V.C. Summer Power Station
Safety Analysis Report

Initial Tests and Operation

Chapter 14

Revision 23--Updated Online 07/13/23

This Revision summary replaces the List of Effective pages of the VC Summer FSAR, effective June 30, 2021. It will appear in Chapter 00 of the VC Summer FSAR and is the best history available of all the changes made to the original VC Summer FSAR.

Reactor Coolant System
Table of Contents

Section	Title	Page
14.1	TEST PROGRAM	14.1-1
14.1.1	Administrative Procedures (Testing)	14.1-2
14.1.1.1	Development of Procedures	14.1-2
14.1.1.2	Execution of Test Procedures	14.1-4
14.1.1.3	Review, Evaluation, and Approval of Test Results	14.1-5
14.1.1.4	Personnel Responsibilities and Qualifications	14.1-6
14.1.1.5	Test Records	14.1-9
14.1.2	Administrative Procedures (Modifications)	14.1-9
14.1.2.1	Test Initiated Changes for Systems and Components	14.1-9
14.1.2.2	Test Procedure Change and Modifications	14.1-10
14.1.3	Test Objectives and Procedures	14.1-10
14.1.3.1	Phase I (Construction, Component, and Subsystem Functional Tests)	14.1-10
14.1.3.2	Phase II (Preoperational Tests)	14.1-11
14.1.3.3	Phase III (Fuel Loading and Pre-Critical Test)	14.1-13
14.1.3.4	Phase III (Power Ascension Test)	14.1-14
14.1.4	Core Loading and Initial Operation	14.1-14
14.1.4.1	Core Loading	14.1-15
14.1.4.2	Postloading Tests	14.1-16
14.1.4.3	Initial Criticality	14.1-17
14.1.4.4	Low Power Testing	14.1-17
14.1.4.5	Power Ascension	14.1-18
14.1.5	Administrative Procedures (System Operation)	14.1-19
14.2	AUGMENTATION OF STAFF FOR INITIAL TEST AND OPERATION	14.2-1
14.2.1	Organizational Functions, Responsibilities, and Authorities	14.2-1
14.2.1.1	Plant Operating Staff	14.2-1
14.2.1.2	Westinghouse Electric Corporation	14.2-1
14.2.1.3	Gilbert Associates, Inc.	14.2-1
14.2.2	Interrelationships and Interfaces	14.2-2
14.2.3	Personnel Functions, Responsibilities, and Authorities	14.2-2
14.2.3.1	Plant Staff	14.2-2
14.2.3.2	Westinghouse Electric Corporation	14.2-2
14.2.3.3	Gilbert Associates, Inc.	14.2-2
14.2.4	Personnel Qualifications	14.2-2

Reactor Coolant System

List of Tables

Table	Title	Page
Table 14.1-1	Fire Protection System	14.1-20
Table 14.1-2	Containment Isolation Valves Leakage Rate Test	14.1-21
Table 14.1-3	Containment Penetrations Leakage Rate Test	14.1-22
Table 14.1-4	Containment Air Locks Leakage Rate Test	14.1-23
Table 14.1-5	Reactor Building Structural Acceptance Test	14.1-24
Table 14.1-6	Containment Integrated Leakage Rate Test	14.1-25
Table 14.1-7	Unit Auxiliary, Emergency Auxiliary, and Engineered Safety Features Transformers	14.1-26
Table 14.1-8	7200 Volt Electrical System	14.1-27
Table 14.1-9	480 Volt Buses	14.1-29
Table 14.1-10	480 Volt Motor Control Centers	14.1-30
Table 14.1-11	120 Volt AC	14.1-31
Table 14.1-12	DC System	14.1-32
Table 14.1-13	Plant Paging and Communication System	14.1-34
Table 14.1-14	Diesel Fuel Oil Transfer and Storage System	14.1-35
Table 14.1-15	Emergency Diesel Generators	14.1-36
Table 14.1-16	Response to Loss of Instrument Air	14.1-38
Table 14.1-17	Auxiliary Building Ventilation System (Radioactive Portion)	14.1-39
Table 14.1-18	Fuel Handling Building Ventilation System (Radioactive Portion)	14.1-40
Table 14.1-19	Process and Area Radiation Monitoring System	14.1-41
Table 14.1-20	Component Cooling Water System	14.1-42
Table 14.1-21	Service Water System	14.1-43
Table 14.1-22	Boric Acid Batching and Transfer System	14.1-44
Table 14.1-23	Heat Tracing for Boron Injection Tank and Associated Piping	14.1-45
Table 14.1-24	Reactor Building Cooling System	14.1-46
Table 14.1-25	Chemical and Volume Control System	14.1-47
Table 14.1-26	Pressurizer Relief Tank	14.1-48
Table 14.1-27	Reactor Coolant System Heatup for Hot Functional Testing	14.1-49
Table 14.1-28	Systems Thermal Expansion	14.1-51
Table 14.1-29	Hot Functional Testing	14.1-52

Reactor Coolant System

List of Tables (Continued)

Table	Title	Page
Table 14.1-30	Emergency Feedwater System	14.1-53
Table 14.1-31	Engineered Safety Features Circuitry	14.1-54
Table 14.1-32	Nuclear Sampling System	14.1-55
Table 14.1-33	Reactor Coolant System Cooldown from Hot Functional Testing	14.1-56
Table 14.1-34	Residual Heat Removal System Flow Tests	14.1-57
Table 14.1-35	Nuclear Instrumentation System	14.1-59
Table 14.1-36	Control Building Ventilation Systems	14.1-60
Table 14.1-37	Core Loading Instrumentation	14.1-62
Table 14.1-38	Reactor Components and Fuel Handling Tools and Fixtures	14.1-63
Table 14.1-39	Fuel Transfer System	14.1-64
Table 14.1-40	Safety Injection High Head Flow Balancing Test	14.1-65
Table 14.1-41	S. I. Accumulator Blowdown Test	14.1-67
Table 14.1-42	Spent Fuel Cooling System	14.1-68
Table 14.1-42a	Spent Fuel Cooling System	14.1-69
Table 14.1-43	Containment Isolation System	14.1-70
Table 14.1-44	Reactor Protection Operational Check	14.1-71
Table 14.1-45	Engineered Safety Features System Operational Check	14.1-72
Table 14.1-46	Integrated Engineered Safety Features Test	14.1-73
Table 14.1-47	Reactor Building Spray System	14.1-74
Table 14.1-48	Leak Detection Monitoring System	14.1-76
Table 14.1-49	Post Accident Hydrogen Removal System	14.1-77
Table 14.1-50	Radioactive Waste Disposal System	14.1-78
Table 14.1-51	Boron Thermal Regeneration System	14.1-80
Table 14.1-52	Reactor Protection System Time Response Measurement	14.1-81
Table 14.1-53	Initial Fuel Loading	14.1-83
Table 14.1-54	Incore Movable Detectors	14.1-84
Table 14.1-55	Rod Drop Time Measurement	14.1-85
Table 14.1-56	Rod Drive Mechanism Timing	14.1-86
Table 14.1-57	Rod Position Indication	14.1-87
Table 14.1-58	Reactor Coolant System Flow Measurement	14.1-88

Reactor Coolant System

List of Tables (Continued)

Table	Title	Page
Table 14.1-59	Reactor Coolant System Flow Coastdown	14.1-89
Table 14.1-60	Resistance Temperature Detector Bypass Loop Flow Verification	14.1-90
Table 14.1-61	Reactor Vessel O-Ring Leak Test	14.1-91
Table 14.1-62	Pressurizer Spray and Heater Capability and Setting Continuous Spray Flow	14.1-92
Table 14.1-63	Water Quality Test	14.1-93
Table 14.1-64	Initial Criticality	14.1-94
Table 14.1-65	Low Power Test	14.1-95
Table 14.1-65a	Augmented Low-Power Test	14.1-98
Table 14.1-66	Incore Movable Detector and Thermocouple Mapping at Power	14.1-100
Table 14.1-67	Power Coefficient and Power Defect Measurement	14.1-101
Table 14.1-68	Effluent Radiation Monitor Test	14.1-102
Table 14.1-69	Radiation Shielding Survey	14.1-103
Table 14.1-70	Process Computer	14.1-104
Table 14.1-71	Thermal Power Measurements and Instrument Calibration	14.1-105
Table 14.1-72	Automatic Control Systems Checkout	14.1-106
Table 14.1-73	Plant Response to Step Load Changes	14.1-107
Table 14.1-74	Pseudo Rod Ejection Tests	14.1-108
Table 14.1-75	Rod Drop Test	14.1-109
Table 14.1-76	Below-Bank Rod Test	14.1-110
Table 14.1-77	Plant Trip from 100% Power	14.1-111
Table 14.1-78	Loss of Offsite Power	14.1-112
Table 14.1-79	Shutdown from Outside the Control Room	14.1-113
Table 14.1-79a	Emergency Lighting	14.1-114
Table 14.1-79b	Heat Tracing for Safety Related Outdoor Piping	14.1-115
Table 14.1-79c	Pressure Boundary Integrity Test	14.1-116
Table 14.1-79d	Seismic Instrumentation	14.1-117
Table 14.1-80	Power Ascension Test Program	14.1-118
Table 14.1-81	Initial Test Program Schedule	14.1-119
Table 14.1-82	Generic Flush Procedure	14.1-120

Reactor Coolant System

List of Tables (Continued)

Table	Title	Page
Table 14.1-83	Generic Hydrostatic/Pneumatic Test	14.1-121
Table 14.1-84	Instrument Control Procedure	14.1-122
Table 14.1-85	Functional Test	14.1-123
Table 14.1-86	Steam Generator Power Operated Relief Valve	14.1-124
Table 14.1-87	Condensate System	14.1-125
Table 14.1-88	Feedwater System	14.1-126
Table 14.1-89	Main Condenser Dump Valves	14.1-127
Table 14.1-90	Circulating Water System	14.1-128
Table 14.1-91	Chemical Feed System	14.1-129
Table 14.1-92	Nuclear Blowdown Processing System	14.1-130
Table 14.1-93	Control Rod Drive	14.1-131
Table 14.1-94	Miscellaneous Plant Drains	14.1-132
Table 14.1-95	Fuel Handling Building Pool Liner Leak Test	14.1-133
Table 14.1-96	Reactor Building Ventilation “Post Accident Operation”	14.1-134
Table 14.1-97	ESF Equipment Rooms Cooling Systems	14.1-135
Table 14.1-98	S. I. Accumulator Discharge Valve Functional Test	14.1-136
Table 14.1-99	ECCS Check Valve Leak Testing System Operational Test	14.1-138
Table 14.1-100	S. I. Accumulator Check Valve Hot Operational Test	14.1-139
Table 14.1-101	Instrument Air System	14.1-140
Table 14.1-102	Pressurizer Pressure and Level Control	14.1-141

CHAPTER 14 - INITIAL TESTS AND OPERATION

NOTE 14.0
Chapter 14, in its entirety, is being retained for historical purposes only.

An extensive test program is conducted by SCE&G to verify that the systems, components, and structures which make up Virgil C. Summer Nuclear Station will perform as they were designed. The overall test objective is to assure that the operation of Virgil C. Summer Nuclear Station will not endanger the health and safety of the public. The ultimate responsibility for the initial tests and operation belongs to SCE&G.

14.1 TEST PROGRAM

The initial test program of Virgil C. Summer Nuclear Station is in three phases; Phase I, component or construction tests; Phase II, acceptance and preoperational tests; and Phase III, core loading and initial startup tests.

Component or construction tests are performed to ensure that components and subsystems meet their functional requirements. The Phase I test program consists of hydrostatic test, flushing, electrical checks, initial operation of equipment, and other specific tests on individual items of equipment.

Acceptance and preoperational tests demonstrate that systems and structures can perform their intended functions. These tests start with system or subsystem turnovers from construction and continue through core loading.

Core loading and initial startup tests begin only after the plant operating license has been issued. It begins with core loading and continues through initial criticality, ascension to power, and is complete when the plant is fully licensed for commercial operation. The results of these tests show that the plant follows its predicted nuclear parameters and can be operated at rated capacity without endangering the health or safety of the public.

Some of the tests described in Regulatory Guide 1.68 are considered preoperational tests but, because of their requirements, are performed during startup testing. An example is scram performance of control rods. This can only be done after the core is loaded and the vessel head is on although this test appears in the preoperational section of the guide.

To assure quality control, procedures used in testing are written and approved in accordance with Section 14.1.1. Changes made to approved procedures are in accordance with Section 14.1.2. The use of plant procedures is discussed in Section 14.1.5. Compliance with regulatory guides is discussed in Appendix 3A.

The Manager Virgil C. Summer Nuclear Station is responsible for the development, administration, and conduct of the test program. The test program is conducted by a startup group which is organized specifically for performing the initial tests and startup of the plant. After commercial operation, this group will be disbanded. The startup group is described in more detail in Section 14.1.1.4.

The initial test program schedule is presented as Table 14.1-81.

14.1.1 Administrative Procedures (Testing)

14.1.1.1 Development of Procedures

The preparation of Phase I, II, and III test procedures is the responsibility of the Plant Manager or his designee (qualification described in Section 13.1.3). The Startup Supervisor may assume these duties for Phase I, II, and III while the startup group is active. Procedures which are contracted to other organizations are written in accordance with the terms of the contract but are reviewed as if written by SCE&G Nuclear Operations. Phase II and III test procedures as described in this Chapter are approved by the Manager Virgil C. Summer Nuclear Station. Acceptance criteria and performance requirements are determined by SCE&G Nuclear Operations by evaluating data furnished by Westinghouse, Gilbert, other vendors, and contractors. Information received from other departments of SCE&G is given close evaluation in the determination of acceptance criteria and performance requirements.

The preparation of Phase I Test Instructions is the responsibility of the Startup Supervisor, who will designate this responsibility to the Test Supervisors. The Test Supervisor will prepare the original test instruction following the guidelines and test methods set forth in generic instructions. If more guidelines are considered necessary, the Test Supervisor will follow specified formats depending on the type of instruction being written (Hydro, Electrical, I&C, Flush). During preparation of the Phase I Test Instruction, the Test Supervisor will use the following references as applicable: Virgil C. Summer Nuclear Station, FSAR, Westinghouse System Descriptions, Gilbert Design Descriptions, Westinghouse NSSS Startup Manuals, applicable vendor Instruction Manuals, and other sources as necessary. After preparation of the test instruction is completed, the Test Supervisor will submit the instruction to the Lead Systems Supervisor, who will review and approve the test instruction.

The preparation of Phase II test procedures as described in Section 14.1.3.2 is the responsibility of the Startup Supervisor who will designate this responsibility to the Test Supervisors. The Test Supervisor(s) prepares the assigned procedure in the prescribed format and submits the procedure for distribution. Copies will be sent to the Westinghouse Startup Representative, the Gilbert Associates Startup Representative, the Startup Supervisor, and the Manager, Virgil C. Summer Nuclear Station, or their designated alternates, each having at least the qualifications of a Lead Systems Supervisor as described in Section 14.1.1.4, for review. The Startup Supervisor may also send the procedure to designated groups or persons for review. These designated groups or persons may include Nuclear Engineering personnel, Quality Assurance personnel, the Assistant Managers Operations, Maintenance Services, and/or Technical Support. Minimum qualifications for Nuclear Engineering and plant personnel assigned to review Phase II test procedures are provided in Section 13.1.

The reviewers examine the procedure for correctness and comment as necessary. The procedure with comments is then returned to the originator for resolution/incorporation of comments. When comments are resolved/incorporated, the procedure is forwarded to the Startup Supervisor. The Startup Supervisor or his designee signs the procedure recommending approval. The procedure is transmitted to the Plant Manager or his designee for his approval.

The preparation of Phase III test procedures will be the responsibility of the Assistant Manager Technical Support or his designated alternate, who will assign the responsibility for the preparation of individual test procedures to plant or support personnel. The originator(s) prepares the assigned procedure in the prescribed format and submits the procedure for distribution. The procedure(s) will be reviewed and approved as per Plant Administrative Procedures (FSAR Chapter 13 and Technical Specifications Section 6).

Test procedures are available to NRC inspection personnel 30 days prior to the scheduled performance of the activity, but not less than 90 days prior to the scheduled core loading date. NRC possession of procedures shall not impede revision, review, or refinement of the procedures.

The format for Phase II and III test procedures is as follows:

TITLE PAGE

The title page contains the station name, procedure title and number, revision number, and signature and date for approval.

1.0 PURPOSE

This section contains the general purpose and objectives of the test.

2.0 REFERENCES

This section contains the references used to develop the test procedure such as FSAR, system descriptions, operating procedures, applicable standards and codes, drawings, manufacturer’s literature, etc. Where possible, revision numbers and dates are shown.

3.0 PREREQUISITES

This section contains title and number of pertinent tests or portions of tests which must be completed prior to conducting this test and/or tests which must be carried out concurrently with this test.

This section also contains the plant status required to conduct the tests such as pressure, temperature, levels, etc. and outline of system status, such as special valve lineups, test equipment installation, temporary equipment installation, temporary equipment, and identification of any equipment that should or should not be operating for equipment or personnel safety.

4.0 SPECIAL TEST EQUIPMENT

This section lists special equipment, other than normal system equipment and instrumentation, required to conduct the test.

5.0 LIMITATIONS AND PRECAUTIONS

This section contains design and safety limits for equipment and any special limitations and precautions needed for safety of personnel or equipment needed to assure that the required results are obtained during the test.

6.0 TEST METHOD

The test method consists of one or more sections containing step-by-step instructions to accomplish the purpose of the test.

Appropriate inspection points are established to record the accomplishment of the test objectives and test requirements.

Test method ensures that the system or plant is placed in a safe condition after a test has been completed and that nonstandard arrangements are restored to their standard condition and that proper verification and records are maintained.

7.0 DATA REQUIREMENTS

This section consists of the necessary instructions to assure that the required data are obtained by outlining requirements that can clearly be associated with steps of the test method.

Preplanned data sheets are used as much as possible with provisions for name of the person responsible for recording data, type of observation performed, and acknowledgment of the acceptability of the data. The data are compared with the acceptance criteria for the test to determine acceptability.

8.0 ACCEPTANCE CRITERIA

This section lists those qualitative or quantitative requirements or limits contained in the design documents against which test results are evaluated.

14.1.1.2 Execution of Test Procedures

Prior to the start of the initial testing program, the Virgil C. Summer Nuclear Station Operations Department arranges itself into a startup group which is more suited for the initial testing program. This organization is headed by the Manager Virgil C. Summer Nuclear Station. A Startup Supervisor who reports to the Manager Virgil C. Summer Nuclear Station organizes and directs the startup program. The Startup Supervisor appoints a Test Supervisor for each test. More than one Test Supervisor may be appointed. The Test Supervisor ensures that the test is conducted according to the test procedure. Qualified test personnel are assigned by the Startup Supervisor to perform the tests. The personnel perform the test work under the supervision of the Test Supervisor.

Prior to fuel loading, all Phase I (component and construction) tests and Phase II (preoperational and acceptance) tests are scheduled to be conducted and the results reviewed and approved in accordance with approved administrative procedures.

A limited number of test deficiencies may exist at the scheduled core loading date. These test deficiencies will be evaluated and categorized.

Appropriate hold points in the Phase III (initial startup) test program will be identified. The applicable deficiencies will be resolved prior to proceeding with the Phase III test program.

During the power ascension phase of testing, certain data are analyzed by the Test Supervisor and the results are reviewed by the Plant Manager or his designee before power is increased to the next higher plateau. Analysis of data includes checking radial flux for symmetry, verifying that axial flux is within predicted values, checking effluent radioactivity, monitoring system operation, and checking power level and nuclear instrumentation by using a heat balance. Before power is increased to a higher plateau, the high flux trip is reset to a value no greater than 20 percent beyond the next power level. Approval of the Plant Manager or his designated alternate must be obtained before increasing power to the next plateau. Approval of the completed procedure documentation is not required for continuation of the startup program or power increases.

When conducting the test, the Test Supervisor ensures that the full intent of the procedure is met. If the Test Supervisor determines the need for either a procedure or plant change, it is accomplished as outlined in Section 14.1.2. The Test Supervisor shall notify the Startup Supervisor when the test has been completed.

14.1.1.3 Review, Evaluation, and Approval of Test Results

After a Phase I test is completed and the data are compiled, the Test Supervisor will review the test results and compare them to the applicable acceptance criteria. If he is satisfied that the test results are satisfactory, he will submit the test to the Lead Systems Supervisor. The Lead Systems Supervisor will be responsible for reviewing the test results and comparing them to the applicable acceptance criteria. If he is satisfied that the test results are acceptable, he will approve the test data. If the test results are not satisfactory, the Lead Systems Supervisor will recommend to the Startup Supervisor what actions are necessary.

After a Phase II test is completed and the data are compiled, the Startup Supervisor will assign the Westinghouse Startup Representative, the Gilbert Associates Startup Representative, or their designated alternates, each having qualifications of a Lead Systems Supervisor as described in Section 14.1.1.4, to review the test results. The assigned personnel will review the test results and compare them to the applicable acceptance criteria specified in the procedure, and forward the test results to the Startup Supervisor. The Startup Supervisor or designated alternate will then review the test results and, if acceptable, sign the test results recommending approval to the Manager Virgil C. Summer Nuclear Station. The test results are then sent to the Manager Virgil C. Summer Nuclear Station for his review and approval. If test results are not acceptable, the personnel assigned to review the data recommends to the Startup Supervisor what actions are necessary. These actions are outlined in more detail in Section 14.1.2.1.

After a Phase III test is completed and the data are compiled, the Lead Phase III Test Supervisor will place the review of the completed test procedure on the agenda of the Plant Safety Review Committee Meeting for consideration for approval of the test results. If the review of the test results during the Plant Safety Review Committee Meeting shows that the test results are acceptable, the Plant Safety Review Committee Chairman signs a procedure recommending approval, the procedure is transmitted to the Plant Manager or his designated alternate for his approval.

14.1.1.4 Personnel Responsibilities and Qualifications

Personnel who will manage, supervise, or execute any of the Phase II or III tests of the initial test program are incorporated into the Virgil C. Summer Nuclear Station startup group. This group consists of the Manager, Virgil C. Summer Nuclear Station, a Startup Supervisor, Lead Systems Supervisor, Test Supervisors, and test personnel. To the extent practical, these individuals come from the plant operating, technical, and maintenance personnel. This allows the utilization of the knowledge these persons have acquired from their training and practical experiences. Utilization of plant personnel during testing further enhances their knowledge of the plant and aids in their training.

SCE&G also utilizes qualified startup personnel from other organizations as members of the startup group. These people constitute a temporary addition to the plant staff which provides the extra people needed during startup to handle the increased work load. These additional people may be obtained from contractors for the specific purpose of starting up the Virgil C. Summer Nuclear Station.

In addition to the startup group, SCE&G may utilize vendor service personnel to provide expert advice and assistance in check out, startup, and testing of their equipment. Technical services are available from Westinghouse, Gilbert, and Daniel.

The Manager Virgil C. Summer Nuclear Station, in addition to his other duties outlined in Section 13.1.2.2, has overall responsibility for Phase II and Phase III of the initial test program. He is responsible for the development of the test procedures, the administration and conduct of the test, and the review and actions taken on the test results. The qualifications of the Plant Manager are outlined in Section 13.1.3.

The Startup Supervisor is under the supervision of the Manager Virgil C. Summer Nuclear Station and ensures effective administrative control and implementation of the test program. The Startup Supervisor meets one of the following qualifications.

1. A graduate of a four-year engineering or science college or university plus five years of experience in operation, testing, or inspection of power plant, nuclear plant, heavy industrial, or other similar equipment or facilities. At least two years of this experience should be associated with nuclear facilities; or if not, the individual shall have training sufficient to acquaint him thoroughly with the safety aspects of a nuclear facility.
2. A high school graduate or equivalent, plus 10 years of experience in operation, testing, or inspection of power plant, nuclear plant, heavy industrial, or other similar equipment or facilities. At least two years of this experience should be associated with nuclear facilities; or if not, the individual shall have training sufficient to acquaint him thoroughly with the safety aspects of a nuclear facility.

See Appendix 3A for details of compliance with Regulatory Guide 1.58.

The Startup Supervisor's duties and responsibilities include, but are not limited to the following:

1. Supervision and coordination of the activities of the startup group.
2. Responsibility for the master startup schedule.
3. Assignment for review responsibilities for individual test results of members of the startup group.
4. Review of test data and test procedure modification in accordance with established administrative procedures.
5. Recommendations to Nuclear Engineering on any request for construction or engineering changes or modifications determined to be necessary by results of a test.
6. Liaison with contractors and vendors and coordination of any activities relative to the test program.
7. The preparation and maintenance of the startup manual.
8. The review of Phase II procedures and test results.

A Lead Systems Supervisor has the responsibility of coordinating test personnel assigned to work for him. He supervises any training needed for the personnel assigned. A Lead Systems Supervisor may be assigned to be the Test Supervisor on an individual test or any number of tests. Lead Systems Supervisors shall meet the qualifications of the Startup Supervisor. Lead Systems Supervisors shall receive indoctrination on startup administrative procedures prior to beginning work.

The Lead Systems Supervisor responsibilities include, but are not limited to, the following:

1. Establish system work loads and responsibility for Test Supervisors with the Startup Organization.
2. Attend meetings with other groups (i.e., construction) as needed.
3. Coordinate turned over system work schedules.

4. Review system turnover packages for completeness of documentation.
5. Review turnover packages for closure and completeness to ensure that the system is ready for testing.
6. Coordinate activities of suppliers/contractors (when applicable) onsite.
7. Coordinate all flushing and cleaning efforts on his assigned systems.
8. Assure that all system deficiencies (design or test) are properly documented, reported, and corrected as expeditiously as possible through the Startup Supervisor.
9. Provide technical guidance for designed systems of testing and operation as required.
10. Assure that the necessary test equipment supplies are available.
11. He is responsible for coordination of the activities of the Startup Test Supervisors assigned to his group. He will assist the Startup Supervisor in scheduling tests and work completion.
12. The review of Phase II procedures and test results.
13. Assign Test Supervisors to the preparation of test procedures.

A Test Supervisor has the responsibility of coordinating the test personnel assigned to work for him. He supervises any training needed for the specific test assigned. A Test Supervisor may be assigned to be the Test Supervisor on an individual test or any number of tests. He is assigned a copy of the test procedure on which all data and acknowledgments are recorded.

Test Supervisors shall meet one of the following qualifications:

1. A graduate of a four-year engineering or science college or university, plus two years of experience in operations, testing, or inspection of power plant, nuclear plant, heavy industrial, or other similar equipment or facilities. (For Phase III, at least one of the two years of experience must be applicable nuclear power plant experience.)
2. A high school graduate or equivalent, plus four years of experience in operations, testing, or inspection of power plant, nuclear plant, heavy industrial, or other similar equipment or facilities. (For Phase III, five years of experience, at least two of which must be applicable nuclear power plant experience.) Test Supervisors shall receive indoctrination on startup administrative procedures prior to beginning work.

See Appendix 3A for details of compliance with Regulatory Guide 1.58.

A Test Supervisor’s duties and responsibilities include, but are not limited to, the following:

1. Coordinate with construction to have the necessary temporary piping installed to facilitate flushing activities and other temporary arrangements to facilitate startup.
2. Carry out system inspection and participate in walkdowns.
3. Assure that the necessary electrical, mechanical, and instrument checkouts have been completed and documented.

4. In the initial operation (if applicable), obtain and record the necessary data. Report, record, and correct deficiencies as required.
5. Present test reports and system data files to the Lead System Supervisor for inclusion in the startup files.
6. Document all deficiencies noted, corrections made, and verifications performed during testing activities.
7. Document all print changes, etc. to ensure final prints are correct and data file is complete.
8. Ensure that approved flushing procedures are implemented and allowed.
9. Calculate the approximate quantities of water required to minimize the use of water and coordinate the use of pumps and the availability of Electrical Power.
10. Walkdown the system with the cognizant personnel using the flushing P & IDs to check valve line up prior to flushing. Supervise the flushing operation.
11. Check for and document, by signing off the steps of the procedure, such as metering devices, orifice plates, valve internals, temporary strainers, blind flanges, piping, and the isolation of sensitive instruments that are removed from the system to facilitate flushing.
12. Verify that the mechanical items are being flushed in accordance with the limits and precautions specified by the procedure so that contaminants and/or flow velocities will not adversely affect subsequent operation or damage the equipment.
13. In conjunction with SCE&G Chemistry Department, verify that the proper chemicals at the designated concentration and temperature are being used in the system layup condition.

14.1.1.5 Test Records

After a test is completed and the results are approved, the master test copy and other permanent information relative to the test will be filed as part of the plant's permanent file in the permanent records room as appropriate. This gives plant personnel access to information on systems, components, etc., from plant startup to serve as a baseline for evaluating performance at any future time in the plant's life.

14.1.2 Administrative Procedures (Modifications)

When the need arises for changes in plant systems or components or in test procedures, administrative procedures are followed.

14.1.2.1 Test Initiated Changes for Systems and Components

A minor change in a system, component, or control is one which does not involve design intent of the system. If, during a test, there arises a need for a minor change in the field, the change, authorized by the Test Supervisor, is made by qualified personnel. Minor changes are indicated with the test data. These minor changes must be approved by the Lead Systems Supervisor before the test results may be approved. The Test Supervisor initiates changes in documents which the minor change affects and notifies appropriate design organization for review.

A major change in a system, component, or control is one which could alter design intent of the system. When personnel designated to review test results, the Test Supervisor or the Startup Supervisor, indicate the necessity of major changes, the Startup Supervisor assigns qualified personnel to review the data at hand and make recommendations to SCE&G Production Engineering for resolution and approval. The Production Engineering personnel studying the necessity of a major change may seek the assistance of vendor, contractor, or others. Before resulting modifications are started, they must have the written approval of the Manager Virgil C. Summer Nuclear Station or his designee. Additional tests or retests shall be rescheduled by the Startup Supervisor. These retests shall be conducted using approved procedures. Modifications or maintenance initiated by test results and the reason they were initiated are noted by the Startup Supervisor.

The Manager Virgil C. Summer Nuclear Station is notified when test results are not acceptable. Vendors, contractors, and others as necessary are notified of any developments and followup activities concerning unacceptable test results.

14.1.2.2 Test Procedure Change and Modifications

Modifications to approved Phase II test procedures are designated either minor or major modifications. A minor modification does not involve changes in scope, intent, or acceptance limits. Minor modification may be effected with approval of the Test Supervisor. The modification must be noted on the test procedure.

Other Phase II procedure modifications are designated as major modifications. These modifications are incorporated into the test procedure by an individual designated by the Startup Supervisor. (If the startup group is not in effect, the Technical Support Engineering Supervisor assumes his duties.) The revised procedure goes through the review and approval steps of an original procedure.

Phase III procedures will be changed and modified in accordance with Technical Specifications.

14.1.3 Test Objectives and Procedures

14.1.3.1 Phase I (Construction, Component, and Subsystem Functional Tests)

NOTE: Phase I tests are generic in nature and are written to demonstrate individual components or subsystems meet their functional requirements. The test abstracts furnished below describe the general objectives, test method, and acceptance criteria for each type of component or subsystem being tested utilizing a Phase I test procedure to demonstrate that the component or subsystem meets its functional requirements.

1. Generic Flush Procedure (see Table 14.1-82).
2. Generic Hydrostatic/Pneumatic Test Procedure (see Table 14.1-83).
3. Instrument Control Procedure (see Table 14.1-84).
4. Generic Functional Test Procedure (see Table 14.1-85).

14.1.3.2 Phase II (Preoperational Tests)

1. Fire Protection System (see Table 14.1-1).
2. Containment Isolation Valves Leakage Rate Test (see Table 14.1-2).
3. Containment Penetrations Leakage Rate Test (see Table 14.1-3).
4. Containment Air Locks Leakage Rate Test (see Table 14.1-4).
5. Reactor Building Structural Acceptance Test (see Table 14.1-5).
6. Containment Integrated Leakage Rate Test (see Table 14.1-6).
7. Unit Auxiliary, Emergency Auxiliary, and Engineered Safety Features Transformers (see Table 14.1-7).
8. 7200 Volt Electrical System (see Table 14.1-8).
9. 480 Volt Buses (see Table 14.1-9).
10. 480 Volt Motor Control Centers (see Table 14.1-10).
11. 120 Volt AC (see Table 14.1-11).
12. DC System (see Table 14.1-12).
13. Plant Paging and Communication System (see Table 14.1-13).
14. Diesel Fuel Oil Transfer and Storage System (see Table 14.1-14).
15. Emergency Diesel Generators (see Table 14.1-15).
16. Response to Loss of Instrument Air (see Table 14.1-16).
17. Auxiliary Building Ventilation System (Radioactive Portion) (see Table 14.1-17).
18. Fuel Handling Building Ventilation System (Radioactive Portion) (see Table 14.1-18).
19. Process and Area Radiation Monitoring System (see Table 14.1-19).
20. Component Cooling Water System (see Table 14.1-20).
21. Service Water System (see Table 14.1-21).
22. Boric Acid Batching and Transfer System (see Table 14.1-22).
23. Heat Tracing for Boron Injection Tank and Associated Piping (see Table 14.1-23).
24. Reactor Building Ventilation Systems (see Table 14.1-24).

25. Chemical and Volume Control System (see Table 14.1-25).
26. Pressurizer Relief Tank (see Table 14.1-26).
27. Reactor Coolant System Heatup for Hot Functional Testing (see Table 14.1-27).
28. Systems Thermal Expansion (see Table 14.1-28).
29. Hot Functional Testing (see Table 14.1-29).
30. Emergency Feedwater System (see Table 14.1-30).
31. Engineered Safety Features Circuitry (see Table 14.1-31).
32. Nuclear Sampling System (see Table 14.1-32).
33. Reactor Coolant System Cooldown From Hot Functional Testing (see Table 14.1-33).
34. Residual Heat Removal System (see Table 14.1-34).
35. Nuclear Instrumentation System (see Table 14.1-35).
36. Control Building Ventilation System (see Table 14.1-36).
37. Deleted.
38. Reactor Components and Fuel Handling Tools and Fixtures (see Table 14.1-38).
39. Fuel Transfer System (see Table 14.1-39).
40. Safety Injection Pumps Operational Test (see Table 14.1-40).
41. Safety Injection Accumulator Blowdown (see Table 14.1-41).
42. Spent Fuel Cooling System (see Table 14.1-42).
43. Containment Isolation System (see Table 14.1-43).
44. Reactor Protection Operational Check (see Table 14.1-44).
45. Engineered Safety Features System Operational Check (see Table 14.1-45).
46. Integrated Engineered Safety Features Test (see Table 14.1-46).
47. Reactor Building Spray System (see Table 14.1-47).
48. Leak Detection Monitoring System (see Table 14.1-48).
49. Post Accident Hydrogen Removal System (see Table 14.1-49).
50. Radioactive Waste Disposal System (see Table 14.1-50).
51. Boron Thermal Regeneration System (see Table 14.1-51).
52. Reactor Protection System Time Response Measurement (see Table 14.1-52).
53. Emergency Lighting (see Table 14.1-79a).
54. Heat Tracing for Safety Related Outdoor Piping (see Table 14.1-79b).
55. Pressure Boundary Integrity Test (see Table 14.1-79c).

56. Seismic Instrumentation (see Table 14.1-79d).
57. Steam Generator Power Operated Relief Valve (see Table 14.1-86).
58. Condensate System (see Table 14.1-87).
59. Main Condenser Dump Valves (see Table 14.1-89).
60. Circulating Water System (see Table 14.1-90).
61. Chemical Feed System (see Table 14.1-91).
62. Nuclear Blowdown Processing System (see Table 14.1-92).
63. Control Rod Drive (see Table 14.1-93).
64. Miscellaneous Plant Drains (see Table 14.1-94).
65. Fuel Handling Building Pool Liner Leak Test (see Table 14.1-95).
66. Reactor Building Ventilation Post Accident Operation (see Table 14.1-96).
67. ESF Equipment Rooms Cooling Systems (see Table 14.1-97).
68. S. I. Accumulator Discharge Valve Functional Test (see Table 14.1-98).
69. ECCS Check Valve Leak Testing System Operational Test (see Table 14.1-99).
70. S. I. Accumulator Check Valve Hot Operational Test (see Table 14.1-100).
71. Instrument Air System (see Table 14.1-101).
72. Pressurizer Pressure and Level Control (see Table 14.1-102).
73. Process Computer (see Table 14.1-70).

14.1.3.3 Phase III (Fuel Loading and Pre-Critical Test)

These tests are listed in the order in which they are most likely to be performed:

1. Core Loading Instrumentation (see Table 14.1-37).
2. Initial Fuel Loading (see Table 14.1-53).
3. Incore Movable Detectors (see Table 14.1-54).
4. Rod Drop Time Measurement (see Table 14.1-55).
5. Rod Drive Mechanism Timing (see Table 14.1-56).
6. Rod Position Indication (see Table 14.1-57).
7. Reactor Coolant System Flow Measurement (see Table 14.1-58).
8. Reactor Coolant System Flow Coastdown (see Table 14.1-59).
9. Resistance Temperature Detector Bypass Loop Flow Verification (see Table 14.1-60).
10. Reactor Vessel O-Ring Leak Test (see Table 14.1-61).

11. Pressurizer Spray and Heater Capability and Setting Continuous Spray Flow (see Table 14.1-62).
12. Water Quality Test (see Table 14.1-63).

14.1.3.4 Phase III (Power Ascension Test)

These tests are listed in the order in which they are most likely to be performed.

1. Initial Criticality (see Table 14.1-64).
2. Low Power Test (see Table 14.1-65).
   a. Augmented Low Power Test (see Table 14.1-65a).
3. Incore Movable Detector and Thermocouple Mapping at Power (see Table 14.1-66).
4. Power Coefficient and Power Defect Measurement (see Table 14.1-67).
5. Effluent Radiation Monitor Test (see Table 14.1-68).
6. Radiation Shielding Survey (see Table 14.1-69).
7. Thermal Power Measurements and Instrument Calibration (see Table 14.1-71).
8. Automatic Control Systems Checkout (see Table 14.1-72).
9. Feedwater System (see Table 14.1-88).
10. Plant Response to Step Load Changes (see Table 14.1-73).
11. Pseudo Rod Ejection Test (see Table 14.1-74).
12. Rod Drop Test (see Table 14.1-75).
13. Below-Bank Rod Test (see Table 14.1-76).
14. Plant Loss of Electrical Load (see Table 14.1-77).
15. Loss of Offsite Power (see Table 14.1-78).
16. Shutdown from Outside the Control Room (see Table 14.1-79).

Table 14.1-80 indicates power levels at which the above tests are performed.

14.1.4 Core Loading and Initial Operation

Core loading begins when all prerequisite system tests and operations are satisfactorily completed and the NRC operating license received. Upon completion of core loading, the reactor upper internals and pressure vessel head are installed and additional mechanical and electrical tests are performed. The reactor is then ready for its initial criticality. After the initial criticality, low power tests, and power ascension test will commence. The purpose of these tests is to establish the operational characteristics of the unit and core, to acquire data for the proper calibration of setpoints, and to ensure that operation conforms to the license requirements.

14.1.4.1 Core Loading

Before starting core loading, the precore loading tests must be complete, the plant shall have a NRC operating license, and there must be an appropriately licensed operating staff. The Plant Manager is responsible for the conduct of core loading and all core loading personnel. Technical assistance will be provided by Westinghouse during the initial core loading operation. During this time, containment integrity and security must be maintained through the use of established procedures. The overall process of initial core loading is, in general, directed from the operating floor of the Reactor Building.

The as-loaded core configuration is specified as part of the core design studies conducted well in advance of plant startup and as such is not subject to change at startup. In the event that mechanical damage is sustained during core loading operations by a fuel assembly of a type for which no spare is available onsite, an alternate core scheme whose characteristics closely approximate those of the initially prescribed pattern will be determined.

The core is assembled in the reactor vessel, submerged in water containing enough dissolved boric acid to maintain a calculated core effective multiplication constant of 0.95 or lower. The refueling cavity is dry during initial core loading. Core moderator chemistry conditions (particularly boron concentration) are prescribed in the core loading procedure document and are verified periodically by chemical analysis of moderator samples taken prior to and during core loading operation.

Core loading instrumentation consists of two permanently installed source range (pulse type) nuclear channels and two temporary incore source range channels plus a third temporary channel which can be used as a spare. The permanent channels, when responding, are monitored in the Control Room by licensed plant operators; the temporary channels are installed in the containment structure and are monitored by fuel loading personnel. At least one permanent channel is equipped with an audible count rate indicator heard in the Reactor Building and the Control Room. Both plant channels have the capability of displaying the neutron flux level on strip chart recorders. The temporary channels indicate on rate meters with a minimum of one channel recorded on a strip chart recorder. Minimum count rates of 1/2 counts per second, attributable to core neutrons, are required on at least two (i.e., temporary and/or permanent source range detectors) available nuclear source channels at all times following installation of the initial nucleus of eight fuel assemblies. A response check of nuclear instruments to a neutron source shall be performed within 12 hours prior to loading of the core, or resumption of loading if delay is for more than 12 hours.

At least two neutron sources are introduced into the core loading program to ensure a neutron population of a minimum of 1/2 counts/sec for adequate monitoring of the core.

Fuel assemblies together with inserted components (control rod assemblies, burnable poison inserts, source spider, or thimble plugging devices) are placed in the reactor vessel one at a time according to a previously established and approved sequence which was developed to provide reliable core monitoring with minimum possibility of core mechanical damage. The core loading procedure documents include a detailed tabular check sheet which prescribes and verifies the successive movements of each fuel assembly and its specified inserts from its initial position in the fuel racks to its final position in the core. Multiple checks are made of component serial numbers and types at successive transfer points to guard against possible inadvertent exchanges or substitution of components and fuel assembly status boards are maintained throughout the core loading operations.

An initial nucleus of eight fuel assemblies, the first of which contains a neutron source, is the minimum source-fuel nucleus which permits subsequent meaningful inverse count rate monitoring. This initial nucleus is determined by calculation and previous experience to be markedly subcritical ($K_{eff} \leq 0.95$) under the required conditions of loading.

Subsequent fuel additions are accompanied by detailed neutron count rate monitoring to determine that the count rate does not increase excessively and that the extrapolated inverse count rate ratio is not decreasing for unexplained reasons. The results of each loading step are evaluated by SCE&G and technical advisors before the next prescribed step is started.

Criteria for safe loading require that loading operations stop immediately if:

1. An unanticipated increase in the neutron count rates by a factor of two occurs on all responding nuclear channels during any single loading step after the initial nucleus of eight fuel assemblies is loaded (excluding anticipated change due to detector and/or source movement).
2. The neutron count rate on any individual nuclear channel increases by a factor of five during any single loading step after the initial nucleus of eight fuel assemblies is loaded (excluding anticipated changes due to detector and/or source movements).
3. A decrease in boron concentration greater than 20 ppm is determined from two successive samples of Reactor Coolant System water until the decrease is explained.

An alarm in the Reactor Building and Control Room is coupled to the source range channels with a setpoint at five times the current count rate. This alarm automatically alerts the fuel loading personnel to an indication of high count rate and requires an immediate stop of all operations until the situation is evaluated by SCE&G and technical advisors.

Core loading procedures specify alignment of fluid systems to prevent inadvertent dilution of the reactor coolant, restrict the movement of fuel to preclude the possibility of mechanical damage, prescribe the conditions under which loading can proceed, identify chains of responsibility and authority, and provide for continuous and complete fuel and core component accountability.

14.1.4.2 Postloading Tests

Upon completion of core loading, the reactor upper internals and pressure vessel head are installed and additional mechanical and electrical tests are performed prior to initial criticality. The final pressure tests are conducted after filling and venting is completed.

Mechanical and electrical tests are performed on the control rod drive mechanisms. These tests include a complete operational checkout of the mechanisms. Checks are made to ensure that the control rod assembly position indicator coil stacks are connected to rod drive mechanism coils.

Tests are performed on the reactor trip circuits to test manual trip operation and actual control rod assembly drop times are measured for each control rod assembly. By use of dummy signals, the Reactor Control and Protection System is made to produce trip signals for the various plant abnormalities that require tripping.

At all times that the control rod drive mechanisms are being tested, the boron concentration in the coolant-moderator is large enough such that the shutdown margin requirements specified in the Technical Specifications are met. During individual RCCA or RCC bank motion, source range instrumentation is monitored for unexpected changes in core reactivity.

A complete functional electrical and mechanical check is made of the incore nuclear flux mapping system at operating temperature and pressure.

14.1.4.3 Initial Criticality

Initial criticality is established by sequentially withdrawing the shutdown and control groups of control rod assemblies from the core, leaving the last withdrawn control group inserted far enough in the core to provide effective control when criticality is achieved, and then continuously diluting the heavily borated reactor coolant until the chain reaction is self-sustaining. Successive stages of control rod assembly group withdrawal and of boron concentration reduction are monitored by observing changes in neutron count rate as indicated by the regular source range nuclear instrumentation as functions of group position during rod motion and, subsequently, of reactor coolant boron concentration and primary water addition to the Reactor Coolant System during dilution. Throughout this period, samples of the primary coolant are obtained and analyzed for boron concentration.

Primary safety reliance is based on inverse count rate ratio monitoring as an indication of the nearness and rate of approach to criticality of the core during control rod assembly group withdrawal and during reactor coolant boron dilution. The rate of approach is reduced as the reactor approaches extrapolated criticality to ensure that effective control is maintained at all times.

Written procedures specify alignment of fluid systems to allow controlled starting, stopping, and adjustment of the rate of the approach to criticality. These procedures also identify chains of responsibility and authority during initial criticality.

14.1.4.4 Low Power Testing

A prescribed program of reactor physics measurements is undertaken to verify that the basic static and kinetic characteristics of the core are as expected and that the values of the kinetic coefficients assumed in the safeguards analysis are indeed conservative.

The measurements are made at low power and primarily at or near operating temperature and pressure. Measurements, to include verification of calculated values of control rod assembly group reactivity worths, of moderator temperature coefficient under various core conditions, of differential boron concentration reactivity worth, and of critical boron concentrations as functions of control rod assembly group configuration, are made. In addition, measurements of the relative power distributions are made. Concurrent tests are conducted on the instrumentation including the source and intermediate range nuclear channels.

In accordance with NUREG 0737, item I.G.1, a discussion of the special low power testing to be performed at the Virgil C. Summer Station has been submitted to the NRC under separate cover letters dated 10/31/80, 12/2/80, and 12/22/80.

Detailed procedures are prepared to specify the sequence of tests and measurements to be conducted and the conditions under which each is to be performed to ensure both safety of operation and the relevancy and consistency of the results obtained. If significant deviations from design predictions exist, unacceptable behavior is revealed, or apparent anomalies develop, a review by qualified personnel will be performed. The Plant Manager may determine that a review by the Plant Safety Review Committee is appropriate prior to increasing power to the next testing plateau.

14.1.4.5 Power Ascension

When the operating characteristics of the reactor and plant are verified by low power testing, a program of power level escalation in successive stages brings the plant to its full rated power level. Prior to starting to the next higher power plateau, as defined by the startup test program, management approval shall be obtained; also, the high flux trip shall be reset to a value no greater than 20 percent beyond the next power level. During the power escalation, a predetermined test program is followed to verify that the reactor and plant are performing as expected. The minimum test requirements for each successive stage of power escalation are specified.

Measurements are made to determine the relative power distribution in the core as functions of power level and control assembly group position.

Secondary system heat balances ensure that the several indications of power level are consistent and provide bases for calibration of the power range nuclear channels. The ability of the Reactor Control System to respond effectively to signals from primary and secondary instrumentation under a variety of conditions encountered in normal operations is verified.

At prescribed power levels, the dynamic response characteristics of the Reactor Coolant and Steam Systems are evaluated. These responses are evaluated for step load changes of 10 percent and a plant loss of electrical load from 100 percent power.

Adequacy of radiation shielding is verified by gamma and neutron radiation surveys inside the containment and throughout the station site. Periodic sampling is performed to verify coolant chemistry and activity.

The sequence of tests, measurements, and intervening operations is described in the power escalation procedure with specific details relating to the conduct of the several tests and measurements.

14.1.5 Administrative Procedures (System Operation)

Whenever the test allows, the plant operating procedures for Virgil C. Summer Nuclear Station will be incorporated into the test procedures. This will help in evaluating plant operating procedures. If during a test it is found that the operating procedure is not adequate, the test procedure will be changed in the manner described in Section 14.1.2.2; and the operating procedure shall be changed in accordance with Chapter 13. Any operating procedure, or part of one, which is referenced in a test procedure must be approved.

Table 14.1-1
Fire Protection System

1.0 Objective

Demonstrate that the Fire Protection System is capable of providing adequate fire protection under all conditions, including loss of power to the motor driven pump.

2.0 Prerequisites

Fire Protection System installation and component checks completed.

3.0 Test Methods

3.1 Align the subsystems for operation and establish normal flow paths for water systems.

3.2 Check operation of water systems and CO_2 system.

3.3 Verify pump heads and flow rates under both normal and emergency power conditions of the water systems.

3.4 Verify operation and response of detector systems.

4.0 Acceptance Criteria

4.1 Alarms, interlocks, and detection devices function as per design requirements.

4.2 System is capable of providing protection in accordance with applicable fire protection codes.

4.3 Where appropriate, flows, pressures, and spray patterns are as per design requirements.

Table 14.1-2
Containment Isolation Valves Leakage Rate Test

1.0 Objective

Demonstrate that the leakage from containment isolation valves and gasketed blind flanges required to be tested by 10 CFR 50, Appendix J is within allowable limits.

2.0 Prerequisites

2.1 Portions of the systems containing isolation valves and/or gasketed blind flanges have been successfully pressure tested.

2.2 Motor operated and air operated containment isolation valves have been functionally tested.

2.3 Portions of the systems containing isolation valves and/or gasketed blind flanges have been properly drained and vented.

2.4 Containment isolation valves have been closed using their normal mode of operation.

3.0 Test Methods

3.1 A pressure of not less than P_a is applied against the isolation valve or gasketed blind flange.

3.2 Measurement of valve leakage is made using a rotameter array or other equivalent instrumentation.

4.0 Acceptance Criteria

4.1 Containment isolation valve and gasketed blind flange leakage rates are within allowable design limits.

Table 14.1-3
Containment Penetrations Leakage Rate Test

1.0 Objective

Demonstrate that the leakage from containment penetrations required to be tested by 10 CFR 50, Appendix J is within allowable limits.

2.0 Prerequisites

2.1 Penetrations have been properly installed.

3.0 Test Methods

3.1 A pressure of not less than P_a is applied to the penetration.

3.2 Measurement of penetration leakage is made using a rotameter array or other equivalent instrumentation.

4.0 Acceptance Criteria

4.1 Containment penetration leakage rates are within allowable design limits.

Table 14.1-4
Containment Air Locks Leakage Rate Test

1.0 Objective

Demonstrate that leakage from the containment personnel air locks and equipment hatch is within allowable limits.

2.0 Prerequisites

2.1 Containment personnel air locks and equipment hatch have been properly installed.

3.0 Test Methods

3.1 A pressure of not less than P_a is applied to the seals of the containment personnel air lock and equipment hatch.

3.2 Measurement of seal leakage is made using a rotameter array or other equivalent instrumentation.

4.0 Acceptance Criteria

4.1 Containment personnel air lock and equipment hatch leakage is within allowable design limits.

Table 14.1-5
Reactor Building Structural Acceptance Test

1.0 Objective

Verify the structural integrity of the Reactor Building.

2.0 Prerequisites

2.1 Reactor Building penetrations installed and penetration leak tests (Type B test) completed.

2.2 Isolation valve leak test (Type C test) completed.

2.3 Reactor Building Ventilation Systems operable to extent required to control Reactor Building internal temperature.

3.0 Test Methods

3.1 Prior to initial fuel loading, the Reactor Building will be subjected to a pressure equivalent to 115 percent of the Reactor Building designed pressure. This test demonstrates that the Reactor Building is capable of resisting the postulated accident pressure. In addition, by measuring the structural response and comparing the results with analytical predictions, the test verifies that the structure does behave as anticipated.

3.2 Instrumentation, measuring systems, pressurization procedure, deformation, strain and temperature measurements, crack pattern mapping, and data acquisition schedules for the preoperational structural acceptance test will be in accordance with the approved test procedure.

4.0 Acceptance Criteria

The Reactor Building meets structural integrity design requirements.

Table 14.1-6
Containment Integrated Leakage Rate Test

1.0 Objective

Demonstrate that the containment leakage rate following a postulated loss of coolant accident (LOCA) is within allowable limits.

2.0 Prerequisites

2.1 Reactor Building structural acceptance test completed.

2.2 Affected systems lined up in their post accident mode.

3.0 Test Methods

3.1 The containment is pressurized at a rate of 5 psi per hour or less to P_a as defined in the approved test procedure.

3.2 Containment temperature is held essentially constant for 24 hours while the internal temperature, pressure, and dewpoint are closely monitored.

3.3 Using the perfect gas law, the change in the containment air mass is computed.

3.4 The leakage rate in percent/day is computed from the changes in containment air mass.

3.5 A known leak is superimposed on the containment to verify instrumentation accuracy.

4.0 Acceptance Criteria

4.1 Integrated leakage rate is within allowable design limits.

4.2 Instrumentation accuracy is verified to be within allowable design limits.

Table 14.1-7

Unit Auxiliary, Emergency Auxiliary, and Engineered Safety Features Transformers

1.0 Objective

1.1 Demonstrate the capability of the unit auxiliary, emergency auxiliary, and engineered safety features transformers to supply electrical power to the 7200 volt buses.

1.2 Verify operation of protection devices and functional operation of controls and interlocks.

2.0 Prerequisites

2.1 230 kV substation operational and energized.

2.2 Meters, relays, and protective devices calibrated and tested.

2.3 125 volt DC available.

2.4 Erection work on transformers and switchgear completed.

2.5 Transformer oil and fan systems tested and in service.

2.6 Isolated phase bus tested and ready for service.

2.7 Breaker controls and transfer scheme verified.

2.8 PT and CT circuits checked for polarity and continuity.

2.9 7200 volt breakers racked out.

2.10 115 kV supply line energized.

3.0 Test Methods

3.1 Simulate signals to temperature controls and verify operation of transformer oil pumps and fans.

3.2 Simulate signals to verify annunciators for transformer protective devices.

3.3 Energize transformers and verify phase rotation.

4.0 Acceptance Criteria

Transformers provide reliable source of electrical power to 7200 volt buses in accordance with design requirements and Section 8.3.

Table 14.1-8
7200 Volt Electrical System

1.0 Objective

1.1 Verify that 7200 volt buses can be energized from their respective normal and alternate sources.

1.2 Verify that electrical and mechanical interlocks function properly.

2.0 Prerequisites

2.1 Breakers in the 7200 volt buses are racked out and tagged.

2.2 Meters, relays, and protective devices calibrated and tested.

2.3 125 volt DC available.

2.4 Phase rotation checked on 7200 volt buses.

2.5 Unit auxiliary, emergency auxiliary, and ESF transformers energized.

3.0 Test Methods

3.1 Rack in and close 7200 volt breakers to energize associated 7200 volt buses.

3.2 Record voltage and verify phase relationship.

3.3 Shift buses to alternate power sources as applicable and verify phase relationship.

3.4 Verify 7200 Volt BOP buses will transfer from normal source to alternate source if a fault occurs on normal supply.

3.5 Verify 7200 Volt ESF buses will transfer from normal source to emergency diesel generator if voltage is lost on normal supply.

4.0 Acceptance Criteria

4.1 The 7200 volt buses are capable of being energized from their normal and alternate sources and that proper phase relationship is exhibited.

4.2 System interlocks and alarms function properly.

4.3 BOP buses transfer from normal source to alternate source if a fault occurs on normal supply.

Table 14.1-8 (continued)
7200 Volt Electrical System

4.4 ESF uses will transfer from normal source to emergency diesel generator if voltage is lost on normal supply,

Table 14.1-9
480 Volt Buses

1.0 Objective

1.1 Verify that 480 volt buses can be energized from their normal and alternate sources.

1.2 Verify that electrical and mechanical interlocks function properly.

2.0 Prerequisites

2.1 Breakers in the 480 volt buses are racked out and tagged.

2.2 Meters, relays, and protective devices calibrated and tested.

2.3 125 volt DC and 7.2 kV buses energized.

2.4 Phase rotation checked on 480 volt buses.

3.0 Test Methods

3.1 Close 7.2 kV breakers to energize load center transformers and buses.

3.2 Measure voltage and verify phase relationship.

3.3 Shift buses to alternate power sources as applicable and verify phase relationship.

3.4 Simulate loss of power.

4.0 Acceptance Criteria

4.1 480 volt buses are capable of being energized from their normal and alternate sources, and proper phase relationship is exhibited.

4.2 The 480 volt buses respond correctly to a loss of power.

4.3 Interlocks and alarms function properly.

Table 14.1-10
480 Volt Motor Control Centers

1.0 Objective

1.1 Verify that 480 volt motor control centers can be energized from their normal sources.

1.2 Verify that electrical and mechanical interlocks function properly.

2.0 Prerequisites

2.1 All breakers in 480 volt motor control centers are racked out and tagged.

2.2 Meters, relays, and protective devices calibrated and tested.

2.3 125 volt DC available.

2.4 480 volt buses energized.

2.5 Phase rotation checked on motor control centers.

3.0 Test Methods

3.1 Rack in and close motor control center supply breakers.

3.2 Measure voltage and verify phase relationship.

3.3 Simulate loss of power.

4.0 Acceptance Criteria

4.1 Motor control centers are capable of being energized from their normal sources, and proper phase relationship is exhibited.

4.2 The 480 volt motor control centers respond correctly to a loss of power.

4.3 System interlocks and alarms function properly.

Table 14.1-11
120 Volt AC

1.0 Objective

Demonstrate the capabilities of the 120 volt vital instrument power system and the 120 volt AC regulated instrument power system to supply power to instrumentation and control loads under normal and emergency conditions at full load.

2.0 Prerequisites

2.1 120 volt instrument power systems installation and component checks completed.

2.2 480 volt motor control centers available.

2.3 125 volt DC system operable

3.0 Test Methods

3.1 Energize 120 volt instrument power buses from their normal power sources and load to full load using a load bank.

3.2 Demonstrate ability to transfer each vital instrument bus manually to a backup instrument bus and back to its static inverter.

3.3 Trip the normal power supplies to the static inverters. Verify automatic transfer to alternate DC source. Verify transfer back to normal supply when re-energized.

3.4 Demonstrate ability to transfer each instrument panel manually to its alternate source.

4.0 Acceptance Criteria

4.1 Vital buses or panels can be manually transferred to alternate sources.

4.2 Vital inverters will transfer to the alternate 125V DC input source upon loss of normal 480V AC input source. Normal 120V AC is maintained during the transfer.

4.3 System interlocks and alarms function properly.

4.4 Vital AC inverters will supply their design load at 60 amps.

Table 14.1-12
DC System

1.0 Objective

Demonstrate the capability of the DC system to provide a source of reliable, uninterruptible DC power for normal and emergency instrumentation, control, and power loads.

2.0 Prerequisites

2.1 480 volt AC power available.

2.2 Battery Room Ventilation System operable.

2.3 Batteries, battery chargers, and DC distribution system, including protective devices, installation, and component checks completed.

2.4 DC breakers are open.

3.0 Test Methods

3.1 Energize the battery chargers and verify this normal feed to bus.

3.2 Verify alarms and interlocks.

3.3 Discharge the batteries at a controlled rate and determine ampere-hour capacity.

3.4 Adjust chargers to supply DC load and charge batteries simultaneously.

3.5 De-energize battery chargers while the applicable buses are carrying their normal station load to verify that battery will maintain load.

3.6 Verify that 125 volt bus can be fed from the backup charger upon loss of normal charger (manual transfer).

3.7 Verify ground detection by connecting variable load resistor to ground.

4.0 Acceptance Criteria

4.1 System interlocks and alarms function properly.

4.2 Batteries are capable of supplying plant DC power upon de-energization of their chargers.

Table 14.1-12 (continued)
DC System

4.3 Battery chargers are capable of maintaining normal bus loads concurrent with charging the batteries.

4.4 Bus can be supplied by backup charger.

Table 14.1-13
Plant Paging and Communication System

1.0 Objective

1.1 Demonstrate the adequacy of the plant paging systems intracommunication between all local stations in each separate system, and interconnection of the plant PABX system to the commercial telephone service and SCE&G microwave system.

1.2 Demonstrate that the radiation emergency (site evacuation) alarm can be heard from any location in the plant under all required conditions.

1.3 Demonstrate operability of Reactor Building evacuation alarm and fire alarm.

2.0 Prerequisites

2.1 Communications systems installation and component checks completed.

2.2 Sound levels established for locations where noise levels might interfere with communication.

3.0 Test Methods

3.1 Test the portable stations, page/party line phone station, and redundant communication phone stations for proper operation.

3.2 Test interconnection of the plant PABX system to the commercial telephone service, and SCE&G microwave system.

3.3 Verify alarms.

3.4 Shift PABX equipment to alternate power sources and verify operation.

4.0 Acceptance Criteria

4.1 Communication systems provide for paging, normal plant communications, shutdown communications, interconnection to SCE&G microwave system and commercial telephone service and alarm signaling in accordance with design requirements and Section 9.5.2.

4.2 Evacuation alarm can be heard from any location in the plant.

4.3 Paging systems and alarms will not produce sound pressure levels above 130 dB level where personnel will conduct normal plant communications.

Table 14.1-14
Diesel Fuel Oil Transfer and Storage System

1.0 Objective

Demonstrate that the Diesel Fuel Oil Transfer and Storage System supplies fuel oil to the diesel fuel oil day tanks and verify modes of operation.

2.0 Prerequisites

2.1 Fire protection is available.

2.2 Diesel Fuel Oil System installation and component checks completed.

3.0 Test Methods

3.1 Align system for operation and establish normal transfer flow paths.

3.2 Verify capability to transfer fuel oil to each day tank.

3.3 Verify alarms and automatic pump operations.

4.0 Acceptance Criteria

Fuel transfer capability of the system meets the design requirements.

Table 14.1-15
Emergency Diesel Generators

1.0 Objective

1.1 Demonstrate manual start and synchronization of the diesel generators.

1.2 Demonstrate load-carrying capacity of diesel generators.

1.3 Demonstrate fuel consumption of diesels.

1.4 Demonstrate proper operation of diesel auxiliaries during the load carrying capacity test.

2.0 Prerequisites

2.1 Station batteries charged and DC control power available.

2.2 Relays calibrated and all normal bus protective devices checked and in service.

2.3 Diesel engine auxiliary systems installation and component checks completed as specified.

2.4 Diesel room ventilation and fire protection available.

2.5 Diesel Fuel Oil System operable.

3.0 Test Methods

3.1 Demonstrate manual start and synchronization of each diesel generator, including synchronizing the diesel generator unit to offsite power while the unit is connected to the emergency load, isolating the diesel generator unit, and restoring it to standby status.

3.2 Verify timing of diesel generators starting sequence and available for load.

3.3 Verify capability to control diesel generators in local and remote operation.

3.4 The diesel generators will be operated at continuous rated load for 22 hours. The load will then be increased to the two hour rating and held at this condition for a period of two hours. During this 24 hour period, the indicated readings from supervisory instrumentation will be recorded to establish base line operating conditions.

3.5 Conduct load-carrying duration test.

Table 14.1-15 (continued)
Emergency Diesel Generators

3.6 Verify load rejection and overspeed trip.

3.7 Demonstrate diesel generator reliability by performing 69/N starts (where N is the number of diesel generator units).

4.0 <u>Acceptance Criteria</u>

4.1 Diesel generators function in maintaining the 7200 volt ESF buses as designed.

4.2 Diesel generators do not overspeed when load is removed.

4.3 Each redundant onsite power source and its load group can function without any dependence upon any other redundant load group or portion thereof.

4.4 Diesel auxiliaries perform their design requirements.

4.5 Diesel generators demonstrate required reliability.

Table 14.1-16
Response to Loss of Instrument Air

1.0 Objective

Demonstrate that pneumatically operated “Active” valves fail to their safe position on a loss of instrument air.

2.0 Prerequisites

2.1 Instrument Air System installation and component checks completed.

2.2 Associated systems completed to the extent necessary to allow conduct of this test.

2.3 System has been blown down and cleanliness requirements met.

3.0 Test Methods

Note: Specific valves and systems may be tested individually.

3.1 Align system for normal operation.

3.2 Reduced instrument air pressure to zero psig.

3.3 Observe the response of pneumatically operated “Active” valves during loss of air pressure and record the position to which each valve fails.

3.4 Air operated valves equipped with safety related volume tanks will be isolated from the instrument air header and stroked to verify their operability.

4.0 Acceptance Criteria

4.1 Pneumatically operated “Active” valves fail to their “safe” position on loss of instrument air.

4.2 Components with “safety related” air volume tanks operate in accordance with design.

Table 14.1-17
Auxiliary Building Ventilation System (Radioactive Portion)

1.0 Objective

1.1 Demonstrate the capabilities of the Auxiliary Building Ventilation System to provide for control and disposal of airborne radioactivity.

1.2 Confirm the proper operation of system interlocks and controls.

2.0 Prerequisites

2.1 Auxiliary Building Ventilation System installation and component checks completed.

2.2 Associated systems completed to the extent necessary to allow conduct of this test.

3.0 Test Methods

3.1 Align system for normal operation.

3.2 Verify building internal negative pressure differential with respect to atmosphere.

3.3 Test positioning on pneumatically operated dampers.

3.4 Simulate isolation actuation signal and observe system response.

3.5 Verify fan and damper, interlocks and permissives.

4.0 Acceptance Criteria

4.1 System provides for control and disposal of airborne radioactivity in accordance with design requirements and Section 9.4.

4.2 Fans and dampers function as per design.

4.3 Auxiliary Building internal pressure is less than atmospheric.

Table 14.1-18
Fuel Handling Building Ventilation System (Radioactive Portion)

1.0 Objective

Demonstrate the capabilities of the Fuel Handling Building Ventilation System to provide for control and disposal of airborne radioactivity.

2.0 Prerequisites

2.1 Fuel Handling Building Ventilation System installation and component checks completed.

2.2 Associated systems completed to the extent necessary to allow conduct of this test.

3.0 Test Methods

3.1 Align system for normal operation.

3.2 Verify fan and damper, interlocks, and permissives.

3.3 Test positioning on pneumatically operated dampers.

3.4 Simulate isolation actuation signal and observe system response.

3.5 Verify building internal negative pressure differential with respect to atmosphere.

4.0 Acceptance Criteria

4.1 System provides for control and disposal of airborne radioactivity in accordance with design requirements and Section 9.4.

4.2 Fans and dampers function as per design.

4.3 Building internal pressure with respect to atmospheric pressure is per design.

Table 14.1-19

Process and Area Radiation Monitoring System

1.0 Objective

Demonstrate the capability of the Process and Area Radiation Monitoring Systems to monitor effectively the levels of radiation in the plant or its effluents and to initiate isolation and alarms as required.

2.0 Prerequisites

2.1 Process and Area Radiation Monitoring Systems installation and component checks completed.

2.2 Associated systems completed to the extent necessary to allow the conduct of this test.

3.0 Test Methods

3.1 Align system for normal operation. Position valves in associated systems as necessary to allow response to isolation signals.

3.2 Verify proper functioning of system detectors by utilizing test sources and other procedures as appropriate.

3.3 Verify proper system response to simulated alarm conditions by monitoring controller outputs, alarm indications, and the operation of isolation valves where possible.

4.0 Acceptance Criteria

System effectively monitors and responds to levels of radiation in the plant areas and effluents in accordance with design requirements and Sections 11.4, 12.1.4, and 12.2.4.

Table 14.1-20
Component Cooling Water System

1.0 Objective

Demonstrate the capability of the Component Cooling System to supply design flow to system components.

2.0 Prerequisites

2.1 Component Cooling (CC) System installation and component checks completed.

2.2 Adequate supply of demineralized water available.

2.3 Associated systems completed to the extent necessary to allow conduct of this test.

3.0 Test Methods

3.1 Verify the ability of the CC pumps to deliver design low and high speed flows to system components.

3.2 Verify the ability of the CC system to perform its design functions for SI and recirculation modes of operation.

3.3 Verify CC system controls operate as designed.

4.0 Acceptance Criteria

4.1 System flows, pressures, and automatic functions are in accordance with design requirements identified on the applicable flow diagrams.

4.2 System interlocks, instrumentation, and alarms function properly.

Table 14.1-21
Service Water System

1.0 Objective

Demonstrate the capability of the Service Water System to provide adequate cooling water.

2.0 Prerequisites

2.1 Service Water System installation and component checks completed.

2.2 Associated systems completed to the extent necessary to allow conduct of this test.

3.0 Test Methods

3.1 Align system for normal operation.

3.2 Verify system flow rates and system control.

4.0 Acceptance Criteria

4.1 System flows, pressures, and automatic functions are in accordance with design requirements of Section 9.2.1.

Table 14.1-22
Boric Acid Batching and Transfer System

1.0 Objective

Verify proper functioning of equipment and instrumentation utilized in batching, storage, transfer, and recirculation of boric acid solutions.

2.0 Prerequisites

2.1 Boric Acid System installation and component checks completed.

2.2 Adequate supply of Grade A water available.

2.3 Steam supply available to batching tank jacket heater.

2.4 Associated systems completed to the extent necessary to allow conduct of this test.

3.0 Test Methods

3.1 Align system for normal operation.

3.2 Verify boric acid tank and batching tank level setpoints, controller functions, and steam delivery to batching tank heaters.

3.3 Verify capability of boric acid transfer pumps to deliver water from the batching tank to the boric acid tanks and to recirculate each boric acid tank.

3.4 Verify capability of supplying the charging pump suction header.

4.0 Acceptance Criteria

4.1 System provides for batching, storage, transfer, and recirculation flow paths in accordance with Section 9.3.4.

4.2 Interlocks, automatic functions, alarms, flows, and pressures are within design limits.

Table 14.1-23

Heat Tracing for Boron Injection Tank and Associated Piping

1.0 Objective

Demonstrate the ability of the Heat Tracing System to maintain proper temperature control in the various piping systems involved with the boron injection tank.

2.0 Prerequisites

2.1 Heat Tracing System installation and component checks completed.

2.2 Associated systems completed to the extent necessary to allow the conduct of this test.

3.0 Test Methods

3.1 Energize Heat Tracing System.

3.2 Monitor temperatures maintained by each heat tracing circuit with the system in a static condition.

3.3 Place boron injection recirculation pump in operation and establish transfer flow path.

3.4 Monitor temperatures maintained by each heat tracing circuit.

4.0 Acceptance Criteria

Each heat tracing circuit maintains temperature within allowable design limits.

Table 14.1-24
Reactor Building Cooling System

1.0 Objective

1.1 Demonstrate the operation of the Reactor Building cooling equipment for normal plant operating conditions.

1.2 Demonstrate the capacity of the Reactor Building cooling units to maintain area temperatures within design limits during normal operating conditions.

2.0 Prerequisites

2.1 Reactor Building Cooling System installation and component checks completed.

2.2 Service Water and Industrial Cooling Water Systems operable.

2.3 Associated systems completed to the extent necessary to allow conduct of this test.

3.0 Test Methods

3.1 Align system for normal operation.

3.2 Verify fan, damper, and cooling unit controls, interlocks, and permissives.

3.3 With the plant at, or near, normal operating conditions, survey various areas to verify that temperatures do not exceed design limits.

4.0 Acceptance Criteria

4.1 System interlocks and controls function properly.

4.2 Temperature survey does not show any hot spots or exceed design limits.

Table 14.1-25
Chemical and Volume Control System

1.0 Objective

Demonstrate that the Chemical and Volume Control System (CVCS) performs as required during plant operation.

2.0 Prerequisites

2.1 CVCS installation and component checks completed.

2.2 Reactor Coolant System at the condition specified in the approved test procedure.

2.3 Adequate supply of Grade A water available in refueling water storage tank or reactor makeup tank.

2.4 Associated systems completed to the extent necessary to allow conduct of this test.

3.0 Test Methods

3.1 Align CVCS for normal operation and establish normal flow paths.

3.2 Verify capacities of letdown orifices and pressure drop of reactor coolant filter.

3.3 Check operation of the letdown line temperature and pressure controllers with the demineralizers bypassed.

3.4 Verify operation of excess letdown and seal water subsystems.

3.5 Verify flow rates and pressure drops of demineralizers.

3.6 Verify charging pumps' flow rates and the seal water flow rate for each reactor coolant pump.

3.7 Verify volume control tank level controller operation. Check reactor makeup control system response to inventory changes of volume control tank.

4.0 Acceptance Criteria

System performance, interlocks, and automatic functions are in accordance with Section 9.3.4.

Table 14.1-26
Pressurizer Relief Tank

1.0 Objective

Verify that the pressurizer relief tank provides for adequate control of the discharge from the primary reliefs and safety valves.

2.0 Prerequisites

2.1 Hydrostatic test of pressurizer relief tank completed.

2.2 Pressurizer relief tank installation checks completed.

2.3 Radioactive waste disposal system completed to the extent necessary to allow conduct of this test.

2.4 Adequate supply of Grade A water available.

2.5 Adequate supply of nitrogen available.

3.0 Test Methods

3.1 Verify alarms, interlock operations, and spray flow control.

3.2 Demonstrate ability to maintain nitrogen blanket in pressurizer relief tank.

3.3 Verify transfer flow paths from pressurizer relief tank.

4.0 Acceptance Criteria

Pressurizer relief tank provides disposal of primary plant coolant discharge in accordance with design requirements and Section 5.5.11.

Table 14.1-27

Reactor Coolant System Heatup for Hot Functional Testing

1.0 Objective

Perform functional checks on the Reactor Coolant System and associated systems components and instrumentation required to bring the plant from a cold shutdown condition to normal operating temperature and pressure.

2.0 Prerequisites

2.1 Reactor Coolant System and supporting systems valve lineups for normal operation completed and normal flow paths established.

2.2 Reactor Coolant System cold hydrostatic test completed.

2.3 Preoperational and acceptance tests completed as necessary.

2.4 Instrumentation and control checkouts and calibrations completed as necessary.

2.5 Secondary system ready to receive steam and return feedwater to the steam generators.

2.6 Diesel generators fully operable. Batteries and battery chargers are in service.

2.7 Systems completed to the extent necessary to allow conduct of this test.

3.0 Test Methods

3.1 Establish specified charging and letdown flow rate and seal water flow to the reactor coolant pumps.

3.2 Operate reactor coolant pumps.

3.3 Energize pressurizer heaters and conduct solid system pressure control demonstration.

3.4 Perform chemistry adjustment demonstrations.

3.5 Form pressurizer steam bubble.

3.6 At approximately 100°F intervals, stabilize system parameters and record required data, measurements, and observations for incore thermocouple and RTD cross calibration, reactor coolant pump vibration measurements, and Reactor Coolant System thermal expansion measurements.

Table 14.1-27 (continued)
Reactor Coolant System Heatup for Hot Functional Testing

3.7 Verify ability to maintain steam generator levels by operation of the atmospheric steam dump and the Emergency Feedwater System.

3.8 Check operability of pressurizer power operated relief valves, spray valves, and steam generator atmospheric steam dump valves by either placing in service or performing functional check.

3.9 Main steam power operated relief valves are functionally checked.

4.0 Acceptance Criteria

Systems, components, instrumentation, and controls function within allowable design limits.

Table 14.1-28
Systems Thermal Expansion

1.0 Objective

1.1 Verify that the applicable systems piping can expand without obstruction during initial heatup to normal operating conditions.

1.2 Confirm that systems piping and components return to their approximate baseline cold position after cooldown to ambient conditions.

2.0 Prerequisites

2.1 To commence with the Reactor Coolant System heatup for hot functional testing.

2.2 Hanger lock pins removed and expansion clearances set to the proper cold values.

2.3 Reference points for measurements established.

2.4 Piping supports are verified for proper installation prior to heatup for thermal expansion measurements.

3.0 Test Methods

3.1 Record cold baseline data.

3.2 Obtain a set of measurements during Reactor Coolant System heatup at approximately 250, 350, 450, and 550°F.

3.3 Upon completion of Reactor Coolant System cooldown, obtain a set of measurements.

4.0 Acceptance Criteria

4.1 Piping movements do not cause piping rubs or interference with other equipment.

4.2 Piping movements do not cause undue stresses as determined by inspection.

4.3 Piping and components return to approximate baseline position on cooldown.

Table 14.1-29
Hot Functional Testing

1.0 Objective

Perform functional checks on the Reactor Coolant System and associated systems components and instrumentation required during normal hot plant operation.

2.0 Prerequisites

2.1 Reactor Coolant System heatup completed, Reactor Coolant System conditions of 525-557°F and 2235 psig being maintained.

2.2 Systems completed to the extent necessary to allow conduct of this test.

3.0 Test Methods

3.1 Check the response, stability, and general control characteristics of the pressure control system.

3.2 Perform other tests which required the Reactor Coolant System to be at normal operating no-load temperature and pressure as outlined in the hot functional testing procedures.

4.0 Acceptance Criteria

Systems, components, instrumentation, and controls function within allowable design limits.

Table 14.1-30
Emergency Feedwater System

1.0 Objective

Demonstrate that the Emergency Feedwater System is capable of providing adequate quantities of feedwater for the removal of decay heat.

2.0 Prerequisites

2.1 Emergency Feedwater System installation and component checks completed.

2.2 Condensate storage tank adequately filled to supply the required water for the duration of the test.

3.0 Test Methods

3.1 Verify flow rates of the pumps and system control.

3.2 Verify that the turbine driven emergency feedwater pump cold starts successfully five successive times.

4.0 Acceptance Criteria

4.1 Emergency flow capability of the system meets the design requirements.

4.2 System interlocks and alarms function within allowable design limits.

4.3 The turbine driven emergency feedwater pump cold starts successfully five successive times.

Table 14.1-31
Engineered Safety Features Circuitry

1.0 Objective

1.1 Verify proper operation of motor and air operated valves to the different ESF signals and various interlocks.

1.2 Verify proper operation of breakers to ESF signals.

2.0 Prerequisites

2.1 Associated systems have been checked.

2.2 Necessary breakers are racked out and other conditions are as outlined in test.

3.0 Test Methods

Simulate various ESF signals and note component responses to signals.

4.0 Acceptance Criteria

Valves and breaker respond properly to actuation signals.

Table 14.1-32
Nuclear Sampling System

1.0 Objective

Verify that a quantity of representative fluid can be obtained from each sampling point.

2.0 Prerequisites

2.1 Reactor Coolant System at operating pressure and temperature.

2.2 Installation checks complete.

3.0 Test Methods

3.1 From each nuclear sampling point take a sample.

3.2 Check operation of remotely and manually operated valves.

4.0 Acceptance Criteria

Flows are adequate for gathering samples. Remote valve actuation signals get proper response.

Table 14.1-33
Reactor Coolant System Cooldown from Hot Functional Testing

1.0 Objective

Perform functional checks on the Reactor Coolant System and associated systems components and instrumentation required to bring the plant to the cooled-down, depressurized condition.

2.0 Prerequisites

2.1 Reactor Coolant System hot functional testing completed, Reactor Coolant System conditions of 525-557°F and 2235 psig being maintained.

2.2 Reactor makeup water storage tank contains sufficient quantity of Grade A water to accommodate the contraction of the primary coolant during cooldown.

2.3 Specified systems completed to the extent necessary to allow conduct of this test.

3.0 Test Methods

3.1 Demonstrate the Reactor Coolant System degassing procedure.

3.2 Secure two reactor coolant pumps and commence plant cooldown by decreasing the set pressure of the steam dump valves.

3.3 Record data as required for incore thermocouple and RTD cross calibration.

3.4 When reactor coolant temperature and pressure are below 350°F and 425 psig, place the Residual Heat Removal System in operation.

3.5 Collapse the steam bubble.

3.6 Continue pressurizer and Reactor Coolant System cooldown to 140°F and reduce pressure to 50 psig.

3.7 Establish conditions for Reactor Coolant System draining.

4.0 Acceptance Criteria

Systems, components, instrumentation, and controls function within allowable design limits.

Table 14.1-34
Residual Heat Removal System Flow Tests

1.0 Objective

1.1 To record actual RHR pump data (flow versus head) and compare this to the manufacturer's pump curve.

1.2 To demonstrate proper flow rates in the cold leg injection, cold leg recirculation, and hot leg recirculation modes.

1.3 To demonstrate that motor operated valves in the LHSI system stroke properly against maximum differential pressure.

1.4 Verify proper operation of flow control valves (603A & B, 605A & B).

1.5 To verify the friction loss in the sump suction lines to the RHR pumps and verify vortex control.

1.6 To demonstrate the automatic opening of the RHR sump isolation valves (8811A & B, 8812A & B) on receipt of a RWST lo-lo level signal coincident with a safety injection signal.

1.7 To demonstrate proper RHR system flow rate in the cooldown lineup (RHR pumps taking suction from the Reactor Coolant System loops and discharging back into the Reactor Coolant System cold legs with the reactor vessel head removed).

1.8 To demonstrate that interlocks associated with the following valves operate properly; 8701A, 8701B, 8702A, 8702B, 8706A, and 8706B.

2.0 Prerequisites

2.1 Reactor vessel head is not installed and the internals are not in the vessel.

2.2 Sufficient water available in the RWST to conduct the test.

3.0 Test Methods

3.1 Each RHR pump will be run at various flow rates to record pressure and flow data (motor currents and vibration data will be recorded at full flow).

3.2 Each RHR pump will be run in the cold leg injection, cold leg recirculation (with suction from the RWST instead of the containment sump), and hot leg recirculation (with suction from the RWST instead of the containment sump) modes to record flow rates.

Table 14.1-34 (continued)
Residual Heat Removal System Flow Tests

3.3 Each motor operated valve in the low head safety injection system will be stroked against maximum differential pressure.

3.4 The RHR pumps will be run at various flow rates using flow control valves 603A & B, and 605A & B.

3.5 Each RHR recirculation sump will be flooded with water and each RHR pump will be operated taking suction from its respective sump to verify friction losses in each sump suction line and to demonstrate vortex control.

3.6 Each of the sump isolation valves (8811A & B and 8812A & B) will receive a lo-lo RWST level coincident with a safety injection signal to verify that each of the four valves open.

3.7 Each of the RHR pumps will take a suction from the Reactor Coolant System (with the level in the vessel at least one foot above the nozzles) and discharge back into the Reactor Coolant System cold legs.

3.8 Demonstrate that the interlocks associated with valves 8701A, 8701B, 8702A, 8702B, 8706A, and 8706B operate properly.

4.0 <u>Acceptance Criteria</u>

4.1 Pump performance characteristics and required flow rates in the injection and recirculation modes will be in accordance with design requirements.

4.2 Each motor operated valve will be observed locally for proper operation and timed to verify the valve strokes in less than the maximum allowable time.

4.3 Flow control valves will be monitored to verify no abnormal system flow oscillations.

4.4 Actual friction loss in the sump suction lines will be compared to the calculated friction losses for acceptability. Each sump will be monitored during pump operation to verify that no vortices are formed.

4.5 RHR system flow rate in the cooldown lineup will be in accordance with design requirements.

4.6 Valve interlocks operate as required by design.

Table 14.1-35
Nuclear Instrumentation System

1.0 Objective

Verify that the Nuclear Instrumentation System performs the required indication and control functions through the source, intermediate, and power ranges of operation.

2.0 Prerequisites

2.1 Nuclear Instrumentation System installed with calibration and initial alignments completed.

2.2 System energized for stabilization prior to commencing this test.

2.3 Systems complete as required for conducting this test.

3.0 Test Methods

Using the installed test facilities, verify proper performance of instrumentation, including output signals to the Reactor Protection System, and remote indications.

4.0 Acceptance Criteria

System performance is in accordance with Section 7.2.

Table 14.1-36
Control Building Ventilation Systems

1.0 Objective

1.1 Demonstrate the operation of the following Control Building HVAC systems during normal and abnormal plant operating conditions.

1.1.1 Control Room Ventilation

1.1.2 Relay Room Ventilation

1.1.3 Computer Room Ventilation

1.1.4 Controlled Access Ventilation

1.2 Confirm the proper operation of system equipment interlocks and controls.

1.3 Measure the total Control Room boundary leak rate.

2.0 Prerequisites

2.1 Individual Control Building Ventilation systems installation and component checks completed.

2.2 Associated systems completed to the extent necessary to allow conduct of this test.

2.3 Control Room pressure boundaries are sealed properly.

3.0 Test Methods

3.1 Verify fan, damper, heater, humidifier, and cooling unit controls, interlocks, and permissives for all systems.

3.2 Verify isolation damper operation on applicable systems.

3.3 Verify actuations from radiation monitors and safety injection signals on applicable systems.

3.4 Verify that Control Room internal pressure is greater than atmospheric pressure with a maximum of 400 cfm admitted from outside air.

Table 14.1-36 (continued)
Control Building Ventilation Systems

4.0 Acceptance Criteria

4.1 The dampers and fans respond to recirculation signals in accordance with Sections 6.5.1 and 9.4 for applicable systems.

4.2 Fans, dampers, heaters, humidifiers, and cooling units function correctly for each system.

4.3 Control Room is maintained at positive (1/8”) differential pressure with respect to atmosphere in the normal and emergency modes of operation.

4.4 Control Room leak rate does not exceed its maximum design value.

Table 14.1-37
Core Loading Instrumentation

1.0 Objective

Verify proper operation of the source range instrumentation channels prior to fuel loading operations.

2.0 Prerequisites

2.1 Temporary source range instrumentation installation checks completed.

2.2 Permanent source range channels operable.

3.0 Test Methods

3.1 Perform calibration of each source range channel.

3.2 Verify response of each channel to a neutron source.

3.3 Verify audible signal from at least one permanent channel available in Control Room and Reactor Building.

4.0 Acceptance Criteria

Instrumentation provides monitoring of source range neutron level for loading fuel as required by the Technical Specifications.

Table 14.1-38
Reactor Components and Fuel Handling Tools and Fixtures

1.0 Objective

Verify the adequacy of the special equipment required for refueling operations.

2.0 Prerequisites

Equipment to be checked out is onsite and inspected in accordance with the routine receiving inspection.

3.0 Test Methods

3.1 Check each tool for smooth performance and complete actuation.

3.2 Check adequacy of locating devices, guides, and chambers.

3.3 Verify operation of interlocks and/or safety devices.

3.4 Verify load test lifting devices.

4.0 Acceptance Criteria

Equipment provides for safe handling of fuel assemblies and reactor components.

NOTES:

1. Test may be conducted with a dummy fuel element when a fuel element is necessary for test.

2. Testing was conducted on the polar crane in accordance with standard crane testing procedures during the construction of the station. This test included:

   a. Hoists upper and lower limit switches verified.

   b. Load test to 125 percent.

   c. Operational performance under load.

   The polar crane is under the administrative controls of the nuclear operations department.

Table 14.1-39
Fuel Transfer System

1.0 Objective

Provide functional demonstration of the Fuel Transfer System and fuel handling tools prior to initial core load.

2.0 Prerequisites

2.1 Reactor components and fuel handling tools and fixtures test completed.

2.2 Fuel Transfer System installation and component checks completed.

2.3 Reactor vessel head and upper internals stored in the refueling positions.

2.4 Dummy fuel assembly stored in a new fuel storage rack.

3.0 Test Methods

With canal drained, conduct the various fuel handling evolutions with the dummy fuel assembly.

4.0 Acceptance Criteria

System provides for storage, transfer, and handling of fuel assemblies as designed.

NOTE: Test may be conducted with a dummy fuel element when an element is needed.

Table 14.1-40
Safety Injection High Head Flow Balancing Test

1.0 Objective

1.1 To establish proper positioning of the high head cold leg injection and recirculation throttle valve (8996A, B, C, 9884A, B, C) to balance injection flows to each loop and to limit charging pump runout flow.

1.2 To establish proper positioning of the high head hot leg recirculation throttle valves (8989A, B, C, 8991A, B, C) to balance injection flows to each loop and to limit charging pump runout flow.

1.3 To record actual charging pump data (flow versus head) and compare this to manufacturer's pump curve.

1.4 To demonstrate that motor operated valves in the high head S. I. System stroke properly against maximum expected differential pressure.

1.5 To demonstrate that the charging pumps are capable of taking a suction from the RHR pumps.

2.0 Prerequisites

2.1 Reactor vessel head is not installed and the internals are not in the vessel.

2.2 Sufficient water available in RWST to conduct test.

3.0 Test Methods

3.1 Each charging pump will be run through the cold leg injection path. Throttle valves will be adjusted to provide the minimum required branch line flows from the pump whose flow path has the highest resistance (lowest flow) to the throttle valves. The throttle valves will then be locked in position and flow from each pump will be run through the branch lines to verify that minimum flow rates are still met and charging pump runout flow is limited. This method of testing will also be used for positioning throttle valves in the cold leg recirculation and hot leg recirculation flow paths.

3.2 Each charging pump will be run at various flow rates through the high head injection lines to record pressure and flow data (motor currents and vibrations data will be recorded at full flow).

Table 14.1-40 (continued)
Safety Injection High Head Flow Balancing Test

3.3 Each charging pump will be operated while taking suction from an RHR pump. The charging pumps will be lined up to provide flow through one of the four high head safety injection flow paths.

4.0 Acceptance Criteria

Pump performance characteristics and minimum required flow rates in the injection and recirculation flow paths will be in accordance with design requirements. Each motor operated valve will be observed locally for proper operation and timed to verify the valve strokes in less than the maximum allowable time. Each charging pump will be observed for any abnormal vibration under full flow when taking suction from the RHR pumps.

Table 14.1-41

S. I. Accumulator Blowdown Test

1.0 Objective

1.1 To demonstrate accumulator blowdown and verify that the accumulator blowdown data are within the acceptable L/D range for each accumulator.

1.2 Time the opening of each accumulator discharge valve (8808A, B, & C) under flow conditions.

2.0 Prerequisites

2.1 The reactor vessel head is not installed and the internals are not in the vessel.

3.0 Test Methods

3.1 Fill each accumulator to a level consistent with vendor supplied accumulator blowdown prerequisites.

3.2 Connect a brush recorder to accumulator pressure and level instrumentation and to the accumulator discharge valve indication circuitry.

3.3 Pressurize each accumulator to 100 psig.

3.4 Start the brush recorder and then open the accumulator discharge valve.

3.5 Using data obtained during accumulator blowdowns, calculate the L/D for each accumulator discharge line.

4.0 Acceptance Criteria

The L/D values for each accumulator discharge line are within design limits and that each accumulator discharge valve opens in less than the maximum allowable stroke time.

4.1 Pressure and level alarm setpoints are proper.

4.2 Valve opening times and blowdown rates satisfy design requirements.

Table 14.1-42
Spent Fuel Cooling System

1.0 Objective

Demonstrate flow capabilities of the Spent Fuel Cooling System.

2.0 Prerequisites

2.1 Spent Fuel Cooling System installation and component checks completed.

2.2 Adequate supply of Grade B water available.

2.3 No fuel is stored in the spent fuel pool.

3.0 Test Methods

3.1 Demonstrate filling and draining of the spent fuel pool, fuel transfer canal, cask loading area, and the refueling water storage tank.

3.2 Demonstrate circulation through demineralizer loop, heat exchangers, and skimmer loop.

4.0 Acceptance Criteria

System provides for filling, draining, and/or purification of the water in the spent fuel pool, fuel transfer canal, the cask loading area, and refueling water storage tank in accordance with Section 9.1.3.

Table 14.1-42a
Spent Fuel Cooling System

1.0 Objective

Demonstrate flow capabilities of the Spent Fuel Cooling System.

2.0 Prerequisites

2.1 Spent Fuel Cooling System installation and component checks.

2.2 Reactor coolant drain tank and pumps installation and component checks completed.

2.3 Adequate supply of Grade B water available.

3.0 Test Methods

3.1 Demonstrate filling and draining of the refueling canal and refueling cavity.

3.2 Demonstrate circulation through demineralizer loop and skimmer loop.

4.0 Acceptance Criteria

System provides for filling, draining, and/or purification of the water in the refueling canal and refueling cavity, in accordance with Section 9.1.3.

Table 14.1-43
Containment Isolation System

1.0 Objective

Demonstrate the capability of the containment isolation system to respond properly to an isolation signal.

2.0 Prerequisites

2.1 Containment isolation system installation and component checks completed.

2.2 Associated systems completed to the extent necessary to allow the conduct of this test.

2.3 Containment isolation system and the applicable isolation valves in associated systems aligned for normal operation.

3.0 Test Methods

3.1 Verify component response to Phase A containment isolation by manually initiating a Phase A containment isolation signal from the MCB.

3.2 Verify component response to Phase B containment isolation by manually initiating a spray actuation signal from the MCB.

4.0 Acceptance Criteria

System response to containment isolation actuation signals is in accordance with Section 6.2.4.

Table 14.1-44
Reactor Protection Operational Check

1.0 Objective

Verify the correct installation and proper operation of the reactor trip portion of the Reactor Protection System.

2.0 Prerequisites

2.1 Reactor plant in cold shutdown condition.

2.2 Instrumentation and Reactor Protective Systems installation checks and calibrations completed.

3.0 Test Methods

3.1 Utilizing the appropriate train test panels, conduct individual tests of each train's tripping logic.

3.2 Conduct overall logic test for both trains.

4.0 Acceptance Criteria

System performance is in accordance with Section 7.2 and the approved test procedure.

Table 14.1-45
Engineered Safety Features System Operational Check

1.0 Objective

Verify the operation of the ESF logic systems for all conditions of trip logic.

2.0 Prerequisites

2.1 Instrumentation and ESF systems installation checks and calibration completed.

2.2 Reactor plant in cold shutdown condition prior to core loading.

3.0 Test Methods

3.1 Conduct individual train logic tests.

3.2 Conduct overall logic test for both trains.

3.3 Verify redundant tripping of each ESF channel through to the relay or controller that actuates the ESF device.

4.0 Acceptance Criteria

System performance is in accordance with Section 7.3.

Table 14.1-46
Integrated Engineered Safety Features Test

1.0 Objective

Demonstrate the capability of the ESF equipment during a simulated accident condition to function in the proper sequence of manner within acceptable parameters.

2.0 Prerequisites

2.1 ESF systems checks and component checks completed.

2.2 Emergency diesel generators are fully operational.

2.3 Systems to be tested are filled and aligned in recirculation with the appropriate storage tanks.

3.0 Test Methods

3.1 Verify the train A ESF load group assignment and component response to an ESF signal by defeating the automatic start of the train B diesel generator and de-energizing the train B ESF 7200 volt bus 1DB, then manually initiating a safety injection and spray actuation from the MCB.

3.2 Verify the train B ESF load group assignment and component response to an ESF signal by defeating the automatic start of the train A diesel generator and de-energizing the train A ESF 7200 volt bus 1DA, then manually initiating a safety injection and spray actuation signal from the MCB.

3.3 Verify the train A & B ESF component response to ESF signals with offsite power by manually initiating a safety injection and spray actuation signal from the MCB.

3.4 Verify the train A & B ESF component response to ESF signals with only onsite power by simultaneously de-energizing offsite power and manually initiating a safety injection and spray actuation signal from the MCB. Diesel generator starting time and loading sequence will be recorded.

4.0 Acceptance Criteria

4.1 Emergency diesel generators respond within acceptable design limits.

4.2 ESF systems and components respond as required.

Table 14.1-47
Reactor Building Spray System

1.0 Objective

1.1 To record actual Reactor Building Spray pump data (flow vs. head) and compare this to the manufacturer's pump curve.

1.2 To demonstrate that motor operated valves in the Reactor Building Spray System stroke properly against maximum differential pressure.

1.3 To determine the friction loss in the sump suction lines to each Reactor Building Spray pump and verify vortex control.

1.4 To demonstrate that the spray ring nozzles are free of obstructions.

1.5 To record the NaOH drawdown rates using various combinations of ECCS pumps.

2.0 Prerequisites

2.1 Reactor Building Spray System installation and component checks completed.

2.2 Sufficient Grade A water available in the refueling water storage tank and sodium hydroxide storage tank.

3.0 Test Methods

3.1 Each Reactor Building Spray pump will be run at various flow rates to record pressure and flow data (motor currents and vibration data will be recorded at full flow).

3.2 Each motor operated valve in the Reactor Building Spray System will be stroked against maximum differential pressure.

3.3 Each Reactor Building Spray pump recirculation sump will be flooded with water and each Reactor Building Spray pump will be run taking a suction from its respective sump to determine friction losses in each pump suction line and to demonstrate vortex control.

3.4 Air will be forced through each spray nozzle to verify that nozzles are free of obstructions.

3.5 Various combinations of ECCS pumps will be run and the NaOH drawdown rates will be recorded for each combination.

Table 14.1-47 (continued)
Reactor Building Spray System

4.0 Acceptance Criteria

4.1 Actual pump performance characteristics will be in accordance with design requirements.

4.2 Each motor operated valve will be observed locally for proper operation and timed to verify the valve strokes in less than the maximum allowable time.

4.3 Actual friction loss in the sump suction lines will be compared to the calculated friction losses for acceptability. Each sump will be monitored during pump operation to verify no vortexes are formed.

4.4 Each spray nozzle will be checked to ensure it passes air.

4.5 Actual NaOH drawdown rates will be analyzed for acceptability.

Table 14.1-48
Leak Detection Monitoring System

1.0 Objective

Demonstrate system capability of detecting the presence of significant leakage from the reactor coolant loops to the Reactor Building atmosphere during normal operations.

2.0 Prerequisites

2.1 Leak Detection Monitoring System installation and component checks completed.

2.2 Associated system completed to the extent necessary to allow the conduct of this test.

3.0 Test Methods

3.1 Verify proper functioning of containment air particulate monitor and radioactive gas monitor detectors by exposure to standard test sources.

3.2 Verify monitor’s flow rates and associated controls, indications, and alarms.

3.3 Verify proper functioning of leak detection instrumentation associated with the system.

4.0 Acceptance Criteria

System provides for monitoring of Reactor Coolant System leakage within design acceptance limits.

Table 14.1-49

Post Accident Hydrogen Removal System

1.0 Objective

Demonstrate the capability of the Post Accident Hydrogen Removal System to provide adequate flow and heat for removal of combustible gases.

2.0 Prerequisites

Post Accident Hydrogen Removal System installation and component checks completed.

3.0 Test Methods

3.1 Verify remote actuation.

3.2 Demonstrate ability to obtain atmospheric samples from each sample point.

3.3 Verify proper operation of each hydrogen recombiner.

4.0 Acceptance Criteria

Hydrogen recombiners function as designed.

Table 14.1-50
Radioactive Waste Disposal System

1.0 Objective

Demonstrate the ability of the Radioactive Waste Disposal System to provide controlled handling and disposal of solid, liquid, and gaseous radioactive wastes.

2.0 Prerequisites

2.1 Solid Waste Processing, Liquid Waste Processing, and Gaseous Waste Processing Systems installation and component checks completed.

2.2 Associated systems completed to the extent necessary to allow the conduct of this test.

3.0 Test Methods

3.1 The system will be tested in a series of functional Phase I tests as described in Table 14.1-85 for the following subsystems:

a. Reactor coolant drain tank and pumps

b. Waste evaporator feed pump and holdup tank

c. Floor drain tank and pump

d. Waste evaporator condensate tank and pump

e. Waste evaporator

f. Chemical drain tank and pump

g. Spent resin storage and transfer

h. Laundry and hot shower tank and pump

i. Waste monitor tank and pump

j. Waste evaporator concentrates tank and pump

k. Radwaste solidification module

l. Excess waste holdup tank and pump

Table 14.1-50 (continued)
Radioactive Waste Disposal System

m. Decontamination pit collection tank and pump

n. Nuclear drain sump pumps

o. Waste gas compressors and control valves

p. Waste gas hydrogen recombiners

q. Waste gas decay tank drain pump

4.0 Acceptance Criteria

System provides controlled handling and disposal of radioactive wastes in accordance with Sections 11.2, 11.3, and 11.5.

Table 14.1-51
Boron Thermal Regeneration System

1.0 Objective

Operationally checkout the Boron Thermal Regeneration System (BTRS) and operate the system with letdown flow.

2.0 Prerequisites

2.1 BTRS installation and component checks completed.

2.2 The Reactor Coolant System at normal operating temperature and pressure.

2.3 Associated systems completed to the extent necessary to allow the conduct of this test.

3.0 Test Methods

3.1 Align the system for normal operation.

3.2 Operate the system in the dilution and the boration modes.

4.0 Acceptance Criteria

System flow, pressures, and temperatures are within design limits.

Table 14.1-52
Reactor Protection System Time Response Measurement

1.0 Objective

Verify the Reactor Protection System response times and function of each trip path including sensor response time. Response time measurements will be verified for all sensors for which response time measurements are required by Technical Specifications, Tables 3.3-2 and 3.3-5.

2.0 Prerequisites

2.1 To be performed prior to initial fuel loading.

2.2 Instrumentation and Reactor Protective System installation checks and calibrations completed.

3.0 Test Methods

3.1 Utilizing test panels and temporary instrumentation as required, measure the time response and verify the functioning of each trip path in the reactor protective circuitry by simulating the sensor input to the process protection cabinets.

For ESF trip paths, the time response measured will include the sensor input to the process protection cabinets through the energization of the slave relay in the solid state protection cabinets.

Component response times (i.e., the valves travel to their required position, pump discharge pressures reach their required values, etc.) will be obtained from the preoperational test performed on the systems for which the component is a part.

Diesel generator starting and sequence loading delays will be obtained from the Integrated Engineered Safety Features Test (Table 14.1-46).

Sensors response times will be obtained by vendor testing, by onsite bench testing, or by in-place testing.

The response times measured by this test and those sensor time responses obtained as outlined above and the component time response obtained from preoperational tests will be algebraically summed to obtain an overall response time for each trip path.

Delays in sensing lines will be determined analytically.

Table 14.1-52 (continued)
Reactor Protection System Time Response Measurement

4.0 Acceptance Criteria

Response times of the individual "trip paths" including process to sensor coupling delay are less than the maximum allowable times specified in the Technical Specifications, Tables 3.3-2 and 3.3-5.

Table 14.1-53
Initial Fuel Loading

1.0 Objective

To accomplish initial fuel loading in a safe, orderly manner.

2.0 Prerequisites

2.1 All the tests required to be performed before fuel loading is completed.

2.2 The Residual Heat Removal System is maintaining the coolant in constant recirculation.

2.3 Boron concentration is sufficient to maintain $K_{eff} \leq .95$.

2.4 Five source range neutron detectors are installed; two permanently installed, two temporary incore, and a third temporary to act as a spare.

2.5 Containment integrity has been established.

3.0 Test Methods

3.1 An initial nucleus of eight fuel assemblies with a source is loaded.

3.2 Using an inverse neutron count rate plot as a guide to ensure safe loading, fuel assemblies are placed in the core until core loading is complete.

4.0 Acceptance Criteria

The core is loaded in the specified configuration barring mechanical damage to an assembly.

Table 14.1-54
Incore Movable Detectors

1.0 Objective

Verify proper response of the individual channels of instrumentation and the ability to accurately position the detectors of the Incore Movable Detector System.

2.0 Prerequisites

2.1 Incore Movable Detector System installation and component checks completed.

2.2 "Manual local" operation has been checked using a dummy cable.

2.3 Core installed.

2.4 Gas Purge System and Leak Detection System installation and component checks completed.

3.0 Test Methods

3.1 Align system for normal operation.

3.2 Verify proper operation of all transfer devices, isolation valves, safety and limit switches, and readout and control equipment.

3.3 Compare position readouts with observed position of detectors.

4.0 Acceptance Criteria

4.1 System provides mapping capability as described in Section 7.7.

Table 14.1-55
Rod Drop Time Measurement

1.0 Objective

Determine the drop time for each full length control rod at no flow cold conditions and at full flow hot conditions. Also, the slowest rod and the fastest rod are tripped 10 times at no flow/cold conditions and at full flow/hot conditions.

2.0 Prerequisites

2.1 Core installed and reactor vessel head in place.

2.2 Boron concentration equal to or greater than that required for refueling shutdown.

2.3 Rod Position Indication System operable.

2.4 Both source range protection channels available in the control room.

3.0 Test Methods

3.1 Withdraw selected bank to the fully withdrawn position.

3.2 Conduct individual rod drop tests, recording rod drop time, rod travel time, and other specified data.

3.3 Repeat for all banks of full length rods in required conditions of flow and temperature.

3.4 Drop the slowest rod and the fastest rod 10 times at the required flow and temperature conditions.

4.0 Acceptance Criteria

4.1 Drop time for all rods is less than the maximum value specified in the Technical Specifications.

4.2 Operation of the dashpot for all rods, as indicated by recorder traces, will be verified.

Table 14.1-56
Rod Drive Mechanism Timing

1.0 Objective

Verify proper timing of each Rod Control System slave cycler and conduct an operational check of each full length control rod drive mechanism.

2.0 Prerequisites

2.1 All full length control rod drive mechanism equipment installed with rod control cluster assemblies attached.

2.2 Reactor Coolant System filled and vented.

2.3 Boron concentration equal to or greater than that required for refueling shutdown.

2.4 Baseline count rates established for each source range channel.

2.5 Test is to be performed at cold and hot standby conditions.

3.0 Test Methods

3.1 Verify the timing of each power cabinet's slave cycler.

3.2 Conduct individual mechanism operational checks by withdrawing and inserting each mechanism a specified number of steps while obtaining an oscillograph trace.

4.0 Acceptance Criteria

Mechanism timing and operational checks verified to be within acceptable design limits.

Table 14.1-57
Rod Position Indication

1.0 Objective

1.1 Demonstrate that the Rod Position Indication System performs the required indication and alarm functions for each full length rod control cluster assembly.

1.2 Demonstrate performance of the full length rod control cluster assemblies over their full range of travel.

2.0 Prerequisites

2.1 Reactor Coolant System at normal operating no load temperature and pressure.

2.2 Boron concentration equal to or greater than that required for refueling shutdown.

2.3 Cold shutdown alignment and adjustments of Rod Position Indication System completed.

3.0 Test Methods

3.1 The rods are withdrawn in groups and their indicated positions are compared with the group step counters.

4.0 Acceptance Criteria

4.1 Indicators and alarms function in accordance with Section 7.7.

Table 14.1-58
Reactor Coolant System Flow Measurement

1.0 Objective

Obtain the data to compute actual Reactor Coolant System flow rates as they relate to the design flow rates.

2.0 Prerequisites

2.1 Core installed.

2.2 Reactor plant is in hot standby condition with all control rods fully inserted.

2.3 Reactor coolant pumps operable.

3.0 Test Methods

3.1 Measure loop temperatures, loop elbow tap Δp's, and reactor coolant pump input power and speed for various configurations of reactor coolant pumps.

3.2 Compute actual Reactor Coolant System flow rate. Density variation of cold leg fluid will be accounted for in the data reduction method to provide direct comparison to full power conditions.

4.0 Acceptance Criteria

4.1 Reactor Coolant System flow rates are determined to be greater than or equal to the thermal design minimum less than or equal to the mechanical design maximum as per FSAR Table 5.1-1.

4.2 If the criteria as described in 4.1 are not met, the power level will be restricted to the rated thermal power which the measured Reactor Coolant System flow rate will support.

Table 14.1-59
Reactor Coolant System Flow Coastdown

1.0 Objective

1.1 Measure the rate at which Reactor Coolant System flow changes subsequent to reactor coolant pump stops and starts.

1.2 Measure time delays associated with the loss of flow accident.

2.0 Prerequisites

2.1 Core installed.

2.2 Reactor plant is in hot standby condition with all control rods fully inserted.

3.0 Test Methods

3.1 Selectively trip reactor coolant pumps from various configurations of pump operation.

3.2 Measure required flow data and response times for each configuration of pump operation.

4.0 Acceptance Criteria

4.1 Time delays associated with the loss of flow accident are within the design values.

4.2 Rate of change of reactor coolant flow is within the design limits for the various pump configurations.

Table 14.1-60

Resistance Temperature Detector Bypass Loop Flow Verification

1.0 Objective

To ensure the flow necessary to achieve the design objective for reactor coolant transport time in each resistance temperature detector (RTD) bypass loop and to verify flow setpoint.

2.0 Prerequisites

2.1 The Reactor Coolant System is at normal operating no load temperature and pressure.

2.2 Installed pipe measurements have been made and necessary construction and tests are finished.

3.0 Test Methods

3.1 Measure flow in RTD bypass loops.

3.2 Reduce flow to verify alarm setpoints.

3.3 Increase flow and verify alarm setpoints.

4.0 Acceptance Criteria

4.1 Flow gives a transport time of 1 second or less in the RTD bypass loops such that the total time response given in Technical Specification Table 3.3-2, item 7, is not exceeded.

4.2 Alarms actuate and clear at proper setpoints.

Table 14.1-61
Reactor Vessel O-Ring Leak Test

1.0 Objective

Verify that there is no leakage past the reactor vessel head and vessel seal following installation of the reactor vessel head after core loading.

2.0 Prerequisites

2.1 Core installed, reactor vessel head installed, and reactor vessel head studs torqued.

2.2 Reactor Coolant System pressure integrity verified in accordance with ASME Code prior to core loading.

3.0 Test Methods

3.1 Establish normal operating no load temperature and pressure conditions for Reactor Coolant System.

3.2 Increase system pressure to 100 psi above operating pressure and check for leakage past the head and vessel seal.

4.0 Acceptance Criteria

Acceptable leakage past reactor vessel head and vessel seal is determined.

Table 14.1-62

Pressurizer Spray and Heater Capability and Setting Continuous Spray Flow

1.0 Objective

1.1 Establish proper continuous spray flow rates.

1.2 Verify pressurizer normal control spray effectiveness.

1.3 Verify pressurizer heater effectiveness.

2.0 Prerequisites

2.1 Core installed.

2.2 Plant is in shutdown condition at approximately the normal operating no load temperature and pressure.

3.0 Test Methods

3.1 Adjust continuous spray flow rates such that ΔT between the pressurizer and spray lines is less than or equal to 200°F and the spray line low-temperature alarms are clear.

3.2 Check normal control spray effectiveness by spraying down to approximately 2000 psig.

3.3 Check heater effectiveness by energizing heaters with power operated relief valves in “close” and spray and level controls in manual. Allow pressure to increase to approximately 2300 psig.

4.0 Acceptance Criteria

4.1 Continuous spray flow adjusted in accordance with design requirements.

4.2 Heater and normal control spray effectiveness are in accordance with design requirements.

Table 14.1-63
Water Quality Test

1.0 Objective

Verify acceptable water quality of Reactor Coolant System fill and makeup water prior to initial criticality.

2.0 Prerequisites

2.1 Reactor Coolant System filled and vented in preparation for initial criticality.

2.2 Reactor makeup water storage tank at operating level.

3.0 Test Methods

3.1 Sample Reactor Coolant System and analyze for chlorides, conductivity, total dissolved solids, pH, clarity, and fluorides.

3.2 Sample Reactor Makeup Water System and analyze for the above.

4.0 Acceptance Criteria

Analyses are within the limits specified in the Technical Specifications.

Table 14.1-64
Initial Criticality

1.0 Objective

To bring the reactor critical.

2.0 Prerequisites

2.1 All tests to be performed before the initial criticality have been performed.

2.2 Reactor Coolant System is at normal operating temperature and pressure.

3.0 Test Methods

3.1 Withdraw shutdown bank.

3.2 Withdraw control banks leaving the last bank far enough in to provide effective control.

3.3 Dilute the reactor coolant until critical.

3.4 Achieve steady-state hot zero power by using control rod movement.

4.0 Acceptance Criteria

The reactor achieves criticality in an orderly, safe manner.

Table 14.1-65
Low Power Test

1.0 Objective

1.1 Verify nuclear instrumentation overlap.

1.2 Verify point of adding heat.

1.3 Measure rods out boron concentration.

1.4 Determine moderator temperature coefficient.

1.5 Determine integral and differential worths for sequenced control banks.

1.6 Determine differential boron worth.

1.7 Measure ejected control cluster assembly worth at hot zero power.

2.0 Prerequisites

2.1 The Reactor Coolant System is in the hot zero power condition with the reactor critical.

2.2 Reactor Coolant System temperature is being maintained.

2.3 Required signals for data collection and recording are available.

3.0 Test Methods

3.1 The neutron flux level will be increased by outward control rod motion and the nuclear instrumentation overlap recorded. Adjustments will be made as necessary to ensure minimum overlap as described in the Technical Specifications.

3.2 The neutron flux level will be increased by outward control rod motion until temperature feedback effects are noted. The upper limit for zero power physics testing is defined as approximately one decade below this level.

3.3 The all rods out, critical boron concentration is determined by measuring the just critical boron concentration with bank D near the fully withdrawn position. The amount of reactivity held down by bank D is then dynamically determined by withdrawal of bank D, noting the amount of reactivity inserted and converting this value to an equivalent amount of boron.

Table 14.1-65 (continued)
Low Power Test

3.4 The moderator temperature coefficient for various boron concentrations is obtained by dynamically measuring the reactivity change due to a temperature change in the primary system.

3.5 The sequenced bank differential rod worth is determined by either borating the Reactor Coolant System while withdrawing the control banks or by diluting the Reactor Coolant System while inserting the control banks to maintain nominal system criticality. Integral worth is then determined from the differential reactivity data.

3.6 Differential boron worth at hot zero power is determined by obtaining and analyzing reactor coolant samples for boron content in conjunction with control bank movement to maintain nominal criticality during boration. Boron concentration as a function of time in combination with integrated reactivity as a function of time is used to plot reactivity versus boron concentration, the slope of which yields differential boron worth.

3.7 Ejected rod cluster control assembly worth at hot zero power is determined by obtaining a critical configuration with the sequenced rod banks at their insertion limit as defined in the Technical Specifications. The most reactive inserted rod is withdrawn to maintain nominal criticality during boration. The reactivity addition is determined by summing the differential reactivity insertions as the rod is withdrawn to its withdrawal limit.

4.0 Acceptance Criteria

4.1 Nuclear instrumentation overlap meets the minimum requirements.

4.2 The all rods out, critical boron concentration is within ± 50 ppm of design prediction.

4.3 The moderator temperature coefficient is negative under the allowed conditions of normal critical operation.

4.4 Measured integral worths for control banks are within 10 percent of predicted worths and total worth of all rods less the most reactive rod exceeds the shutdown reactivity requirements throughout the fuel cycle.

4.5 Differential boron worth, over the range measured, is within ± 10 percent of the predicted value.

Table 14.1-65 (continued)
Low Power Test

4.6 The measured integral reactivity worth of the RCCA withdrawn during the rod ejection test, and the resultant hot channel factor, F_Q, are less than or equal to the values used in the safety analysis with adequate allowance for measurement uncertainty.

Table 14.1-65a
Augmented Low-Power Test

1.0 Objective

1.1 Demonstrate decay heat removal capability of natural circulation.

1.2 Determine the depressurization rate following a loss of pressurizer heaters for evaluation of the loss of all AC emergency procedure.

1.3 Demonstrate to the plant operators the effect of increased charging flow and reduced steam generator pressure on the saturation margin.

1.4 Demonstrate under simulated loss of offsite power conditions that decay heat can be removed via the steam generators by maintaining steam generator level with the Emergency Feedwater System.

1.5 Demonstrate under simulated loss of onsite and offsite power conditions that decay heat can be removed via the steam generators by maintaining steam generator level with the Emergency Feedwater System.

1.6 Demonstrate boron mixing and Reactor Coolant System cooldown using natural circulation (credit for this objective may be taken for testing completed on a similar plant).

1.7 Train Operators on a simulator in:

a. Natural circulation operations

b. The use of auxiliary pressurizer spray

c. Loss of offsite, and loss of offsite and onsite AC power

2.0 Prerequisites

2.1 The Reactor Coolant System and all emergency and auxiliary systems are at the conditions specified in the appropriate approved test procedure.

2.2 Required signals for data collection and recording are available.

2.3 Reactor Power is maintained less than or equal to 5 percent.

Table 14.1-65a (continued)
Augmented Low-Power Test

3.0 Test Methods

3.1 In hot standby with the reactor coolant pumps supplying heat input to the secondary side, simulate removal of onsite AC power sources and operate the plant utilizing manual control and the steam driven emergency feedwater pump. HVAC to the pump room is isolated to verify pump operability in this environment.

3.2 After fuel loading, but prior to Initial Criticality, establish stable condition at T_{no} Load and 2235 psig with RCP B in operation. Reduce pressure by turning off pressurizer heaters noting depressurization rate. Re-establish heaters and reduce pressure by use of auxiliary spray noting depressurization rate and effect on margin to saturation temperature. At reduced pressure, observe the effects of changes in charging flow and steam flow on margin to saturation temperature.

3.3 With the reactor critical at approximately 3 percent reactor power, place the plant in natural circulation mode observing the length of time for plant to stabilize, flow distribution, power distribution, and ability to maintain cooling mode.

3.4 Perform Loss-of-Offsite Power/Station Blackout Test with plant trip from 10-20 percent Rated Thermal Power. Operate Plant establishing stable conditions in natural circulation using batteries and emergency diesels.

3.5 Referencing boration and cooldown tests performed at Sequoyah I, North Anna II, Farley II, and Diablo Canyon I, verify similar plant response by parameter and plant comparison. Operator training for cooldown on natural circulation provided on a simulator.

4.0 Acceptance Criteria

4.1 Natural circulation was established and maintained under steady state conditions in all cases.

4.2 Operator training during natural circulation was accomplished.

4.3 Adequate boron mixing during Reactor Coolant System cooldown on natural circulation has been proven at Virgil C. Summer Nuclear Station or credit has been taken for this test performed on a similar plant.

Table 14.1-66

Incore Movable Detector and Thermocouple Mapping at Power

1.0 Objective

To obtain and analyze core power distributions for various control rod configurations at each major power plateau.

2.0 Prerequisites

2.1 The reactor is critical at a steady-state power level.

2.2 Incore Instrumentation System functional test is complete and the system is operable.

2.3 Computer systems are operable as necessary for incore map processing.

3.0 Test Methods

Reactor power level is stabilized and complete incore flux maps are obtained and processed.

4.0 Acceptance Criteria

Core peaking factors are within acceptable limits as defined in the Technical Specifications.

Table 14.1-67

Power Coefficient and Power Defect Measurement

1.0 Objective

To determine the differential power coefficient of reactivity and the integral power defect.

2.0 Prerequisites

2.1 The reactor is in the hot zero power condition with rods in the specified maneuvering band.

2.2 The instrumentation necessary for collection of data is installed, calibrated, and operable.

3.0 Test Methods

Reactor power is maintained congruent with turbine load demand by control bank adjustment throughout the range of each load change from the hot zero power condition to the hot full power condition. Reactivity increments due to periodic control bank steps are determined and recorded throughout each load change. At selected power levels, conditions are stabilized and a heat balance obtained to accurately determine core power. Power coefficient and power defect are calculated with data obtained over the range from hot zero power to hot full power.

4.0 Acceptance Criteria

4.1 The best estimate of the measured power coefficient as a function of power, derived from experimental data, is equal to or more conservative than that used in the accident analysis.

4.2 The measured power defect is compatible with design predictions.

Table 14.1-68
Effluent Radiation Monitor Test

1.0 Objective

To verify the performance of the effluent monitors under actual discharge conditions. This test is to be performed at each major power plateau.

2.0 Prerequisites

2.1 The reactor has been operating for a time sufficient to generate representative effluents.

2.2 The effluent monitors have been checked against known sources.

3.0 Test Methods

Following standard procedures, the suitability of effluents for discharge is verified by radiochemical analysis. Discharge is commenced and the response of effluent monitors is observed and recorded. Effluent is sampled in accordance with established procedures and effluent monitor performance is verified through radiochemical analysis.

4.0 Acceptance Criteria

The installed effluent monitors perform in accordance with design standards and properly indicate the radioactive content of the effluent.

Table 14.1-69
Radiation Shielding Survey

1.0 Objective

To measure radiation dose levels at preselected points throughout the plant to verify shielding effectiveness.

2.0 Prerequisites

2.1 Radiation survey instruments to be used are calibrated against known sources.

2.2 The reactor is critical at a steady-state power.

3.0 Test Methods

In accordance with procedures for radiation surveys, dose levels are measured at points throughout the station.

4.0 Acceptance Criteria

Measured radiation levels are within the limits for the zone designation of each area surveyed.

Table 14.1-70
Process Computer

1.0 Objective

Verify the output value printout of the nonsafety related process computer for computer inputs.

2.0 Prerequisites

Computer has been functionally checked out.

3.0 Test Methods

Data comparisons are made between simulated process signals and the printout of the process computer.

4.0 Acceptance Criteria

4.1 Errors between simulated process signals and computer output are within acceptable design limits.

4.2 Alarm functions are within acceptable design limits.

Table 14.1-71
Thermal Power Measurements and Instrument Calibration

1.0 Objective

To determine the power output of the core at major power plateaus for nuclear instrumentation calibration.

2.0 Prerequisites

2.1 The plant is in a steady-state condition.

2.2 Necessary process instruments have been checked and calibrated.

2.3 Steam generator blowdown has been stopped.

3.0 Test Methods

3.1 For each loop, check to ensure steam flow and feed flow are equal, then record the mass flow rate.

3.2 Record steam pressure and find steam enthalpy of saturated liquid conditions.

3.3 Record feedwater temperature and find feedwater enthalpy for saturated liquid conditions.

3.4 Using the proper equation, determine thermal output.

3.5 Calibrate nuclear instrumentation to agree with core thermal output.

4.0 Acceptance Criteria

Instrumentation is calibrated to indicate core output.

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Table 14.1-72
Automatic Control Systems Checkout

1.0 Objective

To demonstrate that the automatic control systems for pressurizer pressure and level control, rod control, steam generator level control, and turbine generator control respond properly to changes in controlling parameters.

2.0 Prerequisites

2.1 The reactor and turbine generator are at approximately 25 percent power with normal operating parameters.

2.2 Related instrumentation has been checked and calibrated.

3.0 Test Methods

3.1 Using manual control of pressure control devices (sprays, reliefs, and heaters), increases and decreases are made in system pressure. The controls are placed in automatic and the responses noted.

3.2 Using manual control of pressurizer level control, changes are made from the normal level. The controller is placed in automatic and the responses to high and low levels are noted.

3.3 Using manual rod control, errors in Reactor Coolant System average temperature are initiated. The rod control is placed in automatic and the responses to high and low average temperatures are noted.

3.4 Using manual control of the various controllers (three main feedwater valve controllers and the master feed pump controller), steam generator level and feedwater pressure changes are made. The controllers are placed in automatic and the responses noted.

3.5 With turbine control in automatic, changes in steam pressure are made by manual manipulations of control rods. Closing of a stop and control valve is used to change steam conditions. The turbine generator responses to these manipulations are noted.

4.0 Acceptance Criteria

4.1 Automatic controllers return plant parameters to normal values without excessive overshoot.

4.2 The recorded process variables are not more limiting than stated in the setpoint study document.

Table 14.1-73
Plant Response to Step Load Changes

1.0 Objective

To demonstrate satisfactory plant response to a 10 percent load change from various power levels.

2.0 Prerequisites

2.1 The various control systems have been tested and are in automatic.

2.2 All pressurizer and main steam relief and safety valves are operable.

2.3 The control rods are in the maneuvering band for the power level existing at the commencement of the test.

2.4 Plant conditions are stabilized and pertinent parameters to be measured are connected to high speed recorders.

3.0 Test Methods

3.1 Output is manually reduced at a rate sufficient to simulate a step load change equivalent to approximately a 10 percent load decrease.

3.2 After stabilization of systems, output is manually increased at a rate sufficient to simulate a step load change equivalent to approximately a 10 percent load increase.

3.3 Pertinent parameters affected by a load change are measured and recorded.

3.4 At various power levels, as required by the test procedure, the test is repeated.

4.0 Acceptance Criteria

4.1 Neither the turbine nor the reactor trips, and no initiation of safety injection is experienced.

4.2 No pressurizer or main steam relief or safety valves lift.

4.3 No operator action is required to restore conditions to steady state.

4.4 Control systems maintain their parameters within their design transient limits per NSSS Supplier Setpoint Study Document.

Table 14.1-74
Pseudo Rod Ejection Tests

1.0 Objective

To verify the rod worth and hot channel factors assumed in the safety analysis.

2.0 Prerequisites

2.1 The reactor is critical and at a steady-state power level of greater than or equal to 10 percent but no more than 50 percent.

2.2 All of the excore instrumentation channels are operable.

2.3 The incore detectors and thermocouples are operable.

3.0 Test Methods

3.1 The affected rod bank is placed at the full power insertion limit.

3.2 Single rod motion is accomplished by disconnecting the lift coils on all the rods in the affected bank except the coil on the selected rod.

3.3 The selected rod is withdrawn from the core while power and reactor coolant temperature are held constant by boron concentration changes.

3.4 Data are gathered by use of the incore detectors and thermocouples and boron concentration.

4.0 Acceptance Criteria

The measured worth of the pseudo ejected rod and the associated hot channel factors is more conservative than that assumed in the safety analyses.

Table 14.1-75
Rod Drop Test

1.0 Objective

To demonstrate the operations of the negative rate trip circuitry in detecting the simultaneous insertion of two cluster control assemblies.

2.0 Prerequisites

2.1 All power range nuclear instrumentation channels are operable.

2.2 The reactor is at the steady-state power level specified in the procedure with the controlling bank near the full power insertion limit.

2.3 Pertinent parameters to be measured are connected to recording devices.

3.0 Test Methods

3.1 All four power range nuclear instrumentation channel positive and negative rate trips are defeated with instrumentation set up to monitor the negative rate trip bistables.

3.2 Two rods from a common group most difficult to detect by excore detectors due to low worth and core location are simultaneously dropped by removing voltage to both the movable and stationary gripper coils of the designated rod.

3.3 Following the transient, recorded data are evaluated for system and instrumentation response.

4.0 Acceptance Criteria

4.1 The negative rate trip circuitry is initiated on a minimum of three power range nuclear instrumentation channels as a result of simultaneously dropping two control rods.

Table 14.1-76
Below-Bank Rod Test

1.0 Objective

To demonstrate the response of the nuclear and incore instrumentation to a rod cluster control assembly below the nominal bank position and to determine hot channel factors associated with this misalignment.

2.0 Prerequisites

2.1 All power range nuclear instrumentation channels are operable.

2.2 The moveable incore detectors are operable.

2.3 Power escalation testing is completed to approximately the 50 percent reactor power level.

3.0 Test Methods

3.1 Single rod movement is accomplished by disconnecting the lift coils of all rods in the affected bank except the selected rod.

3.2 During rod cluster control assembly insertion, power range detector currents, thermocouple maps, and moveable incore detector traces are periodically recorded to demonstrate sensitivity to RCCA misalignment. The power range detector data provide information to relate core quadrant tilt to rod cluster control assembly position. With the RCCA fully misaligned, a moveable detector flux map is obtained to verify resultant core hot channel factors.

4.0 Acceptance Criteria

4.1 The measured radial hot channel factor resultant from a single RCCA fully misaligned from its bank is less than or equal to the value assumed in the safety analysis (Table 15.2-2) and does not exceed the Technical Specification limit for the power level at which the test is performed.

4.2 Incore and/or nuclear instrumentation is demonstrated to detect any significant power maldistribution caused by the misaligned rod cluster control assembly.

Table 14.1-77
Plant Trip from 100% Power

1.0 Objective

1.1 To demonstrate the ability of the primary and secondary plant and the plant automatic control systems to sustain a trip from 100 percent power and to bring the plant to a stable condition following the transient.

1.2 To determine the overall response time of the reactor coolant hot leg resistance temperature detectors.

1.3 To obtain data which are to be evaluated to determine if changes in the control system setpoints are warranted to improve transient response based on actual plant operation.

2.0 Prerequisites

2.1 The various control systems are in the automatic mode and functioning properly.

2.2 The reactor is steady state of 100 percent power, with the rods in the maneuvering band.

2.3 Pressurizer and main steam safety and relief valves are in service and operable.

2.4 Pertinent parameters to be measured are connected to recording devices.

3.0 Test Methods

3.1 Initiate a plant trip by manually initiating a turbine generator trip.

3.2 Pertinent parameters are recorded on recording devices.

3.3 Following the transient, recorded data are evaluated for system and controller response and possible abnormalities.

4.0 Acceptance Criteria

4.1 The parameters recorded are not more limiting than those in the setpoint study document.

Table 14.1-78
Loss of Offsite Power

1.0 Objective

To demonstrate that the necessary equipment, controls, and indication are available following the isolation of the Offsite Power Distribution System to remove decay heat from the core using only emergency power supplies.

2.0 Prerequisites

The plant is at a steady-state condition with greater than 10 percent generator output.

3.0 Test Methods

3.1 Simulate loss of power by manually de-energizing the offsite power supplies to all 7.2 kV buses, and initiating a turbine generator trip.

3.2 Using approved operating procedures, bring the plant to a hot standby condition and maintain the plant in a hot standby condition for at least 30 minutes using the only emergency onsite power sources.

4.0 Acceptance Criteria

The hot standby condition is achieved and maintained for at least 30 minutes using only emergency onsite power sources.

Table 14.1-79
Shutdown from Outside the Control Room

1.0 Objective

The purpose of this test is to demonstrate the following:

1.1 That the plant can be taken off the line from power operations and maintained in hot standby from outside the control room.

1.2 That cooldown from hot standby can be initiated and maintained from outside the control room by reducing the Reactor Coolant System temperature approximately 50°F without exceeding the cooldown rate.

1.3 That the Residual Heat Removal System can be initiated and controlled from outside the control room by placing the Residual Heat Removal System in service and reducing the Reactor Coolant System temperature approximately 50°F without exceeding the cooldown rate.

2.0 Prerequisites

2.1 The plant is at some power level greater than or equal to 10 percent output on the generator.

2.2 Two shifts of operators are onsite, one observes from control room, the other performs the test.

3.0 Test Methods

3.1 The plant is tripped off the line from outside the control room.

3.2 Using switchgear, manual operators on valves, local indicators, and local panels of controls and indicators, hot standby (approximately no load temperature) is maintained through the assistance of the plant communication system for a period of at least 30 minutes.

3.3 The plant is cooled from approximately no-load temperature approximately 50°F without exceeding the cooldown rate.

3.4 Residual Heat Removal System is initiated from outside the control room and the plant is cooled approximately 50°F without exceeding the cooldown rate.

4.0 Acceptance Criteria

Hot standby is maintained by the members of one shift from outside the control room for at least 30 minutes.

The plant is cooled approximately 50°F below the approximately no-load Reactor Coolant System temperature without exceeding the cooldown rate.

The RHR system is initiated from outside the control room and is used to reduce the Reactor Coolant System temperature approximately 50°F.

Note: Steps 3.3 and 3.4 may be performed during hot functional testing.

Table 14.1-79a
Emergency Lighting

1.0 Objective

Verify that the Emergency DC Lighting System meets design requirements.

2.0 Prerequisites

All construction checks have been completed.

3.0 Test Methods

3.1 Interrupt the standby lighting sources to provide illumination solely from the emergency system.

3.2 Record foot-candle level data at selected locations.

4.0 Acceptance Criteria

Emergency Lighting System meets requirements of Section 9.5.3.3.

Table 14.1-79b
Heat Tracing for Safety Related Outdoor Piping

1.0 Objective

Demonstrate the ability of the Heat Tracing System to maintain proper temperature control in safety related outdoor piping.

2.0 Prerequisites

2.1 Heat Tracing System installation and component checks completed.

2.2 Associated systems completed to the extent necessary to allow conduct of this test.

3.0 Test Methods

3.1 Energize Heat Tracing System.

3.2 Monitor temperatures maintained by each heat tracing circuit with the system in a static condition.

4.0 Acceptance Criteria

Each heat tracing circuit maintains temperature within design limits.

Table 14.1-79c
Pressure Boundary Integrity Test

1.0 Objective

Demonstrate pressure boundary integrity conforms to applicable codes.

2.0 Prerequisites

2.1 Reactor vessel internals, head, and studs installed.

2.2 Required weld non-destructive testing is complete and accepted.

3.0 Test Methods

3.1 The Reactor Coolant System is filled with Grade “A” water.

3.2 The Reactor Coolant System is brought to hydrostatic test temperature utilizing the system pumps.

3.3 The Reactor Coolant System is brought to the required test pressure utilizing the Chemical Volume Control System.

4.0 Acceptance Criteria

4.1 The pressure boundary satisfactorily withstands the test pressure as required by applicable ASME codes.

Table 14.1-79d
Seismic Instrumentation

1.0 Objective

Verify operability of the seismic instrumentation.

2.0 Prerequisites

Installation and calibration of the seismic instrumentation is complete.

3.0 Test Methods

3.1 Verify system response to a simulated signal.

3.2 Verify operability of system alarms.

4.0 Acceptance Criteria

4.1 System response to a simulated signal meets design intent.

4.2 System alarms function as designed.

Table 14.1-80
Power Ascension Test Program

Test	Low Power	30%	50%	75%	90%	100%
Initial Criticality	N/A					
Low Power Test	X					
Incore Moveable Detector and Thermocouple Mapping at Power	X	X	X	X	X	X
Power Coefficient and Power Defect Measurement	X	X	X	X		X
Effluent Radiation Monitor Test	X	X	X	X	X	X
Radiation Shielding Survey	X		X			X
Thermal Power Measurements and Instrument Calibration		X	X	X	X	X
Automatic Control Systems Checkout		X				
Plant Response to Step Load Changes		X		X		X
Pseudo Rod Ejection Test		To be specified in the test				
Rod Drop Test		To be specified in the test				
Below-Bank Rod Test			X			
Plant Loss of Electrical Load						X
Loss of Offsite Power		Greater than or equal to 10% gen. load				
Shutdown from Outside the Control Room		Greater than or equal to 10% gen. load				

X - To be performed

Note: Tests at each given power test plateau will be reviewed before increasing power to the next test plateau.

Table 14.1-81
Initial Test Program Schedule

Startup Activity	Months Before Commercial Operation	Approximate Duration Weeks
Reactor Coolant System Cold Hydro	15	1
Hot Functional Testing	10	3
Core Loading	6	2
Low Power Test	5	4
Power Ascension	3	8

Startup group staffing will begin approximately 30 months prior to commercial operation. The startup group will be completely staffed and trained approximately 20 months prior to commercial operation.

Table 14.1-82
Generic Flush Procedure

1.0 Objective

Flush plant systems to the appropriate level class of cleanliness.

2.0 Prerequisites

2.1 Construction is completed and the system is turned over to the point to allow flushing.

2.2 Adequate source of clean water is available.

2.3 Permanent plant equipment, i.e., pump or temporary flush equipment, i.e., Hydrolaser, is available for the flush.

3.0 Test Methods

3.1 Align the system valves to flush the system.

3.2 Using permanent plant equipment or Hydrolaser, flush the system.

4.0 Acceptance Criteria

4.1 By flush cloth or visual observation, verify that the system meets the desired cleanliness class.

Table 14.1-83
Generic Hydrostatic/Pneumatic Test

1.0 Objective

Prove structural integrity of the systems being tested to the design requirements as specified in the particular design specification.

2.0 Prerequisites

2.1 The system to be tested must be completed sufficiently enough by construction to alleviate the need for system boundary re-entry and test invalidity.

2.2 The system is to be flushed, if practical, before the test is to be conducted.

2.3 The document research and quality control requirements must be completed before testing can begin.

3.0 Test Methods

3.1 Calibrated test gages are installed at selected locations for test pressure verification.

3.2 The system is filled with the appropriate hydrostatic or pneumatic test medium at a temperature higher than the minimum specified in the design specification.

3.3 By use of test pumps, compressors, or other appropriate means, the system is pressurized to the test pressure and held for the specified time limit, then lowered to the inspection pressure and structural integrity is verified.

3.4 After the test, the system is drained or vented, then it is put in the proper layup condition.

4.0 Acceptance Criteria

4.1 No external leakage is allowed except at (1) temporary connections, installed for the purpose of making the test, (2) at gaskets, seals, leak offs, etc., on previously tested components, (3) items noted on the test report as being permitted by specification.

4.2 The leakage shall not exceed the capacity of the pressure source to maintain the required test pressure.

Table 14.1-84
Instrument Control Procedure

1.0 Objective

1.1 Verify and, if required, re-establish the accuracies and control functions of the channel sensors, associated signal processing equipment, indicating equipment, and alarms associated with the analog process signals.

2.0 Prerequisites

2.1 Process control cabinets are installed and energized.

2.2 Process control sensors are installed and connected to the process control cabinets.

2.3 Interconnection between the process control cabinets and the main control board is complete.

3.0 Test Methods

3.1 Using test equipment to simulate the process parameter, the correction conversion, by the sensor, of the process parameter to an analog signal will be verified.

3.2 Using a signal simulator to simulate an analog signal from the sensor, the correct processing of the analog signal by the process equipment, setpoints of comparators, and operation of indicating equipment will be verified.

4.0 Acceptance Criteria

4.1 The process instrumentation provides intolerance conversion of the process parameter and performs its as-designed indication and control functions.

Table 14.1-85
Functional Test

1.0 Objective

To test the operability of subsystems and non-safety related systems to demonstrate their ability to meet their functional requirements.

2.0 Prerequisites

2.1 Specify any tests or portions of tests which must be completed prior to conduct of this test.

2.2 Specify plant status necessary to start the test.

3.0 Test Methods

3.1 Step by step method to accomplish the test.

3.2 Specify data to be taken during the test such as; vibration, bearing temperatures, pressure and flow characteristics, automatic control functions, valve open and closing under actual pressure conditions.

3.3 Restore the system to a safe post test condition.

4.0 Acceptance Criteria

4.1 Specify those qualitative or quantitative requirements that demonstrate the system's ability to meet its functional requirements.

Table 14.1-86
Steam Generator Power Operated Relief Valve

1.0 Objective

1.1 Demonstrate that the steam generator power operated relief valves respond as designed to control Reactor Coolant System temperature utilizing steam pressure as the input signal.

1.2 Demonstrate that the steam generator power operated relief valves respond as designed to control Reactor Coolant System temperature utilizing T_{avg} as the input signal.

2.0 Prerequisites

2.1 Phase I testing complete on steam generator power operated relief valves and associated process instrumentation control loops.

3.0 Test Methods

3.1 During hot functional testing, verify proper operation of the power operated relief valves in the pressure control mode at Reactor Coolant System temperatures of 350°F, 450°F, and approximately 557°F.

3.2 Verify the proper operation of the steam generator power operated relief valves in the temperature control mode by inducing a simulated T_{avg} signal in the process control racks.

4.0 Acceptance Criteria

4.1 Visual observation of the valves stroking to full flow at a reactor coolant temperature of approximately 557°F detects no abnormal movement of valves or associated piping.

4.2 Steam generator power operated relief valves respond as required to simulated inputs of T_{avg}.

Table 14.1-87
Condensate System

1.0 Objective

1.1 Demonstrate that the Condensate System delivers condensed steam from the main condenser hotwell through the low pressure feedwater heaters to the deaerator.

1.2 Demonstrate that the Hotwell Level Control System automatically makes up and rejects water to the condensate storage tank.

1.3 Demonstrate the system interlocks and automatic devices perform their intended functions.

2.0 Prerequisites

2.1 Condensate System installation is complete and component checks are completed.

2.2 Deaerator and hotwell are capable of receiving water.

3.0 Test Methods

3.1 System is aligned for operation.

3.2 Check operation of condensate pump speed controls.

3.3 Verify pump head and flow rates.

3.4 Verify that the Hotwell Level Control System functions to maintain hotwell level.

3.5 Check operation of pump trips and interlocks.

4.0 Acceptance Criteria

4.1 Pump flow capabilities meet or exceed design requirements.

4.2 Interlocks, pump trips, and protective devices function per design requirements.

4.3 Verify control system function per design requirements.

Table 14.1-88
Feedwater System

1.0 Objective

1.1 Demonstrate that the Feedwater System provides heated and deaerated water to the steam generators during normal and transient plant conditions.

1.2 Demonstrate that plant and component protection devices perform their intended functions.

2.0 Prerequisites

2.1 Feedwater System installation is complete and component checks are completed.

2.2 Steam generators are capable of receiving water.

3.0 Test Methods

3.1 System is aligned for operation.

3.2 Check operation of feedwater pump turbine speed controls to provide programmed differential pressure between the steam generator and feedwater pump.

3.3 Verify pump head and flow rates.

3.4 Check operation of pump trips and interlocks.

4.0 Acceptance Criteria

4.1 Pump flow capabilities meet or exceed design requirements.

4.2 Interlocks, pump trips, and protective devices function per design requirements.

4.3 Verify control system function per design requirements.

Table 14.1-89
Main Condenser Dump Valves

1.0 Objective

1.1 Demonstrate that the main condenser dump valves respond properly to simulated temperature and pressure input signals.

1.2 During hot functional testing, cycle each steam dump valve full open.

2.0 Prerequisites

2.1 Phase I testing complete on main condenser dump valves and associated process instrumentation control loops.

3.0 Test Methods

3.1 Simulate temperature and pressure inputs to the control circuitry for the main steam dump valves and verify proper system response.

3.2 During hot functional testing, cycle each steam dump valve fully open and fully closed and verify no abnormal valve or pipe movement.

4.0 Acceptance Criteria

4.1 Main condenser dump valves respond properly to simulated temperature and pressure inputs.

4.2 Each main steam dump valve cycles fully open and closed with no abnormal valve or pipe movement.

Table 14.1-90
Circulating Water System

1.0 Objective

1.1 Demonstrate the capability of the Circulating Water System to provide adequate cooling water.

2.0 Prerequisites

2.1 Circulating Water System installation, piping flushes, and component checks are completed.

2.2 Associated systems are completed to the extent necessary to allow conduct of this test.

3.0 Test Methods

3.1 Align the system for operation.

3.2 Verify system protective interlocks.

3.3 Verify flows and pressures for normal operations.

4.0 Acceptance Criteria

4.1 System flows, pressures, and automatic functions are in accordance with design requirements.

4.2 System interlocks function in accordance with design.

Table 14.1-91
Chemical Feed System

1.0 Objective

1.1 Demonstrate that the Condensate Chemical Injection System can maintain established limits of pH and dissolved oxygen in the Condensate and Feedwater Systems.

1.2 Demonstrate that the Steam Generator Standby Chemical Injection System can maintain established limits of pH and dissolved oxygen in the secondary side of the steam generators during wet layup.

2.0 Prerequisites

2.1 Chemical Injection System installation and component checks are complete.

3.0 Test Methods

3.1 Align systems for normal operation and establish flow paths.

3.2 Check operation of metering controls for injection systems.

4.0 Acceptance Criteria

4.1 Condensate System delivers calibrated volume to the Condensate System.

4.2 Steam Generator Standby Chemical Injection System delivers a calibrated volume to the steam generator.

Table 14.1-92
Nuclear Blowdown Processing System

.0 Objective

1.1 Demonstrate flow capabilities of the Nuclear Blowdown Processing System.

2.0 Prerequisites

2.1 Nuclear Blowdown Processing System installation and component checks are completed.

3.0 Test Methods

3.1 Demonstrate circulation through different loops of the Nuclear Blowdown Processing System and verify ability to demineralize water to Condensate System grade water.

4.0 Acceptance Criteria

4.1 System provides the capability to demineralize steam generator nuclear blowdown to Condensate System cleanliness criteria.

Table 14.1-93
Control Rod Drive

1.0 Objective

1.1 Demonstrate that the circuitry and components comprising the Control Rod Drive System will perform their design requirements without control rod drives installed.

2.0 Prerequisites

2.1 Wiring and component installation complete.

3.0 Test Methods

3.1 Initially energize the rod position indication system and verify proper signal response from the detection coils to the indication display.

3.2 Verify proper control rod drive mechanism polarity and coil currents.

3.3 Verify proper control rod drive M-G set operation.

3.4 Verify proper control rod drive mechanism magnetic coil sequencing.

4.0 Acceptance Criteria

4.1 Control rod drive components and circuitry function as required by design.

Table 14.1-94
Miscellaneous Plant Drains

1.0 Objective

1.1 Demonstrate the ability of Miscellaneous Plant Drains System to remove water from the plant.

2.0 Prerequisites

2.1 Miscellaneous Plant Drains System installation and component checks are completed as necessary.

3.0 Test Methods

3.1 Verify capability of the sump pumps to remove water form the sumps.

3.2 Verify sump level interlocks to applicable plant equipment.

4.0 Acceptance Criteria

4.1 Sump level interlocks to plant equipment function as designed.

4.2 System provides for water removal in accordance with design requirements.

Table 14.1-95
Fuel Handling Building Pool Liner Leak Test

1.0 Objective

1.1 Demonstrate watertight integrity of spent fuel pit, fuel transfer canal, and cask loading pit.

1.2 Demonstrate watertight integrity of the fuel transfer tube isolation valve and blind flange.

1.3 Demonstrate watertight integrity of spent fuel pit gate and cask loading pit gate.

1.4 Demonstrate airtight integrity of the inflatable seals on the spent fuel pit and cask loading pit gates.

2.0 Prerequisites

2.1 Pool liners have been installed and cleaned.

2.2 Spent fuel racks are not installed.

2.3 Adequate source of water is available.

3.0 Test Methods

3.1 Fill pools with water and monitor liner leakage.

3.2 Install transfer canal isolation gates, drain canal and monitor leakage through the gates.

4.0 Acceptance Criteria

4.1 Total leakage for liner is less than design maximums.

4.2 Fuel transfer tube isolation valve.

4.2.1 Blind flange and valve is less than design maximums.

4.2.2 Valve stem is less than design maximums.

4.3 Isolation gates.

4.3.1 Inflatable seal on gates - no visible bubbles.

4.3.2 Spent fuel pit gate is less than design maximums.

4.3.3 Cask loading pit gate is less than design maximums.

Table 14.1-96
Reactor Building Ventilation "Post Accident Operation"

1.0 Objective

1.1 Demonstrate that the Reactor Building cooling units have the capacity to cool the Reactor Building within the design load during the worst postulated accident conditions.

1.2 Demonstrate during the integrated leak rate test that the Reactor Building cooling fan motor over current protection will allow operation of the motors under the maximum load.

1.3 Demonstrate during the integrated leak rate test that the Reactor Building cooling unit bypass damper closes.

2.0 Prerequisites

2.1 Installation of components and support systems is complete and operational.

2.2 The integrated leak rate test is in progress for objective 1.2.

2.3 Adjusts fan pitch settings to accommodate increased containment air density (for ILRT).

3.0 Test Methods

3.1 Align the Reactor Building coolers for system operation in the "post-accident" mode.

3.2 Measure the flow rate and temperature drop across the cooling coil air and water sides at ambient conditions.

3.3 Calculate the heat removal capacity and extrapolate for worst conditions using the coil data sheets and measured data.

3.4 Align system for operation during the containment integrated leak rate test and monitor the fan motor operation.

3.5 During the integrated leak rate test, reposition the Reactor Building cooling unit dampers from the bypass to the closed position.

4.0 Acceptance Criteria

4.1 The cooling units are shown to have the capacity to remove the designed heat load at the worst postulated conditions.

4.2 The fan motor operates in accordance with design requirements during the integrated leak rate test.

4.3 Reactor Building cooling unit dampers operate from the bypass to the closed position.

Table 14.1-97
ESF Equipment Rooms Cooling Systems

1.0 Objective

1.1 Demonstrate that the cooling systems for the following ESF Equipment Rooms have the capacity to cool the areas within design loads during the worst postulated conditions.

1.1.1 Reactor Building Cooling Units (Normal Mode)

1.1.2 Charging Pump Room Cooling Unit

1.1.3 RHR-Spray Pump Room Cooling Units

1.1.4 Safety Related MCC Switchgear Cooling Units

1.1.5 Relay Room Cooling System (Recirc. Mode)

1.1.6 Control Room Ventilation System (Recirc. Mode)

1.1.7 ESF Switchgear Room Cooling

1.1.8 Speed Switch Room Cooling

1.1.9 Service Water Booster Pump Cooling Units

1.1.10 Emergency Feedwater Pump Cooling Units

2.0 Prerequisites

2.1 Installation of components and support systems is complete and operational.

3.0 Test Methods

3.1 Align the cooler for system operation and measure the flow rate and temperature drop across the cooling coil air and water sides at ambient conditions.

3.2 Calculate the heat removal capacity at ambient conditions. Verify that the coils are operating on their characteristic curve by comparing test data results to manufacturer’s design program data.

4.0 Acceptance Criteria

4.1 The cooling units are shown to operate on their characteristic curve, thereby verifying that they have the capacity to remove the design heat load at the worst postulated conditions for each of their respective areas.

Table 14.1-98

S. I. Accumulator Discharge Valve Functional Test

1.0 Objective

1.1 To demonstrate that each accumulator isolation valve (8808A, B, & C) will open under the maximum differential pressure conditions of zero Reactor Coolant System pressure and maximum expected accumulator precharge pressure upon receipt of a safety injection signal by each valve.

1.2 To verify the actual accumulator level matches the indicated accumulator level at the minimum technical specification level.

1.3 To demonstrate that each accumulator isolation valve (8808A, B, & C) will open on an increasing Reactor Coolant System pressure signal.

2.0 Prerequisites

2.1 The Reactor Coolant System is depressurized and adequately vented.

2.2 A source of nitrogen is available to pressurize the accumulators.

2.3 A tygon hose is connected to the accumulator for level indication.

3.0 Test Methods

3.1 Close valves 8808A, B, & C and then fill each accumulator with Grade A water. As each accumulator fills, compare the accumulator actual level with the indicated level when actual level reaches the minimum technical specification level. Isolate the tygon hose before pressurizing the accumulators.

3.2 Pressurize each accumulator to the maximum expected accumulator precharge pressure.

3.3 Initiate a safety injection signal to the control circuitry of each valve.

3.4 Increase the Reactor Coolant System pressure signal to each valve.

4.0 Acceptance Criteria

4.1 That each accumulator isolation valve will open in less than the maximum allowable stroke time under maximum differential pressure conditions.

4.2 That indicated accumulator level is within tolerance at the actual minimum technical specification level in the accumulator.

Table 14.1-98 (continued)

S. I. Accumulator Discharge Valve Functional Test

4.3 That each accumulator isolation valve will open when required on an increasing RCS pressure signal.

Table 14.1-99
ECCS Check Valve Leak Testing System Operational Test

1.0 Objective

1.1 Demonstrate proper functioning of the ECCS Check Valve Leak Testing System and perform a backleakage test on each check valve monitored by the ECCS Check Valve Leak Testing System.

2.0 Prerequisites

2.1 Instrumentation in the ECCS Check Valve Leak Testing System has been calibrated.

2.2 Hot functional testing is in progress.

3.0 Test Methods

3.1 Perform a leak test on each check valve in the ECCS normally checked using the ECCS Check Valve Leak Testing System.

4.0 Acceptance Criteria

4.1 System operates satisfactorily during leak check tests.

Table 14.1-100
S. I. Accumulator Check Valve Hot Operational Test

1.0 Objective

1.1 To demonstrate that the accumulator discharge check valves (8948A, B & C and 8956A, B & C) will function under normal operating temperature and pressure conditions.

2.0 Prerequisites

2.1 Hot functional testing is in progress.

3.0 Test Methods

3.1 Inject or pump water through each check valve during hot functional testing.

4.0 Acceptance Criteria

4.1 That each check valve passes water into the RCS during hot functional testing.

Table 14.1-101
Instrument Air System

1.0 Objective

1.1 Demonstrate the ability of the Instrument Air System to supply instrument and service air.

2.0 Prerequisites

2.1 Instrument Air System installation and component checks are completed as necessary.

2.2 System has been blown down and cleanliness requirements met.

3.0 Test Methods

3.1 Verify operability of system alarms.

3.2 Verify operability of system interlocks.

3.3 Verify ability of air compressors to maintain system pressure.

3.4 Verify start of standby compressor on reduction of air pressure.

3.5 Verify isolation of service air on reduction of air pressure.

3.6 Verify backup supply to Reactor Building header on reduction of pressure.

3.7 Verify operability of dryers.

4.0 Acceptance Criteria

4.1 System interlocks and alarms function as designed.

4.2 Instrument Air System supplies air to Reactor Building instrument air services on loss of Reactor Building instrument air.

4.3 Service air is isolated on loss of instrument air.

4.4 Air compressors and dryers function as designed.

Table 14.1-102
Pressurizer Pressure and Level Control

1.0 Objective

1.1 To demonstrate the response, stability, and control characteristics of the Pressurizer Pressure and Level Control System.

1.2 To demonstrate the operation of the pressurizer power relief valves.

2.0 Prerequisites

2.1 The Reactor Coolant System is at hot no-load conditions as required by hot functional testing.

2.2 The pressurizer relief tank is operable.

2.3 Pressurizer pressure and level process instrumentation has been calibrated.

3.0 Test Methods

3.1 Place the pressurizer pressure control in manual and increase (decrease) the setpoint of the automatic controller 50 psig. Switch the pressurizer pressure control back to automatic control and observe the system response as pressure increases (decreases) to the new setpoint.

3.2 Using manual control, increase the system pressure to the pressurizer high pressure reactor trip value, then lower the pressure to the pressurizer low pressure reactor trip value, and verify the operation of the alarms and interlocks associated with the Pressurizer Pressure Control System.

3.3 Place the pressurizer level control in manual and decrease (increase) the pressurizer level 5 percent. Switch the pressurizer level control to automatic and observe the system response as pressurizer level increases (decreases) to the normal setpoint.

3.4 Using manual control, increase pressurizer level to the high level reactor trip, then lower the pressurizer level to the low level heater cutout and letdown isolation value, and verify the operation of alarms and interlocks associated with the Pressurizer Level Control System.

3.5 Verify the operation and response time of the pressurizer power relief valves by opening and closing the valves from the MCB and allowing a blowdown for 10 seconds or until 1900 psig is reached.

Table 14.1-102 (continued)
Pressurizer Pressure and Level Control

3.6 Verify the operation of the pressurizer backup heaters from the control room evacuation panel.

4.0 Acceptance Criteria

4.1 System operation is in accordance with design requirements.

14.2 AUGMENTATION OF STAFF FOR INITIAL TEST AND OPERATION

During the initial test program at Virgil C. Summer Nuclear Station, SCE&G is using a special startup organization. In addition to the plant operating staff, the startup organization is augmented by representatives from Westinghouse, Gilbert, and other contractors and vendors as required. Competent technical personnel from other SCE&G departments may be called upon to assist and advise the startup organization as necessary.

14.2.1 Organizational Functions, Responsibilities, and Authorities

The functions, responsibilities, and authorities of organizations participating in the startup program are discussed in Sections 14.2.1.1 through 14.2.1.3.

14.2.1.1 Plant Operating Staff

Under the direction of the Manager, Virgil C. Summer Nuclear Station qualified plant personnel to assist in preparation of test procedures and performance of tests. Test procedure preparation includes writing and review of the procedure and approval of the procedure by the Manager, Virgil C. Summer Nuclear Station. Test performance includes checking of prerequisites, operation of equipment, and recording of data. All functions requiring an NRC license are performed by licensed personnel.

Prior to receiving nuclear fuel at the plant site, SCE&G will establish industrial security and health physics programs under the control and administration of the Manager, Virgil C. Summer Nuclear Station. Also, under the direction of the Manager, Virgil C. Summer Nuclear Station, plant operating and maintenance personnel will assume responsibility for operation and maintenance of tested and accepted systems.

14.2.1.2 Westinghouse Electric Corporation

Westinghouse provides onsite technical assistance to SCE&G during the installation, startup, testing, and initial operation of each nuclear steam supply system (NSSS). In this manner, Westinghouse aids the owner and assures that each NSSS is installed, started, tested, and operated in conformance with design intent. Westinghouse onsite personnel provide direct assistance and act as technical liaison with Westinghouse headquarters to resolve problems within the Westinghouse scope. Personnel assignments are made as required by site activities.

14.2.1.3 Gilbert Associates, Inc.

Gilbert provides experienced personnel to assist in the startup activities. Liaison is maintained between the Gilbert Reading, PA, offices and field personnel to facilitate resolution of problems related to test specifications and system operation for which Gilbert has design responsibility.

14.2.2 Interrelationships and Interfaces

Onsite representatives of Westinghouse, Gilbert, and other contractors and vendors are responsible to the Manager, Virgil C. Summer Nuclear Station. If any of the above personnel participate in the performance of a test, they will be responsible to the person above them in the startup organization, that is a Test Supervisor or the Startup Supervisor. For activities related to construction, they will be responsible to the SCE&G Manager of Construction.

14.2.3 Personnel Functions, Responsibilities, and Authorities

The functions, responsibilities, and authorities of major augmenting personnel are as discussed in Sections 14.2.3.1 through 14.2.3.3.

14.2.3.1 Plant Staff

Members of the Virgil C. Summer Nuclear Station operating, maintenance, and technical groups who meet the requirements for Test Supervisor or test personnel are utilized in these capacities. Their functions, responsibilities, and authorities are described in Section 14.1.1.4.

14.2.3.2 Westinghouse Electric Corporation

Westinghouse startup specialists assigned to the Virgil C. Summer Nuclear Station act as technical advisors to the Plant Manager and assist him in NSSS startup activities. Their function and responsibilities include, but are not limited to, assisting the startup group in procurement of procedures, system checkout, functional testing, and coordination of the test program. Resolution of technical problems within the Westinghouse scope of supply shall be resolved by the startup specialists by direct liaison with Westinghouse headquarters.

14.2.3.3 Gilbert Associates, Inc.

Gilbert personnel assigned to the Virgil C. Summer Nuclear Station site assist in startup activities. Liaison is maintained between the site personnel and the Gilbert home office to facilitate resolution of problems and questions which may arise during startup and testing and are related to Gilbert design activities. Gilbert site personnel may assist SCE&G in actual performance of startup and testing of the plant.

14.2.4 Personnel Qualifications

Personnel who manage, supervise, or perform preoperational or startup tests shall satisfy the qualifications stated in Section 14.1.1.4.