2.10 Initial Fuel Loading and Initial Criticality

14.2.10.1 Fuel Loading and Shutdown Power Level Tests

Fuel loading and initial criticality are conducted in accordance with written procedures after prerequisite tests are satisfactorily completed and an operating license has been issued. Prior to approving fuel loading, the plant is verified ready to load fuel. This verification is accomplished by the following steps, which are performed near the completion of preoperational testing.

14.2.10.1.1 Loss of Off-Site Power Demonstration - Standby Core Cooling Required

This test is described in Section 14.2.12.1.44. The test demonstrates the capability of each diesel generator to start automatically and assume an emergency core cooling load during a loss of normal auxiliary power. It also demonstrates the independence of ESF divisions. To enhance training benefits specified by NUREG-0737, Item I.G.1, the testing is scheduled so each operating shift participates in at least one of the tests described in Section 14.2.12.1.44. Operators also obtain familiarization with the main control room and plant conditions/limitations and are required to resolve operational problems associated with the loss of emergency batteries and diesel generators.

14.2.10.1.2 Cold Functional Testing

Cold functional testing is defined as an integrated operation of various plant systems prior to fuel loading. The intent is to observe any unexpected operational problems from either equipment or procedures and to provide an opportunity for operator familiarity with the system operating procedures under operating conditions.

The cold functional tests are performed using plant procedures and are controlled and documented by checklists. The checklist assures that each shift has received training and experience on specified systems. The cold functional tests also assure that certain plant systems are available to support fuel load and that operating procedures have been tried and are usable.

14.2.10.1.3 Routine Surveillance Testing

Because the interval between completion of a preoperational test on a system and the requirement for that system to be operated may be of considerable duration, a number of routine surveillance tests are performed prior to fuel loading and are repeated on a routine basis. The Technical Specifications (Chapter 16) detail the test frequency. In general, this surveillance test program is instituted prior to fuel loading by the plant operating staff.

14.2.10.1.4 Master Startup Checklist

A master startup checklist of items that must be complete, including the preoperational tests, work requests, proper disposition of all deficiencies noted during preoperational testing, and other prerequisites per Regulatory Guide 1.68,

Appendix C, is checked to verify completion just prior to the final approval for fuel loading.

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14.2.10.1.5 Initial Fuel Loading (Historical)

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The overall responsibility and direction of the initial core loading is exercised by the Plant Manager. The process of initial core loading is directly supervised from the refueling floor of the containment structure by a senior reactor operator having no concurrent duties and in strict adherence to detailed approved procedures. Procedures for the control of personnel access and the maintenance of containment security is implemented prior to starting loading operations. The composition, duties, and emergency procedure responsibilities of the fuel handling crew are specified in the Station Operating Manual.

Fuel loading requires the movement of the full core complement of assemblies from the fuel pool to the core, with each assembly identified by number before being placed in the correct coordinate position. The procedure controlling this movement is written so that shutdown margin and subcritical checks are made at predetermined intervals throughout the loading, thus ensuring safe loading increments. Sensitive in-vessel neutron monitors that are maintained near the loading faces until a satisfactory source range monitor (SRM) count rate is achieved as loading progresses serve to provide indication for the shutdown margin measurements, and also to allow the recording of the core flux level as each assembly is added. A complete check is made of the fully loaded core to ascertain that all assemblies are properly installed, correctly oriented, and are occupying their designated positions.

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14.2.10.1.6 Open Vessel Tests (Historical)

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At this point in the program, a number of tests are conducted which are best described as initial open vessel tests. Chemical and radiochemical tests are made to check the quality of the reactor water before fuel is loaded, and to establish base and background levels which are required to facilitate analysis and instrument calibrations. Plant and site radiation surveys are made at specific locations for comparison with the values obtained at the subsequent operating power levels. Shutdown margin checks are repeated for the fully loaded core, and criticality is achieved with the data being recorded for each rod withdrawn. If initial criticality is performed with the vessel head installed, the initial criticality and associated full core shutdown margin tests will be performed during the first part of test condition heatup. Each rod drive is subjected to scram and performance testing. The initial setting of the intermediate range monitors (IRMs) is at maximum gain.

14.2.11 Test Program Schedule

Fig. 14.2-3 represents the tentative startup and test schedule for River Bend Station. The schedule depicts testing to be performed from the time a system is turned over to GSU from SWEC to completion of the test program. In general, test procedure preparation is scheduled to allow review of approved preoperational test procedures at least 60 days prior to use and startup test procedures at least 60 days prior to fuel load.

14.2.12 Individual Test Descriptions

14.2.12.1 Preoperational Test Procedures

The following general descriptions are the specific objectives of each preoperational test. During the final construction phase, it may be necessary to modify the preoperational test methods as operating and preoperational test procedures are developed. Consequently, methods described in the following descriptions are general, not specific.

Acceptance criteria for each preoperational test are in accordance with documentation and specifications listed below, where applicable.

Technical Specifications - USAR Chapter 16

Design Specification - Design criteria provided for each GE-supplied system.

System Elementary Diagrams - System logic tests, permissives, interlocks, and controls are tested to the latest revised SWEC engineering change request or GE elementary wiring diagram.

Preoperational Test Specification - Documents provided by GE containing minimum testing requirements and acceptance criteria on all GE-supplied systems.

Process Diagrams - Drawings provided for GE-supplied systems that state system flow, pressure, and temperature criteria for all modes of operations.

Loop Diagrams - Drawings provided by SWEC that define instrument loops and set points.

Technical Data Sheets for Motor-Operated Valves - Documents provided by SWEC that define operating characteristics of each motor-operated valve.

Technical Data Sheets for Air Dampers - Documents provided by SWEC that define operating characteristics of each air damper.

Water Quality Specification - Documents provided by GE which define water quality requirements in BWRs.

Process Computer I/O Specification - Defines I/O require-ments for all process computer points both analog and digital.

Manufacturer's Technical Instruction Manual - Components are tested and results verified to be comparable to the instruction manual when no other design criteria exist.

14.2.12.1.1 Feedwater System Acceptance Test

1. Test Objective

   To verify proper operation of the controls, support systems, safety devices, alarms, and annunciators for the reactor feed pumps.

2. Prerequisites

   a. Required preliminary phase tests are completed and approved.

   b. Verify that instruments within the feedwater system boundary have been calibrated and instrument loop checks complete.

   c. Ac and dc electrical power are available.

   d. Instrument air is available.

   e. The condensate system is available.

   f. Turbine building closed cooling water is available.

   g. Feed pump lube oil system is available.

3. Test Procedure

   a. The feedwater pump, motor, and auxiliaries are operationally tested. Pump performance requirements including flow rates, head, and suction pressure are checked.

   b. Feedwater flow performance is verified to the maximum extent possible.

   c. Pump minimum flow rates and valve operation are verified.

   d. Operation of alarms, trips, and interlocks is verified, including the automatic tripping features of the feedwater pump.

   e. Operation of alarms, trips, and interlocks is verified.

   f. Valve operation and timing are verified.

4. Acceptance Criteria

   a. Pump, motor, and auxiliary equipment performances are as specified in USAR Chapter 10, Sections 10.1 and 10.4.7, and comparable to the specifications in the manufacturer's technical instruction manual.

   b. Pump flow and head characteristics are comparable to the curves provided by the manufacturer's technical instruction manual.

   c. Alarms, trips, and interlocks function as specified by the system elementary diagram.

   d. Containment isolation valve operating times are as specified in USAR Chapter 6, Table 6.2-40.

14.2.12.1.2 Reactor Water Cleanup System Acceptance Test

1. Test Objectives

   a. To verify the flow path and operational capability of the system.

   b. To operationally check the following:

(1) Reactor water cleanup pumps

(2) Flow control stations

(3) Filter/demineralizers and associated equipment

(4) Valve and pump interlocks

(5) Alarm and trip interlocks

(6) Ability of filter/demineralizer to produce and maintain acceptable water quality.

2. Prerequisites

a. Required preliminary tests completed and approved.

b. Chemically acceptable water available to supply cleanup recirculation pump suction.

c. Reactor plant component cooling water system available.

d. Ac and dc electrical power available.

e. Cation/anion resin available.

f. Instrument air available.

g. Instrument calibration and instrument loop checks completed.

h. The reactor pressure vessel, main condenser, and liquid radwaste system are available to receive water.

i. Service air available.

3. Test Procedure

a. Check operation of reactor water cleanup pumps by pumping reactor water to the hotwell, radwaste, and recirculating back to the reactor (the filter/demineralizers are bypassed during this portion of the test).

b. Check operation of condenser and radwaste flow control station.

c. Check operation of filters, demineralizers, and all associated equipment in the following flow modes:

   (1) Precoating

   (2) Normal operation

   (3) Standby recirculation

   (4) Backwashing.

d. Simulate pumping of sludge to the radwaste system (pump nonradioactive sludge water generated during preoperational test program).

e. Check operation of all valve and pump interlocks by simulated signals to appropriate instrumentation.

f. Check calibration and alarm of trip (interlock) set points of all instrumentation and verify proper operation of annunciators.

4. Acceptance Criteria

   a. The system operates in all modes as specified by the GE Preoperational Test Specification and the GE Process Diagram.

   b. The filter/demineralizers provide output consistent with the GE Preoperational Test Specification.

   c. All valve and pump interlocks function as specified by the system elementary diagrams.

   d. Alarm and trip set points of all instrumentation are as specified by the GE Preoperational Test Specification.

14.2.12.1.3 Standby Liquid Control System Preoperational Test

1. Test Objectives

   a. To verify the flow path and operational capability of the system.

   b. To verify operation of the system in the test modes.

   c. To verify the pump produces rated flow at rated pressure.

2. Prerequisites

   a. Required construction tests completed and approved.

   b. Demineralized water available.

   c. Ac and dc electrical control power available.

   d. Reactor vessel available for injecting demineralized water.

   e. Service air available.

   f. Instrument calibration and instrument loop checks completed.

3. Test Procedure

   a. The standby liquid control tank is filled with demineralized water and the following operations checked:

      (1) The standby liquid control pumps are operated to verify rated flow at rated head and absence of cavitation at low tank level.

      (2) Operation of the standby liquid control solution temperature controls and air sparger are verified.

      (3) Tank level and temperature alarms are verified.

(4) Set points of the standby liquid control pumps discharge relief valves are checked.

b. The test tank is filled with demineralized water and the standby liquid control pumps are operated in the test mode to verify rated flow at rated head and absence of cavitation at low tank level.

c. Each loop is manually initiated using the keylock switch to fire the explosive valve and start the injection pump. Flow into the reactor is verified.

d. The interlock associated with the reactor water cleanup (RWCU) system is verified to isolate the RWCU system upon actuation of the standby liquid control system.

4. Acceptance Criteria

a. The standby liquid control storage tank air sparger mixes the solution, and the tank heaters maintain the liquid at the temperature specified by the GE Preoperational Test Specification.

b. Standby liquid control pumps discharge pressure relief valves relieve within the set point as specified by the GE Preoperational Test Specification.

c. The standby liquid control system operates in the test mode as specified by the GE Preoperational Test Specification.

d. Keylock switch and interlocks function as specified by the system elementary diagrams.

e. System flow rates are as specified by the GE Preoperational Test Specification.

f. Pumps do not show evidence of cavitation at low storage or test tank levels.

g. Liquid mixing results in a uniform solution and samples are representative of storage tank liquid.

h. Pump packing leakage is as specified by the manufacturer's technical instruction manual.

14.2.12.1.4 Nuclear Boiler System Preoperational Test

1. Test Objectives

   a. To verify operation of all controls, interlocks, alarms, and valves associated with the nuclear boiler system and the main steam system.

   b. To verify proper operation of the MSIVs and accumulators.

   c. To verify the operability of main steam drain valves.

   d. To verify the response of nuclear boiler process instruments.

2. Prerequisites

   a. Required preliminary tests completed and approved.

   b. Ac and dc electrical power available.

   c. Instrument calibration and integrated loop checks completed.

   d. Instrument air available.

3. Test Procedure

   a. All controls, alarms, and interlocks are checked for proper operation.

   b. All remotely operated valves are checked for proper operation and indication.

   c. Proper operation of the MSIVs are checked and closure times are adjusted. An individual MSIV is operated to demonstrate adequate accumulator capacity.

   d. The reactor vessel water level is varied to check operation of level instrumentation.

e. Operation of main steam drain valves is demonstrated.

f. Reactor head seal and other leak detection systems are checked.

4. Acceptance Criteria

a. Nuclear boiler process instrumentation set points are within limits of the GE preoperational test specification.

b. Isolation valve operating times are within limits of the GE preoperational test specification.

c. Capacity of the MSIV accumulators is sufficient to operate the MSIVs the required number of times.

d. Operability of the main steam drain valves is verified.

14.2.12.1.5 Residual Heat Removal System Preoperational Test

1. Test Objectives

To verify that the residual heat removal (RHR) system provides the following safeguards and operational functions:

a. Low pressure coolant injection (LPCI)

b. Suppression pool cooling

c. Shutdown cooling

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d. DELETED

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2. Prerequisites

a. Required preliminary tests completed and approved.

b. Demineralized water available in the suppression pool, spent fuel pool, and reactor vessel.

c. Ac and dc electrical power available.

d. Instrument air available.

e. Instrument calibration and instrument loop checks completed and approved.

f. Reactor vessel available to receive water during the LPCI tests.

g. Service water operable and available.

h. Reactor plant component cooling water available.

3. Test Procedure

a. Operate all applicable valves in the RHR system from the main control room, remote shutdown panels, and the local control panels. Verify proper operation and indication.

b. Conduct a logic and interlock test as follows:

(1) LPCI - verify initiation logic and response time, automatic isolation, and valve and pressure interlocks and response time. Signals are simulated to cause an automatic initiation signal to the LPCI system. The start signal is introduced into the system under conditions of both normal auxiliary power and standby diesel generator power to verify required sequencing of the valve and pump.

(2) Shutdown cooling - verify the automatic isolation of the shutdown cooling system on high-drywell pressure or low reactor water level and the automatic initiation of the LPCI system.

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(3) DELETED.

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c. Conduct the following system test:

(1) LPCI - with the suction valves from the suppression chamber to the RHR pumps

locked open and the LPCI system lined up to take suction from the suppression pool, start the LPCI system using a simulated automatic initiation signal. After flow has been established through the system by manual operation of the pumps and valves, establish the system operating characteristics by separately operating each RHR pump. In the LPCI lineup verify pump head flow characteristics and available net positive suction head (NPSH).

(2) Shutdown cooling - line up the RHR system to take suction on the reactor pressure vessel (RPV) and place the system in its normal shutdown cooling lineup. Start the shutdown cooling system and verify system flow paths. Verify pump head flow characteristics and available NPSH. Simultaneous operation of the service water system verifies compatible integrated operation. If, during steady-state operation, visual observation indicates significant piping vibration, measurements are taken using a hand-held instrument.

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(3) DELETED.

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(4) Suppression pool cooling - line up the RHR system to take a suction on the suppression pool, pump it through the heat exchangers, and return the water to the suppression pool. Obtain pump head flow characteristics and available NPSH.

(5) Fuel pool cooling intertie - line up to verify flow capability and NPSH adequacy. May be done with fuel pool cooling and cleanup preoperational test.

(6) Test mode - demonstrate that acceptable flow and head conditions can be produced in recirculation flow paths from the suppression pool and that available NPSH is adequate. Demonstrate that acceptable

flow and head conditions can be produced for simulated automatic actuation of LPCI pumps A and B from the recirculation lines to the vessel, and for LPCI pump C.

d. Verify proper operation of all alarms and proper annunciations at the main control room panels.

e. In conjunction with the remote shutdown preoperational test, demonstration of the shutdown cooling mode and suppression pool cooling mode is accomplished from the remote shutdown panel.

f. Verify systems standby operation with jockey pumps operating.

4. Acceptance Criteria

a. Operating times for all valves in the RHR system are as specified by USAR Chapter 6, Table 6.2-40, and the GE Preoperational Test Specification.

b. Initiation logic, automatic isolations, and valve and pressure interlocks function as specified by the system elementary diagrams.

c. Pump head flow characteristics and NPSH are as specified by the GE Preoperational Test Specification for the following modes of operation: LPCI, shutdown cooling, and suppression pool cooling.

d. Annunciator indications are consistent with system operation.

e. The jockey pump maintains the RHR system filled and pressurized.

f. Piping vibration levels are within limits (reference Section 3.9.2).

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g. DELETED.

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h. The shutdown cooling mode and suppression pool cooling mode operation from the remote shutdown panel functions as specified by the GE Preoperational Test Specification.

14.2.12.1.6 Reactor Core Isolation Cooling System Preoperational Test

1. Test Objective

   a. To verify operation of the controls, alarms, interlocks, and valves associated with the RCIC system, including standby operation.

   b. To verify that the system can be initiated automatically and manually and that automatic isolation occurs when any of the required isolation signals are simulated.

   c. RCIC turbine operation, flow parameters, pump available NPSH, speed/flow controls, and auxiliary equipment are demonstrated with auxiliary steam available to the RCIC pump turbine.

   d. Flow and minimum start time criteria cannot be demonstrated until the startup test phase.

2. Prerequisites

   a. Required preliminary tests are completed and approved.

   b. Ac and dc electrical power are available.

   c. Instrument air is available.

   d. Instrument calibration and instrument loop checks are completed.

   e. Demineralized water is available in the condensate storage tank and suppression pool.

   f. The reactor vessel is able to receive water during RCIC testing.

   g. A source of steam is available for RCIC turbine operation.

h. The suppression pool is available to receive the RCIC turbine exhaust.

3. Test Procedure

a. All alarms, controls, and interlocks are checked for proper operation.

b. All automatic valves are cycled in manual and remote modes (closing times are in accordance with design specifications).

c. A manual initiation of the system is initiated to verify proper operation of system valves.

d. Simulate initiation of the RCIC system valves. Automatic isolate signals are also evaluated. The system is operated in the vessel injection and test recirculation modes.

e. Verify system standby lineup.

f. Verify system control capability from remote shutdown panel in conjunction with the remote shutdown system preoperational test.

g. Demonstrate the startup of the RCIC system after loss of ac power to the system.

h. Operate the RCIC system with a sustained loss of ac power to the system.

i. Verify that dc loads of the RCIC system are provided by the Division I battery system and are totally independent of other ESF divisional batteries except the gland seal air compressor motor. The RCIC turbine gland seal compressor is powered from a nondivisional dc power source.

j. In conjunction with the remote shutdown preoperational test, demonstrate operation of the RCIC in the test mode from the remote shutdown panel.

4. Acceptance Criteria

a. All alarms, controls, and interlocks function as specified by the system elementary diagrams.

b. Automatic valves can be operated remotely and valve operating times are as specified by USAR Chapter 6, Table 6.2-40 and the GE Preoperational Test Specification.

c. RCIC responds to manual and automatic initiation signals and isolation signal as specified by the system elementary diagrams.

d. Using auxiliary steam, flow can be obtained through the normal vessel injection (excepting spray into the vessel head, a jumper pipe directs flow into the vessel or the suppression pool) and test recirculation flow paths. Pump available NPSH is adequate.

e. Available NPSH to the RCIC pump is at least as that specified in the GE Preoperational Test Specification.

f. RCIC operation in the test mode from the remote shutdown panel functions as specified by the GE Preoperational Test Specification.

g. On startup of RCIC with loss of ac power, all dc components operate to give rated flow.

14.2.12.1.7 Low Pressure Core Spray System Preoperational Test

1. Test Objectives

a. To verify operation of the low pressure core spray (LPCS) system, including spray pumps, spray nozzles, control valves, etc, during both recirculation and simulated accident conditions.

b. To verify operation of all controls, interlocks, alarms, and valves associated with the LPCS system, including standby operation.

c. To verify that automatic initiation and response times of the LPCS system meet test specification criteria.

2. Prerequisites

a. Required preliminary tests are completed and approved.

b. Ac and dc electrical power is available.

c. Instrument air is available.

d. Demineralized water is available in the suppression pool.

e. The reactor vessel is capable of receiving water.

f. Instrument calibration and instrument loop checks are completed.

g. The RHR system is available for testing.

3. Test Procedure

a. All controls, alarms, and interlocks are checked for proper operation, and remote-operated valves are operated in all modes.

b. The system is operated in the recirculation mode to demonstrate the test mode of operation. Pump and system parameters, head flow characteristics, and NPSH are verified to be in accordance with test specifications.

c. Operation of the system is demonstrated under normal initiation lineup. With the system spraying into the reactor vessel, proper flow rates and spray pattern are verified via photographs.

d. Accident conditions are simulated to verify all modes of emergency operation and initiation. Loss of normal ac power under accident conditions is demonstrated to verify proper sequential operation of system pumps and valves. (This portion of the test can be completed during the loss of offsite power testing.)

e. Verify system standby operation and jockey pump operability.

4. Acceptance Criteria

   a. System flow paths are correct, and pump head-flow characteristics and NPSH are as specified by the GE Preoperational Test Specification. Photographs of the core spray pattern are determined by General Electric to indicate that the spray provides acceptable core coverage.

   b. All automatic valves can be operated and valve operating times are as specified by USAR Chapter 6, Table 6.2-40, and the GE Preoperational Test Specification.

   c. Under simulated initiation signal, LPCS pump starts and valves sequence open and closed to provide flow to the RPV as specified by the GE Preoperational Test Specification.

   d. The jockey pump keeps the LPCS system filled and pressurized.

14.2.12.1.8 High Pressure Core Spray System Preoperational Test

1. Test Objectives

   a. To verify operation of the high pressure core spray (HPCS) system including the HPCS diesel generator and related auxiliary equipment while pumping from both the suppression pool and condensate storage tanks to the RPV, including standby pump operation.

   b. To verify operation in the recirculating test mode.

   c. To verify operation of all controls, interlocks, alarms, and valves associated with the HPCS system.

   d. To verify automatic initiation capability of the HPCS system.

   e. To verify pump operation within test specification limits.

2. Prerequisites

   a. Required preliminary tests completed and approved.

   b. Ac and dc electrical power available.

   c. Instrument air available.

   d. Demineralized water available to the suppression pool and condensate storage tank.

   e. The reactor vessel capable of receiving water.

   f. Instrument calibration and instrument loop checks completed.

3. Test Procedure

   a. All controls, alarms, and interlocks are checked for proper operation and remote-operated valves are operated in all modes.

   b. The system is operated in the recirculation mode from the suppression pool to demonstrate the test mode of operation. Pump and system parameters are verified to be within design specifications.

   c. The system is operated using the condensate storage tank as a suction source. The system sprays into the reactor vessel and proper flow rates and spray pattern are verified via photographs.

   d. Item c is repeated using the suppression pool as a suction source. Automatic transfer between suppression pool and condensate storage tank is demonstrated.

   e. Accident conditions are simulated to verify all modes of emergency operation and initiation. An HPCS initiation signal using full-flow conditions for normal power and also for emergency HPCS diesel generator power is given. Pump flow, time to rated flow, rated diesel generator speed and diesel generator operating voltage are measured.

f. Verify standby lineup and jockey pump operability.

4. Acceptance Criteria

a. System flow paths are correct. Pump head-flow characteristics and NSPH requirements are as specified by the GE Preoperational Test Specification for all modes of operation. Photographs of the core spray pattern are determined by General Electric to indicate that the spray provides acceptable core coverage.

b. All automatic valves can be operated and valve operating times are as specified by USAR Chapter 6, Table 6.2-40, and the GE Preoperational Test Specification.

c. Under simulated initiation signal, HPCS pump starts and valves sequence open and closed to provide flow to the RPV as specified by the GE Preoperational Test Specification. The HPCS diesel generator attains rated speed and operating voltage as specified by the GE Preoperational Test Specification.

14.2.12.1.9 Main Steam Positive and Penetration Valve Leakage Control Systems Preoperational Test

1. Test Objectives

a. To verify operation of all controls, interlocks, alarms, and valves associated with the MS-PLCS and the PVLCS.

b. To verify performance characteristics of the MS-PLCS and the PVLCS.

2. Prerequisites

a. Required preliminary tests are completed and approved.

b. Instrument calibration and integrated loop checks are completed.

c. Electrical power is available.

d. Containment isolation valves for the following systems are available:

   (1) Main steam system (MSIVs)

   (2) Reactor water cleanup system

   (3) Condensate makeup and drawoff system

   (4) Ventilation chilled water system

   (5) Service air system

   (6) Instrument air system

   (7) Feedwater system.

e. Service water system available.

3. Test Procedure

   a. All instrumentation, controls, alarms, and interlocks are checked for proper operation.

   b. All remotely operated valves are checked for operation and indication.

   c. System functional performance is checked.

4. Acceptance Criteria

   a. All instrumentation controls, alarms, and interlocks function as specified by the system elementary diagrams.

   b. Valve operating times are as specified by the GE Preoperational Test Specification.

   c. System performance for volumetric flow and pressurization is as specified by the GE Preoperational Test Specification and USAR Chapter 9, Section 9.3.6.

14.2.12.1.10 Reactor Recirculation System Preoperational Test

1. Test Objectives

   a. Determine recirculation loop characteristics with no fuel in the reactor.

   b. Determine jet pump characteristics under both normal and abnormal conditions.

   c. Demonstrate the proper operation of the reactor recirculation flow control system, including controls, safety devices, permissives, prohibit interlocks, alarms, and annunciators.

   d. Demonstrate the proper operation of the low-frequency motor generator set and the ability to transfer to and from flow control.

   e. Demonstrate flow control valve stroke times are within test specification limits.

   f. Demonstrate the operation of instumentation used for monitoring system performance.

2. Prerequisites

   a. Required preliminary tests completed and approved.

   b. Demineralized water available for recirculation pumps suction.

   c. Ac and dc electrical power available.

   d. Instrument air available.

   e. Instrument calibration and instrument loop checks completed.

   f. Reactor plant component cooling water (RPCCW) system operational.

   g. Flow control valves hydraulic control unit operational.

   h. Low-frequency motor generator set and switchgear operational.

i. The reactor vessel available for testing.

j. Seal water available from control rod drive (CRD) system.

3. Test Procedure

a. Operate all recirculation loop valves, check interlocks, and verify control and indication capability.

b. Operate recirculation pumps at reduced flow (consistent with cold water atmospheric reactor pressure) and perform the following:

(1) Check loop instrumentation, controls, permissives and prohibit interlocks.

(2) Check pump operation and controls using low-frequency motor generator.

(3) Verify hydraulic control unit operation.

4. Acceptance Criteria

a. System flow characteristics are as specified by the GE Preoperational Test Specification for flow conditions with fuel removed and fuel support orifices installed.

b. All interlocks, controls, permissives, prohibit interlocks, and instrumentation function as specified by the system elementary diagrams.

c. Recirculation pump performance, while operating on the low-frequency motor generator, and low-frequency motor generator performance are as specified by the GE Preoperational Test Specification.

d. Transfer from the low-frequency motor generator to the 4-kV power supply, transfer from the 4-kV power supply to the low-frequency motor generator, the low power start sequence, and the high power start sequence operate as specified by the GE Preoperational Test Specification.

e. Flow control valve stroke times, including ultimate stroke rate and electronically limited stroke rate are as specified by the GE Preoperational Test Specification.

14.2.12.1.11 Control Rod Drive Hydraulic System Preoperational Test

1. Test Objectives

   a. To verify flow path and flow logic of hydraulic system.

   b. To verify pump performance data for the CRD water pumps.

   c. To adjust individual flow control valves for proper flow response.

   d. To verify operating parameters of the installed system.

   e. To verify the failure mode of the CRD system on loss of power.

2. Prerequisites

   a. Required preliminary tests completed and approved.

   b. Demineralized water available

   c. Instrument air available.

   d. Ac and dc power available.

   e. Power available through the reactor protection system (RPS) circuit to energize scram valves.

   f. Instrument calibration and instrument loop checks, including rod control and information system (RCIS) completed to the extent necessary to support rod movement.

   g. Reactor vessel available to receive water.

3. Test Procedure

   a. Operate the CRD water pumps to verify pump and motor performance data.

b. Verify CRD notch control including latching and position indication.

c. Perform scram testing of control rods at atmospheric pressure.

d. Verify scram discharge level switches, and CRD position indication, alarms, and interlocks.

e. The operation of valves from appropriate selector switches, interlocks, or trip signals is checked, including:

   (1) Scram valves and scram solenoid pilot valves

   (2) Backup scram pilot valves

   (3) Scram volume dump and vent valves

   (4) Drive selection valves; withdraw and insert controls.

f. Flow control valves are adjusted for proper flow response.

g. Total system performance data is compiled with all drives installed including:

   (1) Cooling water flow

   (2) Total system flow

   (3) System pressures

   (4) Transient response of system during insert and withdraw operations and following scrams.

h. Verify proper seal water flow to recirculation pumps.

i. The scram valves are verified to open when providing a loss of instrument air to the CRD system.

j. The CRD pumps are tripped and the time for accumulator inoperable alarms to occur is recorded as baseline data.

4. Acceptance Criteria

   a. Flows and pressures for all normal flow paths and operational transients are as specified by the GE Preoperational Test Specification and the GE process diagram.

   b. CRD pump and motor characteristics are comparable to the manufacturer's technical instruction manual.

   c. CRD insert and withdraw speeds, scram times, and buffer times are as specified by the GE Preoperational Test Specification.

   d. Operating parameters of the system are as specified by the GE Preoperational Test Specification.

   e. Scram discharge volume capacity and instrument discharge volume trips are as specified by the GE Preoperational Test Specification.

   f. All scram valves open on a loss of instrument air to the CRD system.

14.2.12.1.12 Fuel Handling and Vessel Servicing Equipment Preoperational Test

1. Test Objectives

   To verify operation of the fuel handling and vessel servicing equipment, including tools for servicing control rods, fuel assemblies, local power range monitors (LPRMs) and dry tubes; to verify the operation of the vertical/horizontal fuel transfer system including the transfer of a dummy fuel assembly.

2. Prerequisites

   a. Required preliminary tests complete.

   b. The following systems must be operational for portions of this test:

      (1) Service air system

      (2) Reactor cavity and core structure available

(3) Ac and dc electrical power available.

c. All slings and lifting devices are certified at their design load by vendor.

d. The refueling platform, fuel preparation equipment, and fuel racks are installed and operational.

e. Fuel storage pool is available for testing.

f. The RPS is available for testing.

g. The RCIS is available.

3. Test Procedure

a. Verify proper operation of indicating and position instruments simultaneously with steps below.

b. Verify proper operation of the refueling system interlocks associated with the refueling platform and service platform in conjunction with the RCIS preoperational test, including interlocks associated with the reactor mode switch.

c. Verify the operability of the following equipment by operating them dry:

(1) Cell disassembly tools

(2) Channel replacement tools

(3) Instrument handling tools

(4) Refueling and service platform

(5) Containment polar cranes and fuel handling hoists

(6) Refueling, service platform, and crane interlocks.

d. Verify the operability of the vertical/horizontal fuel transfer system by:

(1) Mechanical and electrical subsystem checkouts

(2) Containment isolation capability test

(3) Leak testing of penetration assembly

(4) Dummy fuel assembly transfer.

e. Cranes and hoists are demonstrated to operate by performing a static test at 125 percent of rated load and a full operational test at 100 percent of rated load.

4. Acceptance Criteria

a. Fuel handling and vessel servicing equipment function as specified by the GE Preoperational Test Specification.

b. All areas in the fuel pool and the reactor cavity are accessible from the refueling platform.

c. Reactor building and fuel building refueling platform position readout system indicates the correct fuel location.

d. Refueling interlock and logic systems function as specified by the system elementary diagrams for the rod control information system.

e. Cranes and hoists have demonstrated 125 percent static capacity and 100 percent operational capacity.

14.2.12.1.13 Rod Control and Information System Preoperational Test

1. Test Objective

To verify the operation of the RCIS, including relays, control circuitry, switches and indicating lights, and control valves.

2. Prerequisites

a. The required preliminary tests have been completed.

b. Ac and dc electrical power is available.

3. Test Procedure

   Verification of RCIS capability is demonstrated by the proper integrated operation of the following:

   a. Rod blocks, alarms, and interlocks for all modes of the reactor mode switch.

   b. Rod position information circuits.

   c. Rod drift alarm circuit.

   d. Rod directional control valve time sequence for insert and withdraw commands.

4. Acceptance Criteria

   a. All rod blocks, alarms, and interlocks function as specified by the system elementary diagrams.

   b. Rod position information operates as specified by the GE Preoperational Test Specification.

   c. Rod selection, timer controls, and alarms function as specified by the system elementary diagrams.

   d. Interlocks and bypasses associated with the reactor mode switch function as specified by the system elementary diagrams.

14.2.12.1.14 Feedwater Control System Preoperational Test

1. Test Objective

   To verify operation and response of the feedwater control system.

2. Prerequisites

   a. Required preliminary phase tests completed and approved.

   b. Ac and dc power available

   c. Instrument calibration and instrument loop checks are completed. These include transmitters, analog trip units, controllers, signal resistor units, summers, square root converters, and dynamic compensators.

d. Instrument air system available.

3. Test Procedure

The feedwater control system is tested to verify operational capability using simulated signals.

System alignment is accomplished by:

a. Verifying system response to abnormal signal inputs by alarms, interlocks, and signal outputs.

b. Verifying response of the feed pump regulating valve to varying steam, feed, and level signals.

c. Verifying response in single element mode and manual control.

4. Acceptance Criteria

Feedwater controls function as specified by the GE Preoperational Test Specification.

14.2.12.1.15 Leak Detection System Preoperational Test

1. Test Objective

To conduct an integrated test of the leak detection system which demonstrates the following:

a. All inputs to the leak detection system function properly.

b. All recorders, alarms, indicators, etc, function properly.

c. Signal output, processing, and logic function in accordance with test specifications, including group isolation logic.

2. Prerequisites

a. Required preliminary tests complete and approved.

b. Electrical power available.

c. Interconnecting cables, panel power, local power, and alarms available for the leak detection components associated with the following systems:

(1) RWCU system

(2) Reactor recirculation system

(3) RHR system

(4) HPCS system

(5) LPCS system

(6) Nuclear boiler system

(7) RCIC system.

d. All instrument calibration completed.

3. Test Procedure

a. All instrumentation, controls, permissive and prohibit interlocks, alarms, and annunciators are checked for proper operation.

b. Integrated system actions resulting from leak detection devices are tested by simulating or operating the following leak detection subsystems:

(1) Area temperature monitors

(2) Drywell sump monitors

(3) Valve stem leakoff monitors

(4) HPCS/LPCS/LPCI injection line integrity monitors

(5) RHR/RCIC steam line high flow monitors

(6) Main steam line high flow monitors

(7) RWCU flow leak monitors

(8) Auxiliary building flood monitors

(9) Refueling bellows leakage monitors.

4. Acceptance Criteria

All trips, interlocks, and logic sequences function as specified by the system elementary diagrams and the GE Preoperational Test Specification. All recorders, alarms, and indicators function as specified by the elementary diagrams.

14.2.12.1.16 Reactor Protection System Preoperational Test

1. Test Objectives

   a. To demonstrate the capability of the RPS to initiate a scram signal in conformance with system design.

   b. To demonstrate RPS response to motor-generator (MG) set coastdown.

   c. To demonstrate that the RPS channel response times meet the requirements of the test specification.

2. Prerequisites

   a. Required preliminary tests are completed and approved.

   b. Instruments within the RPS boundary have been calibrated and all trip points set.

   c. Ac and dc electrical power is available.

   d. RPS MG sets are in service.

   e. Instrument air is available.

3. Test Procedure

   a. Verify proper performance and operation of the RPS MG sets.

   b. Verify all RPS sensor logic systems and scram relay operation.

   c. Verify all reactor mode switch interlocks and bypasses.

d. Demonstrate the scram reset delay operation.

e. Measure, by injection of a process ramp to the sensor input or by manipulation of the digital detection device, as applicable, the response time of each RPS channel.

f. Verify proper operation of the annunciators, alarms, and computer points.

g. Verify proper system operation from normal and alternate power supplies and during switching transients.

h. Verify proper operation of RPS interlocks associated with the reactor mode switch.

4. Acceptance Criteria

a. RPS MG sets operate as specified by the GE Preoperational Test Specification and the manufacturer's technical instruction manual.

b. All system logic functions, interlocks, and time delays function as specified by the system elementary diagrams.

c. RPS responds to simulated scram condition as specified by the system elementary diagrams.

d. Response times for the RPS channels are less than or equal to the values as specified by the Technical Specifications and the GE Preoperational Test Specification.

e. Power supply switching and interlocks function as specified by the system elementary diagrams.

f. All RPS interlocks associated with the reactor mode switch function as specified by the system elementary diagrams.

14.2.12.1.17 Neutron Monitoring Systems Preoperational Tests

1. Test Objectives

   a. To demonstrate that the neutron monitoring system (NMS) functions in accordance with design specifications.

   b. The tests include the following NMSs:

      (1) Source range monitor (SRM)

      (2) Intermediate range monitor (IRM)

      (3) Local power range monitor (LPRM)

      (4) Average power range monitor (APRM).

2. Prerequisites

   a. Required preliminary tests completed and approved.

   b. All instrument calibrations and trip point settings within the NMS boundaries completed.

   c. Ac and dc power supplies operational.

   d. RCIS operational.

   e. RPS operational.

3. Test Procedure

   Demonstrate proper integrated operation of the following:

   a. SRM detectors and their respective insert and retract mechanisms and cable.

   b. SRM channels, including pulse preamp, remote meter and recorder, trip logic, logic bypass and related lamps and annunciators, control system interlocks, refueling instrument trips, and power supply.

   c. IRM detectors and their respective insert and retract mechanisms and cables.

d. IRM channels, including voltage preamps, recorders, RCIS interlocks, RPS trips, annunciators and lamps, and power supplies.

e. All LPRM detectors and their respective cables and power supplies.

f. All APRM channels, including trips, trip bypasses, annunciators and lamps, remote recorders, RCIS interlocks, RPS interlocks, and power supplies.

g. Recirculation flow unit, flow transmitters, and related annunciators, interlocks, and power supplies.

4. Acceptance Criteria

Proper integrated operation as specified by the GE Preoperational Test Specification of the following NMS subsystems is demonstrated:

a. All SRM detectors, and their respective insert and retract mechanisms, and cables.

b. SRM channel, including pulse preamp, remote meter and recorder, trip logic, logic bypass and related lamps and annunciators, control system interlocks, refueling instrument trips, and power supply.

c. All IRM detectors and their respective insert and retract mechanisms and cables.

d. IRM channels, including voltage preamps, remote recorders, RMCS interlocks, RPS trips, annunciators, and lamps, and power supplies.

e. All LPRM detectors and their respective cables, and power supplies.

f. All APRM channels, including trips, trip bypasses, annunciators and lamps, remote recorders, RMCS interlocks, RPS trips, and power supplies.

g. Recirculation flow bias signal, including flow unit, flow transmitters, and related annunciators, interlocks, and power supplies.

14.2.12.1.18 Traversing Incore Probe System Preoperational Test

1. Test Objectives

   To verify operational capability of the traversing incore probe (TIP) system and to demonstrate that the system functions in accordance with design specification.

2. Prerequisites

   a. Required preliminary tests completed and approved.

   b. Ac and dc power supplies operational.

   c. All mechanical portions of the system lubricated and ready for operation.

   d. Instrument air available.

   e. Instruments within the TIP system boundary calibrated.

3. Test Procedure

   Demonstrate the proper integrated operation of the following:

   a. Indexer cross calibration interlock.

   b. Drive manual control and override, automatic control and stop, and low speed control.

4. Acceptance Criteria

   a. Only one indexer at a time can be stopped at the cross calibration tube.

   b. All modes of operation of the TIP system have been demonstrated as specified by the GE Preoperational Test Specification.

   c. All recorders and drives operate as specified by the GE Preoperational Test Specification.

   d. All alarms, annunciators, interlocks, and logic operate as specified by the system elementary diagrams.

14.2.12.1.19 Process Radiation Monitoring System Preoperational Test

1. Test Objectives

   a. To demonstrate that the process radiation monitoring (PRM) system functions in accordance with the design specifications.

   b. The test includes the following PRM subsystems:

      (1) Off-gas pretreatment subsystem

      (2) Off-gas post-treatment subsystem

      (3) Main steam line subsystem.

2. Prerequisites

   a. Required preliminary tests are completed and approved.

   b Instrument calibration is complete.

   c. Electrical power is available.

   d. All trip points are set.

   e. All system low and high voltage power supplies and signal cables have been tested and meet specifications.

   f. Check sources are in place where required (all radiation monitors are tested using a check source).

3. Test Procedure

   Demonstrate proper operation of the following:

   a. The off-gas pretreatment radiation monitors, including recorders, radiation detectors, and sample equipment.

   b. Main steam line radiation monitoring system, including log radiation monitors (LRM), annunciation, recorders, and trip check.

c. Off-gas post-treatment radiation monitors, including annunciation, recorders, trip check, and sample rack equipment.

4. Acceptance Criteria

a. All PRM systems operate as specified by the GE Preoperational Test Specification.

b. All system logic interlocks, and trips function as specified by the system elementary diagrams.

c. RPS interface is specified by the system elementary diagrams.

d. All sample racks function as specified by the GE Preoperational Test Specification.

14.2.12.1.20 Digital Radiation Monitoring System Preoperational Test

1. Test Objectives

a. To verify the operation of the radiation monitoring system including sensors, alarms, interlocks, trip units, recorders, and sample racks.

b. The test includes both area radiation monitors and the following process radiation monitors:

(1) Main control room ventilation

(2) Fuel building ventilation

(3) Radwaste building ventilation

(4) Main plant exhaust duct

(5) Reactor building annulus ventilation

(6) Auxiliary building ventilation

(7) Containment purge

(8) Turbine building ventilation

(9) Condensate demineralizer and offgas building ventilation

(10) Containment and drywell atmosphere

(11) Radwaste reboiler clean steam

(12) Seal steam evaporator clean steam

(13) RHR heat exchanger service water

(14) Fuel pool cooling and cleanup

(15) Component cooling water

(16) Reactor plant component cooling water

(17) Liquid radwaste effluent

(18) Cooling tower blowdown

(19) Standby gas treatment.

2. Prerequisites

a. Required preliminary tests are completed and approved.

b. Instrument calibration is complete.

c. Electrical power is available.

d. Check sources are in place where required.

e. Trip points are set.

3. Test Procedure

a. Verify area and process radiation monitor channel connection, recording, alarm, isolation, and interlock functions.

b. Check all area and process radiation channels with a radioactive source.

c. Demonstrate proper operation of all process sample racks.

4. Acceptance Criteria

a. System logic functions, including permissive and prohibit interlocks, system initiations and isolations, and alarms, function as specified by the system elementary diagrams.

b. Sample racks operate as specified by the manufacturer's technical instruction manual.

14.2.12.1.21 Nuclear Steam Supply System Process Computer Preoperational Test

1. Test Objectives

To verify the input/output list for the nuclear steam supply system (NSSS) process computer.

2. Prerequisites

a. Computer hardware is operable.

b. Ac electrical power is available.

c. The required computer diagnostic tests have been completed.

d. The scan, log and alarm (SLA) programs have been entered into the process computer.

3. Test Procedure

a. Verify that each analog and digital input point has the correct printout range, alarm, and units in accordance with the I/O list.

b. Verify that each analog and digital sensor input has the correct polarity, signal conditioning, and printout.

4. Acceptance Criteria

a. All analog and digital inputs are terminated to the process computer input points as specified by the Process Computer Input/Output Specification.

b. Each process computer variable is printed out in the engineering units specified by the Process Computer Input/Output Specification.

c. Digital input alarm signals are printed out in statements as specified by the Process Computer Input/Output Specification.

14.2.12.1.22 Fuel Pool Cooling and Cleanup System Preoperational Test

1. Test Objectives

    a. To demonstrate the capability of the fuel pool cooling and cleanup system to provide the water flow to system components and maintain the required water level in the spent fuel pool.

    b. To demonstrate the capability of containment isolation valves to close within the required time in response to a containment isolation signal.

    c. To demonstrate the operability of remotely controlled valves under full flow conditions.

    d. To demonstrate the ability of the fuel pool filter/demineralizers to produce and maintain acceptable water quality.

    e. To demonstrate the operability and leaktightness of the reactor cavity to dryer pit gate, dryer pit to upper transfer pool gate, and spent fuel pool to cask storage gate.

    f. To demonstrate the operability of anti-siphon devices in the fuel pools.

    g. To demonstrate the operability of all alarms, annunciators, and permissive and prohibit interlocks.

2. Prerequisites

    a. Required preliminary tests completed and approved.

    b. The following support systems available:

        (1) Ac and dc electrical power

        (2) RHR systems for fuel pool cooling assistance

        (3) Condensate makeup and drawoff system

(4) Instrument and service air system

(5) Radioactive liquid waste system

(6) Main condenser hotwell

(7) RPCCW system.

c. All instrument calibrations and instrument loop checks are complete.

d. Spent fuel storage pool, upper containment pools filled with demineralized water for portions of this test.

e. Cation/anion resin available.

3. Test Procedure

a. Check all controls, alarms, and interlocks for proper operation, and check remote-operated valves to ensure performance in accordance with design specifications.

b. Verify the RHR fuel pool assist mode for proper operation.

c. Verify the fuel pool filter/demineralizer system for proper operation by checking the following modes:

(1) Backwashing

(2) Standby recirculation

(3) Normal operation.

d. Simulate pumping sludge to radwaste.

e. Verify flow path between fuel pool cooling and cleanup system and RPCCW system.

f. Verify the leaktightness of the sectionalizing gates between the reactor cavity and dryer storage pool, dryer storage pool and upper transfer pool, and spent fuel pool and cask storage pool.

g. Verify that anti-siphon devices stop the flow of water when a line break is simulated or an improper valve lineup is caused.

h. Verify the spent fuel pool, upper pool, and transfer pool high and low level alarms function.

4. Acceptance Criteria

a. Fuel pool cooling pump interlocks function as specified by the system elementary drawings.

b. The fuel pool cooling pumps' performance is as specified by USAR Chapter 9, Table 9.1-5.

c. The filter/demineralizer can be backwashed, placed in service, and put in standby recirculation.

d. The filter/demineralizers are being evenly precoated and produce effluent as specified by USAR Chapter 9, Section 9.1.3.2.2.

e. The filter/demineralizer valve interlocks operate as specified by the elementary diagrams.

f. Alarm and trip set points of all instrumentation are as specified by USAR Chapter 9, Section 9.1.3.5, and the SWEC loop diagrams.

g. The sectionalizing gates can be located into position to provide a watertight seal between pools.

h. The anti-siphon devices stop the flow of water.

i. The high and low level alarms associated with the spent fuel pool, upper pool, and transfer pool function as specified by the system elementary diagrams and the SWEC loop diagrams.

j. Containment isolation valves close within the time specified by USAR Table 6.2-40.

k. Remote-operated valves operate as specified by the system elementary diagrams.

l. Flow is established through the RHR/fuel pool cooling system crosstie as specified by the GE Process Diagram.

14.2.12.1.23 Reactor Plant Component Cooling Water System Acceptance Test

1. Test Objective

To verify the operation of the RPCCW system including pumps, motors, heat exchangers, surge tank, valves, instrumentation and controls and interlocks.

2. Prerequisites

a. Required preliminary test have been completed.

b. Instrument air is in service.

c. Appropriate ac and dc power sources available

d. Instrumentation calibration is complete.

e. Nitrogen system is in service.

f. Makeup water system is in service.

3. Test Procedure

a. Measure the RPCCW pump performance.

b. Check all trips, permissives, interlocks, controls, and alarms for proper operation.

c. System air and motor-operated valve interlocks are verified.

d. Verify system flows through heat exchangers.

e. Verify flow path between the RPCCW system and the service water system.

4. Acceptance Criteria

   a. RPCCW pump performance is as specified by USAR Chapter 9, Section 9.2.2 and Table 9.2-2, and is comparable to the manufacturer's technical instruction manual.

   b. Trips, permissives, interlocks, controls, and alarms are specified by the system elementary diagrams.

   c. System flow rates through all heat exchangers are as specified by each component's manufacturer's technical instruction manual.

14.2.12.1.24 Combustible Gas Control System Preoperational Test

1. Test Objective

   To demonstrate the capability of the combustible gas control system to operate in response of post-LOCA requirements.

2. Prerequisites

   a. Required preliminary tests have been completed and approved.

   b. All permanently installed instrumentation properly calibrated and operable.

   c. Instrument air system available.

   d. Containment ventilation system available as required to support testing.

   e. Appropriate ac and dc power sources available.

3. Test Procedure

   a. Demonstrate that system components and valves respond to manual, test, and post-LOCA initiation signals; check initiation logic for proper operation, including all alarms, computer points, controls, and interlocks.

   b. Measure and verify operability and performance of the drywell and containment mixing and purge fans.

c. Measure recombiner heater performance.

d. Measure recombiner airflow.

e. Measure valve interlocks, opening and closing times.

4. Acceptance Criteria

a. All trips, permissives, and interlocks function as specified in the system elementary diagrams.

b. Drywell and containment mixing and purge fans performance is as specified by USAR Chapter 6, Section 6.2.5 and Table 6.2-41.

c. Recombiner heater performance is as specified by the manufacturer's technical instruction manual.

d. Valve operating times are as specified in USAR Chapter 6, Table 6.2-40, and the SWEC Technical Data Sheets for MOVs.

14.2.12.1.25 Turbine Plant Component Cooling Water System Acceptance Test

1. Test Objectives

To verify the operation of the turbine plant component cooling water system, including pump, motors, heat exchangers, valves, surge tank, and all instrumentation and controls.

2. Prerequisites

a. Required preliminary tests are completed and approved.

b. All permanently installed instrumentation properly calibrated and operable.

c. All test instrumentation available and properly calibrated.

d. Instrument air system available.

e. Appropriate ac and dc power sources available.

f. Annunciator system available.

g. Makeup water system available.

h. Nitrogen system available.

3. Test Procedure

a. Measure containment cooling system (CCS) pump performance.

b. Check all trips, permissives, interlocks, controls, and alarms for proper operation.

c. Check automatic makeup to the surge tank and level control operation.

d. Verify system flows through heat exchangers.

4. Acceptance Criteria

a. CCS pump performance is as specified by USAR Chapter 9, Section 9.2.8, and comparable to the manufacturer's technical instruction manual.

b. Trips, permissives, interlocks, and controls are as specified by the system elementary diagrams.

c. System flow rates through all heat exchangers are as specified by each component's manufacturer's technical instruction manual.

14.2.12.1.26 Normal And Standby Service Water Systems Preoperational Test

1. Test Objectives

•→6

a. To demonstrate the ability of the normal service water system and its related service water cooling system and standby service water system to provide design flow to supplied components.

6←•

b. To demonstrate operation of all system interlocks, instrumentation and controls.

c. To demonstrate operation of all systems components, including pumps, valves, motors, and fans.

2. Prerequisites

   a. Required preliminary tests are completed and approved.

   b. All permanently installed instrumentation properly calibrated and operable.

   c. All test instrumentation available and properly calibrated.

   d. Instrument air system available.

   e. Appropriate ac and dc power sources available.

   f. Chemically acceptable water source available.

3. Test Procedure

•→6

   a. Measure normal service water system pump, service water cooling system pump, and standby service water system pump performance.

6←•

   b. Check trips, permissives, interlocks, controls, alarm and computer points.

   c. Verify flow path between service water pump (SWP) and RPCCW systems.

   d. In conjunction with the remote shutdown preoperational test, demonstrate operation of the standby service water system through the RHR heat exchangers from the remote shutdown panel.

   e. Demonstrate combined operation of standby service water pumps A and C (as well as B and D) at the minimum basin level 30 days after a LOCA (i.e., el 65 ft 0 in).

4. Acceptance Criteria

•→6

   a. Normal service water system pump performance, service water cooling system pump performance, and standby service water pump performance are as specified in USAR Chapter 9, Tables 9.2-1, 9.2-15 and 9.2-20.

6←•

   b. Trips, permissives, interlocks, and controls function as specified by the system elementary diagrams.

c. Operation of the standby service water system from the remote shutdown panel is as specified by the GE Preoperational Test Specification.

d. Rated flow through all heat exchangers is as specified by each component's manufacturer technical instruction manual and within allowable tolerances of USAR Tables 9.2-1 and 9.2-15.

e. Verify pumps A and C (as well as B and D) in combination operate vortex-free at a basin water level of 65 ft 0 in.

•→6

f. Verify that the service water cooling system pumps operate vortex-free at the minimum service water cooling system cooling tower basin water level.

6←•

14.2.12.1.27 Standby Service Water Pumphouse Ventilation System Preoperational Test

1. Test Objective

To demonstrate fan, damper, and unit cooler trips, permissives, interlocks, and controls function.

2. Prerequisites

a. Required preliminary tests are completed and approved.

b. All permanently installed instrumentation properly calibrated and operable.

c. All test instrumentation available and properly calibrated.

d. Appropriate ac and dc power sources available.

3. Test Procedure

Verify that equipment, trips, permissives, interlocks, controls and alarms function correctly.

4. Acceptance Criteria

Trips, permissives, interlocks, controls, and alarms function as specified by the system elementary diagrams.

14.2.12.1.28 Control Building Heating, Ventilation, and Air Conditioning Preoperational Test

1. Test Objectives

   a. To demonstrate that the control building ventilation system fan, heater, damper, filter, and air conditioner interlocks, trips, permissives, and controls function for various modes of operation including post-accident conditions.

   b. To demonstrate the automatic actions on control room HVAC associated with radiation monitors.

   c. To demonstrate the automatic actions of radiation monitors interlocked with the control building HVAC.

2. Prerequisites

   a. Required preliminary tests are completed and approved.

   b. Instrument calibration is complete.

   c. Instrument air system available as necessary to support the test.

   d. Appropriate ac and dc power sources available.

   e. Annunciator system available as necessary to support the test.

   f. Control building chilled water system available as necessary to support the test.

3. Test Procedure

   a. Verify all fan, filter, heater, damper, and air conditioner interlocks, trips, permissives and controls function correctly.

   b. Verify operating times for isolation dampers are acceptable.

   c. Verify correct system response to manual and automatic isolation signals, including actions caused by radiation detectors.

4. Acceptance Criteria

   a. All fan, heater, damper, and air conditioner interlocks, trips, permissives, and controls function as specified by the system elementary diagrams.

   b. Damper operating times are specified by the SWEC Technical Data Sheets for Air Dampers.

   c. System operating response for manual and automatic signals is as specified by USAR Chapter 9, Section 9.4.1 and the system elementary diagrams.

14.2.12.1.29 Control Building Chilled Water System Preoperational Test

1. Test Objective

   To demonstrate the capability of the chilled water system to supply chilled water to the cooling coils of the main control room, the standby switchgear, and the chiller equipment room air conditioning units during the normal, shutdown, and accident modes of operation.

2. Prerequisites

   a. Required preliminary tests complete.

   b. All instrument calibration complete.

   c. Appropriate ac and dc power available.

   d. Makeup water system available.

   e. Service water system available.

   f. Instrument air system available.

3. Test Procedure

   a. Measure chilled water pump and condenser water pump performance.

   b. Check trips, permissives, interlocks, controls, alarms, and computer points.

   c. Check chiller performance.

d. Check control valve operation.

4. Acceptance Criteria

a. Chilled water and condenser water pumps perform as specified by USAR Chapter 9, Table 9.2-19.

b. Trips, permissives, interlocks, controls, and alarms function as specified by the system elementary diagrams.

c. The chiller performance is comparable to the manufacturer's technical instruction manual.

d. Control valves control flow and temperature as specified by the SWEC loop diagrams.

14.2.12.1.30 Ventilation Chilled Water System Acceptance Test

1. Test Objectives

To verify the capability of the ventilation chilled water system to supply chilled water to the cooling coils of the containment unit coolers, the fuel building unit coolers, the turbine building air handling units, and the radwaste and turbine building unit coolers during normal and shutdown modes of operation.

2. Prerequisites

a. Required preliminary tests complete.

b. All permanently installed instrumentation operable and properly calibrated.

c. Appropriate ac and dc power available.

d. Makeup water and service water system available

e. Instrument air system available

3. Test Procedure

a. Measure chilled water pump performance.

b. Measure chiller performance.

c. Check operation of all control valves.

d. Check trips, permissives, interlocks, controls, alarms, and computer points.

4. Acceptance Criteria

a. Chilled water pump performance is comparable to that shown in the manufacturer's technical instruction manual.

b. Chiller performance is comparable to that shown in the manufacturer's technical instruction manual.

c. Trips, permissives, interlocks, controls, and alarms are as specified by the system elementary diagrams.

d. Control valves control flow and temperature as specified by the SWEC loop diagrams.

14.2.12.1.31 Diesel Generator Building Ventilation System Preoperational Test

1. Test Objective

To verify system automatic functions.

2. Prerequisites

a. Required preliminary tests completed.

b. Ac and dc electrical power available as appropriate.

c. Instrument calibrations and loop checks complete.

3. Test Procedures

a. Verify all fan trips, permissives, interlocks, and controls.

b. Verify emergency ventilation fans automatically start in response to their associated diesel generators starting and in response to high room temperature.

4. Acceptance Criteria

   a. All fan interlocks, trips, and permissives function as specified by the system elementary diagrams.

   b. Emergency ventilation fans start automatically in response to their associated diesel generators starting and when room temperature exceeds the high temperature set point.

14.2.12.1.32 Drywell Cooling System Preoperational Test

1. Test Objective

   To demonstrate fan, damper, and unit cooler trips, permissives, interlocks, and controls function.

2. Prerequisites

   a. Required preliminary testing complete.

   b. Service water system available as necessary to support the test.

   c. Ac and dc power available as appropriate.

   d. All permanently installed instrumentation properly calibrated and loop checks complete.

   e. Instrument air available as necessary to support the test.

3. Test Procedure

   Verify that all unit coolers respond correctly for all trips, permissives, interlocks, and controls.

4. Acceptance Criteria

   All trips, permissive and prohibit interlocks, and controls for each unit cooler function as specified by the system elementary diagrams.

14.2.12.1.33 Reactor Plant Ventilation System Preoperational Test

1. Test Objectives

   a. To demonstrate fan, and damper trips, permissives, interlocks, and control function.

   b. To demonstrate the automatic response of the annulus mixing system during emergency modes of operation

   c. To demonstrate containment/drywell purge fan, damper,and heater trips, permissives, interlocks, and controls function.

   d. To demonstrate that a high radiation signal closes the containment ventilation isolation dampers within the required time

   e. To demonstrate the capability of the containment cooling system to operate during normal and emergency modes

2. Prerequisites

   a. Required preliminary testing complete

   b. All permanently installed and test instrumentation properly calibrated and operable

   c. Appropriate ac and dc power sources available

   d. Standby gas treatment system available as necessary to support the test

   e. Combustible gas control system available as necessary to support the test

   f. Ventilation chilled water system available as necessary to support the test

3. Test Procedure

   a. Verify that all fans, dampers and isolation valve trips, permissives, interlocks and controls function correctly.

b. Verify that trips, interlocks, alarms, and controls associated with the exhaust filter train function correctly.

c. Verify that containment ventilation isolation dampers close in the required time in response to a high radiation signal.

d. Verify the operation of the containment/drywell continuous purge and cleanup system.

e. Verify the operation of the containment dome recirculation fans.

4. Acceptance Criteria

a. System dampers operating times are as specified by the SWEC Technical Data Sheets for Air Dampers.

b. Fans, dampers, permissives, interlocks, and controls function as specified by the system elementary diagrams and USAR Chapter 9, Section 9.4.6.

c. Filter train trips, permissives, interlocks, and controls function as specified by the system elementary diagrams and USAR Chapter 9, Section 9.4.6.

d. The annulus mixing system responds to the LOCA signal as described in the USAR, Section 9.4.6.2.4.

e. The containment unit coolers and chilled water system function for normal and emergency modes as specified by USAR Chapter 9, Section 9.4.6.2.1.

14.2.12.1.34 Standby Gas Treatment System Preoperational Test

1. Test Objectives

To demonstrate fan, filter, damper, and heater trips, permissives, interlocks, and controls function.

2. Prerequisites

   a. Required preliminary tests complete.

   b. Reactor plant ventilation system available as necessary to perform the test.

   c. Auxiliary building ventilation system available as necessary to perform the test.

   d. All permanently installed and test instrumentation properly calibrated and operable.

   e. Ac and dc power available as appropriate.

   f. Instrument air available as necessary to support the test.

3. Test Procedure

   a. Demonstrate all alarms, controls, trips, permissives, and interlocks operate correctly.

   b. Activate both trains manually and automatically.

   c. Check damper operation and timing.

4. Acceptance Criteria

   a. Controls, trips, permissives, and interlocks function as specified by the system elementary diagrams.

   b. The system operates in the manual and automatic modes as specified by USAR Chapter 6, Section 6.5.

   c. Damper operating times are as specified by the SWEC Technical Data Sheet for Air Dampers.

14.2.12.1.35 Remote Shutdown System Preoperational Test

1. Test Objective

   To demonstrate that systems required to shut down the reactor from outside the main control room can be operated from the remote shutdown system panel. Individual portions of this test can be performed in conjunction with system tests such as RCIC and nuclear boiler.

2. Prerequisites

a. Required preliminary tests completed.

b. Ac and dc electrical power available.

c. Instrument calibrations and loop checks complete.

d. The following systems are available and required to support the test:

(1) RCIC

(2) RHR

(3) SWP

(4) Nuclear boiler (safety/relief valves).

3. Test Procedure

a. Verify all remote shutdown valves, controls, instruments, and pumps are operable from the remote shutdown panel when the appropriate control switch is in the emergency position.

b. Demonstrate in conjunction with the RCIC preoperational test that the RCIC turbine and valves can be operated in the test mode from the remote shutdown panel.

c. Demonstrate in conjunction with the standby service water preoperational test that the standby service water system can be operated through the RHR heat exchanger from the remote shutdown panel.

d. Demonstrate in conjunction with the RHR preoperational test that the RHR system can be operated in the suppression pool cooling mode and the shutdown cooling mode from the remote shutdown panel.

e. Demonstrate in conjunction with the nuclear boiler preoperational test that the three designated safety relief valves can be operated from the remote shutdown panel.

4. Acceptance Criteria

a. Remote shutdown system valves, controls, instruments, and pumps operate in all required modes as specified by the GE Preoperational Test Specification.

b. Operation of the RHR, RCIC, standby service water, and safety relief valve systems functions as specified by the GE Preoperational Test Specification.

14.2.12.1.36 Standby Diesel Generator Preoperational Test

1. Test Objectives

a. To demonstrate the reliability of the standby diesel generator power sources.

b. To provide assurance that the system is capable of providing standby electrical power during normal and simulated accident conditions.

c. To demonstrate the system's ability to pick up standby loads during simulated accident conditions.

d. To demonstrate the operability of the diesel generator auxiliary systems, i.e., diesel fuel oil transfer and diesel generator starting air supply system.

2. Prerequisites

a. Required preliminary tests completed.

b. All instrument calibration and loop checks completed.

c. The following system and/or components available:

(1) Fire protection system in diesel generator room

(2) SWP

(3) Pneumatic sources

(4) Electrical power to motors, fans, etc

(5) Diesel generator building ventilation system as required to support testing.

d. Sufficient diesel fuel on site to perform tests.

3. Test Procedure

a. Test all diesel starting and trip sequences to assure proper operation.

b. Test all auxiliary systems to demonstrate that they operate in accordance with test specifications.

c. Verify that all interlocks, controls, and alarms operate in accordance with test specifications.

d. Demonstrate proper manual and automatic operation of the diesel generators and that they can start automatically upon simulated loss of ac voltage and attain the required frequency and voltage within the specified limits.

e. Demonstrate proper response and operation for test basis accident (DBA) loading sequence to test basis load requirements, and verify that voltage and frequency are maintained within specified limits.

f. Demonstrate proper operation of the diesel generator during load shedding, load sequencing, and load rejection. Include a test of loss of the largest single load while maintaining voltage and frequency within test limits, and a test of the complete loss of load in which overspeed limits are not exceeded.

g. Demonstrate full-load carrying capability of the diesel generators for a period of not less than 24 hr at 3,500 kW. Verify that voltage and frequency are maintained within test limits and that the diesel cooling systems function within test limits.

h. Demonstrate functional capability at operating temperature conditions by performing a fast start at rated load immediately (within 5 min), after completion of the 24-hr load test g above.

i. Demonstrate the ability to:

   (1) Synchronize the diesel generators with offsite power while connected to the standby load

   (2) Transfer the load from the diesel generators to the offsite power

   (3) Isolate the diesel generators and restore them to standby status.

j. Demonstrate that the rate of fuel consumption while operating at the DBA load is such that the requirements for 7-day storage inventory are met for each diesel generator.

k. The reliability of each diesel generator unit is demonstrated as per the RBS position on Regulatory Guide 1.108, paragraph C.2.a(9), as stated in Section 8.3.1.1.5.2.

l. Demonstrate that the capability of the diesel generators to supply standby power within the required time is not impaired during periodic surveillance testing.

m. Demonstration of reliability and independence of the redundant diesel generator units is provided through their simultaneous starting during the testing discussed in Section 14.2.12.1.44.

n. Demonstrate that the standby diesel generator can be started from minimum design starting air pressure and that the starting air system provides the number of starts by design with the recharging compressors isolated.

4. Acceptance Criteria

   a. System configuration and operation are comparable to that shown in the manufacturer's technical instruction manual.

   b. Automatic sequencing of generator-driven equipment occurs as specified by USAR Chapter 8, Table 8.3-2.

   c. All auxiliary systems function as specified by USAR Sections 9.5.4, 9.5.5, 9.5.6, 9.5.7, and 9.5.8, and the manufacturer's technical instruction manual.

   d. Rated load and frequency can be attained.

   e. Load rejection does not result in exceeding speeds or voltages which cause diesel generator tripping or mechanical damage.

   f. The standby diesels start with minimum air pressure and start with the recharging air compressors isolated, as specified by USAR Sections 9.5.6.1 and 9.5.6.2.1.

14.2.12.1.37 Vessel Internals Vibration Preoperational Test

1. Test Objective

   Vibration tests are conducted to verify the structural integrity of core support structure and reactor internals in accordance with Regulatory Guide 1.20. The jet pumps are part of this program.

2. Prerequisites

   a. Reactor recirculation system operational.

   b. Capability to maintain reactor pressure and temperature requirements has been established.

   c. Reactor assembly, including all core support structures and components, jet pumps, spargers, shroud head and moisture separator, reactor head, and surveillance specimens, has been verified. The fuel assemblies are not installed in the reactor vessel.

d. Vibration measurement program has been completed at the prototype plant, Kuosheng-1, with results confirmed as satisfactory by GE. This qualifies River Bend Station as a non-prototype, Category 1 plant as related to NRC Regulatory Guide 1.20.

3. Test Procedure

a. A pre-flow test visual vessel internal inspection is performed.

b. The reactor recirculation system is operated at rated volumetric flow for a minimum of 35 hr with two-pump balanced flow and for a minimum of 14 hr single loop operation at rated volumetric loop flow for each of the loops.

c. A visual vessel internal inspection is performed following completion of flow excitation.

4. Acceptance Criteria

a. Visual inspection indicates no evidence of loose parts, defects, or wear due to the testing conditions specified by the GE Preoperational Test Specification.

b. Visual inspection indicates no extraneous material in the jet pump annulus or the plenum region below the core plate as a result of the testing conditions specified by the GE Preoperational Test Specification.

c. Flush cloth samples from reactor vessel bottom head are within the criteria of the flushing specification.

14.2.12.1.38 Off-gas System Preoperational Test

1. Test Objective

To verify the operation of the off-gas system including valves, recombiner, condensers, coolers, filters, and hydrogen analyzers.

2. Prerequisites

   a. Required preliminary tests completed.

   b. Electrical power available.

   c. Instrument air and service air available.

   d. Turbine building component cooling water available.

3. Test Procedure

   Demonstrate the following:

   a. Valve operation including failsafe and isolation features.

   b. Pump operation.

   c. Level and temperature control and indication.

   d. Recombiner and preheater tests.

   e. Condenser, cooler, and moisture separator tests.

   f. Gas dryer and cooler tests.

   g. Filter efficiency.

   h. Hydrogen analyzer performance test.

4. Acceptance Criteria

   a. All alarms, controls, trips, permissives, and interlocks function as specified by the system elementary diagrams.

   b. All remote operated valves operate as specified by the GE Preoperational Test Specification.

   c. Mechanical equipment, cooling systems, and sampling systems perform as specified by the GE Preoperational Test Specification.

   d. HEPA filters and charcoal filters perform as specified by the GE Preoperational Test Specification.

14.2.12.1.39 Class 1E 125-V DC System Preoperational Test

1. Test Objective

   To demonstrate that the Class 1E 125-V dc power distribution system is capable of providing power during both normal and abnormal plant conditions.

2. Prerequisites

   a. The energization procedures as required for this test completed and data reviewed.

   b. All instrumentation properly calibrated and operable.

   c. Required preliminary test complete.

   d. Appropriate ac and dc power sources available.

   e. Safeguard switchgear and battery room ventilation available as required to support testing.

   f. Sufficient dc loads, either normal or temporary, installed to provide battery load.

3. Test Procedure

   a. Demonstrate the capability of each battery charger to individually maintain a float charge on its associated battery and to provide an equalizing charge while the normal amount of dc bus load is carried.

   b. Demonstrate the ability of each battery to accept load by deenergizing the battery charger while the affected bus is carrying normal load.

   c. Verify proper load sizing and rated capacity by performing a discharge test. Measure the voltage and specific gravity of each cell following the discharge test. Verify battery charge capability by recharging batteries.

   d. Check for hydrogen buildup in battery rooms.

4. Acceptance Criteria

   a. Battery chargers provide battery float and equalizing charge while maintaining bus loads.

   b. Each Class 1E dc battery system provides the rated load demand as specified by USAR Section 8.3.2, for 2 hr for the battery associated with the HPCS and 4 hr for the other batteries.

   c. Each battery charger fully charges the battery from the minimum designed charged state to the fully charged state, while supplying all normal continuous, steady-state loads.

   d. Following performance discharge test, the individual voltage and specific gravity of each cell is within the limits specified by USAR Section 8.3.2.

14.2.12.1.40 Liquid Radwaste Acceptance Test

1. Test Objective

   To demonstrate the reliable operation of the liquid radwaste equipment drains subsystem, floor drains subsystem, and chemical waste subsystem.

2. Prerequisites

   a. Required preliminary tests completed.

   b. All instrumentation calibrated and loop checks complete.

   c. Ac and dc electrical power available.

   d. The following systems available as required to support the test:

      (1) Instrument air

      (2) Service air

      (3) Condensate makeup and drawoff

      (4) Floor and equipment drains

      (5) Radwaste building ventilation.

3. Test Procedure

   a. Demonstrate flow capabilities, control and interlock operations, and overall system operation using demineralized water.

   b. Demonstrate the ability of the filters to be purged, backwashed, and placed in normal operation.

   c. Demonstrate the ability of the demineralizers to be backwashed and placed in normal operation.

   d. Demonstrate that the filters and demineralizers produce acceptable water quality.

4. Acceptance Criteria

   a. Flow capabilities, controls, and interlocks are as specified by USAR Chapter 11, Table 11.2-1, and the system elementary diagrams.

   b. Filter operations are as specified by the manufacturer's technical instruction manual for the following modes:

      (1) Purge

      (2) Backwash

      (3) Filtration

      (4) Normal.

   c. Demineralizer operations are as specified by the manufacturer's technical instruction manual for the following modes:

      (1) Backwash

      (2) Normal.

   d. Filters and demineralizers operate as specified by the manufacturer's technical instruction manual.

14.2.12.1.41 480-V Distribution System Preoperational Test

1. Test Objectives

   a. To demonstrate the functional capability of the 480-V load distribution centers and their incoming breakers, including their associated annunciation, computer alarms, and protection devices.

   b. To demonstrate the functional capability of the 480-V transformers, including their monitoring and alarm capabilities.

   c. To demonstrate the load carrying capability of load breakers, load breaker protective relay logic, load breaker permissive and prohibit interlocks and the monitoring of alarm devices which monitor the loss of control power in each of the system preoperational tests where the system contains 480-V breakers.

2. Prerequisites

   a. Required preliminary testing complete.

   b. All instrumentation calibrated and operable.

   c. Ac and dc power available as required.

3. Test Procedure

   a. Demonstrate operation of trips and transfer devices, permissive and prohibit interlocks, protective relaying, and logic for bus and load distribution center incoming breakers. Load shedding on bus undervoltage is demonstrated.

   b. Demonstrate trips, permissives, interlocks, controls, and alarms of the 13.8-kV/480-V and 4160-V/480-V transformers.

   c. Demonstrate trips, controls and alarms for motor control center (MCC) feeder breakers.

   d. Observe bus, load center and MCC voltages, both remote and local.

4. Acceptance Criteria

   a. All bus, load center, and MCC voltage variation is with -10 percent.

   b. Functional capability of transformers and feeder breakers is as specified by the manufacturer's technical instruction manual.

   c. Selected bus load breakers are shed on an undervoltage condition.

14.2.12.1.42 Containment Atmosphere Monitoring System Preoperational Test

1. Test Objective

   To demonstrate the operation of hydrogen analyzers, containment pressure instruments, containment temperature instruments, and suppression pool level instruments.

2. Prerequisites

   a. Required preliminary tests completed.

   b. Electrical power available.

   c. Instrument calibrations and loop checks completed.

3. Test Procedure

   a. Verify instrumentation (pressure, temperature, level, hydrogen) operates properly from the sensors through the recorders and annunciators.

   b. Verify the operation of all remote operated solenoid valves.

   c. During the containment integrated leak test, an integrated containment pressure instrumentation test is performed during which proper instrument connections are functionally verified. Tracking of containment pressure instruments is performed.

4. Acceptance Criteria

   a. Alarms, computer points, main control room indicators, and solenoid valves function as specified by the system elementary diagrams.

   b. Hydrogen analyzers function as specified by the manufacturer's technical instruction manual.

14.2.12.1.43 Containment Isolation System Preoperational Test

1. Test Objective

   a. To verify that the containment isolation groups function correctly in response to their initiation signals.

   b. To verify proper operation of the post accident monitoring system.

2. Prerequisites

   a. Required preliminary tests completed.

   b. Instrument calibrations complete.

   c. Electrical power available.

   d. Instrument air available.

3. Test Procedure

   a. Simulate the various isolation group initiation signals and verify that isolation valves and dampers assume correct positions.

   b. Verify correct response of associated plant systems in the presence of the various group isolations.

   c. Verify post accident monitoring system responds to containment isolation signal.

4. Acceptance Criteria

   a. Isolation valves and dampers close with their group assignments as specified by the system elementary diagrams.

b. Associated plant systems respond as specified by USAR Section 7.3.1.1.2, and the system elementary diagrams. USAR Table 6.2-40 defines the required isolation signals.

c. The post accident monitoring system responds as specified by system elementary diagrams.

14.2.12.1.44 Emergency Core Cooling System (ECCS) Integrated Initiation During Loss of Offsite Power (LOOP) Preoperational Test

1. Test Objectives

   a. To demonstrate the capability of load shedding and sequencing to provide alternate power sources to the standby buses during a partial or complete loss of offsite power.

   b. To demonstrate the ability of the RHR, LPCS, and HPCS systems to realign, excluding realignment from secondary modes such as testing, and inject rated flow to the vessel within the prescribed period of time in response to a loss of offsite power coincident with a simulated LOCA signal.

   c. To demonstrate the ability of the diesel generators to maintain ECCS loads while they provide rated flow within the prescribed period of time in response to a loss of offsite power coincident with a simulated LOCA signal.

   d. To demonstrate independence of standby buses and correct assignments of loads by performing the loss of offsite power coincident with LOCA signal three times, each time allowing two diesel generators to start, and having their associated dc system energized.

   e. To demonstrate, under the worst-case conditions of a simulated LOCA coincident with loss of offsite power and inoperable battery chargers that:

      (1) The measured dc system loads and battery voltage levels are consistent with battery sizing criteria

(2) The dc system loads remain operable at the resulting voltage levels.

2. Prerequisites

a. Preoperational/acceptance testing of systems as required for this test is complete and data has been reviewed.

b. All permanently installed instrumentation properly calibrated and operable.

c. All test instrumentation available and properly calibrated.

d. Appropriate ac and dc power sources available

e. Standby electrical switchgear rooms cooling system available as required to support testing.

f. Plant Class 1E standby buses loaded with their normal plant demands.

g. Standby diesel generator system available.

h. Diesel generator rooms ventilation system available.

i. Service water system available.

j. RHR system available.

k. HPCS system and HPCS diesel generator available.

l. LPCS system available.

m. RPV available.

3. Test Procedure

a. Demonstrate the load carrying capability of emergency switchgear, transformers, load centers, and MCCs.

b. Demonstrate a total loss of offsite power with no LOCA and subsequent starting of the diesel generators associated with the standby buses, shedding all 4-kV loads on the bus and tripping incoming feeder breakers to the bus, connecting the diesel generators to the bus after reaching rated voltage at rated frequency, and finally the timed sequential restarting of normal loads.

c. Demonstrate a simulated LOCA signal with normal power available and test ECCS integrated response by injecting to the vessel beginning with normal system lineup.

d. Demonstrate the independence and correct load assignments for each standby bus. Disconnect the Division III ac and dc power sources and provide a simultaneous loss of offsite power and LOCA to the Division I and II buses. Verify load shedding and tripping of incoming feeder breakers to the bus, connecting of diesel generator to the bus after reaching rated voltage and frequency, and the timed sequential restarting of loads. Operate the Division I and II loads until stable conditions are achieved. Repeat the above test for Division I and Division II.

e. Demonstrate a simulated LOCA signal simultaneously with a loss of offsite power. Verify diesel generators' load shedding and sequencing and integrated ECCS response.

The battery chargers for each standby dc bus are to remain disconnected for the duration of the test. The test is continued for a period of 2 hr for the HPCS diesel and 4 hr for the others. Measure battery voltage and current to verify that:

(1) The dc system loads remain within the design load profile values for each respective dc bus

(2) The dc voltage remains greater than or equal to the minimum design value under conditions of steady state and transient loading

(3) The dc system loads respond and operate properly throughout the test period.

4. Acceptance Criteria

a. On loss of standby bus power, diesel generators start and load shedding and sequencing occur as specified by the system elementary diagrams and Table 8.3-2 of USAR Chapter 8.

b. On total loss of offsite power, diesel generators start, shed loads, and accept the sequenced loads as specified in USAR Chapter 8, Table 8.3-2, and the system elementary diagrams.

c. Integrated ECCS response demonstrates the ability of RHR/LPCI, LPCS, and HPCS to inject flow into the RPV at flow rates and time specified by the Technical Specifications and the GE Preoperational Test Specification.

d. Integrated ECCS response in conjunction with simulated LOCA/LOSP signals demonstrates the ability of the diesel generators to maintain ECCS loads while they provide rated flow to the vessel within the prescribed time.

e. Dc system loads, supplied by the battery only during response to a (simulated) LOCA event concurrent with LOSP and inoperable battery charger conditions, are demonstrated within the design load profile values, and therefore are consistent with the battery sizing criteria.

f. Dc system loads operate at the voltage levels which occur during integrated ECCS response to a simulated LOCA event in conjunction with LOSP and inoperative battery chargers.

g. Independence of each standby bus and related auxiliaries is as specified by emergency ac one-line diagrams.

14.2.12.1.45 Auxiliary Building Ventilation System Preoperational Test

1. Test Objectives

   To demonstrate fan, damper, unit cooler, and filter trips, permissives, interlocks, and controls function.

2. Prerequisites

   a. Required preliminary testing complete.

   b. Ventilation chilled water system available as necessary to support the test.

   c. Ac and dc electrical power available.

3. Test Procedures

   Verify fan, filter, unit cooler, and damper controls, interlocks, and alarm operation.

4. Acceptance Criteria

   Fans, filters, unit coolers, damper controls, interlocks, and alarms function as specified by the system elementary diagrams.

14.2.12.1.46 Radwaste Building Ventilation System Preoperational Test

1. Test Objective

   To demonstrate radwaste building ventilation system fan, heater, damper, and unit cooler trips, interlocks, permissives, and controls function.

2. Prerequisites

   a. Required preliminary testing complete.

   b. Ventilation chilled water system available as necessary to support the test.

   c. Ac and dc electrical power available.

   d. All permanently installed instrumentation and test instrumentation properly calibrated and operable.

3. Test Procedure

Verify fans, filters, unit coolers, and damper controls, interlocks, and alarm operation.

4. Acceptance Criteria

Fans, filters, unit coolers, and damper controls, interlocks, and alarms function as specified by the system elementary diagrams.

14.2.12.1.47 Fuel Building Ventilation System Preoperational Test

1. Test Objectives

To demonstrate fan, damper, heater, filter, and unit cooler trips, permissives, interlocks, and controls function.

2. Prerequisites

a. Required preliminary testing complete.

b. All permanently installed and test instrumentation properly calibrated and operable.

c. Ac and dc power available as appropriate.

d. Ventilation chilled water system available as necessary to support the test.

3. Test Procedure

a. Verify fan, unit cooler, heater, and damper controls, interlocks, permissives and alarms.

b. Verify fan and damper operation.

c. Verify trips from high radiation and LOCA signals.

4. Acceptance Criteria

a. Fan, unit cooler, heater, and damper controls, interlocks, and alarms function as specified by the system elementary diagrams.

b. Dampers operate as specified by the manufacturer's technical instruction manual.

c. All radiation, reactor water level, and drywell pressure trips operate as specified by the system elementary diagrams and USAR Section 9.4.2.5.

14.2.12.1.48 Fire Protection and Detection System Preoperational Test

1. Test Objectives

To demonstrate operation of the fire protection and detection system components.

2. Prerequisites

a. Required preliminary testing is complete.

b. All permanently installed instrumentation is operable and properly calibrated.

c. Ac and dc power is available.

d. Diesel fuel oil system is available.

e. Adequate water supply is available.

3. Test Procedure

a. All controls, alarms, interlocks, and logic are checked for proper operation.

b. Remote-operated valve operation is tested.

c. The fire water pumps and drivers (diesel and motor) are functionally tested.

d. Deluge valve operation and associated alarms are tested.

e. Smoke detectors and heat detectors are tested.

f. Halon system functions are tested.

g. Normal system flow paths are verified.

4. Acceptance Criteria

   a. Controls, alarms, and logic function as specified by the system elementary diagrams.

   b. Valves perform as specified by the SWEC Technical Data Sheets for MOVs.

   c. Pumps perform as specified in USAR Section 9.5.1.

   d. Deluge valves operate to fill the systems specified in USAR Section 9.5.1.

   e. The detection systems function as specified by the system elementary diagrams.

   f. The Halon system performs as specified by the manufacturer's technical instruction manual to the plant areas shown in USAR Chapter 9, Appendix 9A.

   g. The system provides the amount of water specified in USAR Section 9.5.1 to all flow paths.

14.2.12.1.49 Turbine Building Ventilation System Acceptance Test

1. Test Objectives

   To demonstrate fan, heater, damper, unit cooler, and filter trips, permissives, interlocks, and controls function.

2. Prerequisites

   a. Required preliminary testing complete.

   b. The ventilation chilled water system available as necessary to support the test.

   c. Ac and dc power available.

   d. All permanently installed and test instrumentation properly calibrated and operable.

3. Test Procedure

   Verify fan, unit cooler, heater, and damper controls, interlocks, and alarms.

4. Acceptance Criteria

   a. Fan, unit cooler, heater, and damper controls, interlocks, and alarms function as specified by the system elementary diagrams.

   b. Dampers operate as specified by the SWEC Technical Data Sheet for Air Dampers.

14.2.12.1.50 Instrument and Service Air System Acceptance Test

1. Test Objectives

   a. To demonstrate the operation of air compressors, dryers, and filters.

   b. To demonstrate that air of sufficient quantity and quality can be supplied to the instrument air system.

   c. To verify proper functioning of certain safety-related components during loss of instrument air.

2. Prerequisites

   a. Preliminary component testing on air compressor motors, compressors, air receivers, air dryers, and air-operated valves has been completed as required.

   b. System electrical and instrumentation devices have been calibrated.

   c. System flushing has been completed as required.

   d. Support systems such as turbine plant component cooling water are available for operation.

3. Test Procedure

   a. Functionally demonstrate compressor, aftercooler, air receiver, filter, and dryer operation. Check operation of compressor unloaders and automatic and manual start and stop circuits.

   b. Test capacity, pressure, temperature, and quality of air from the system.

   c. Check interlocks, controls, and alarms for air compressors, filters, dryers, and receivers.

   d. Conduct a loss of instrument air supply on all air-operated valves or other components served by the instrument air system. This test is done on an individual component basis during the generic test phase as a prerequisite to the start of the respective system preoperational tests. Those system preoperational tests which test the failure mode of air-operated components are:

      Feedwater
      RWCU
      Nuclear boiler
      RHR
      Main steam positive and penetration valve leakage control
      Reactor recirculation
      RCIC
      CRD hydraulic
      Feedwater control
      Fuel pool cooling and cleanup
      RPCCW
      TPCCW
      Normal and standby service water
      SSW pumphouse ventilation
      Control building ventilation
      Control building chilled water
      Diesel generator building ventilation
      Drywell cooling
      Reactor plant ventilation
      Standby gas treatment
      Offgas
      Liquid radwaste
      Containment atmosphere monitoring
      Auxiliary building ventilation

Fuel building ventilation
Fire protection and detection
Turbine building ventilation
Circulating water
Condensate
Reactor plant sampling
Liquid radwaste sampling
Main steam

4. Acceptance Criteria

a. Air compressor, filter, and dryer performance is comparable to that shown in the manufacturer's technical instruction manual.

b. The quantity and quality of air supplied by the instrument air system is as specified by USAR Section 9.3.1.1.2.

c. Interlocks, controls, and alarms function as specified by the system elementary diagrams.

14.2.12.1.51 13.8-kV and 4160-V Distribution System Preoperational Test

1. Test Objective

a. To demonstrate the functional capability of the high and medium voltage plant protective relaying, breaker interlocks, and trip and close logic associated with the 4160-V and 13.8-kV switchgear and transformers.

b. To demonstrate the functional capability to monitor and alarm the status of the high and medium voltage switchgear and transformers via the computer and annunciator logic system.

c. To verify proper voltage, phase sequence, and phase angles of each source feed to each bus in the plant.

d. The demonstration of the load-carrying capability of load breakers, load breaker protective relay logic, load breaker permissive and prohibit interlocks, and the monitoring of alarm devices which monitor the loss of control power are conducted in each of the system preoperational tests where the system contains 13.8-kV or 4.16-kV breakers.

2. Prerequisites

   a. Required preliminary testing complete.

   b. All instrumentation properly calibrated and operable.

   c. Electrical switchgear room cooling available as required to support testing.

   d. Ac and dc power available as required.

3. Test Procedure

   a. Demonstrate the operation of protective devices, relaying and logic, transfer and trip devices, permissive and prohibit interlocks of 4,160-V buses and feeder breakers. Emergency 4,160-V bus load shedding feature on bus undervoltage is demonstrated.

   b. Test the operability of the trips, permissives, interlocks, controls, and alarms of the 13.8-kV buses and feeder breakers.

   c. Test the operability of the trips, permissives, interlocks, controls, and alarms of the 230-kV/13.8-kV, 230-kV/4160-V, and 13.8/4160-V transformers.

   d. Verify proper voltage, phase sequence, and phase angles on the 13.8-kV and 4160-V buses.

   e. Demonstrate slow and fast transfer between power sources.

4. Acceptance Criteria

   a. Bus voltage variation on 4,160-V and 13.8-kV buses does not exceed -10 percent.

   b. Phase sequence is positive phase sequence (ABC) as opposed to negative phase sequence (CBA).

   c. Potential difference does not exceed 42-V ac, which corresponds to 120-V phasers being 20 degrees out of phase.

d. All emergency 4,160-V bus load breakers are shed on an undervoltage condition.

e. Breaker relaying, breaker interlocks, trip and close circuits, and computer and annunciator monitoring circuits function as specified by the system elementary diagrams.

14.2.12.1.52 Drywell Leakage Test

The drywell leakage test is discussed in detail in Section 6.2.6.

14.2.12.1.53 Containment Structural Integrity Test and Containment Leak Rate Preoperational Tests

1. The containment structural integrity test is performed as a prerequisite to the containment integrated leak rate test. The containment vessel is subjected to a pressure as specified by USAR Section 3.8.2.7.1. The acceptance criteria for the structural integrity test is specified in USAR Section 3.8.2.7.1.

2. The containment leak rate preoperational tests, Type A, Type B, and Type C, are discussed in detail in USAR Section 6.2.6. The discussion includes acceptance criteria.

14.2.12.1.54 Seismic Instrumentation Preoperational Test

1. Test Objective

   To demonstrate the response of the seismic instrumentation system and its capability to monitor and record seismic disturbance.

2. Prerequisites

   a. Ac and dc electrical power available.

   b. Instrument calibration and instrument loop checks completed.

3. Test Procedure

   a. Demonstrate the system power supply.

   b. Demonstrate the operation of the switch test panel.

c. Demonstrate the response of the accelerograph, spectrum recorder, and magnetic tape recording unit.

d. Displace the seismic switches and triggers and check response of the system, including the annunciator.

4. Acceptance Criteria

a. The seismic monitoring system functions in the test, record, and playback modes.

b. Annunciation is received when the seismic switches and triggers are displaced.

14.2.12.1.55 Communications Systems Acceptance Test

1. Test Objectives

a. To demonstrate the capabilities of the various inplant and offsite communication systems to be used for normal and abnormal operating conditions.

b. To demonstrate plant emergency alarms.

2. Prerequisites

a. Vendor installation of equipment and testing is complete.

b. Required preliminary testing is complete.

3. Test Procedure

a. Plant emergency alarms are tested.

b. The ability to establish communications required in the RBS Emergency Plan are demonstrated.

c. Operation of the public address system is demonstrated.

d. Communications required for plant shutdown from within or outside the main control room are demonstrated.

4. Acceptance Criteria

   a. Emergency alarms function as specified by the system elementary diagrams.

   b. For simulated plant emergencies and simulated events for which shutdown from inside or outside the main control room is required, communications are established that provide for the planned actions to be carried out.

14.2.12.1.56 Cranes Acceptance Test

1. Test Objectives

   a. To demonstrate the operation of the containment building polar crane.

   b. To demonstrate the operation of the fuel handling cranes.

2. Prerequisites

   a. Required preliminary testing is completed.

   b. Load testing is complete.

3. Test Procedure

   a. Test controls, interlocks, and travel limits are verified.

   b. Cranes and hoists are demonstrated to operate by performing a static test at 125 percent of rated load and a full operational test at 100 percent of rated load.

4. Acceptance Criteria

   a. Controls, interlocks, and travel limits function as specified by the system elementary diagrams.

   b. Cranes and hoists have demonstrated 125 percent static capacity and 100 percent operational capacity.

14.2.12.1.57 Circulating Water System Acceptance Test

1. Test Objectives

   a. To demonstrate circulating water system capability for providing flow to the condenser.

   b. To demonstrate integrated operation of the circulating water, cooling tower, bearing cooling, vacuum priming, and chlorination systems.

2. Prerequisites

   a. Required preliminary testing is complete.

   b. Vacuum priming is available.

   c. The chlorination system is available.

   d. Clarified water is available.

   e. Service water is available.

   f. Bearing cooling water is available.

   g. Cooling towers are available.

   h. Makeup water is available.

3. Test Procedure

   a. Controls, interlocks, and alarms are verified.

   b. System flow characteristics are demonstrated for various pump combinations.

   c. Circulating water system valve operation is demonstrated.

   d. A demonstration of the integrated operation of the circulating water, cooling tower, bearing cooling water, vacuum priming, and chlorination systems is performed.

4. Acceptance Criteria

   a. Controls, interlocks, and alarms function as specified by the system elementary diagrams.

b. System flow characteristics are as specified by USAR Section 10.4.5.

c. Circulating water system valves operate as specified by the manufacturer's technical instruction manual.

d. The circulating water, bearing cooling, vacuum priming, and chlorination systems perform as an integrated unit.

14.2.12.1.58 Condensate Acceptance Test

1. Test Objectives

To demonstrate operation of the condensate, condensate polishing and condensate makeup and drawoff system.

2. Prerequisites

a. Required preliminary testing is completed.

b. The condensate polishing system is available.

c. The reactor feedwater system is available.

d. Turbine building closed cooling water is available.

3. Test Procedure

a. The condensate and condensate transfer pumps are performance tested. Flow rates, suction head, and discharge head are demonstrated.

b. Controls, interlocks, trips, and alarms are verified, including automatic condensate pump electrical trips and manual start and stop features.

c. Hotwell level control is tested.

d. Minimum flow rates and valve operation are verified.

e. Heater controls are tested.

f. Condensate polisher chemistry is verified.

4. Acceptance Criteria

   a. Pump performance is as specified by USAR Section 10.4.7, and the manufacturer's technical instruction manual.

   b. Controls, interlocks, trips, and alarms function as specified by the system elementary diagrams.

   c. Pump minimum flow rates and valve performances are as specified by the manufacturer's technical instruction manual and the SWEC loop diagrams.

   d. Condensate polisher performance is as speci-fied by USAR Section 10.4.6.3.

14.2.12.1.59 Reactor Plant Sampling System Acceptance Test

1. Test Objectives

   To verify the operation of the normal reactor plant sampling system and the post-accident sampling system.

2. Prerequisites

   a. Required preliminary testing complete.

   b. Instrument air available.

   c. Ac and dc power available as appropriate.

   d. All permanently installed instrumentation properly calibrated and operable.

   e. Source of suitable water available.

3. Test Procedure

   a. Verify correct flow paths.

   b. Demonstrate correct operation of valves, temperature baths, reliefs, sensors, indicators, and alarms.

4. Acceptance Criteria

The ability of the system to draw samples from the locations specified by the piping diagrams has been demonstrated.

14.2.12.1.60 Turbine Plant Sampling System Acceptance Test

1. Test Objectives

To verify the operation of the turbine plant sampling system.

2. Prerequisites

a. Required preliminary testing complete.

b. Ac and dc power available as appropriate.

c. All permanently installed instrumentation properly calibrated and operable.

d. A source of suitable water available.

3. Test Procedure

a. Verify correct flow paths.

b. Demonstrate correct operation of valves, temperature bath, reliefs, pressure regulators, and analyzer equipment.

4. Acceptance Criteria

The system has the ability to draw samples from the locations specified by the system piping diagrams.

14.2.12.1.61 Liquid Radwaste Sampling System Acceptance Test

1. Test Objectives

To verify the operation of the liquid radwaste sampling system.

2. Prerequisites

a. Required preliminary testing complete.

b. Ac and dc power available as appropriate.

c. Suitable source of water available.

d. All permanently installed instrumentation properly calibrated and operable.

3. Test Procedure

a. Verify flow paths.

b. Demonstrate correct operation of valves and temperature baths.

4. Acceptance Criteria

The ability of the system to draw samples from the locations specified by the system piping diagrams has been demonstrated.

14.2.12.1.62 120-V AC Power Distribution Preoperational Test

1. Test Objectives

a. To demonstrate the ability of the normal 120-V ac power distribution system to supply and power its loads.

b. To demonstrate the proper operation of the emergency 120-V ac power distribution system.

2. Prerequisites

a. Required preliminary tests complete.

b. Appropriate ac and dc power available.

3. Test Procedure

a. Demonstrate the capability of each rectifier/inverter set to supply uninterrupted 120-V ac to the vital buses when normal supply is lost.

b. Demonstrate the ability of the 120-V ac buses to supply rated voltage and frequency to safety-related components.

c. Verify the 120-V ac breakers are properly sized.

4. Acceptance Criteria

   a. The 120-V ac buses supply rated voltage and frequency.

   b. The 120-V ac breakers are sized as specified by the system elementary diagrams.

   c. The vital uninterruptible 120-V ac buses can be supplied with power from the rectifier/inverter sets.

14.2.12.1.63 Automatic Depressurization System (ADS) Preoperational Test

1. Test Objectives

   a. To verify operation of all controls, interlocks, alarms, and valves associated with the ADS system and the safety relief valves (SRV).

   b. To verify proper operation of the SRVs and accumulators including the air supply system.

2. Prerequisites

   a. Required preliminary tests completed and approved.

   b. All ac and dc electrical power available.

   c. Instrument calibration and integrated loop checks completed.

   d. Penetration valve leakage control air supply available.

3. Test Procedure

   a. SRV actuator accumulators are checked for capacity.

   b. SRV air piston operation is checked.

   c. Relief logic functions are verified including low-low setpoint logic.

   d. ADS logic functions are verified.

e. SRV and air supply leakage rates are verified.

f. In conjunction with the remote shutdown system preoperational test, the operation of the three designated SRVs from the remote shutdown panel is demonstrated.

4. Acceptance Criteria

a. SRVs and their actuators function as specified by the GE Preoperational Test Specification.

b. ADS logic functions as specified by system elementary diagrams.

c. Operation of the SRVs from the remote shutdown panel functions as specified by the GE Preoperational Test Specification.

d. SRV and air supply leakage rates are within the limits specified by the GE design specification.

14.2.12.1.64 Turbine Control Acceptance Test

1. Objectives

a. To verify the capability of the electrohydraulic control (EHC) hydraulic pumping unit to respond to control functions from the pressure regulator controllers.

b. To verify operability of the turbine bypass, turbine stop, control, and intercept valves.

c. Measure valve stroke times.

2. Prerequisites

a. Required preliminary tests completed.

b. Appropriate ac and dc power available.

3. Test Procedure

a. Demonstrate operability of the EHC pumping unit and verify all interlocks, alarms, and operating levels.

b. Demonstrate operation of turbine-related valves from the EHC control panel and measure stroke times.

c. Initiate pressure regulator signals to the EHC control circuit and verify corresponding sequential operation of the turbine-related valves and their interlocks to the RPS.

4. Acceptance Criteria

a. All alarms, controls, trips, permissives, and interlocks function as specified by the system elementary diagrams.

b. The hydraulic power unit operates as specified by the manufacturer's technical instruction manual.

c. Turbine hydraulically operated valves operate smoothly on signal demand and close within the times specified by the manufacturer's technical instruction manual.

14.2.12.1.65 Solid Radwaste System Acceptance Test

1. Test Objectives

Solid radwaste processing is performed by an outside contractor using a mobile solidification unit. The test verifies the operability of the unit interfacing requirements and functionally tests the mobile unit.

2. Prerequisites

a. Ac and dc power is available.

b. Instrument air is available.

c. A source of demineralized water is available.

3. Test Procedure

a. Verify all interfacing requirements between the mobile unit and the plant.

b. Test mobile units are functionally verified.

4. Acceptance Criteria

   a. The mobile unit interfaces with the plant's solid radwaste system.

   b. The mobile unit performs as specified by the manufacturer's technical instruction manual.

14.2.12.1.66 Emergency Lighting System Acceptance Test

1. Test Objective

   a. To demonstrate that the station lighting systems are capable of providing lighting with power supplied from normal and standby ac sources or from an uninterruptible power system and battery pack systems.

   b. To demonstrate that the station lighting systems provide lighting intensities at levels recommended by the Illuminating Engineering Society and in accordance with current OSHA requirements.

   c. To demonstrate that the emergency ac lighting, supplied from the normal uninterruptible power system, is provided in the main control room. Emergency dc lighting, supplied from the battery pack system, is provided in standby diesel generator areas, standby switchgear areas, standby service water pumphouses, all areas required for control and operation of safety-related equipment, and access routes to and between these areas.

2. Prerequisites

   a. Required component tests are completed and approved.

   b. All automatic emergency lighting systems to be tested have been energized.

   c. Required power sources such as the diesel generator, ac sources, and battery system have been tested and are capable of supplying power.

   d. All battery packs for emergency dc lighting are fully charged.

3. Test Procedure

   a. Demonstrate that Station Lighting System 1 (normal) receives power from the normal service buses of the station ac power distribution system. That 20 percent of System 1 lighting in the main control room can be manually transferred to an available Class 1E bus supplied by a standby diesel generator upon loss of the normal service buses of the station ac power distribution system.

   b. Demonstrate that Station Lighting System 2 (emergency ac) receives power from the normal uninterruptible power supply system and is confined to the main control room.

   c. Demonstrate that Station Lighting System 3 (emergency dc) receives power from the local battery packs, which are normally maintained on float from the normal ac system.

   d. Demonstrate that Station Lighting System 3 supplies emergency lighting in the following areas:

      1. Main control room (egress).

      2. Standby diesel generator building.

      3. Class 1E switchgear rooms.

      4. Standby service water pumphouses.

      5. Areas required for control of safety-related equipment and access routes to and between these areas.

      6. Exit signs and means of egress throughout the plant.

4. Acceptance Criteria

   a. Twenty percent of main control room System 1 lighting can be manually transferred to an available Class 1E bus.

b. Main control room System 2 emergency lighting system supplies 20 percent of lighting fixtures in the main control room.

c. Lighting System 3 battery packs are energized from the normal ac system. The system is capable of providing emergency dc lighting from the battery packs for 8 hr.

d. Emergency lighting illuminating levels and types of fixtures used in plant areas necessary for safe shutdown or evacuation of personnel are in compliance with USAR Table 9.5-2.

14.2.12.1.67 Main Condenser Air Removal System Acceptance Test

1. Test Objectives

a. To verify that the mechanical vacuum pumps are capable of generating a vacuum condition within the main condenser.

b. To verify the operation of instrumentation, controls, interlocks, alarms, and valves associated with the air removal system.

2. Prerequisites

a. Required preliminary tests are completed.

b. Instrumentation calibration and integrated loop checks are completed.

c. Electrical power is available.

d. Instrument air is available.

e. Makeup water is available.

f. Component cooling water is available.

g. Main turbine is on the turning gear.

h. Gland seal steam is available.

3. Test Procedure

   a. All instrumentation, controls, alarms, and interlocks are checked for proper operation.

   b. All remote-operated valves are checked for operation and remote indication.

   c. Mechanical vacuum pumps are operated.

   d. Demonstration that a vacuum can be pulled on the main condenser using the mechanical vacuum pumps.

4. Acceptance Criteria

   a. Instrumentation, controls, alarms, and interlocks function as specified by the system elementary diagrams.

   b. Remote-operated valves function as specified by the system elementary diagrams and the SWEC Technical Data Sheets for Motor-Operated Valves.

   c. The mechanical vacuum pump's operation is comparable to that shown in the manufacturer's technical instruction manual and can create a vacuum condition in the main condenser as specified by USAR Section 10.4.2.3.

14.2.12.1.68 Vents and Drains Systems Acceptance Test

1. Test Objectives

   a. To demonstrate the proper operation of the venting and drainage systems serving contaminated or potentially contaminated systems or areas located in the turbine building, reactor building (including drywell and containment), radwaste building, fuel building, auxiliary building, condensate demineralizer/off-gas building, standby diesel generator building, services building, and piping tunnels.

   b. To show that the systems are capable of collecting the equipment and floor drainage and routing the drainage to other areas or systems for disposal or processing.

c. To verify that there is no potential for inadvertent transfer of potentially radioactive drainage to nonradioactive areas.

2. Prerequisites

a. Required preliminary testing complete, including initial pump tests, valve tests, wiring checks, and instrument calibration.

b. Power available to the components of the drainage systems.

c. Water available to test the operation of system pumps.

3. Test Procedure

a. Check interlocks, controls, and alarms for system pumps, motors, sumps, valves, instruments, and the balance of the system.

b. Test the sump pumps to verify that their performances meet the required design flows and pressures.

c. Functionally demonstrate the ability of the systems to properly collect and dispose of drainage.

4. Acceptance Criteria

a. Interlocks, controls, and alarms performances are as specified by the system elementary diagrams.

b. Pump performance is comparable to that shown in the manufacturer's technical instruction manual.

14.2.12.1.69 Loose Parts Monitoring System

1. Test Objectives

a. To demonstrate proper operation of the Loose Parts Monitoring Equipment.

b. To collect data to use as baseline information during subsequent operation.

c. To verify alert (high alarm) level operation.

NOTE: The normal operating baseline data and final alert level settings are obtained during power ascension testing.

2. Prerequisites and Initial Conditions

The Loose Parts Monitoring System is connected to the reactor and instrumentation and control testing is complete. The Loose Parts Monitoring System channel checks have been completed with acceptable results.

3. Test Procedure

a. Set the system trouble (low) alarm.

b. Perform sensor verification and sensitivity measurements.

c. Establish and set an initial alert (high alarm) level.

d. Demonstrate automatic data acquisition upon receipt of alert (high alarm) level.

4. Acceptance Criteria

Alert (high alarm) and automatic data acquisition equipment function as required upon receipt of a loose part signal reaching the alert level.

14.2.12.1.70 Safety-Related Ventilation Systems Environmental Design and Technical Requirement Preoperational Test

1. Test Objectives

a. To demonstrate that filter trains meet test specification requirements.

b. To demonstrate system ventilation capacities.

c. To demonstrate the capability of the annulus pressure control system to operate in accordance with test specifications and to maintain negative pressure in the annulus.

d. To demonstrate the standby gas treatment system's ability to maintain a negative pressure in the annulus and the auxiliary building.

e. To demonstrate the ability of the turbine building, radwaste building, and safety-related ventilation systems to remove design heat loads.

f. To demonstrate the ability of the turbine building, radwaste building, and certain safety-related ventilation systems to prevent the exfiltration of combustible gases and/or radioactive contamination into the surrounding area or atmosphere.

g. To demonstrate that the main control room is maintained at a positive pressure with respect to the surrounding areas, and inleakage is within design limits while operating in the recirculation mode.

h. To demonstrate the capability of the control building HVAC system to provide air flows, heating, and cooling to specified areas in the control building for the various modes of operation, including post-accident conditions.

i. To demonstrate the ability of the containment/drywell purge system to provide flows to and from specified areas during normal and high capacity purge modes of operation.

2. Prerequisites

a. HEPA filters and charcoal absorbers are subjected to the tests listed below prior to starting the appropriate sections of this test. Methodology and acceptance criteria for the prerequisite tests are shown in Section 6.5.1.4 (SGTS), Section 6.4.5 (main control room), Section 9.4.2 (fuel building), Section 9.4.3.4 (radwaste building), Section 9.4.4.4 (turbine building), and Section 9.4.6.4 (reactor plant); all of which are in accordance with ANSI N510.

1) Filter train housing leak test

(2) Filter train bypass leakage test

(3) Individual filter leak rate test

(4) Adsorption filter bank leakage test.

b. The preoperational test for the ventilation system being tested is complete.

c. The air balancing of the ventilation system being tested is complete. Fans operate as specified by Tables 9.4-2, 9.4-3, 9.4-4, 9.4-5, 9.4-7, 9.4-8, and 9.4-9, and are comparable to the manufacturer's technical instruction manual.

d. The equipment in the area/building being tested is available to be placed into a mode of operation that will produce enough heat to permit extrapolating the data to design conditions.

3. Test Procedure

a. Verify that fan performances meet design specifications.

b. Verify the standby service water pumphouse, control, diesel generator, radwaste, and fuel building ventilation systems and drywell cooling system can remove design heat loads by monitoring air and water temperatures and flows during normal operation and extrapolating the data to design conditions.

c. Verify that the air flow in the auxiliary, fuel, turbine, and radwaste buildings is from relatively clean areas to areas with a potential for higher radioactive contamination.

d. Verify capability of each SGTS train to maintain the annulus and auxiliary building at a negative pressure during accident conditions.

e. Verify that the annulus region can be maintained at a negative pressure during normal operation.

f. Verify that the main control room is maintained at a positive pressure with respect to the surrounding areas during normal conditions, and inleakage is within design limits while operating in the recirculation mode.

g. Verify that the containment cooling system can remove design heat loads by monitoring air and water temperatures and flows during normal operation and extrapolating the data to design conditions, including verification of design for motor current considering temperature and density.

h. Verify that the auxiliary building ventilation system for safety-related pumprooms and standby gas treatment system can remove design heat loads by monitoring air and water temperature and flows during normal operation and extrapolating the data to design conditions. Verify the auxiliary building ventilation exhaust and supply fan capacity and flow rates to the auxiliary building.

i. Measure the differential pressure of various areas within the auxiliary building with respect to outside ambient and the differential pressure between selected areas within the auxiliary building.

j. Measure the differential pressure between various areas maintained by the fuel building ventilation system and the outside atmosphere.

k. Measure the differential pressure in the radwaste building with respect to the outside ambient.

l. Measure the differential pressure between the turbine building and the outside atmosphere.

m. Verify the capacity provided by the turbine building ventilation supply and exhaust systems.

n. Verify that design air flows are being provided to designated areas of the turbine building.

o. Verify that design air flows are being provided to designated areas of the radwaste building.

p. Verify design air flow through each SGTS train.

q. Verify the capability of the ESF battery room exhaust fans.

r. Verify that the containment/drywell purge system provides design flow rates.

4. Acceptance Criteria

a. The standby service water pumphouse, drywell, main control room, diesel generator, and fuel, turbine, and radwaste buildings' ventilation system and containment cooling system maintain temperatures in accordance with Table 9.4-1 under design heat loads.

b. Standby service water pumphouse fans operate as specified by Table 9.4-8 and are comparable to the manufacturer's technical instruction manual.

c. The air flow in the auxiliary, fuel, radwaste, and turbine buildings is from relatively clean areas to areas with a potential for higher radioactive contamination.

d. Each SGTS train is capable of maintaining a negative pressure in the annulus and the auxiliary building during accident conditions.

e. The annulus region can be maintained at a negative pressure during normal operation.

f. The main control room is maintained at a positive pressure with respect to surrounding areas during all modes of operation, and exfiltration is as specified by Section 6.4.2.3.

g. The containment/drywell purge system provides flow rates in normal and high flow modes as specified in Section 9.4.6.2.5.

h. The auxiliary building ventilation system for the safety-related pumprooms and the standby gas treatment system maintain temperatures under design heat load in accordance with Table 9.4-1. The auxiliary building ventilation supply and exhaust fan capacity is as specified in Section 9.4.3.2.1.

i. The auxiliary building differential pressures and fan performance are as specified in Section 9.4.3.2 and Table 9.4-4.

j. The fuel building ventilation system maintains a negative pressure relative to outdoor atmosphere as specified in Section 9.4.2.1.4.

k. Radwaste building pressure is negative with respect to the outside ambient as specified by Table 9.4-1.

l. The turbine building to outside atmosphere differential pressure is maintained as specified by Table 9.4-1.

m. The air flows and fan capacity are as specified by Table 9.4-7 (turbine building), Table 9.4-8 (diesel generator building), and Table 9.4-2 and Section 9.4.1.2.1 (control building).

n. The radwaste building ventilation system supplies air to all areas served by the system as specified by Section 9.4.3.2.2 and Fig. 9.4-3b.

o. The ESF battery room exhaust ventilation system operates in accordance with Section 9.4.1.2.2 and Table 9.4-2.

p. HEPA filters and charcoal absorbers perform as specified in Section 6.4.2.

14.2.12.2 Initial Startup Test Phase Discussion

1. Startup Test Procedure

All those required tests comprising the initial startup test phase are discussed in Section 14.2.12.3. For each test a description is provided for test objective, test prerequisites, test procedure, and a statement of test acceptance criteria, where applicable.

The operating power-flow map is presented as Fig. 14.2-4. The test conditions are marked on Fig. 14.2-4, and each test described in Section 14.2.12.3 is accomplished at the test conditions stated in Fig. 14.2-5.

The acceptance criteria section of each test has one or two sections. The following two paragraphs describe the degree of each kind of test criterion and the actions to be taken after an individual criterion is not satisfied.

a. Level 1

   If a Level 1 test criterion is not satisfied, the plant is placed in a hold condition that is judged to be satisfactory and safe, based upon prior testing. Plant operating or test procedures or the Technical Specifications may guide the decision on the direction taken. Startup tests consistent with this hold condition may be continued. Resolution of the problem is immediately pursued by appropriate equipment adjustments or through engineering support by offsite personnel if needed.

   Following resolution, the applicable test portion is repeated to verify that the Level 1 requirement is satisfied. A description of the problem resolution is included in the report documenting the sucessful test.

b. Level 2

   If a Level 2 test criterion is not satisfied, plant operating or startup test plans are not necessarily altered. The limits stated in this category are usually associated with expectations of system transient performance, and whose characteristics can be improved by equipment adjustments. An investigation of the related adjustments, as well as the measurement and analysis methods, is initiated.

   If all Level 2 requirements in a test are ultimately met, there is no need to document a temporary failure in the test report unless there is an educational benefit involved. Following resolution, the applicable test portion is repeated to verify that the Level 2 requirement is satisfied.

If a certain controller-related Level 2 criterion is not satisfied after a reasonable effort, then the control engineers may choose to document that result with a full explanation of their recommendations. This report discusses alternatives of action, as well as the concluding recommendation, so that it can be evaluated by all related parties.

During the conduct of this initial startup test phase, Technical Specifications override any test in progress if plant conditions dictate.

2. Hot Functional Testing

During the initial startup test phase, hot functional tests are performed to assure that insofar as possible the system, procedure, and personnel are ready for operation at various power levels. This verification is accomplished by operating systems in an integrated fashion at operating temperatures and pressures at the earliest opportunity for meaningful checks. These hot functional tests satisfy the intent of NUREG-0737, Item I.G.1.

The hot functional tests cover those areas of the plant systems which are not tested by formal startup test procedures described in Section 14.2.12.3, but where additional data over and above the cold functional tests are beneficial.

The hot functional tests begin after fuel load, through heatup to rated temperature, and finally finish when 30 percent power is achieved. The hot functional tests are not intended to replace any of the startup test procedures described in Section 14.2.12.3, though portions are conducted simultaneously. Those systems whose environments do not change during power ascension do not receive additional testing.

3. Training During Initial Startup Test Phase

Training is realized by all operating shifts as the plant progresses through the initial startup test phase. Testing is balanced as much as practical to ensure even exposure to testing for all operating shifts as intended by NUREG-0737, Item I.G.1. In particular, formal startup tests described in Section 14.2.12.3 are balanced so that each operating shift:

a. Sees at least one reactor scram.

b. Sees at least one pressure regulator transient.

c. Sees at least one turbine trip transient or load rejection.

d. Operates the RCIC system.

e. Sees at least one water level set point transient.

During the performance of the informal hot functional testing, the operations group reviews the main control room copy of the procedures manual to ensure that changes are made as reflected by problems discovered during hot functional testing. The operations group additionally verifies that personnel on each operating shift have been familiarized with the changes to the procedures. The hot functional testing makes operators aware of the normal operating conditions in the plant's system early in the test program.

14.2.12.3 Initial Startup Test Procedures

14.2.12.3.1 Test Number 1 - Chemical and Radiochemical

1. Test Objectives

The principal objectives of this test are a) to secure information on the chemistry and radiochemistry of the reactor coolant and b) to verify that the sampling equipment, procedures, and analytic techniques are adequate to demonstrate that the chemistry of all parts of the entire reactor system meets specifications and process requirements.

Specific objectives of the test program include evaluation of fuel performance, evaluations of demineralizer operations by direct and indirect methods, measurements of filter performance, confirmation of condenser integrity, demonstration of proper steam separator-dryer operation, and measurement and calibration of certain process instrumentation. Data for these purposes are secured from a variety of sources: plant operating records, regular routine coolant analysis, radiochemical measurements of specific nuclides, and special chemical tests.

2. Prerequisites

The appropriate preoperational tests have been completed; the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

Prior to fuel loading a complete set of chemical and radiochemical samples are taken to the extent practicable to ensure that all sample stations are functioning properly and to determine initial concentrations. Subsequent to fuel loading during reactor heatup and at each major power level change, samples are taken and measurements are made to determine the chemical and radiochemical quality of reactor water and reactor feedwater, amount of radiolytic gas in the steam, gaseous activities leaving the air ejectors, decay times in the off-gas lines, and performance of filters and demineralizers. Calibrations are made of monitors in the stack, liquid waste system, and liquid process lines.

4. Acceptance Criteria

Level 1

Chemical factors are within the limits specified by the Technical Specifications and the Water Quality Specification.

The activities of gaseous and liquid effluents are within the limits specified by the Technical Specifications.

Reactor coolant water quality is within the limits specified by the Technical Specifications and the Water Quality Specification.

14.2.12.3.2 Test Number 2 - Radiation Measurement

1. Test Objective

   The purposes of this test are a) to determine the background radiation levels in the plant environs prior to operation for base data on activity buildup and b) to monitor radiation at selected power levels to assure the protection of personnel during plant operation.

2. Prerequisites

   The appropriate preoperational tests have been completed; the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

   A survey of natural background radiation at selected locations throughout the plant site is made prior to fuel loading. Subsequent to fuel loading, during reactor heatup and at selected power levels of between 0 and 100 percent of rated power, gamma radiation level measurements, and where appropriate, thermal and fast neutron dose rate measurements are made at significant locations throughout the plant. All potentially high radiation areas are surveyed.

4. Acceptance Criteria

   Level 1

   The radiation doses of plant origin and the occupancy times of personnel in radiation zones are controlled consistent with the guidelines of the standards for protection against radiation outlined in 10CFR20 and the River Bend Station Radiation Protection Manual.

14.2.12.3.3 Test Number 3 - Fuel Loading

1. Test Objective

   The purpose of this test is to load fuel safely and efficiently to the full core size.

2. Prerequisites

   Prerequisites to fuel loading are established in Section 14.2.10, and the tests required thereby are implied in those prerequisites. Also, the FRC has approved fuel loading, and the following additional prerequisites have been met to assure that fuel loading is performed in a safe manner:

   a. All systems required for fuel loading are in the required status.

   b. Fuel and control rod inspections are complete. Control rods are installed and tested.

   c. At least three movable neutron detectors are calibrated and operable. At least three neutron detectors are connected to the high flux scram trips. They are located so as to provide acceptable signals during fuel loading.

   d. Nuclear instruments are source-checked with a neutron source prior to loading or resumption if significant delays are incurred.

   e. Reactor vessel status is specified relative to internal component placement and this placement established to make the vessel ready to receive fuel.

   f. Reactor vessel water level is established and minimum level prescribed.

3. Test Procedure

   Fuel loading begins at the center of the core and proceeds radially to the fully loaded configuration.

   Control rod functional tests and subcriticality checks are performed periodically during the loading. Shutdown margin is demonstrated in the partially loaded -144 fuel bundle configuration.

4. Acceptance Criteria

Level 1

The partially loaded core is subcritical by at least 0.38 percent Wk/k with the analytically strongest rod fully withdrawn.

14.2.12.3.4 Test Number 4 - Full Core Shutdown Margin

1. Test Objective

The purpose of this test is to demonstrate that the reactor is subcritical throughout the first fuel cycle with any single control rod fully withdrawn.

2. Prerequisites

The appropriate preoperational tests have been completed. Also, the following prerequisites are complete prior to performing the full core shutdown margin tests:

a. The predicted critical rod position is available.

b. The standby liquid control system is available.

c. Nuclear instrumentation is available with neutron count rate of at least 0.7 counts per second and a signal-to-noise ratio greater than two.

d. High flux scram trips are conservatively low.

The FRC has reviewed and approved test procedures and initiation of testing.

3. Test Procedure

This test is performed in the fully loaded core at ambient temperature in the xenon-free condition. The shutdown margin is measured by withdrawing the analytically strongest rod or the equivalent (another rod plus an added reactivity) and one or more additional rods which have been calibrated by calculation until criticality is reached. The difference between the measured k_{eff} and the calculated k_{eff} for the in-sequence criticality is applied to the calculated value to obtain the true shutdown margin.

4. Acceptance Criteria

Level 1

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The shutdown margin of the fully loaded, cold (68°F), xenon-free core occurring at the most reactive time during the cycle is at least 0.38 percent $\Delta k/k$ with the analytically strongest rod (or its reactivity equivalent) withdrawn. If the shutdown margin is measured at some time during the cycle other than the most reactive time, compliance with the above criterion is shown by demonstrating that the shutdown margin is 0.38 percent $\Delta k/k$ plus an exposure-dependent increment which adjusts the shutdown margin at that time to the minimum shutdown margin.

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Level 2

Criticality occurs within 1.0 percent W k/k of the predicted critical.

14.2.12.3.5 Test Number 5 - Control Rod Drive System

1. Test Objective

The purposes of the CRD system test are a) to demonstrate that the CRD system operates properly over the full range of primary coolant temperatures and pressures from ambient to operating and b) to determine the initial operating characteristics of the entire CRD system.

2. Prerequisites

The appropriate preoperational tests have been completed. The FRC has reviewed and approved the test procedures and initiation of testing. The CRD manual control system preoperational testing must be completed on CRDs being tested. The reactor vessel, reactor plant component cooling water system, condensate supply system, and instrument air system must be operational to the extent required to conduct the test.

3. Test Procedure

The CRD tests performed during the startup test program are tested as an extension of the tests performed during the preoperational CRD system tests. Thus, after it is verified that all CRDs operate properly when installed, they are tested periodically during heatup to assure that there is no significant binding caused by thermal expansion of the core components. A list of all CRD tests to be performed during startup testing is given below.

CONTROL ROD DRIVE SYSTEM TESTS

	Test Conditions Reactor Pressure With Core Loaded (psig)			
Action	0	600	800	Rated
Position indication	All			
Insert/withdraw				
Single CRD notch and continuous modes	All			
Coupling	All			
Friction	All			4[1]
Individual CRD scram All[4] times	All[3]	4[1]	4[1]	
Individual CRD scram times				4[1,2]

[1] Refers to four CRDs selected for continuous monitoring based on slow normal accumulator pressure scram times as determined from preoperational testing or unusual operating characteristics. The "four selected CRDs" must be compatible with the requirements of both the withdrawal sequence and the installed rod movement limitation system.

(2) Scram times of the four selected CRDs will be determined at Test Conditions 1 and 6 for planned reactor scrams (see Tests 25B, 27 and 28.)

(3) Credit can be taken for CRD scram times performed in conjunction with the CRD Hydraulic System Preoperational Test (14.2.12.1.11), provided that no modifications were done on the CRD after scram timing and the test was performed less than 120 days before fuel loadings.

(4) Credit can be taken for CRD scram times determined at TC-1 or TC-2 during reactor scrams. Control rods not fully withdrawn during the scrams must have their scram times determined individually prior to exceeding 40-percent thermal power.

NOTE: Single CRD scrams should be performed with the charging valve closed (Do not ride the charging pump head).

4. Acceptance Criteria

Level 1

Each CRD has a normal withdraw speed less than or equal to 3.6 in per sec, indicated by a full 12-ft stroke in greater than or equal to 40 sec.

The maximum scram times, measured with vessel pressures between 950 and 1,050 psig, of individual CRDs comply with line 1 of the following table. (Performance rated with charging headers greater than or equal to 1,520 psig):

		Maximum Scram Time from Opening of Main Scram Contactor to Notch Position* (sec)		
Line	Pressure (psig)	43	29	13
1	950	0.31	0.81	1.44
	1,050	0.32	0.86	1.57
2	950	0.38	1.09	2.09
	1,050	0.39	1.14	2.22
3	950	0.30	0.78	1.40
	1,050	0.31	0.84	1.53

(*For intermediate vessel dome pressure, the scram time criteria is determined by linear interpolation at each notch position.)

In the event that any CRD scram time exceeds the criteria listed in line 1 of the above table, the following acceptance criteria are applicable:

1. The maximum scram time of any CRD which failed the criteria of line 1 does not exceed the criteria of line 2.

2. The average scram time of those rods which meet the criteria of line 1 does not exceed the criteria of line 3.

3. The total number of slower control rods which do not meet the criteria of line 1 do not exceed five and they do not occupy adjacent drive locations in any direction including the diagonal.

Level 2

Each CRD must have a normal insert or withdraw speed of 3.0 plus or minus 0.6 in per sec, indicated by a full 12-ft stroke in 40 to 60 sec.

With respect to the CRD friction tests, if the differential pressure variation exceeds 15 psid for a continuous drive in, a settling test must be performed, in which case, the differential settling pressure should not be less than 30 psid nor should it vary by more than 10 psid over a full stroke.

(Note: The differential setting pressure should be nominally 5 psid higher at 00 position than at any other position along the control rod.)

The CRDs total cooling water flow rate is between 0.28 and 0.34 gpm times the total number of drives.

For vessel pressures below 950 psig, the maximum scram time of individual fully withdrawn CRDs complies with a figure provided in the startup test procedure (time versus reactor dome pressure). This is the time from the deenergizing of the scram solenoid valve to notch 11.

14.2.12.3.6 Test Number 6 - SRM Performance and Control Rod Sequence

1. Test Objective

   The purpose of this test is to demonstrate that the operational sources, SRM instrumentation, and rod withdrawal sequences provide adequate information to achieve criticality and increase power in a safe and efficient manner. The effect of typical rod movements on reactor power is determined.

2. Prerequisites

   The appropriate preoperational tests have been completed, and the FRC has reviewed and approved the test procedure and the initiation of testing. The CRD system must be operational.

3. Test Procedure

   The operational neutron sources are installed and source range monitor count-rate data is taken during rod withdrawals to critical and compared with stated criteria on signal and signal count-to-noise count ratio.

   A withdrawal sequence has been calculated which completely specifies control rod withdrawals from all-rods-in condition to the rated pressure configuration.

   Movement of rods in a prescribed sequence is monitored by the rod pattern control system which enforces specific rules based on power level, rod sequence, and rod group.

4. Acceptance Criteria

   Level 1

   There is a neutron signal count-to-noise count ratio of at least 2 to 1 on the minimum number of operable SRMs or fuel loading chambers as specified in the Technical Specifications.

   There is a minimum count rate of 0.7 counts/sec on the minimum number of operable SRMs or fuel loading chambers as specified in the Technical Specifications.

The IRMs are on scale before the SRMs exceed the rod block set point.

14.2.12.3.7 Test Number 16B - Water Level Reference Leg Temperatures

1. Test Objective

   The purposes of this test are a) to check the calibration of the various level indicators and b) to measure the reference leg temperature and recalibrate the affected wide range level instruments if the measured temperature is different from the value assumed during the initial calibration.

2. Prerequisites

   Required preoperational tests have been completed; the FRC has reviewed and approved the test procedure and the initiation of testing. All system controls and interlocks have been checked. All system instrumentation is installed and calibrated.

3. Test Procedure

   To monitor the reactor vessel water level, five level instrument ranges are provided. These are:

   a. Shutdown range

   b. Narrow range

   c. Wide range

   d. Fuel zone range

   e. Upset range.

   These systems are used respectively as follows:

   a. Water level measurement in cold, shutdown conditions (shutdown range)

   b. Feedwater flow and water level control functions (narrow range)

   c. Safety functions (wide range)

d. Post-LOCA monitoring (fuel zone range)

e. During and following abnormal water level increases (upset range).

The test is done at rated temperature and pressure and under steady-state conditions. It verifies that the reference leg temperature of the wide range and narrow range level instruments are the value assumed during initial calibration. If not, the instruments are recalibrated using the measured value.

The Level 2 criteria determine whether recalibration is necessary.

4. Acceptance Criteria

Level 2

The difference between the variable leg and the reference leg temperatures determined from the containment and drywell temperature measurements and the values assumed during initial calibration are less than the amount which will result in a scale endpoint error of 1 percent of the instrument span for each range.

14.2.12.3.8 Test Number 10 - Intermediate Range Monitor Performance

1. Test Objective

The purpose of this test is to adjust the IRM system to obtain an optimum overlap with the SRM and APRM systems.

2. Prerequisites

The appropriate preoperational tests have been completed. The FRC has reviewed and approved the test procedures and the initiation of testing. Instrumentation for calibration has been checked and installed.

3. Test Procedure

Initially the IRM system is set to maximum gain. After the APRM calibration, the IRM gains are adjusted to optimize the IRM overlap with the SRMs and APRMs.

4. Acceptance Criteria

Level 1

Each IRM channel is adjusted so that the overlap with the SRMs and APRMs is assured. The IRMs produce a scram at less than or equal to the Technical Specification trip set point.

14.2.12.3.9 Test Number 11 - LPRM Calibration

1. Test Objective

The purpose of this test is to calibrate the LPRM system.

2. Prerequisites

The appropriate preoperational tests have been completed, the FRC has reviewed and approved the test procedures and the initiation of testing. Instrumentation for calibration has been checked and installed.

3. Test Procedure

The LPRM channels are calibrated to make the LPRM readings proportional to the neutron flux in the water gap at the chamber elevation. Calibration factors are obtained through the use of either an offline or a process computer calculation that relates the LPRM reading to average fuel assembly power at the chamber height.

4. Acceptance Criteria

Level 2

Each LPRM reading is within 10 percent of the value determined to be the average fuel assembly power at the chamber height.

14.2.12.3.10 Test Number 12 - APRM Calibration

1. Test Objective

The purpose of this test is to calibrate the average power range monitor system.

2. Prerequisites

The appropriate preoperational tests have been completed and the FRC has reviewed and approved the test procedures and the initiation of testing. Instrumentation for calibration has been checked and installed.

3. Test Procedure

A heat balance is generally made each shift and after each major power level change. Each APRM channel reading is adjusted to be consistent with the core thermal power as determined from the heat balance. During heatup a preliminary calibration is made by adjusting the APRM amplifier gains so that the APRM readings agree with the results of a constant heatup rate heat balance. The APRMs are recalibrated in the power range by a heat balance as soon as adequate feedwater indication is available.

4. Acceptance Criteria

Level 1

The APRM channels are calibrated to read equal to or greater than the actual core thermal power.

Technical Specification limits on APRM scram and rod block are not exceeded.

In the startup mode, all APRM channels produce a scram at less than or equal to 15 percent power as specified by the Technical Specifications.

Recalibration of the APRM system is not necessary from safety considerations if at least two APRM channels per RPS trip circuit have readings greater than or equal to core power.

Level 2

If the above criteria are satisfied, then the APRM channels are considered to be reading accurately if they agree with the heat balance to within plus or minus 7 percent of rated power.

14.2.12.3.11 Test Number 13 - NSSS Process Computer

1. Test Objective

The purpose of this test is to verify the performance of the NSSS process computer under plant operating conditions.

2. Prerequisites

The appropriate preoperational tests have been completed and the FRC has reviewed and approved the test procedures and initiation of testing. Computer diagnostic test completed. Construction and construction testing on each input instrument and its cabling are completed.

3. Test Procedure

Computer system program verification and calculational program validations at static and at simulated dynamic input conditions are preoperationally tested at the computer supplier's site and following delivery to the plant site. Following fuel loading, during plant heatup and the ascension to rated power, the nuclear steam supply system and the balance-of-plant system process variables sensed by the computer as digital or analog signals become available. Verify that the computer is receiving correct values of sensed process variables and that the results of performance calculations of the nuclear steam supply system and the balance-of-plant are correct. At steady-state power conditions the dynamic system test case is performed.

4. Acceptance Criteria

Level 2

Programs OD-1, P1, and OD-6 are considered operational when:

a. The MCPR calculated by BUCLE and the process computer either:

   (1) Are in the same fuel assembly and do not differ in value by more than 2 percent or,

   (2) For the case in which the MCPR calculated by the process computer is in a different assembly than that calculated by BUCLE, for each assembly, the MCPR and CPR calculated by the two methods agree within 2 percent.

b. The maximum linear heat generation rates (LHGRs) calculated by BUCLE and the process computer either:

   (1) Are in the same fuel assembly and do not differ in value by more than 2 percent, or

   (2) For the case in which the maximum LHGR calculated by the process computer is in a different assembly than that calculated by BUCLE, for each assembly, the maximum LHGR and LHGR calculated by the two methods agree within 2 percent.

c. The maximum average planar LHGRs (MAPLHGR) calculated by BUCLE and the process computer either:

   (1) Are in the same fuel assembly and do not differ in value by more than 2 percent, or

   (2) For the case in which the MAPLHGR calculated by the process computer is in a different assembly than that calculated by BUCLE, for each assembly, the MAPLHGR and APLHGR calculated by the two methods agree within 2 percent.

d. The LPRM calibration factors calculated by the independent method and the process computer agree within 2 percent.

e. The remaining programs are considered operational upon successful completion of the static and dynamic testing.

14.2.12.3.12 Test Number 14 - RCIC System

1. Test Objective

The purpose of this test is to verify the proper operation of the RCIC system over its expected operating pressure range and to demonstrate reliability at power conditions.

2. Prerequisites

The appropriate preoperational tests have been completed and the FRC has reviewed and approved the test procedures and the initiation of testing.

3. Test Procedure

The RCIC system test consists of two parts: injection to the condensate storage tank (CST) and injection to the reactor vessel.

The CST injections consist of manual and automatic starts at 150 psi and at rated reactor pressure. The pump discharge pressure during these tests is throttled to 100 psi above reactor pressure. The initial testing is for demonstrating operability and making initial controller adjustments. This is followed by vessel injections beginning with cold RCIC hardware. "Cold" is defined as a minimum 3 days without any kind of RCIC operation.

The vessel injections verify the adequacy of the startup transient and also include steady-state controller adjustments. Two consecutive vessel injections starting from cold conditions and with the same equipment settings are necessary to demonstrate system reliability.

After final controller settings are determined, CST injections are done with initially cold RCIC equipment. These runs provide a benchmark for future surveillance testing.

After the auto start portion of certain of the above tests is completed, and while the system is still operating, small step disturbances in speed and flow command are input (in manual and automatic mode respectively) in order to demonstrate satisfactory stability. This is done at both low (above minimum turbine speed) and near rated flow initial conditions to span the RCIC operating range.

A demonstration of expanded operation of up to 2 hr (or until pump and turbine oil temperature is stabilized) of continuous running is scheduled at a convenient time during the test program.

	Action		Test Conditions
1.	CST tank injection	a.	For all RCIC testing, the recirculation flow controllers are in manual mode, and all other controllers are in their normal mode
		b.	150 psig reactor pressure, RCIC discharge 100 psi above reactor pressure initial controller, settings, RCIC hot
		c.	Rated reactor pressure, RCIC discharge 100 psi above reactor pressure, RCIC hot
2.	Step changes in flow for controller adjustments	a.	Immediately after 1c with RCIC discharge to condensate storage tank
3.	Extended operation demonstration	a.	In conjunction with 2a
4.	Reactor vessel injection, quick start	a.	150-psig reactor pressure
5.	Reactor vessel injection, manual start, step changes for controller adjustments	a.	Rated reactor pressure, manual and automatic modes
6.	Reactor vessel injection, hot quick start	a.	Rated reactor pressure, automatic mode

	Action		Test Conditions
7.	Reactor vessel injection, hot or cold quick start followed by stability demonstration	a.	150-psig reactor pressure, automatic mode
8.	Confirmatory reactor vessel injection, cold quick start	a.	Rated reactor pressure, final RCIC controller settings
9.	Second consecutive confirmatory reactor vessel injection, cold quick start	a.	Same as Item 8a
10.	Condensate storage tank injection for surveillance test base data, cold quick starts	a.	Rated reactor pressure, final controller settings, RCIC discharge approximately 100 psi above RPV
		b.	150-psig reactor pressure, final controller settings, RCIC discharge approximately 100 psi above RPV

4. Acceptance Criteria

Level 1

a. The average pump discharge flow is equal to or greater than the 100 percent rated value after 30 sec have elapsed from initiation on auto starts at any reactor pressure between 150 psig and rated.

b. The RCIC turbine does not trip or isolate during auto or manual start tests.

If any Level 1 criteria are not met, the reactor is only allowed to operate up to a restricted power level defined by Fig. 14.2-7 until the problem is resolved.

Level 2

a. The turbine gland seal condenser system is capable of preventing steam leakage to the atmosphere.

b. The ΔP switch for the RCIC steam supply line high-flow isolation trip is adjusted to actuate at the value specified in the Technical Specifications.

c. The speed and flow control loops are adjusted so that the decay ratio of any RCIC system-related variables is not greater than 0.25.

d. In order to provide an overspeed and isolation trip avoidance margin, the transient start first and subsequent speed peaks do not exceed 5 percent above the rated RCIC turbine speed.

14.2.12.3.13 Test Number 16A - Selected Process Temperatures

1. Test Objective

a. To assure that the measured bottom drain temperature corresponds to bottom head coolant temperature during normal operations.

b. To identify any reactor operating modes that cause temperature stratification.

c. To determine the proper setting of the low flow control limiter for the recirculation pumps to avoid coolant temperature stratification in the reactor vessel bottom head region.

d. To familiarize plant personnel with the temperature differential limitations of the reactor system.

2. Prerequisites

The appropriate preoperational tests have been completed and the FRC has reviewed and approved the test procedures, and initiation of testing. System and test instrumentation have been calibrated.

3. Test Procedure

The adequacy of bottom drain line temperature sensors is determined by comparing them with recirculation loop temperature when core flow is 100 percent of rated.

During initial heatup while in hot standby, the bottom drain line temperature and recirculation loop temperature are monitored as the recirculation flow is slowly lowered to either minimum stable flow or the low recirculation pump speed minimum valve position, whichever is greater. The effects of bottom head drain flow also is investigated. Utilizing this data, it can be determined whether coolant temperature stratification occurs when the recirculation pumps are on and, if so, what minimum recirculation flow prevents it.

All data are analyzed to determine if changes in operating procedures are required.

4. Acceptance Criteria

Level 1

The reactor recirculation pumps are not started nor flow increased unless the coolant temperatures between the steam dome and the bottom head drain are within 100°F.

The recirculation pump in an idle loop is not started unless the temperature differential between the reactor coolant within the idle and operating recirculation loops is less than or equal to 50°F, and the operating loop flow rate is less than or equal to 50 percent rated loop flow.

14.2.12.3.14 Test Number 17 - System Expansion

1. Test Objective

The purpose of the thermal expansion test is to confirm that the pipe suspension system is working as designed and that the pipe is free of obstructions that could constrain free pipe movement.

2. Prerequisites

The appropriate preoperational tests are complete; the FRC has reviewed and approved the test procedure and initiation of testing. Instrumentation has been installed and calibrated.

3. Test Procedure

The thermal expansion tests consist of measuring displacements and temperatures of piping during various operating modes. The first power level used to verify expansion is as low as practicable.

Thermal movement and temperature measurements are recorded at the following test points:

a. Reactor pressure vessel heatup and hold, at least, at one intermediate temperature before reaching normal operating temperature; at this time the drywell piping and suspension are inspected for obstruction or inoperable supports.

b. Reactor pressure vessel heatup and hold at normal operating temperature.

c. Main steam and recirculation piping heatup and hold at normal operating temperature.

d. On three subsequent heatup cooldown cycles, measurements are recorded at the operating and shutdown temperatures to measure possible shakedown effects.

The piping considered to be within the boundary of this test is:

a. Main steam - Steam lines, including the RCIC piping on line A, are tested. Those portions within the scope of the test are bounded by the reactor pressure vessel nozzles and the penetration head fittings.

b. Recirculation piping - The recirculation piping, bounded by the reactor pressure vessel nozzles, is within the scope of the test. The RHR suction line from the branch connection to the penetration head fitting is also monitored during the tests.

c. Small attached piping - All small branch piping attached to those portions of the preceding piping is within the scope of the test. The small attached piping is bounded by the large pipe branch connection and the first downstream guide or anchor. Small branch pipes that cannot be monitored because of limited access are excluded from the scope of this test.

4. Acceptance Criteria

Correlation of Test Data and Analysis - The predicted movements are based on mathematical calculations that are dependent on assumed nozzle movements and temperature distributions. The measured temperatures and nozzle movements are compared with those assumed in the analysis to determine which analysis condition corresponds to the test condition. Only corresponding conditions are used to evaluate test results. If the test conditions do not correspond to any of those assumed in the analysis, the evaluating piping design engineer may find it necessary to calculate movements based on measurements and compare the predicted movements with the measured moments to establish acceptability.

The thermal expansion acceptance criteria are based upon the actual movements being within a prescribed tolerance of the movements predicted by analysis. Measured movements are not expected to correspond precisely with those mathematically predicted. Therefore, a tolerance is specified for differences between measured and predicted movement. The tolerances are based on consideration of measurement accuracy, suspension free play, and piping temperature distribution. If the measured movement does not vary from the predictions by more than the specified tolerance, the piping is expanding in a manner consistent with predictions and is therefore acceptable. Tolerances are the same for all operating test conditions. For the locations to be monitored, predicted displacements and actual measurements are compared.

Level 1

The Level 1 movement tolerances provided in Table 14.2-1 and the startup test procedure are intended to set bounds on thermal movement which, if exceeded, requires that the test be placed on hold. Pipe does not necessarily converge smoothly to predicted movements with increase in operating temperature. During the first part of the test, vessel movements often move the pipe in a direction opposite of stress report predictions; the pipe may also advance in a stepwise fashion due to friction constraint. Level 1 criteria discount spurious movement measurements that could result in unnecessary test holds but still maintain safe limits on movement.

To assure that the criteria are applied at relevant test conditions, the criteria cannot be applied before the vessel and piping temperatures are at meaningful values. In addition, a voting logic is used to discount spurious movements due to instrument malfunction. If the free thermal expansion of the piping is obstructed, movement discrepancies would occur at multiple locations because of coupling effects; therefore, in specified cases, if only one instrument out of several indicates movements are not within Level 1 criteria, that measurement is discounted as spurious.

Main Steam Thermal Evaluation - In accordance with the voting logic, main steam thermal limits have been exceeded if:

a. Both of the pairs of M transducers S2MX and S6MX or S6MY and S7MY exceed limits specified.

b. Any of the other main steam M transducers exceed limits specified.

Main Steam Prerequisites - Thermal limits application:

a. Thermal transducers 1 and 5 must indicate that piping is at specified operating temperature.

b. Thermal transducer SA10 must indicate that the RCIC line is at specified operating temperature.

   (Applicable to steam line A only, when evaluating movement transducers SA2 and SA6.)

Recirculation Thermal Evaluation - In accordance with the voting logic, recirculation thermal limits have been exceeded if:

1. Both pairs of M transducers R3MX and R5MX or R3MZ and R5MZ exceed limits specified.

2. Any of the other recirculation M transducers exceed limits specified.

   Recirculation Piping Prerequisites - Thermal limits application:

   Recirculation thermal transducers must indicate that piping and vessel are at the specified operating temperature.

Level 2

Level 2 limits on piping displacements are provided in Table 14.2-1.

14.2.12.3.15 Test Number 18 - Deleted

14.2.12.3.16 Test Number 19 - Core Performance

1. Test Objective

   a. To evaluate the core thermal power and flow

   b. To evaluate whether the following core performance parameters are within limits:

      (1) Maximum linear heat generation rate (MLHGR)

      (2) Minimum critical power ratio (MCPR)

      (3) Maximum average planar linear heat generation rate (MAPLHGR).

2. Prerequisites

   The appropriate preoperational tests have been completed and the FRC has reviewed and approved the test procedure and initiation of testing. System instrumentation has been installed and calibrated and test instrumentation calibrated.

3. Test Procedure

Core performance evaluation is employed to determine the principal thermal and hydraulic parameters associated with core behavior. These parameters are:

a. Core flow rate

b. Core thermal power level

c. MLHGR

d. MAPLHGR

e. MCPR.

The core performance parameters listed above are evaluated by manual calculation techniques or may be obtained from the process computer.

If the process computer is used as a primary means to obtain these parameters, it must be proven that it agrees with BUCLE within 2 percent on all thermal parameters (Section 14.2.12.3.11), or the results must be corrected to do so. If the BUCLE and process computer results do not agree within 2 percent for any thermal parameter, the parameter calculated by the process computer is corrected by a multiplication factor to bring it within the 2 percent criteria.

4. Acceptance Criteria

Level 1

The MLHGR of any rod during steady-state conditions does not exceed the limit specified by the plant Technical Specifications.

The steady-state MCPR does not exceed the limits specified by the Technical Specifications.

The MAPLHGR does not exceed the limits specified by the Technical Specifications.

Steady-state reactor power is limited to the rated thermal power and values on or below the design flow control line (100 percent rod line).

Core flow does not exceed rated flow.

14.2.12.3.17 Test Number 20 - Steam Production Startup Test

1. Test Objective

   To demonstrate that the reactor steam production rate is satisfied.

2. Prerequisites

   All plant instrumentation used in performing the test is calibrated by methods mutually agreed upon by GSU and GE.

   Only equipment essential to normal plant operation is operating.

   The reactor is at steady-state power and flow and at as near rated conditions as possible.

   The FRC has reviewed and approved the test procedure and initiation of testing.

3. Test Procedure

   Compliance with the steam output warranty is demonstrated by a steam output performance test of 100 hr continuous duration or as provided in the NSSS contract. At two separate times during the test, when it is determined that all plant conditions are stabilized, the steam production rate is measured during a 4-hr period at conditions prescribed in the nuclear steam generating system warranty.

4. Acceptance Criteria

   Level 1

   When operating at warranty conditions, the NSSS is capable of supplying steam in an amount and quality corresponding to the final feedwater temperature and other rated steam output conditions.

14.2.12.3.18 Test Number 21 - Deleted

14.2.12.3.19 Test Number 22 - Initial Pressure Controller

1. Test Objective

   The purposes of this test are: a) to determine the optimum settings for the initial pressure control (IPC) loop by analysis of the transients induced in the reactor pressure control system by means of the pressure controller, b) to demonstrate the capability of the IPC to maintain stable pressure control for various IPC single failure situations, and c) to demonstrate smooth pressure control transition between the control valves and bypass valves when reactor steam generation exceeds steam used by the turbine.

2. Prerequisites

   The appropriate preoperational tests have been completed, and the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

   The pressure set point is decreased rapidly and then increased rapidly by several psi and the response of the system is measured in each case. It is desirable to accomplish the set point change in less than 1 sec. At specified test conditions the load limit set point is set so that the transient is handled by control valves, bypass valves and both. Various inputs to the IPC averaging and comparison circuits are failed, and the ability of the IPC to maintain stable reactor pressure is demonstrated. The response of the system is measured and evaluated and IPC settings are optimized.

4. Acceptance Criteria

   Level 1

   The decay ratio is no greater than 1.0 for each pressure control system related process variable (neutron monitoring and RPV dome pressure) that exhibits oscillatory response to pressure controller changes.

Level 2

In all tests the decay ratio is expected to be less than or equal to 0.25 for each pressure control system process variable that exhibits oscillatory response to pressure controller changes.

Pressure control deadband, delay, etc, are small enough that steady-state limit cycles, if any, produce turbine steam flow variations no larger than plus or minus 0.5 percent of rated flow as measured by the gross generated electrical power.

When in the recirculation position command mode, the pressure response time from initiation of pressure set point change to the turbine inlet pressure peak is less than or equal to 10 sec.

During the various failures in the IPC, if the set point of the IPC is optimally set, the IPC controls the transient such that the peak neutron flux and/or peak vessel pressure remain below the scram settings by 7.5 percent and 10 psi, respectively.

The variation in the incremental regulation (ratio of the maximum to the minimum value of the quantity "incremental change in pressure control signal/incremental change in steam flow" for each flow range) meets the following:

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*Percent of Steam Flow Obtained with Valves Wide Open	Variation
0 - 85%	<4:1
85% - 97%	<2:1
85% - 99%	<5:1

NOTE:
* The pressure regulator did not meet the Level 2 acceptance criteria for variation in incremental regulation for the range of 85-97%. Based on Engineering evaluation, reliable control performance and satisfactory operation through numerous actual plant transients, Startup Test #22, Test Exception #17 has been closed.

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14.2.12.3.20 Test Number 23 - Feedwater System

14.2.12.3.20.1 Test Number 23C - Feedwater Pump Trip

1. Test Objective

   The purpose of this test is to demonstrate the capability of the automatic core flow runback

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feature to prevent low water level scram following the trip of one feedwater pump.

2. Prerequisites

The preoperational tests have been completed and the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate. All feedwater controllers have been tuned to provide the dynamic response to as fast as possible with proper damping.

3. Test Procedure

One of the operating feedwater pumps is tripped and the automatic recirculation runback circuit acts to drop the power to within the capacity of the remaining feedwater pump. Prior to the test a simulation of the feedwater pump trip is done to verify the runback capability of the recirculation system.

4. Acceptance Criteria

Level 1

Not applicable

Level 2

A scram does not occur from low water level following a trip of one of the operating feedwater pumps. There is greater than 3-in water level margin to scram for a feedwater pump trip initiated at 100 percent power conditions.

14.2.12.3.20.2 Test Number 23A - Water Level Set Point, Manual Feedwater Flow Changes

1. Test Objective

The purpose of this test is to verify that the feedwater system has been adjusted to provide acceptable reactor water level control.

2. Prerequisites

The appropriate preoperational tests have been completed and the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

Reactor water level set point changes of approximately 3 to 6 in are used to evaluate (and adjust as necessary) the feedwater control system settings for all power and feedwater level control valve modes. The level set point changes also demonstrate core stability to subcooling changes.

4. Acceptance Criteria

Level 1

The transient response of any level control system-related variable (reactor water level) to any test input does not diverge.

Level 2

a. Level control system-related variable may contain oscillatory modes of response. In these cases, the decay ratio for each controlled mode of response is less than or equal to 0.25.

b. The open loop dynamic valve position response of each feedwater level control valve to small (<10 percent) step disturbances is:

   (1) Maximum time to 10 percent of a step disturbance: ≤ 1.2 sec

   (2) Maximum time from 10 percent to 90 percent of a step disturbance: ≤ 2.1 sec

   (3) Peak overshoot (percent of step disturbance): ≤ 15 percent

c. The maximum rate of response of the total feedwater flow to large (≥ 20 percent of pump flow) step disturbances shall be between 3.3 percent and 8.3 percent NBR feedwater flow/sec. This response rate will be assessed by determining the maximum slope of feedwater flow versus time.

d. At steady-state operation, input scaling to the mismatch gains is adjusted such that the mismatch gain output within ± 1 inch.

14.2.12.3.20.3 Test Number 23B - Loss of Feedwater Heating

1. Test Objective

   The purpose of this test is to demonstrate adequate response to a feedwater temperature loss.

2. Prerequisites

   The appropriate preoperational tests have been completed; the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

   The condensate/feedwater system is studied to determine the single failure that causes the largest loss in feedwater heating. This event is then performed at between 80 and 90 percent power with the recirculation flow near its rated value.

4. Acceptance Criteria

   <u>Level 1</u>
   The increase in simulated heat flux does not exceed the Level 2 value by more than 2 percent. This value is based on the actual test values of feedwater temperature change and power level.

   For the feedwater heater loss test, the maximum feedwater temperature decrease due to single failure is ≤100°F. The resultant MCPR is greater than the fuel thermal safety limit.

   <u>Level 2</u>

   The increase in simulated heat flux does not exceed the value determined by using the actual feedwater temperature change and power level.

14.2.12.3.20.4 Test Number 23D - Maximum Feedwater Runout Capability

1. Test Objective

   The purpose of the test is to determine that the maximum feedwater runout capability is comparable with the safety analysis assumptions in USAR Chapter 15.

2. Prerequisites

   The appropriate preoperational tests have been completed, the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedures

   Pressure, flow, and controller data are taken at as high a power as necessary to allow the determination of the maximum feedwater runout capability. These data are compared with the USAR values and the impact on thermal parameters determined.

4. Acceptance Criteria

   <u>Level 1</u>

   The feedwater flow runout capability does not exceed the value stated in USAR Section 15.1.2.

14.2.12.3.21 Test Number 24 - Turbine Valve Surveillance

1. Test Objective

   The purpose of this test is to demonstrate the acceptable procedures and maximum power levels for surveillance testing of the main turbine control, stop and bypass valves without producing a reactor scram.

2. Prerequisites

   The appropriate preoperational tests have been completed; the FRC has reviewed and approved the test procedures and initiation of testing.

Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

Individual main turbine control, stop and bypass valves are tested routinely during plant operation as required for turbine surveillance testing. At several test points the response of the reactor is observed, and although it is not required, it is recommended that the maximum possible power level for performance of these tests along the 100 percent load line be established. First actuation should be between 45 and 65 percent power, and used to extrapolate to the next test point between 70 and 90 percent power and ultimately to the maximum power test condition with ample margin to scram. Note proximity to APRM flow bias scram point. The turbine valves are tested manually. Rate of valve stroking and timing of the close-open sequence are such that the minimum practical disturbance is introduced and any fuel-related limits are not exceeded.

4. Acceptance Criteria

Level 2

a. Peak neutron flux is at least 7.5 percent below the high flux scram trip setting specified in the Technical Specifications. Peak vessel pressure remains at least 10 psi below the high reactor pressure scram trip setting specified in the Technical Specifications.

b. Peak steam flow in each steam line remains 10 percent below the high steam flow MSIV isolation trip setting specified in the Technical Specifications.

14.2.12.3.22 Test Number 25 - Main Steam Isolation Valves

14.2.12.3.22.1 Test Number 25A - MSIV Functional Tests

1. Test Objective

The purposes of this test are: a) to functionally check the MSIVs for proper operation at approximately 5- and 25-percent power and b) to determine isolation valve closure time at 5- and 25-percent power.

2. Prerequisites

The appropriate preoperational tests have been completed and the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

At approximately 5-percent and 25-percent power levels, individual fast closure of each MSIV will be performed to verify their functional performance and to determine closure times. The times to be determined are the time from deenergizing the solenoids until the valve is 100 percent closed (tsol), and, the valve stroke time (ts). Time tsol equals the interval from deenergizing the solenoid until the valve reaches 90 percent closed plus 1/8 times the interval from 10 percent to 90 percent closure. Time ts equals the interval from when the valve starts to move until it is 100 percent closed, and is based on the interval from 10 percent to 90 percent closure and linear valve travel from 0 percent to 100 percent closure.

4. Acceptance Criteria

<u>Level 1</u>

The MSIV stroke time (ts) shall be no faster than 3 sec (average of the fastest valve in each steam line), and for any individual valve 2.5 sec ≤ ts ≤ 5 sec. Total effective closure time for any individual MSIV shall be tsol plus the maximum instrumentation delay time as determined in the Nuclear Boiler System Preoperational Test (14.2.12.1.4) and shall be less than or equal to 5.5 sec.

<u>Level 2</u>

During full closure of the individual valve, peak pressure is 10 psi below scram, peak neutron flux is 7.5 percent below scram, and steam flow in individual lines is 10 percent below isolation valve trip setting. The peak heat flux is 5 percent less than its trip point.

14.2.12.3.22.2 Test Number 25B - Full Reactor Isolation

1. Test Objective

   The purpose of this test is to determine the reactor transient behavior that results from the simultaneous full closure of all MSIVs.

2. Prerequisites

   The appropriate preoperational tests have been completed; the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

   A test of the simultaneous full closure of all MSIVs is performed at 95 to 100 percent of rated thermal power. Correct performance of the RCIC and relief valves is shown. Reactor process variables are monitored to determine the transient behavior of the system during and following the main steam line isolation.

4. Acceptance Criteria

   Level 1

   The positive change in vessel dome pressure occurring within 30 seconds after closure of all MSIVs does not exceed the Level 2 criteria by more than 25 psi. The positive change in simulated heat flux does not exceed the Level 2 criteria by more than 2 percent of rated value.

   Feedwater control system settings prevent flooding of the steam lines.

   The low-low set pressure relief logic functions to preclude subsequent simultaneous SRV actuations following the initial SRV actuation due to original pressurization transient.

Level 2

The RCIC system adequately takes over water level protection. The relief valves reclose properly (without leakage) following the pressure transient.

For the full MSIV closure from full power, predicted analytical results based on beginning of cycle design-basis analysis, assuming no equipment failures and applying appropriate parametric corrections, are used as the basis to which the actual transient is compared. The following table specifies the upper limits of these criteria during the first 30 seconds following initiation of the indicated conditions.

Initial Conditions		Criteria	
Power (%)	Dome Pressure (psia)	Increase In Heat Flux (%)	Increase In Dome Pressure (psi)
100	1040	<4 NBR	<132.7

Initial action of the RCIC and HPCS is automatic when water Level 2 is reached, and system performance is within specifications.

Recirculation runback occurs. Recirculation pump trip is initiated when Level 2 is reached.

When the low-low pressure relief logic functions, the open/close actions of the SRVs occur within ±15 psi of their design points.

14.2.12.3.22.3 Test Number 25C - Main Steam Line Flow Venturi Calibration

1. Test Objective

The purpose of this test is to calibrate the main steam flow venturis at selected power levels over the entire core flow range. The final calibration takes place with the data accumulated along the 100 percent rod line.

2. Prerequisites

The appropriate preoperational tests have been completed; the FRC has reviewed and approved the test procedures and initiation of testing.

Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

Beginning at approximately 40 percent core thermal power, pertinent plant data is taken along the 75 percent rod line at selected power levels. The same process is repeated along the 100 percent rod line. The accumulated data is then compared against the calibration curves and a known flow source to verify that acceptable steam flow measurements have been made.

4. Acceptance Criteria

<u>Level 1</u>

Not applicable

<u>Level 2</u>

The flow venturi dp is equal to or greater than 79.3 psi at rated steam flow.

14.2.12.3.22.4 Test Number 25D - Main Steam Line Elbow Tap Calibration

1. Test Objective

The purpose of this test is to investigate the performance of the main steam line elbow taps at selected power levels over the entire core flow range. With the accumulated data, the main steam line elbow tap instrumentation is calibrated to accurately reflect the process flows.

2. Prerequisites

The appropriate preoperational tests have been completed; the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

Beginning at approximately 40 percent core thermal power, pertinent plant data is taken along the 75 percent rod line at selected power levels. The same data connection process is repeated along the 100 percent rod line. Using the accumulated data, a calibration curve is constructed and compared against a known flow source.

4. Acceptance Criteria

Level 1

Not applicable

Level 2

The accuracy of the elbow tap relative to the calibrated feedwater flow is at least ±5 percent of rated flow at flow rates between 40 and 100 percent of rated. The repeatability/noise is within ±15 percent of rated flow.

14.2.12.3.23 Test Number 26 - Relief Valves

1. Test Objectives

The purposes of this test are: a) to verify that the relief valves function properly (can be open and closed manually), b) to verify that the relief valves reseat properly after operation, c) to verify that there are no major blockages in the relief valve discharge piping, and d) to confirm proper overall functioning of the low-low set pressure relief logic.

2. Prerequisites

The appropriate preoperational tests have been completed and the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

A functional test of each SRV is made as early in the startup program as practical. This is normally the first time the plant reaches 950 psig. Bypass valves (BPV) response is monitored during the low pressure test and the electrical output response is monitored during the rated pressure test. The test duration is about 10 sec to allow turbine valves and tailpipe sensors to reach a steady state.

The tailpipe sensor responses are used to detect the opening and subsequent closure of each SRV. The BPV responses are analyzed for anomalies indicating a restriction in an SRV tailpipe. In addition, lead BWR plants measure SRV tailpipe back pressure on the longest and shortest tailpipes.

Valve capacity is based on certification by ASME code stamp and the applicable documentation being available in the onsite records. Note that the nameplate capacity/pressure rating assumes that the flow is sonic. This is true if the back pressure is less than 55 percent of inlet pressure. The GE design specification required the back pressure to be less than 40 percent of the inlet pressure, and present designs have back pressures on the order of 30 percent of the inlet pressures. Methods of calculating line losses and pressure drops are reliable enough to assure that the 15 percent to 25 percent conservatism in the design more than offsets any slight inaccuracies in the calculations. A major blockage of the line would not necessarily be offset and it should be determined that none exists through the BPV response signatures.

Vendor bench test data of the SRV opening responses are available onsite for comparison with design specifications.

During operation transients, such as MSIV full closures and turbine trips/generator load rejection, the operation of the safety grade low-low pressure relief logic system is monitored. A comparison between the reactor pressure behavior and SRV actuations are made to confirm open/close set points and containment load mitigation through the prevention of subsequent simultaneous SRV actuations. Recirculation drive flow, loop vibration, and pump head are recorded for one pump as a noncavitation check during low-low SRV action.

4. Acceptance Criteria

<u>Level 1</u>

There is positive indication of steam discharge during the manual actuation of each valve.

Level 2

a. Pressure control system - related variables (RPV dome pressure, neutron monitoring) may contain oscillatory modes of response. In these cases, the decay ratio for each controlled mode of response is less than or equal to 0.25.

b. The temperature measured by thermocouples on the discharge side of the valves returns to within 10°F of the temperature recorded before the valve was opened. If pressure sensors are available, they return to their initial states upon valve closure.

c. During the 950 psig functional test the steam flow through each relief valve, as measured by the initial and final bypass valve position, is not less than 10 percent of valve position under the average of all valve responses.

14.2.12.3.24 Test Number 27 - Turbine Trip and Generator Load Rejection

1. Test Objective

The purpose of this test is to demonstrate the response of the reactor and its control systems to protective trips in the turbine and generator.

2. Prerequisites

The appropriate preoperational tests have been completed; the FRC has reviewed and approved the test procedures and initiation of testing. All controls and interlocks are checked and instrumentation calibrated.

3. Test Procedure

Turbine trip (closure of the main turbine stop valves within approximately 0.1 sec) and generator trip (closure of the main turbine control valves in about 0.1 to 0.2 sec) are performed at selected power levels. A turbine trip is performed at low power level such that steam generation is just within bypass valve capacity to demonstrate scram avoidance.

The accident analysis shows the generator trip to be more limiting than the turbine trip. Therefore, a generator trip is performed at full rated power. The trip is initiated by an electrical signal condition indicating a generator trip is required. The turbine generator overspeed response is monitored. Other parameters, such as reactor power and pressure, are also monitored.

4. Acceptance Criteria

Level 1

For turbine and generator trips there is a delay of less than 0.1 sec following the beginning of control or stop valve closure before the beginning of bypass valve opening. The bypass valves are opened to a point corresponding to greater than 80 percent of their capacity within 0.3 sec from the beginning of control or stop valve closure motion.

Feedwater system settings prevent flooding of the steam line following these transients.

The positive change in vessel dome pressure occurring within 30 sec after either generator or turbine trip does not exceed the Level 2 criteria by more than 25 psi.

The positive change in simulated heat flux does not exceed the Level 2 criteria by more than 2 percent.

The low-low set pressure relief logic functions to preclude subsequent simultaneous SRV actuations following the initial SRV actuation due to original pressurization transient.

Level 2

There is no MSIV closure during the first 3 min of the transient from low water level, and operator action is not required during that period to avoid the MSIV trip.

The positive change in vessel dome pressure and in simulated heat flux which occurs within the first 30 sec after initiation of either generator or turbine trip does not exceed the predicted values, as determined by the nuclear engineer at the time of the test.

NOTE: Predicted values are referenced to actual test conditions of initial power level and dome pressure and use beginning-of-life nuclear data. Worst case design or Technical Specification values of all hardware performance are used in the prediction, with the exception of control rod insertion time and delay from the beginning of turbine control valve or stop valve motion to the generation of the scram signal. The predicted pressure and heat flux are corrected for the actual measured values of these two parameters.)

For the turbine trip within the bypass valves capacity, the reactor does not scram for initial thermal power levels within that bypass valve capacity.

Low water level total recirculation pump trip, HPCS, and RCIC are not initiated.

Feedwater level control avoids loss of feedwater due to a high level (L8) trip during the event.

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When the low-low pressure relief logic functions, the open/close actions of the SRVs occur within ±13 psi and ±20 psi of their design points, respectively.

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14.2.12.3.25 Test Number 28 - Shutdown From Outside the Main Control Room

1. Test Objective

The purpose of this test is to demonstrate that the reactor can be brought from a normal initial steady-state power level down to the point where normal low pressure shutdown cooling is initiated and is under control with reactor vessel pressure and water level controlled from outside the main control room.

2. Prerequisites

The appropriate preoperational tests have been completed; the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate. Operating procedures governing remote shutdown have been approved. Communications exist between the main control room observers and the remote shutdown panel. All test participants have been thoroughly briefed in their duties. Plant operating staff and main control room observers assume responsibility and establish criteria to take control of the plant from the main control room if unsafe conditions develop.

3. Test Procedures

The test simulates the reactor shutdown following a main control room evacuation. From outside the main control room, the reactor is scrammed from normal steady-state conditions and the MSIVs are closed. At the time of scram the reactor is between 10 percent and 25 percent power level sufficiently high that plant systems are in the normal configuration with the turbine-generator in operation.

Following the event, the vessel water level and pressure are controlled from outside the main control room in a hot standby condition for 30 min.

When the reactor plant is in an evolution requiring cooldown, it is demonstrated from the remote shutdown panel that the RHR system can be initiated and control decay heat. A heat transfer path through the RHR heat exchangers to the standby service water tower is established and it is shown that reactor coolant temperature can be reduced 50°F from the remote shutdown panel.

4. Acceptance Criteria

Level 1

Not applicable

Level 2

During a simulated main control room evacuation, the reactor is brought to the point where cooldown is initiated and under control. The reactor vessel pressure and water level are controlled using equipment and controls outside the main control room.

The plant is brought to hot standby and subsequently, but not necessarily immediately, it is demonstrated by partially cooling down the plant with RHR in the shutdown cooling mode that cold shutdown could be achieved using equipment and controls outside the main control room.

14.2.12.3.26 Test Number 29 - Recirculation Flow Control

14.2.12.3.26.1 Test Number 29A - Valve Position Control

1. Test Objective

   The purpose of this test is to demonstrate the capability of the recirculation flow control system when in the position command mode.

2. Prerequisites

   The appropriate preoperational tests have been completed; the FRC has reviewed and approved the test procedures and initiation of testing. All controls are checked and instrumentation calibrated.

3. Test Procedure

   The testing of the recirculation flow control system follows a "building block" approach while the plant is ascending from low- to high-power levels. Components and inner control loops are tested first, followed by drive flow control and plant power maneuvers to adjust and then demonstrate the outer loop controller performance. While operating at low power, with the pumps using the low frequency power supply, small step changes are input into the position controller and the response recorded.

4. Acceptance Criteria

   <u>Level 1</u>

   The transient response of any recirculation system-related variables to any test input does not diverge.

Level 2

Recirculation system-related variables may contain oscillatory modes of response. In these cases, the decay ratio for each controlled mode of response is less than or equal to 0.25. Maximum rate of change of valve position is 10 ±1 percent/sec.

During test condition 3 and test condition 6, while operating on the high speed (60 Hz) source, gains and limiters are set to obtain the following responses:

a. Delay time for position demand step is less than or equal to 0.2 sec for step inputs of 1.0 percent to 5 percent.

b. Response time for position demand step is less than or equal to 0.5 sec for step inputs of 1.0 percent to 5 percent.

c. Overshoot after a small position demand input (1 to 5 percent) step is less than 10 percent of the magnitude of input.

14.2.12.3.26.2 Test Number 29B - Recirculation Flow Loop Control

1. Test Objective

a. To demonstrate the core flow system's control capability over the entire flow control range, including both core flow and neutron flux modes of operation.

b. To determine that all electrical compensators and controllers are set for desired system performance and stability.

2. Prerequisites

The appropriate preoperational tests have been completed; the FRC has reviewed and approved the test procedures and initiation of testing. All controls are checked and instrumentation calibrated.

3. Test Procedure

Following the initial position mode tests of Test 29A, the final adjustment of the position loop gains, flow loop gains, and preliminary values of the flux loop adjustments are made on the mid-power line. This is the most extensive testing of the recirculation control system. In general, the system is set to be the slowest that performs satisfactorily, in order to maximize stability margins and to minimize equipment wear by avoiding controller overactivity.

Due to any fuel-limited power maneuvering rate restrictions, the fast-flow maneuvering adjustments may be performed along a midpower rod line, and an extrapolation made to the expected results along the 100 percent rod line.

For commercial operation, the flux loop may be set slower, and the operator will limit usage of the manual mode. Fuel limitations permitting, the tested faster auto settings can be inserted onto the controller with only a brief dynamic test, rather than a full startup test.

4. Acceptance Criteria

Level 1

The transient response of any recirculation system-related variable to any test input does not diverge.

Level 2

Flow Loop Criteria

a. The decay ratio of the flow loop response to any test inputs is less than 0.25.

b. The flow loops maintain equal steady-state flow in the two loops. Flow loop gains are set to correct a flow imbalance in less than 25 sec.

c. The delay time for flow demand step (less than or equal to 5 percent) is 0.5 sec or less.

d. The response time for flow demand step (less than or equal to 5 percent) is 1.2 sec or less.

e. The maximum allowable flow overshoot for step demand less than or equal to 5 percent of rated is 6 percent of the demand step.

f. The flow demand step settling time is less than or equal to 6 sec.

Flux Loop Criteria

a. Flux overshoot to a flux demand step does not exceed 2 percent of rated for a step demand less than or equal to 20 percent of rated.

b. The delay time for flux response to a flux demand step is less than or equal to 0.9 sec.

c. The response time for flux demand step is less than or equal to 2.6 sec.

d. The flux setting time is less than or equal to 15 sec for a flux demand step less than or equal to 20 percent of rated.

Scram Avoidance and General Criteria

For test maneuvers for any one of the above loops the trip avoidance margins must be at least the following:

a. For APRM ≥7.5 percent

b. For simulated heat flux ≥5.0 percent

Flux Estimator Test Criteria

a. Switching between estimated and actual flux does not exceed 5 times/5 min at steady state.

b. During flux step transient, there is no switching to actual flux; or, if switching does occur, it switches back to estimated flux within 20 sec of the start of the transient.

Flow Control Valve Duty Test Criteria

The flow control valve duty cycle in any operating mode does not exceed 0.2 percent Hz. Flow control valve duty cycle is defined as:

$$\frac{\text{Integrated Valve Movement in Percent (\% Hz)}}{\text{2 x Time Span in Seconds}}$$

14.2.12.3.27 Test Number 30 - Recirculation System

14.2.12.3.27.1 Test Number 30A - Deleted

14.2.12.3.27.2 Test Number 30B - Trip of Two Pumps

1. Test Objective

   The purpose of the test is to record and verify acceptable performance of the recirculation two-pump trip.

2. Prerequisites

   The appropriate preoperational tests have been completed and the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

   Both recirculation pumps are tripped at the desired power level, and the flow coastdown transient is recorded.

4. Acceptance Criteria

   Level 1

   The two-pump drive flow coastdown transient during the first 5 sec is equal to or greater than that specified in the General Electric Transient Safety Analysis Design Report (TSADR).

14.2.12.3.27.3 Test Number 30C - System Performance

1. Test Objective

   The purpose of this test is to record recirculation system parameters during the power test program.

2. Prerequisites

The appropriate preoperational tests are complete. The FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

Recirculation system parameters are recorded at several power-flow conditions.

4. Acceptance Criteria

Level 2

The flow control system is adjusted to limit the maximum core flow to 102.5 percent of rated by limiting the flow control valve opening position.

14.2.12.3.27.4 Test Number 30D - Deleted

14.2.12.3.27.5 Test Number 30E - Recirculation System Cavitation

1. Test Objective

The purpose of this test is to verify that no recirculation system cavitation occurs in the operable region of the power-flow map.

2. Prerequisites

The appropriate preoperational tests have been completed. The FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

Both the jet pumps and the recirculation pumps cavitate at conditions of high flow and low power where NPSH demands are high and little feedwater subcooling occurs. However, the recirculation flow automatically runs back upon sensing a decrease in subcooling to lower the reactor power. The maximum recirculation flow is limited by appropriate limiters which run back the recirculation flow away from the possible cavitation region. It is verified that these limits are sufficient to prevent operation where recirculation pump or jet pump cavitation is predicted to occur.

4. Acceptance Criteria

Level 1

Not applicable

Level 2

Runback logic is set so operation in areas of potential cavitation is not possible.

14.2.12.3.28 Test Number 31 - Loss of Turbine-Generator and Offsite Power

1. Test Objective

The purpose of this test is to determine the reactor transient performance during the loss of the main generator and all offsite power, and to demonstrate acceptable performance of the station electrical supply system. Loss of offsite power is maintained for sufficient time to demonstrate that necessary equipment, controls, and indications are available to remove decay heat from the core using only standby power supplies and distribution systems.

Presently this test is only a loss of turbine-generator and offsite power. Some plant startup programs also include a simulated loss of onsite ac power. However, the performance of a simulated loss of all ac power, or station blackout (SBO) test, will not be conducted owing to the hazard presented to plant equipment}2{. To comply with NUREG-0737, TMI Item I.G.1, RBS complies with the BWR Owners' Group recommendations, as contained in BWROG-8120, BWR Owners' Group Evaluation of NUREG-0737, Requirement I.G.1, Training During Low Power Testing. This commitment satisfies the intent of LRG-II position 1-HFS as clarified by Generic Letter 83-24 and Reference 2.

2. Prerequisites

The appropriate preoperational tests have been completed and the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate. Required electrical systems are aligned for full power operation.

3. Test Procedure

The loss of auxiliary power test is performed at 10 to 30 percent of rated power. The proper response of reactor plant equipment, automatic switching equipment, and the proper sequencing of the diesel generator load are checked. Appropriate reactor parameters are recorded during the resultant transient. Offsite power is not restored for at least 5 min.

4. Acceptance Criteria

Level 1

Reactor pressure is maintained below the set point of the first safety valve, during the transient following the loss of the main generator and all offsite power. Reactor protection systems (RPS) operate to prevent violations of fuel thermal limits as specified in the Technical Specifications.

All safety systems such as the RPS, diesel generators, and HPCS automatically operate as specified by the Technical Specifications without manual assistance.

The HPCS and RCIC operate to keep the reactor coolant level above the initiation level of the LPCS, LPCI, and ADS.

Level 2

The maximum reactor pressure is more than 40 psi below the first safety valve set point, during the transient following the loss of the main generator and all offsite power. Normal reactor cooling systems are able to maintain adequate suppression pool water temperature, maintain adequate drywell cooling, and prevent actuation of the automatic depressurization system.

14.2.12.3.29 Test Number 33 - Drywell Piping Vibration

1. Test Objective

The purpose of this test is to verify that the main steam, recirculation, and RCIC steam piping vibration are within acceptable limits and to verify that, during operating transient loads, pipe stresses are within code limits.

2. Prerequisites

The appropriate preoperational tests are complete; the FRC has reviewed and approved the test procedure and initiation of testing. Instrumentation has been installed and calibrated.

3. Test Procedure

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This test is an extension of Test Number 17 (Section 14.2.12.3.14), system expansion, and the preoperational vibration tests. Consult the specification of Test 17 for piping considered to be within the scope of testing.

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Because of limited access due to high-radiation levels, no visual observation is required during the startup phase of the testing. Remote measurements of piping vibration are made during the following steady-state conditions:

a. Recirculation flow at minimum flow.

b. Recirculation flow at 50 percent of rated.

c. Recirculation flow at 75 percent of rated.

d. Recirculation and main steam flow at 100 percent of rated.

e. RCIC turbine steam line at 100 percent of rated.

f. RHR suction piping at 100 percent of rated flow in shutdown cooling mode.

During the operating transient load testing, the amplitude of displacement and number of cycles per transient of the main steam and recirculation piping are measured, and the displacements compared with acceptance criteria. Remote vibration and deflection measurements are taken during the following transients:

a. Recirculation pump start.

b. Recirculation pump trip at 100 percent of rated flow.

c. Turbine stop valve closure at 100 percent power.

d. Manual discharge of each SRV valve at 1,000 psig and at planned transient tests that result in SRV discharge.

For the locations to be monitored, predicted displacements and actual measurements are compared.

4. Acceptance Criteria

Level 1

Operating Transients - Level 1 limits on piping displacements are prescribed in Table 14.2-3 and in the startup test procedure. These limits are based on keeping the loads on piping and suspension components within safe limits. If any one of the transducers indicates that these movements have been exceeded, the test is placed on hold.

Operating Vibration - Level 1 limits on piping displacement are prescribed in Table 14.2-4 and in the startup test procedure. These limits are based upon keeping piping stresses and pipe-mounted equipment displacements within safe limits. If any one of the transducers indicates that the prescribed limits are exceeded, the test is placed on hold.

Level 2

Operating Transients - Transducers have been placed near points of maximum anticipated movement. Where movement values have been predicted, tolerances are prescribed for differences between measurements and predictions. Tolerances are based on instrument accuracy and suspension free play. Where no movements have been predicted, limits on displacement have been prescribed. Allowable movements or movement tolerances for each transducer are prescribed in Table 14.2-3 and in the startup test procedure.

Operating Vibration - Acceptable levels of operating vibration are prescribed in Table 14.2-4 and in the startup test procedure. The evaluation criteria consist of limits on vibratory displacement. The limits have been set, based on consideration of analysis, operating experience, and protection of pipe-mounted components.

14.2.12.3.30 Test Number 35 - Recirculation System Flow Calibration

1. Test Objective

   The purpose of this test is to perform complete calibration of the installed recirculation system flow instrumentation.

2. Prerequisites

   The appropriate preoperational tests have been completed and the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

   During the testing program at operating conditions which allow the recirculation system to be operated at rated flow at power, the loop and core flow instrumentation are adjusted to provide correct flow indication based on jet pump flow and other parameters. After the relationship between drive flow and core flow is established, the flow biased APRM/RBM (rod block monitor) system is adjusted to match this relationship.

4. Acceptance Criteria

   Level 1

   Not applicable

Level 2

Jet pump flow instrumentation is adjusted such that the jet pump total flow recorder provides a correct core flow indication at 100 percent power, 100 percent drive flow.

The APRM/RBM flow-bias instrumentations is adjusted to function properly at 100 percent power, 100 percent drive flow.

14.2.12.3.31 Test Number 70 - Reactor Water Cleanup System

1. Test Objective

The purpose of this test is to demonstrate specific aspects of the mechanical ability of the RWCU. (This test, performed at rated reactor pressure and temperature, is actually the completion of the preoperational testing that could not be done without nuclear heating.)

2. Prerequisites

The appropriate preoperational tests have been completed and the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

With the reactor at rated temperature and pressure, process variables are recorded during steady-state operation in two modes as defined by the system process diagram: blowdown and normal.

4. Acceptance Criteria

Level 1

Not applicable

Level 2

The temperature at the tube side of the nonregenerative heat exchangers does not exceed 130°F in any mode.

The pump available NPSH is equal to or greater than that defined in the process diagrams.

14.2.12.3.32 Test Number 71 - Residual Heat Removal System

1. Test Objective

The purpose of this test is to demonstrate the ability of the RHR system to remove heat from the reactor system so that the refueling and nuclear system servicing can be performed.

2. Prerequisites

The appropriate preoperational tests have been completed and the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

During the first suitable reactor cooldown, the shutdown cooling mode of the RHR system is demonstrated. The suppression pool cooling mode is tested in the preoperational test (Section 14.2.12.1.5).

4. Acceptance Criteria

Level 1

Not applicable

Level 2

The RHR system is capable of operating in the shutdown cooling mode at the flow rates and temperature differentials specified by the GE process diagrams.

14.2.12.3.33 Test Number 103 - Drywell Atmosphere Cooling System

1. Test Objective

The purpose of this test is to verify the ability of the drywell atmosphere cooling system to maintain test conditions in the drywell during operating conditions and post-scram conditions.

2. Prerequisites

The appropriate preoperational tests have been completed and the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been checked or calibrated as appropriate.

3. Test Procedure

During heatup and power operation, data is taken to ascertain that the drywell temperature is within test limits.

4. Acceptance Criteria

Level 1

Not applicable

Level 2

The drywell cooling system maintains drywell air temperature at or below the values specified by the Technical Specifications.

14.2.12.3.34 Test Number 105 - Penetration Temperatures Test

1. Test Objective

The purpose of this test is to demonstrate the ability of the concrete to remain cool around selected high temperature pipe penetrations in the containment wall.

2. Prerequisites

The appropriate preoperational tests are complete; the FRC has reviewed and approved the test procedures and initiation of testing. Instrumentation has been installed and calibrated.

3. Test Procedure

The penetration temperature test consists of measuring penetration collar temperatures surrounding selected main steam and reactor water cleanup piping penetrations in the shield building wall. Measurements from temperature sensors are taken at rated reactor temperatures.

4. Acceptance Criteria

Level 2

The penetration collar temperatures adjacent to the shield building concrete do not exceed the predicted value for normal plant operation which corresponds to a maximum concrete temperature of 200°F.

References - 14.2

1. ANSI N510-1975, Testing of Nuclear Air Cleaning Systems, American Standards Institute, New York, NY.

GSU Letter No. RBG-20046, J. E. Booker (GSU, Beaumont, TX) to H. R. Denton (NRC, Bethesda, MD) dated February 1, 1985.