CHAPTER 14: INITIAL TESTS AND OPERATION

This chapter describes the initial testing and operating program conducted at Fermi 2. The program describes the manner in which the testing and initial operation was performed, controlled, and documented for the following four testing and initial operating phases:

a. Construction Test Phase - the period during which the Construction Manager had responsibility for activities. Construction tests were generally carried out before the energization of equipment. The transfer of jurisdiction over equipment and systems from the Construction Manager to the System Completion Organization (SCO) occurred at the end of this period

b. Checkout and Initial Operations Test Phase - the period during which the Edison Startup Group conducted checkout and initial operations (CAIO) tests, including initial equipment energizing, flushing and cleaning operations, initial calibration of instrumentation, electrical wiring and equipment tests, valve testing, and initial equipment and system operation. Hydrotesting (a construction test) was also conducted during this phase

c. Preoperational Test Phase - the period during which approved preoperational tests were performed. The preoperational testing was the responsibility of the Edison Startup Group

d. Startup Test Phase - the period beginning with preparation for fuel loading and extending through 100 percent power and warranty demonstrations, where the Edison Startup Test Phase Group has responsibility for startup testing. A detailed description of this test phase is provided in Subsection 14.1.3. The startup test phase is subdivided into four parts:

   1. Fuel-loading and open-vessel tests

   2. Initial heating to rated temperature and pressure

   3. Power testing from rated temperature and pressure to 100 percent of rated output

   4. Warranty demonstration.

The test program also encompassed cold functional testing, the Surveillance Testing Program, and hot functional testing.

The construction, CAIO, and preoperation test phases were not necessarily performed in series. Certain test activities were conducted in parallel, such as construction tests with CAIO tests and CAIO tests with preoperational tests. On ASME Code systems, the contractor maintained the responsibilities of the Installer through the ASME Code hydrotesting and N-stamping. Overall systems jurisdiction, however, was maintained by Edison's SCO in these situations. Figure 14.1-1 is an overall test program outline.

This test program closely adhered to Regulatory Guide 1.68 (11/73), "Preoperational and Initial Startup Test Programs for Water-Cooled Power Reactors," while recognizing the specific requirements of the construction codes (ASME Section III).

14.1 TEST PROGRAM

A comprehensive testing program was implemented at Fermi 2. This program was designed to ensure the following:

a. That the equipment and systems perform in accordance with General Design Criteria

b. That the plant is properly designed and constructed and is ready to operate in a manner that will not endanger the health or safety of the public

c. That the initial fuel loading is accomplished in a safe and efficient manner

d. That required verification of nuclear parameters is obtained

e. That the procedures for operating the plant are evaluated and demonstrated

f. That the operating staff is knowledgeable about the plant and procedures and fully prepared to operate the facility in a safe manner

g. That the plant achieves rated capacity while meeting all safety and environmental conditions.

Systems and components were tested and evaluated according to written and approved test procedures. An analysis of test results verified that each system or component performed satisfactorily. The written procedures for the initial tests and operation included objectives and prerequisites of the tests, initial conditions, precautions, the test method, acceptance criteria, return to normal status, and appropriate references.

During the preoperational and startup test phases, the permanent plant operating procedures, as described in Section 13.5, were used to support the preoperational and startup tests. The use of the plant system operating procedures in this manner enabled them to be verified and changed as necessary to become a safe, comprehensive set of system operating procedures.

14.1.1 Administrative Procedures (Testing)

The preoperational test program has been essentially completed for Fermi 2. All that presently (December 1988) remains is a small amount of testing to close out certain test items still open from previous testing on other systems.

The preoperational tests of the solid radwaste system were suspended in December 1987 because the system was unable to meet the design throughput values for ion-exchange resin waste streams. The objectives and test descriptions discussed in Subsection 14.1.3.2.17, as they apply to this system, will remain in effect should testing be resumed in the future.

The responsibilities and administrative controls necessary to complete this testing are defined in plant administrative procedures.

14.1.2 Administrative Procedures (Modifications)

(This section has been deleted.)

14.1.3 Preoperational Test Phase Objectives and Test Descriptions

14.1.3.1 General Objectives

(This section has been deleted.)

14.1.3.2 Discussion of Preoperational Tests

The preoperational test discussions that follow indicate the objectives, prerequisites, general test method, and acceptance criteria which formed the basis for the detailed preoperational test procedures. A listing of all preoperational tests, together with subsection and page references for use in locating a particular test discussion, follows under the heading "Preoperational Tests."

Systems that were not to be tested preoperationally were subjected to an acceptance test or a specific checkout and initial operations test. A list of acceptance tests that were performed follows the list of preoperational tests. After the list of acceptance tests is a list of specific checkout and initial operations tests that were used instead of acceptance tests.

PREOPERATIONAL TESTS

PREOPERATIONAL TESTS

PREOPERATIONAL TESTS

PREOPERATIONAL TESTS

Subsection Reference	Test Title
14.1.3.2.54	Communication and Evacuation Alarm System Preoperational Test
14.1.3.2.55	Seismic Monitoring System Preoperational Test
14.1.3.2.56	Residual Heat Removal Complex Heating and Ventilation System Preoperational Test
14.1.3.2.57	Residual Heat Removal Complex Service Water Systems Preoperational Test
14.1.3.2.58	Condensate Makeup Demineralizer System Preoperational Test
14.1.3.2.59	General Service Water System Preoperational Test
14.1.3.2.60	Circulating Water System Preoperational Test
14.1.3.2.61	Offgas System Preoperational Test
14.1.3.2.62	Main Turbine Electro-Hydraulic Control System Preoperational Test
14.1.3.2.63	Thermal Recombiner System Preoperational Test
14.1.3.2.64	System Vibration and Expansion Preoperational Test
14.1.3.2.65	Primary Containment, Secondary Containment, and Auxiliary Building Equipment Drains and Floor Drains Preoperational Test
14.1.3.2.66	Containment Vacuum Breakers Preoperational Test
14.1.3.2.67	Emergency Lighting System Preoperational Test
14.1.3.2.68	Personnel Monitoring, Survey Instruments, and Laboratory Equipment Preoperational Test
14.1.3.2.69	Reactor System Hydrostatic Preoperational Test
14.1.3.2.70	Main Steam Line Isolation Valve Leakage Control System Preoperational Test
14.1.3.2.71	Reactor Internals Flow-Induced Vibration Preoperational Test
14.1.3.2.72	Remote Shutdown Preoperational Test
14.1.3.2.73	Torus Water Management System Preoperational Test

PREOPERATIONAL TESTS

Subsection Reference	Test Title
14.1.3.2.74	Postaccident Sampling System Preoperational Test

ACCEPTANCE TESTS

Item	Test Title
1.	Security System
2.	Loose Parts Monitoring System
3.	Automated Records Management System/Plant Computer Network System
4.	Emergency Response Information System
5.	Plant Meteorological Monitoring System
6.	Onsite Storage Building Miscellaneous Systems
7.	Engineered Safety Feature Status Display
8.	Annunciator and Sequence Recorder System
9.	Heater Drain System
10.	Turbine Steam System
11.	Turbine Supervisory Equipment
12.	Main Turbine Protection System
13.	Turbine Sealing Steam System
14.	Turbine Lubricating Oil System
15.	Main Turbine Extraction Steam System
16.	Low Pressure Turbine Hood Cooling System

ACCEPTANCE TESTS

Item	Test Title
17.	High Pressure Turbine Flange Heating System
18.	Main Turbine Hydrogen Seal Oil System
19.	Stator Winding Cooling System
20.	Main Turbine Generator Cooling System/H_2 Supply System/CO_2 Purge System
21.	Potable Water System
22.	General Service Water Chlorination System
23.	Breathing Air System
24.	Auxiliary Boiler System
25.	Waste Oil System
26.	Plant Grounding System
27.	Steam Tunnel Cooling System
28.	Recirculation Motor Generator Ventilation System
29.	Turbine Building Crane
30.	Turbine Building Radioactive Drains System
31.	Radwaste Building Floor and Equipment Drains System
32.	Circulating Water Chlorination System
33.	Circulating Water Pumphouse Heating Ventilation System
34	Office and Service Building Heating, Ventilation, and Air Conditioning System
35.	General Service Water Pumphouse Heating and Ventilation System
36.	Onsite Storage Building Heating, Ventilation, and Air Conditioning System

ACCEPTANCE TESTS

Item	Test Title
37.	Residual Heat Removal Complex Equipment and Floor Drains System
38.	Technical Support Center/Office Building Annex (TSC/OBA) Heating, Ventilation, and Air Conditioning System

ACCEPTANCE TESTS THAT WERE REPLACED BY SPECIFIC CHECKOUT AND INITIAL OPERATIONS TESTS

Item	Test Title
1.	Main Unit Generator Relaying
2.	Main Unit Generator and Exciters
3.	Generator Field Breaker, Rectifier Assembly, and Suppression Resistor
4.	Generator Excitation System
5.	Engineers Test System
6.	Isophase Bus System
7.	Generator Synchronization System
8.	EF1-EF2 Telemetering
9.	Michigan Electric Power Pool Coordination Center Interface

14.1.3.2.1 Feedwater Control System Preoperational Test

a. Test Objective - To verify proper operation of the feedwater control system

b. Prerequisites - The checkout and initial operations tests have been completed and the technical review committee (TRC) has reviewed and approved the test procedure and the initiation of testing. The control air system must be available and all feedwater control components should have an initial calibration in accordance with vendor's instructions

c. General Test Method - Verification of the feedwater control system capability is demonstrated by the proper, integrated operation of the following.

1. Feedwater control instrumentation and interlocks
2. Startup (low-flow) valve regulator
3. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.2 Reactor Feedwater System Preoperational Test and Reactor Feedwater Pump Turbine Control System Preoperational Test

a. Test Objective - To verify the proper operation of the reactor feedwater pump turbine control system, including turbine support systems, controls, safety devices, and alarms and annunciators. Verify the proper operation of the reactor feedwater system valves and interlocks, and alarms and annunciators

b. Prerequisites - The checkout and initial operations tests have been completed, and the TRC has reviewed and approved the test procedure and the initiation of testing. The related support systems, the main turbine sealing steam, and the lube oil systems must have readiness verification. The Turbine Instruction Manual is reviewed in detail

c. General Test Methods - Verification of the reactor feedwater system and the turbine control system capability is demonstrated with actual and simulated signals by the proper, integrated operation of the following:

1. Automatic valves and interlocks
2. Alarms and annunciators
3. Lube-oil alarms and protective devices
4. Turbine hydraulic and lube oil system
5. Turbine turning gear and interlocks
6. Turbine trip and trip-reset system
7. Clean steam operation of north and south reactor feed pump turbine.

d. Acceptance Criteria - In addition to verification of operation of all system components, the turbine hydraulic and lube oil systems, turbine turning gear, and turbine trip and reset systems must be shown to be within their respective engineering design specifications.

14.1.3.2.3 Deleted (incorporated into Subsection 14.1.3.2.2)

14.1.3.2.4 Reactor Water Cleanup System Preoperational Test

a. Test Objective - To verify the operation of the reactor water cleanup (RWCU) system, including pumps, valves, and demineralizers

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. Anion and cation resin mixture is available. Reactor building closed cooling water system (RBCCWS) and control air must have readiness verification

c. General Test Methods - Verification of the RWCU system capability is demonstrated by the proper, integrated operation of the following:

   1. Drain flow regulator flow interlocks
   2. System and filter isolation and logic
   3. Valve-operating sequence
   4. Pump and related control and logic
   5. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications. Total system filterability must be demonstrated similarly.

14.1.3.2.5 Standby Liquid Control System Preoperational Test

a. Test Objective - To verify the operation of the standby liquid control system (SLCS) including pumps, tanks, control, logic, and instrumentation

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. Relief valves are bench tested previously and other precautions relative to positive displacement pumps taken. The reactor pressure vessel (RPV) is available for injecting demineralized water

c. General Test Method - Verification of the SLCS capability is demonstrated by the proper, integrated operation of the following:

   1. SLCS tank level instrumentation
   2. Heaters and heat tracing
   3. Alarms and logic
   4. Relief valves
   5. Pumps and related controls and logic
   6. Flow testing with different flow paths
   7. Injection of demineralized water by actual firing of squib valves
   8. Volume and concentration limits according to the Technical Specifications.

d. Acceptance Criteria - All systems components must be either verified for proper operation, or demonstrated to be within their respective engineering design specifications.

14.1.3.2.6 Nuclear Boiler System Preoperational Test

a. Test Objective - To verify the proper operation of the nuclear boiler system, including the reactor vessel and containment isolation control logic, main steam isolation valves, automatic depressurization control logic, safety/relief valves (SRVs), and reactor vessel head leak detection system

b. Prerequisites - The checkout and initial operations tests have been completed as required and the TRC has reviewed and approved the test procedure and the initiation of testing

c. General Test Method - Verification of the system capability is demonstrated by integrated operation of the following portions of this system:

   1. Reactor vessel and containment isolation control including process sensors, logic channels, main steam isolation valves (MSIVs), drain valves, reactor water sample isolation valves, vacuum breakers, and pneumatic accumulators
   2. Automatic depressurization system (ADS) including sensors, logic channels, SRVs, manual controls, and pneumatic accumulators
   3. Non-ADS SRVs and associated manual controls
   4. Reactor head seal leak detection
   5. Annunciator and sequential operations recorder inputs
   6. Reactor head vent isolation valves
   7. Reactor vessel level instrument responses to actual water-level changes.

d. Acceptance Criteria - All system components must be verified for proper operation. The valves tested must meet required closing time maximum values. Logic response times where time delay devices are included must meet design values.

14.1.3.2.7 Residual Heat Removal System Preoperational Test

a. Test Objective - To verify the operation of the residual heat removal (RHR) system under its various modes of operation: standby, low pressure coolant injection (LPCI), shutdown cooling and vessel head spray, containment spray, suppression pool water cooling, and fuel pool cooling and cleanup (FPCC). Heat removal capabilities in certain modes are not verified

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The RPV and recirculation loops are intact and capable of receiving water

c. General Test Method - Verification of the RHR system capability is demonstrated by the proper, integrated operation of the following:

   1. System isolation valve control and logic tests
   2. RHR pumps, motors, controls, and related logic features
   3. Automatic LPCI initiation logic
   4. Break detection loop selection logic

5. Verification of all flow paths. The time from initiation signal to full flow is verified similarly to be within design specifications
6. Demonstrate adequate net positive suction head (NPSH) with simulated suppression chamber inlet strainer 50 percent plugged
7. Alarms and annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications; system flow paths under various modes of operation must be demonstrated similarly.

The time from initiation signal to full flow is verified similarly to be within design specifications.

14.1.3.2.8 Reactor Core Isolation Cooling System Preoperational Test

a. Test Objective - To verify the operation of the reactor core isolation cooling (RCIC) system, valves, instrumentation, and control

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing

c. General Test Method - Verification of system capability is demonstrated with simulated signals by the proper, integrated operation of the following:

1. All valves and related controls, interlocks, and indicators
2. Manual and automatic initiation logic
3. Automatic isolation, including leak detection system logic
4. Turbine speed control, trip logic, instrumentation, and test mode
5. Barometric condenser condensate pump, and vacuum pump controls
6. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.9 Reactor Recirculation and Motor-Generator Sets Preoperational Test

a. Test Objective - To verify the operation of the reactor recirculation system, including pumps, and their associated motors and motor-generator (M-G) sets, valves, instrumentation, and controls. The rated conditions tests are conducted during the startup test program.

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The RBCCWS must receive readiness verification. All required testing of equipment up to the operation of the recirculation pump has been completed, including operation of the M-G sets and fluid coupling, recirculation pump motor (uncoupled), and all control loops. Reactor internals which are in place are those which can satisfactorily withstand the pressure drops encountered during these tests. Means must be provided to monitor audible noise and vibration of the pumps

c. General Test Method - After prerequisite testing, verification of system capability is demonstrated by the proper, integrated operation of the following:

1. System valves

   (a) Operability

   (b) Opening and closing speed

   (c) Manual operation

   (d) Limit switch and torque switch operation

   (e) Position indicating lights.

2. Logic and interlocks

   (a) Recirculation pump trip with reactor low level and/or with reactor high pressure (anticipated transient without scram [ATWS]) recirculation pump runback with reactor low level and loss of feed pump

   (b) Recirculation flow limit for NPSH protection with low feedwater flow

   (c) Scoop tube positioner lockup with signal failure

   (d) M-G set drive motor lockout

   (e) M-G set drive motor circuit breaker trip

   (f) Circulating lube oil system

   (g) Annunciators.

3. Operational Testing

   (a) Single pump operation at minimum speed

   (b) Single and dual-pump operation at higher loop flows within flow and cavitation

   (c) Pump trips, including one- and two-pump drive motor breaker trips and a two-pump trip consistent with the ATWS pump trip. (In addition, the time delay for the field breaker trip will be confirmed)

   (d) Recirculating pump and piping vibration measurements

   (e) M-G set motor, coupler, and generator

   (f) Jet pump consistency.

d. Acceptance Criteria - Performance cannot be evaluated properly in the preoperational phase, and, therefore, no conclusions on performance can be reached until the system is tested during the power test program. Expected values of measured parameters will be tabulated before the test. Significant variations from these values will be investigated. All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specification.

14.1.3.2.10 Control Rod Drive Manual Control System Preoperational Test

a. Test Objective - To verify the operation of the reactor manual control system (RMCS), including relays, control circuitry, switches and indicating lights, and control valves

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. Associated primary coolant systems must be flushed

c. General Test Method - Verification of RMCS capability is demonstrated by the proper, integrated operation of the following:

   1. Control valve sensor and logic
   2. Rod blocks, interlocks, and alarms
   3. Control rod drive (CRD) position indication, alarms, and interlocks
   4. Alarms, annunciators, and system timer.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.11 Control Rod Drive Hydraulic System Preoperational Test

a. Test Objective - To verify the operation of the CRD hydraulic system, including CRD mechanisms, hydraulic control units (HCUs), hydraulic power supply, instrumentation, and controls

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The CRD manual control system preoperational test (Subsection 14.1.3.2.10) must be completed on associated CRDs. The RBCCWS and control air system must receive readiness verification

c. General Test Method - Verification of CRD system capability is demonstrated by the proper, integrated operation of the following:

   1. Logic and interlocks
   2. CRD pumps and related controls and interlocks
   3. Flow controller, pressure control valves, and stabilizer valves
   4. Scram discharge level switches, and CRD position indication and alarms
   5. CRDs including latching and position indication

6. Scram testing of control rods at atmospheric pressure

7. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specification; full scram capability must be similarly demonstrated.

14.1.3.2.12 Fuel Handling and Vessel Servicing Equipment Preoperational Test

a. Test Objective - To verify the operation of the fuel handling and vessel servicing equipment, including tools used in the servicing of control rods and fuel assemblies, local power range monitors (LPRMs), and dry tubes. The test will also verify the operation of vacuum cleaning equipment, the refueling platform, the fuel preparation machine, and the service platform

b. Prerequisites - The checkout and initial operations tests have been completed as necessary, and the TRC has reviewed and approved the test procedure and the initiation of testing. Additionally, the refueling platform, fuel preparation machine, and fuel racks must be installed and operational; all slings and lifting devices must be certified at their design load, at least, by the vendor

c. General Test Method - Verification of the fuel handling and vessel servicing equipment is demonstrated by dry operation of the following equipment:

1. Cell disassembly tools

2. Channel replacement tools

3. Vacuum cleaning equipment

4. Interlocks and logic associated with the refueling and service platform

5. Refueling and service platforms.

d. Acceptance Criteria - The above tools must be verified for proper operation. In addition, logic and interlocks and grapple load cells must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.13 Core Spray System Preoperational Test

a. Test Objective - To verify the operation of the core spray system, including spray pumps, sparger ring, spray nozzles, controls, valves, and instrumentation

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The RPV must be available and ready to receive water

c. General Test Method - Verification of core spray system capability is demonstrated by the proper, integrated operation of the following:

1. Logic and interlocks

2. Core spray system pumps, including auto initiation

3. Flow path verification
4. Annunciators
5. Adequate NPSH with simulated suppression chamber inlet strainer 50 percent plugged.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications; system flow rates and patterns and initiation time must be demonstrated similarly.

14.1.3.2.14 High Pressure Coolant Injection System Preoperational Test

a. Test Objective - To verify the operation of the high pressure coolant injection (HPCI) system, including turbine and related auxiliary equipment as available, vacuum pump, condensate pump, valves, instrumentation, and control

b. Prerequisites - The checkout and initial operations tests have been completed as necessary, and the TRC has reviewed and approved the test procedure and the initiation of testing

c. General Test Method - Verification of HPCI system capability is demonstrated with simulated signals by the proper, integrated operation of the following:

1. Automatic initiation
2. Automatic isolation, including leak detection and interlocks
3. Valve controls and interlocks
4. Turbine test mode and trip
5. Gland condenser condensate pump and vacuum pump, and interlocks
6. Alarms and annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications. All pump tests involving the HPCI main and booster pumps are deferred to the startup test phase.

14.1.3.2.15 Fuel Pool Cooling and Cleanup System Preoperational Test

a. Test Objective - To verify the operation of the fuel pool cooling and cleanup system (FPCCS), including valves, pumps, and demineralizer

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The related support systems, the RBCCW, control air, and portions of the radwaste system must have readiness verification

c. General Test Method - Verification of the FPCCS is demonstrated by the proper, integrated operation of the following:

1. Control air-operated valves and related sequence logic

2. Flow path verification
3. Pumps, and their motors and related automatic controls, interlocks, and vacuum breaker verification
4. Demineralizer operation
5. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications; a total system operational capability must be demonstrated similarly.

14.1.3.2.16 Leak Detection System Preoperational Test

a. Test Objective - To summarize the test requirements and verify the leak detection test data for each of the nuclear systems

b. Prerequisites - The prerequisites are included in the preoperational test specifications for each of the nuclear systems listed below

c. General Test Method - As an integral part of each of the following system preoperational tests, the nuclear systems leak detection is verified by the proper operation of the leak detection features of the following nuclear systems:

1. RWCU
2. Nuclear boiler system
3. RHR
4. RCIC
5. HPCI
6. Radwaste system

d. Acceptance Criteria - The leak detection features of the nuclear systems must be verified for proper operation and shown to be within their respective engineering design specifications.

14.1.3.2.17 Liquid and Solid Radwaste System Preoperational Test

a. Test Objective - To verify the operation of the radwaste system, including pumps, filters and demineralizers, centrifuge, and solid-handling equipment

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. Additionally, laboratory facilities must be available to perform water quality tests

c. General Test Method - Verification of the radwaste system capability is demonstrated by the proper, integrated operation of the following:

1. System pumps under all normal possible flow paths and component operation
2. Isolation valve operation, including valve logic and leak detection sensors and related annunciators
3. Filters and demineralizers and related controls
4. Centrifuges and solid-handling equipment
5. Phase separator and waste sludge subsystems
6. Chemical waste and spent resin subsystems.

d. Acceptance Criteria - All system and subsystem components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.18 Reactor Protection System Preoperational Test

a. Test Objective - To verify the proper operation of the reactor protection system (RPS), including sensors, logic channels, scram relays, reset logic, and motor-generator power supplies

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. Checkout and initial operations tests of the MSIV limit switches must be complete. The CRD hydraulic system should have readiness verification

c. General Test Method - Verification of the RPS capability is demonstrated by the proper, integrated operation of the following.

1. M-G sets and associated voltage and underfrequency control logics
2. RPS input sensors including automatic bypass functions
3. Scram channel relay logic, including scram relays and manual scram switches
4. Mode switch functions and bypass time delays
5. Full scrams including CRDs if the CRD hydraulic system is available. Otherwise this verification is performed with the preoperational test of the CRD hydraulic system
6. Annunciator and sequential operations recorder inputs
7. RPS sensor initiation of reactor and containment isolation.

The method used for measuring the response times of initiating channels is described in Subsection 7.2.1.1.3.8.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to perform within their respective engineering design specifications; the RPS must demonstrate the ability to scram the reactor within a specified, maximum time. Each portion of the scram chain including sensors must meet a specified, maximum-allowable operating time.

14.1.3.2.19 Neutron Monitoring System Preoperational Test

a. Test Objective - To verify the operation of the neutron monitoring system (NMS), including startup, intermediate, power range detectors, rod block monitor (RBM), and related equipment

b. Prerequisites - The checkout and initial operations tests have been completed as required, and the TRC has reviewed and approved the test procedure at the initiation of testing. Additionally, all source range monitors (SRMs) and pulse preamplifiers, intermediate range monitors (IRMs) and voltage preamplifiers, and average power range monitors (APRMs) will have been calibrated per vendor's instructions

c. General Test Method - Verification of the NMS capability is demonstrated by the proper, integrated operation of the following.

   1. All SRM detectors, and their respective insert and retract mechanisms, and cables
   2. SRM channel, including pulse preamp, remote meter and recorder, trip logic, logic bypass and related lamps and annunciators, control system interlocks, refueling instrument trips, and power supply
   3. All IRM detectors and their respective insert and retract mechanisms and cables
   4. IRM channels, including voltage preamps, remote recorders, RMCS interlocks, RPS trips, annunciators and lamps, and power supplies
   5. All LPRM detectors and their respective cables, and power supplies
   6. All APRM channels, including trips, trip bypasses, annunciators and lamps, remote recorders, RMCS interlocks, RPS interlocks, and power supplies
   7. Recirculation flow bias signal, including flow unit, flow transmitters, and related annunciators, interlocks, and power supplies.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications; the ability of the system to interface properly with the reactor protection system must be demonstrated similarly.

14.1.3.2.20 Traversing In-Core Probe System Preoperational Test

a. Test Objective - To verify the operation of the traversing in-core probe (TIP) system, including the TIP detector, controls and interlocks, containment secure lamp, and squib circuits

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. Additionally, the TIP detector and dummy detector, ball valve time delay, core top and bottom limits, clutch, X-Y recorder, shear valves, and purge system are shown to be operational

c. General Test Method - With the exception of the shear valve which is not fired, verification of the TIP system is demonstrated by the proper, integrated operation of the following:

1. Indexer cross-calibration interlock
2. Shear valve monitor lamps
3. Drive motor manual control and override, automatic control and stop, and low speed control
4. TIP automatic detector withdrawal
5. Containment secure lamp and squib circuits
6. Ball valve control.

In addition, one explosive device is test fired to verify operability of the squib explosive channels. The squib valve firing circuit is checked by

(a) Jumpering pins to the valve actuators
(b) Operating the "fire" switch
(c) Measuring the current.

This test verifies wiring, operability of switch and interlocks, and capacity of the power supply. Continuity through the squib is monitored continuously by a "trickle" current

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.21 Rod Worth Minimizer System Preoperational Test

a. Test Objective - To verify the operation of the rod worth minimizer (RWM) system under its various modes of operation

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The CRD system, RMCS, and rod position indication system are shown to be operational. The rod sequence control system (RSCS) is bypassed, computer diagnostic and special tests are completed, and fuel is not loaded

c. General Test Method - Proper operation of RWM hardware and program is demonstrated by successful completion of the following items using a rod test sequence loaded into computer memory

1. Proper indication of errors and application of rod blocks while operating between 100 percent and 50 percent rod density and the low-power setpoint
2. Proper indication of errors while operating between the low-power setpoint and the low-power alarm point
3. System initialization below the low-power setpoint, initialization between the low-power setpoint and the low-power alarm point, and initialization above the low-power alarm point
4. Rod test mode
5. RWM acceptance of a substitute rod position valve
6. Rod drift scan.

d. Acceptance Criteria - All system operations must be either verified or demonstrated to be within their respective engineering design criteria.

14.1.3.2.22 Process Radiation Monitoring System Preoperational Test

a. Test Objective - To verify the operation of all subsystems of the process radiation monitoring system (PRMS), both liquid and gaseous. The primary containment radiation monitoring subsystem preoperational test is reviewed in Subsection 14.1.3.2.50

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has approved the test procedure and the initiation of testing. Additionally, all component units, including the pulse preamplifiers, power supplies, indicator and trip units, sensors, and converters, are calibrated according to the vendor's instruction manuals; circuit continuity, insulation resistance, and high potentiometer tests will have been completed

c. General Test Method - Verification of the process PRMS is demonstrated by the proper, integrated operation of the components of all subsystems, including the following:

1. Air or water flow rates and operation of controls and alarms for all off-line subsystems
2. Operation accessibility and viability of all filter collectors (iodine and particulate) included in specified subsystems
3. Accessibility and operability of all grab sample portions, such as the offgas vial sampler
4. Sensors, preamps, cabling, channels, lamps, annunciators, trip units, recorders, sample racks, check sources, and interlocks.

d. Acceptance Criteria - All subsystem components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.23 Area Radiation Monitoring System Preoperational Test

a. Test Objective - To verify the operation of the area radiation monitoring system (ARMS), including sensors and channels, trip units, alarms, and recorder

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. Additionally, indicator and trip units, power supplies, and sensor/converters are calibrated according to the vendor's instruction manual

c. General Test Method - Verification of the ARMS capability is demonstrated by the proper, integrated operation of the following:

   1. Sensor/converter and associated channels
   2. Channel trip units
   3. Alarm annunciators, lights, and beacons
   4. Recorders.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.24 Process Computer Interface System Preoperational Test

a. Test Objective - To verify the operation of the process computer interface system, including computer inputs and printout

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. Additionally, computer diagnostic checks and programming are completed

c. General Test Method - Verification of the process computer interface system is demonstrated by proper operation of the following:

   1. Analog input signals
   2. Computer printout
   3. Digital input signals
   4. Digital output signals.

d. Acceptance Criteria - All system operations must be either verified or demonstrated to be within their respective engineering design specifications.

14.1.3.2.25 Rod Sequence Control System Preoperational Test

a. Test Objective - To verify the operation of the RSCS under its various modes of operation

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. Additionally, the self-test feature of the RSCS is verified

c. General Test Method - Verification of the RSCS is demonstrated by the proper operation of the following functions:

1. Group fence blocks
2. Full-in, full-out bypass blocks
3. Group select blocks
4. 50 percent rod density notch control logic
5. 20 percent power notch control bypass (minimum)
6. Illuminations and annunciation.

d. Acceptance Criteria - All system operations must be either verified, or demonstrated to be within their respective engineering design specifications; RSCS acceptance of an operator-initialized group reset must be demonstrated similarly.

14.1.3.2.26 Condensate System Preoperational Test

a. Test Objective - To verify the operation of the condensate system, including pumps, motors, controls and interlocks, feedwater heaters, control valves, condensers, and flow and pressure instrumentation. No attempt is made to verify design heat loads until nuclear steam is available

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. Related support systems (condensate makeup demineralizer, condensate storage, and control air) must have readiness verification

c. General Test Method - With the exception of the condensate polishing demineralizer, condensate storage, condenser vacuum, and condensate makeup demineralizer systems, which are the subjects of their own preoperational tests, verification of the condensate system capability is demonstrated by the proper, integrated operation of the following:

1. Condenser pumps, motors, controls, and interlocks
2. Offgas, steam-jet air ejector, and gland steam condensers, and their related water control valves
3. System normal and emergency relief protection valves
4. System minimum recirculation flow and bypass control valves
5. Condenser hotwell level controls
6. System normal and emergency makeup valves and control
7. Heater feed pumps and bypasses, motors, controls, and interlocks

8. System flow and pressure instrumentation
9. Feedwater heaters and control valves
10. Reactor feed pump seal water injection and return pumps, motors, controls and logic
11. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications. Verification of system design heat loads is deferred until nuclear steam is available.

14.1.3.2.27 Condensate Polishing Demineralizer System Preoperational Test

a. Test Objective - To verify the operation of the condensate polishing demineralizer system, including demineralizers, pumps, motors, and automatic controls

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedures and the initiation of testing. The related support systems (condensate storage, condensate portions of radwaste, station air, and control air) must have readiness verification

c. General Test Method - Verification of the condensate polishing demineralizer system is demonstrated by the proper, integrated operation of the following:

1. Holding pumps, precoat pumps, and related automatic controls and interlocks
2. System flow, flow balance control, interlocks and override, and automatic valve operation
3. Demineralizers' automatic controls and valves
4. Resin precoat batch preparation subsystem, automatic sequencing, and tank agitators
5. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications; effective system filterability must be demonstrated similarly.

14.1.3.2.28 Condenser Vacuum System Preoperational Test

a. Test Objective - To verify the operation of the condenser vacuum system, including air-ejectors, and seal water and vacuum pumps

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The related support systems (the condensate makeup demineralizer, condensate, condensate storage, general service water, control air, and radwaste systems) must have readiness verification

c. General Test Method - Total system performance cannot be verified until nuclear steam is available; functional verification of the condenser vacuum system capability is demonstrated by the proper operation of the following:

1. Vacuum and seal water pumps automatic operation
2. System automatic valve operation
3. Water makeup system automatic operation
4. Air-ejector system operation
5. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.29 Condensate Storage System Preoperational Test

a. Test Objective - To verify the operation of the condensate storage system, including tanks, storage tank recirculating heat exchanger, pumps, reducing station, valves, instrumentation and controls

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The related support systems (the condensate makeup demineralizer and demineralized water supply header) must have readiness verification

c. General Test Method - Verification of the condensate storage system capability is demonstrated by the proper, integrated operation of the following:

1. System pumps, motors, and their related automatic controls, interlocks, and safety devices
2. Condensate storage tank heat exchanger
3. Automatic valve operation
4. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications; the emergency capacity of the condensate storage tank must be demonstrated similarly.

14.1.3.2.30 Plant Process Sampling System (Liquid Radwaste) Preoperational Test

a. Test Objective - To verify the operation of the plant process sampling system (liquid radwaste), including valves and controls

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedures and the initiation of testing. The required support systems and demineralized water must have readiness verification. Additionally, portions of the radwaste system must have readiness verification

c. General Test Method - Verification of the plant process sampling system (liquid radwaste) is demonstrated by the ability of the system to draw samples from the following radwaste subsystems:

   1. Chemical waste tank
   2. Waste sample tanks
   3. Liquid radwaste effluent
   4. Waste collector system: waste-collector tank, etched-disk filter, oil coalescer, precoat filter, demineralizer
   5. Floor drain collector system: collector tank, etched-disk filter, oil coalescer, precoat filter, demineralizer
   6. Evaporator feed surge tank, evaporator drains, evaporator drains holdup tank, evaporator concentrates feed tank, evaporator distillate surge tank
   7. Waste clarifier tank and condensate phase separators
   8. Decant from centrifuge and distillate from extruder-evaporator
   9. Centrifuge feed tank and spent resin slurry feed tank
   10. Fuel pool filter-demineralizer.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.31 Plant Process Sampling System (Reactor) Preoperational Test

a. Test Objective - To verify the operation of the plant process sampling system (reactor), including sampling valves, isolation valves, pumps, motors, heat exchangers, and related equipment

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedures and the initiation of testing. The required support systems (control air, demineralized water, emergency equipment service water [EESW], and RBCCWS) must have readiness verification

c. General Test Method - Verification of the plant process sampling system (reactor) is demonstrated by the proper, integrated operation of the following:

   1. Sampling lines and valve, automatic isolation valves, and the related sensors and indicators
   2. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications. The ability of the system to draw samples from the reactor building equipment must be demonstrated.

14.1.3.2.32 Plant Process Sampling System (Turbine) Preoperational Test

a. Test Objective - To verify the operation of the plant process sampling system (turbine) including sampling valves, pressure regulators and reliefs, flow meter, monitor and recorder, pumps valve controls, and lights

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedures and the initiation of testing. Required support systems (demineralized water, turbine building closed cooling water system [TBCCWS], RBCCWS, condensate, circulating water, and condensate polishing demineralizer) must have readiness verification

c. General Test Method - Verification of the plant process sampling system (turbine) is demonstrated by the proper, integrated operation of the following:

   1. Sample lines pressure regulators, relief valves, and temperature baths

   2. Related sensors and indicators

   3. Condenser sample pump and motor

   4. Solenoid valve controls and indicator lights.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications. The ability of the system to draw samples from the turbine building equipment must be demonstrated.

14.1.3.2.33 Turbine Building Closed Cooling Water System Preoperational Test

a. Test Objective - To verify the operation of the TBCCWS, including pumps and associated motors, heat exchangers, makeup tank, valves, and instrumentation and control

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The related support systems (condensate storage, and control air) must have readiness verification

c. General Test Method - Verification of the TBCCWS is demonstrated by the proper, integrated operation of the following:

   1. Pumps, motors, and associated controls, interlocks, and alarms

   2. Automatic makeup to head tank, and all control valve operation

   3. System flow through all heat exchangers and coolers

   4. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications. However, no attempt will be made to simulate design heat loads or design flow rates through the various coolers and heat exchangers.

14.1.3.2.34 Reactor Building Closed Cooling Water System Preoperational Test

a. Test Objective - To verify the operation of the RBCCWS, including pumps and associated motors, heat exchangers, makeup tank, valves, and instrumentation and control

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The related support systems (condensate storage and control air) must have readiness verification

c. General Test Method - Verification of the RBCCWS capability is demonstrated by the proper, integrated operation of the following:

1. Pumps, motors, and associated controls, interlocks, and alarms
2. System flow through all heat exchangers and coolers
3. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications. However, no attempt will be made to simulate design heat loads or design flow rates through the various coolers and heat exchangers.

14.1.3.2.35 Emergency Equipment Cooling and Service Water System Preoperational Test

a. Test Objective - To verify the operation of the emergency equipment cooling water (EECW) system, including pumps and motors, heat exchangers, makeup tanks, valves, and instrumentation and control

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The related support systems (condensate storage, RBCCW, RHR service water system, RHR cooling towers, RHR reservoir, and control air) must have readiness verification

c. General Test Method - Verification of the EECW system is demonstrated by the proper, integrated operation of the following:

1. Pumps, motors, and associated controls, interlocks, and alarms
2. Automatic makeup to makeup tank, and control valve operation
3. System flow through all heat exchangers and coolers
4. Annunciators
5. EECW pumps automatic start logic

6. Automatic isolation of nonessential RBCCW system cooling loads from the EECW system loads.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications. However, no attempt will be made to simulate design heat loads or design flow rates through the various coolers and heat exchangers.

14.1.3.2.36 Station and Control Air System Preoperational Test

a. Test Objective - To verify the operation of the station and control air systems, including station air compressors and their related motors and controls, aftercoolers and air receivers, control air compressors and their related motors and controls, and air drying equipment

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The related support systems (the TBCCW and RBCCW) must have readiness verification

c. General Test Method - Verification of the station and control air system capability is demonstrated by the proper, integrated operation of the following:

1. Station air compressors and their motors and related controls, including loading and unloading

2. Aftercoolers, moisture separators, air receivers, and related solenoid-operated valves

3. Control air compressors and their related motors and automatic start loading and unloading controls

4. Air dryers and desiccant purge system blower, heater, and heat exchanger

5. Annunciators

6. System pressure decay test on noninterruptible control air.

d. Acceptance Criteria

1. All system components must be either verified for proper operation, or demonstrated to be within their respective engineering design specifications

2. Preoperational testing of the control air system is in accordance with Regulatory Guide 1.80 (June 1974).

14.1.3.2.37 Fire Protection System Preoperational Test

a. Test Objective - To verify the operation of the fire protection system, including normal and emergency water supplies, heat and smoke detection equipment and alarms, carbon dioxide systems, and Halon systems

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The general service water (GSW) system must have readiness verification. Prior to test of the transformer deluge systems, upstream manual valves are closed

c. General Test Method - Verification of the fire protection system capability is demonstrated by the proper, integrated operation of the following:

1. Motor-driven fire pump and related automatic startup controls and alarms
2. Diesel-driven fire pump and related diesel automatic startup controls, alarms, automatic battery selector, and engine cooling water
3. Deluge and sprinkler systems solenoid valves and their related alarms and detectors
4. Main control room smoke detectors and alarms
5. Turbine building heat and smoke vents, outbuildings smoke and fire detectors, and diesel generator building smoke and fire detectors
6. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.38 Auxiliary Electrical Power System Preoperational Test

Contained in the auxiliary electrical power system are two engineered safety feature (ESF) load divisions (load groups), which are totally independent of one another. Within each division are two ESF power trains that can be tested individually without affecting the other train's buses or emergency diesel generator (EDG). The two divisions can be tested independently without affecting the alternate division's buses, EDGs, or redundant equipment. The tests are designed to prove the operability of the redundant systems and the availability of onsite power sources beyond l0 sec and to ensure proper loading for each EDG. The independence of divisions and redundancy of load groups will be verified to meet the requirements of Regulatory Guide 1.41 in the ECCS integrated test.

a. Test Objective - To verify the operation of the 4.16-kV/480-V ac power systems, including bus ties, transformers, switchgear, and related controls for

1. Load group assignments
2. Full load capability
3. Loss of offsite power.

b. Prerequisites - The checkout and initial operations tests have been completed, and the TRC has reviewed and approved the test procedure and the initiation of testing. The offsite l3.8-kV (l20-kV) and 345-kV preferred power supply sources must have readiness verification

c. General Test Method - Verification of the 4.l6-kV/480-V ac power systems is demonstrated by the proper, integrated operation on a divisional basis of the following:

1. 13.8-kV (120-kV) and 345-kV system service transformers and related controls
2. 13.8-kV source breaker and related controls
3. 4.16-kV buses and related controls
4. 4.16-kV tie breakers and related controls
5. 4.16-kV/480-V unit substations, including transformers
6. 480-V buses and related controls
7. 480-V motor control centers (MCCs) and related controls
8. 480-V load breakers and related controls
9. Load shedding - loss of offsite power and LOCA
10. Load sequencer operation
11. Annunciators.

Actual loading of the EDGs will be performed in the EDG system preoperational test (refer to Subsection 14.1.3.2.39)

d. Acceptance Criteria - All system components must be verified for proper load group assignment. All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.39 Emergency Diesel Generator System Preoperational Test

a. Test Objective - To verify the proper operation of the EDG system under all design test conditions. The testing will include diesel engines, related support equipment and controls; generators, related electrical switchgear and load-shedding devices; safety devices and alarms

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The related support systems (the RHRSW and emergency diesel generator service water [EDGSW] system, EDG room ventilation system, auxiliary electrical system, 130/260-V dc system) must have readiness verification

c. General Test Method

1. Loss of Offsite Power - Simulate loss of offsite power and verify that the EDG system starts automatically
2. Loss of Offsite Power and LOCA - Simulate loss of offsite power and a LOCA condition and verify the proper operation of the load sequencer
3. Full-Load Test - Parallel the EDG to the offsite system and demonstrate operation for 2 hr at the 2-hr rating for the EDGs and continue operation for an additional 22 hr at the continuous rated load of the EDG

4. Hot Condition Test - Following the full-load test, repeat the loss of offsite power and LOCA test

5. Load Shed Test - Verify that voltage limits and overspeed limits are not reached when testing the loss of RHR pumps load and loss of complete rated load

6. Simulate Recovery - Verify that the EDG can be synchronized with offsite power to restore it to standby status, following the loss of offsite power tests, while the unit is connected to the emergency load

7. Reliability Test - Demonstrate 23 consecutive successful tests consisting of a manual start and load to 50 percent of continuous rating.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications; automatic startup and total load-carrying capability under emergency conditions must be demonstrated similarly.

14.1.3.2.40 120-V AC Instrument and Control Power System Preoperational Test

There are six l20-V ac instrument and control power supply systems. Three are located in each redundant electrical division; one from each division is used for ESF equipment. The tests are designed to prove the independence of the load groups of each instrument and control supply, to the requirements of Regulatory Guide 1.41.

a. Test Objective - To verify the operation of the l20-V ac instrument and control power system, including regulators, transformers, automatic switchgear, and related controls

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The system supply transformers, transfer switches, and regulators must have readiness verification

c. General Test Method - Verification of the 120-V ac instrument and control power system capability is demonstrated by the proper, integrated operation of the following:

1. System supply transformers

2. Automatic transfer switchgear and respective controls

3. Regulators

4. Annunciators.

d. Acceptance Criteria - All system components must be verified for proper load group assignment. They must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.41 130/260-V DC Power System Preoperational Test

The 130/260-V dc power system consists of two divisional redundant and one balance-of-plant (BOP) 130/260-V battery charger load group combinations. The divisional dc systems used for ESF loads are redundant and independent of each other and of the BOP dc system.

The tests are designed to prove the independence of the systems and their load groups and to verify the supply and operability of the required load throughout the entire designed battery load period during the design-basis event. This includes verification of the operability of Class 1E dc loads that are required to operate at reduced battery voltage conditions. The requirements of Regulatory Guide 1.41 for the two divisional 130/260-V dc power systems for redundancy and load group assignment will be verified in the integrated ECCS test.

a. Test Objective - To verify the operation of the 130/260-V dc power system, including batteries, battery chargers, distribution panels, ground detectors, and alarms

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The ac supply power, batteries, and system components must have readiness verification

c. General Test Method - Verification of the 130/260-V dc power system is demonstrated by the proper, integrated operation of the following:

    1. Battery chargers: 480-V ac-130-V dc, and related controls

    2. Batteries

    3. Ground detectors

    4. DC power distribution panels

    5. Annunciators.

d. Acceptance Criteria - Required system components must be verified for proper operation at the reduced dc system voltage encountered when they are required to operate or must have been qualification-tested previously to a lower voltage. Total battery capacities under specified discharge rates must be demonstrated similarly.

14.1.3.2.42 24/48-V DC Power System Preoperational Test

There are two, independent 24/48-V dc power systems. Each system can be tested independently without affecting the other. The tests are designed to prove their ability to perform as designed. The requirements of Regulatory Guide 1.41, for independence and proper load group assignment, are verified in the integrated ECCS preoperational test.

a. Test Objective - To verify the operation of the 24/48-V dc power system, including batteries, battery chargers, distribution panels, and alarms

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The ac supply power, batteries, and system components must have readiness verification

c. General Test Method - Verification of the 24/48-V dc power system is demonstrated by the proper, integrated operation of the following.

1. Battery chargers: 120-V ac-24-V dc, and their 480/120-V ac supply transformers
2. Batteries
3. DC power distribution panels, including under-voltage relays
4. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications; total battery capacities under specified discharge rates must be demonstrated similarly.

14.1.3.2.43 Primary Containment Leak Rate Preoperational Test

a. Test Objective - To determine the leak rates of the primary containment, containment penetrations, MSIVs, and the drywell to suppression pool vacuum breakers

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. Permanent plant air supply or a portable air compressor with filters and valves, pressure and temperature sensors, flow meters, and soap bubble and ultrasonic leak detection equipment must be available. Functional tests of isolation valves described in the nuclear boiler preoperational test (14.1.3.2.6) and vacuum breakers described in the containment vacuum breakers preoperational test (14.1.3.2.66) must be completed

c. General Test Method - Leak rates are determined by leak rate testing of the following:

1. Local leak rate test of primary containment penetrations
2. Local leak rate test of primary containment isolation valves and each torus to reactor building vacuum breaker and isolation valve
3. Local leak rate tests of the MSIV
4. Overall containment integrated leakage
5. Integrated leakage test - drywell to suppression pool.

d. Acceptance Criteria - All leak rates from penetrations, valves, and overall containment must be shown to be within the limits specified in 10 CFR 50, Appendix J. Leakage from the drywell to suppression pool vacuum breakers shall be within the limits specified in the Technical Specifications.

14.1.3.2.44 Reactor Building Crane Preoperational Test

a. Test Objective - To verify the operation of the reactor building crane to design load

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing

c. General Test Method - Verification of the reactor building crane is demonstrated by the proper, integrated operation of the following:

   1. Limit switches
   2. Interlocks
   3. Motors and their related controls
   4. No-load, full-load, and overload conditions tests.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications, at both no-load and overload conditions.

14.1.3.2.45 Reactor Building Heating and Ventilation System Preoperational Test

a. Test Objective - To verify the operation of the reactor building heating and ventilation system, including filters, heaters, supply and exhaust fans, essential cooling coil units, and controls

b. Prerequisites - The checkout and initial pperations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing

c. General Test Method - Verification of the reactor building heating and ventilation system is demonstrated by the proper, integrated operation of the following:

   1. Fresh air intake louvers and filters
   2. Air intake heater and controls
   3. Supply and exhaust air fans and their related motors and controls
   4. Secondary containment isolation logic
   5. System shutoff and modulating dampers
   6. Annunciators
   7. Essential cooling coil units
      (a) ECCS pump rooms
      (b) Control center air conditioning system (CCACS) equipment room
      (c) Thermal recombiner cubicles

(d) Control air compressor areas

(e) EECWS equipment areas

(f) SGTS rooms

(g) Essential switchgear rooms

(h) Essential battery rooms.

8. Reactor building booster exhaust fans

9. Reactor building unit heaters.

d. Acceptance Criteria - All system components including air flow balancing must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.46 Main Control Room Heating, Ventilation, and Air Conditioning Systems Preoperational Test

a. Test Objective - To verify the operation of the main control room heating, ventilation, and air conditioning (HVAC) systems and their related heaters, chillers, fans, chlorine detection, and radiation monitoring response action and controls

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The related support systems (the RBCCW, and control air) must have readiness verification

c. General Test Method - Verification of the main control room HVAC systems is demonstrated by the proper, integrated operation of the following:

1. Refrigeration compressors, condensers, and evaporators

2. Chilled water pump and motor and associated controls

3. Chiller control panel and thermostatic controls

4. Cooling coils and fans

5. Multizone air conditioners, including electronic air cleaners, filters, heaters, and coolers, humidifiers, and all related thermostats, humidistats, and controls

6. Indicating lights and alarms

7. Emergency recirculation fans and motors, and filters

8. All air-operated valves and dampers

9. Return air fans and related controls

10. Deleted

11. Annunciators

12. Deleted

13. Radiation monitoring response action
14. CCACS equipment room.

d. Acceptance Criteria - All system components including air flow balancing must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.47 Standby Gas Treatment System Preoperational Test

a. Test Objective - To verify the operation of the SGTS, including system exhaust fans, decay heat removal fans, filters, air heaters, charcoal adsorber unit, isolation valves, and their controls

b. Prerequisites - The checkout and initial operation tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The control air system must have readiness verification

c. General Test Method - Verification of the SGTS is demonstrated by the proper, integrated operation of the following:

1. Exhaust fans and their related motors and controls
2. Decay heat removal fans and their related motors and controls
3. Charcoal adsorber carbon dioxide fire protection system
4. Air heater and its controls
5. Charcoal adsorber heater and controls
6. Alarms and annunciators.

d. Acceptance Criteria

1. All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications
2. Preoperational testing is in accordance with Regulatory Guide l.52 (June l973), Regulatory Position, C5b, C5c, and C6.

14.1.3.2.48 Drywell Cooling System Preoperational Test

a. Test Objective - To verify the operation of the drywell cooling system, including coolers, blowers, motors, and related logic and controls. Heat load performance of the system is checked during the startup test program

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing

c. General Test Method - Verification of the drywell cooling system capability is demonstrated by the proper, integrated operation of the following:

1. Cooling coils and flow balance valves

2. Cooling fans and their motors and related controls
3. Motor logic circuitry and protective features
4. Annunciator alarms.

d. Acceptance Criteria - All system components including air flow balancing must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.49 Primary Containment Atmosphere Control Preoperational Test

a. Test Objective - To verify the operation of the primary containment atmosphere control system, including nitrogen inerting, purging, primary containment pneumatic supply, and pressure control systems

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The auxiliary steam system must have readiness verification

c. General Test Method - Verification of the primary containment atmosphere control system capability is demonstrated by the proper, integrated operation of the following:

1. Nitrogen storage tank pressure valve and controller, pressure relief valves, and instrumentation
2. Electric vaporizer and pressure buildup coil
3. Automatic pneumatic supply line containment isolation valves, sensors, and controls
4. Primary containment pneumatic supply isolation valves, controls, and interlocks
5. Temperature control and valve controllers
6. Nitrogen receivers pressure monitors and alarms
7. Steam vaporizer and controls
8. Primary containment purging valves, controls, and interlocks
9. Primary containment pressure control valves, makeup valves, vent valves, and controls
10. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.50 Primary Containment Monitoring System Preoperational Test

a. Test Objective - To verify the operation of the primary containment monitoring system, including valves, monitoring sensors and channels, and temperature, pressure, and level monitors

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing

c. General Test Method - Verification of the primary containment monitoring system capability is demonstrated by the proper, integrated operation of the following:

    1. Isolation valves and sample pumps

    2. Primary containment atmosphere monitoring system, including filters, detectors, recorders and meters, alarms, and channels

        (a) Hydrogen-oxygen subsystem, including analyzers, recorders, and alarms

        (b) RMS, including gaseous detector and related monitoring, recording, and annunciating equipment.

    3. Temperature, pressure, and level subsystems, including pressure transmitters and recorders, thermocouples and recorders, and level transmitters and recorders.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.51 Secondary Containment Leak Rate Preoperational Test

a. Test Objective - To measure the secondary containment leak rate

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The SGTS and reactor building heating and ventilation system must have readiness verification

c. General Test Method - Verification of the secondary containment boundary integrity is demonstrated by the leak rate testing of the overall secondary containment

d. Acceptance Criteria

    1. The ability of the SGTS to maintain the design negative pressure under containment isolation conditions must be demonstrated

    2. The SGTS must be able to draw down the secondary containment pressure to -0.25 in. of water under accident conditions within 10 minutes.

14.1.3.2.52 Turbine Building Heating and Ventilation System Preoperational Test

a. Test Objective - To verify the operation of the turbine building heating and ventilation system, including filters, heaters, supply and exhaust fans, and related controls

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing

c. General Test Method - Verification of the turbine building heating and ventilation system capability is demonstrated by the proper, integrated operation of the following:

1. Fresh air intake louvers, filter, heater, and controls
2. Supply and exhaust air fans and their related motors and controls
3. Booster fan and propeller fans and their motors and controls
4. System shutoff and modulating dampers
5. Condensate return tanks and condensate return pumps and their related controls and interlocks
6. Offgas adsorber room air conditioning units and controls
7. Turbine building unit heaters.

d. Acceptance Criteria - All system components including air flow balancing must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.53 Radwaste Building Heating and Ventilation System Preoperational Test

a. Test Objective - To verify the operation of the heating and ventilation system for the radwaste building, Health Physics lab, and radwaste control room

b. Prerequisites - The checkout and initial operations tests have been completed, and the TRC has reviewed and approved the test procedure and the initiation of testing. The related support systems (the auxiliary steam, control air, and condensate makeup demineralizer) must have readiness verification

c. General Test Method - Verification of the heating system is demonstrated by the proper, integrated operation of the following:

1. Radwaste building supply and exhaust fans, steam heater, chiller, and associated controls and interlocks
2. Health Physics lab and radwaste control room supply and exhaust fans, heater and chiller, and associated controls and interlocks
3. Health Physics lab fume hood exhaust fan and controls
4. Radwaste building battery room air conditioning unit

5. Radwaste building booster exhaust fans
6. Radwaste building unit heaters.

d. Acceptance Criteria - All system components including air flow balancing must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.54 Communication and Evacuation Alarm System Preoperational Test

a. Test Objective - To verify the operation of the communication and evacuation alarm system, including the two-way radio, hi-com, telephone, hard-wired headset, and emergency alarm

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing

c. General Test Method - Verification of the communication and evacuation system capability is demonstrated by the proper, integrated operation of the following:

1. Two-way radio system, including base station, monitor receivers, selected portable transmitter/receivers, and base station speaker
2. Hi-com, including amplifiers, speakers, microphones, tone generator, signal relays, and control switches
3. System Supervisor's system
4. Hard-wired headset system and selected headsets
5. Emergency alarm system and alarm devices.

d. Acceptance Criteria - All permanently installed system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications. Proper operation of portable components (headsets and transceivers) will be by random sample and documented in the preoperational test.

14.1.3.2.55 Seismic Monitoring System Preoperational Test

a. Test Objective - To verify the operation of the seismic monitoring system, including accelerometers and recorders

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing

c. General Test Method - Verification of the seismic monitoring system capability is demonstrated by the proper integrated operation of the following:

1. Triaxial accelerometers
2. Signal conditioners and magnetic tape recorders

3. Seismic trigger and logic
4. Strip-chart recorder
5. Alarm circuits and annunciators
6. Batteries.

d. Acceptance Criteria - All system components must either be verified for proper operation or demonstrated to be within their respective engineering design specifications. Accelerometer signal input is simulated with a signal generator.

14.1.3.2.56 Residual Heat Removal Complex Heating and Ventilation System Preoperational Test

a. Test Objective - To verify the operation of the RHR complex heating and ventilation system, including heaters, supply fans, and instrumentation and controls

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing

c. General Test Method - Verification of the RHR complex heating and ventilation system is demonstrated by the proper, integrated operation of the following:

   1. Diesel generator room, switchgear room and pump room fans, motors, and related controls and logic
   2. Pump room temperature monitor and fan logic
   3. Unit heaters and controls.

d. Acceptance Criteria - All system components including air flow balancing must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.57 Residual Heat Removal Complex Service Water Systems Preoperational Test

a. Test Objective - To verify the operation of the RHRSW, EESW, and EDGSW systems, including pumps, fans, motors, cooling towers, and valves

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing

c. General Test Method - Verification of the RHR complex service water systems capability is demonstrated by the proper, integrated operation of the following:

   1. RHRSW, EDGSW, and EESW pumps, motors, controls, and logic
   2. RHRSW, EDGSW, and EESW pumps at minimum submergence level without vortexing
   3. RHRSW, DGSW, and EESW pumps for 100 hr at rated flow

4. Pump minimum flow valves to tower basin
5. Cooling tower fans, motors, and controls, and spray nozzles
6. Cooling tower control valves
7. Pressure sensors, indicators, and annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications; no attempt is made to simulate design heat loads.

14.1.3.2.58 Condensate Makeup Demineralizer System Preoperational Test

a. Test Objective - To verify operation of the condensate makeup demineralizer system including pumps, motors, demineralizers, storage tanks, controls, interlocks, and alarms

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The related support systems (the control air, potable water, and auxiliary steam systems) must have readiness verification

c. General Test Method - Verification of the condensate makeup demineralizer system capability is demonstrated by the proper, integrated operation of the following:

1. System pumps, motors, and the related automatic controls, interlocks, and safety devices
2. Demineralizer train alarms, stops, interlocks, and automatic controls
3. Acid and caustic storage tanks automatic controls, and heating; demineralized water tank controls
4. Annunciators.

d. Acceptance Criteria - All system components must be verified for proper operation and shown to be within their respective engineering design specifications.

14.1.3.2.59 General Service Water System Preoperational Test

a. Test Objective - To verify the operation of the GSW system, including GSW pumps and motors, traveling screens, circulating water reservoir makeup pumps and motors, and GSW pump strainers with motors, valves, and instrumentation and control

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing

c. General Test Method - Verification of the GSW system capability is demonstrated by the proper, integrated operation of the following:

1. GSW pumps, motors, and their controls, interlocks, and alarms
2. Traveling screens, motors, and their controls, interlocks, and alarms
3. Circulating water reservoir makeup pumps, motors, and controls
4. GSW pump strainer controls
5. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications; however, no attempt is made to simulate design heat loads or design flow rate through the various heat exchangers until nuclear steam is available.

14.1.3.2.60 Circulating Water System Preoperational Test

a. Test Objective - To verify the operation of the circulating water system, including pumps and motors, chemical subsystems, cooling towers, and screens

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The GSW and control air systems must have readiness verification

c. General Test Method - Total system performance cannot be verified until full-power operation. Functional verification of the circulating water system is demonstrated by the proper operation of the following:

   1. Circulating water pumps and related motors, pump and motor cooling, discharge valve operation, automatic controls and trips
   2. Cooling tower isolation and bypass valves
   3. Reservoir decanting pumps and related controls and interlocks
   4. Chemical injection equipment
   5. Annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications. Heat load performance is deferred until the power test program.

14.1.3.2.61 Offgas System Preoperational Test

a. Test Objective - To verify the operation of the offgas system, including pumps, motors, fans, gas treatment equipment, and instrumentation and control

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. Demineralized water and control air systems must have readiness verification

c. General Test Method - Verification of the offgas system capability is demonstrated by the proper, integrated operation of the following:

1. All motor-operated pumps, compressors, and fans and their related controls and logic
2. System instrumentation
3. System valves
4. Annunciators
5. Demonstrate offgas system gas-handling ability by introducing control air into the system at rated flow
6. Krypton gas test to verify design delay time.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications. The Krypton gas test will verify design delay time.

14.1.3.2.62 Main Turbine Electro-Hydraulic Control System Preoperational Test

a. Test Objective - To verify the operation of the electrohydraulic control (EHC) system, including speed governor equipment, reactor pressure control equipment valves, and instrumentation and control

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. Turbine cannot be tested until nuclear steam is available, but functional verification is performed. The EHC system and hydraulic fluid cooling system must have readiness verification

c. General Test Method - Verification of the EHC system is demonstrated by the proper, integrated operation of the following:

1. Hydraulic fluid pumps, motors, and their controls; fluid test valve; and fluid heaters, coolers, fans, and their respective controls, alarms, and annunciators
2. Stop valves, control valves, intercept valves, and bypass valves opening, closing, and logic
3. Wide-range runup control
4. Onload testing of turbine valves
5. Narrow-range speed governor and reactor pressure control equipment (using signal generator).

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.63 Thermal Recombiner System Preoperational Test

a. Test Objective - To verify the operation of the thermal recombiner system, including reaction chamber, separator, blower, related valves, and instrumentation and control

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. No attempt is made to simulate design heat loads

c. General Test Method - Verification of the thermal recombiner system capability is demonstrated by the proper, integrated operation of the following:

   1. Blower and controls
   2. Heater chamber and controls
   3. Reaction chamber and controls
   4. Water spray cooler and separator
   5. Instrumentation, valves, and annunciators.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.64 System Vibration and Expansion Preoperational Test

a. Test Objective - To verify proper installation and load adjustment of the piping support system, and to verify that fluid systems and their supports are not subject to excessive deflections and vibrations caused by normal and abnormal hydrodynamic transients

b. Prerequisites - The checkout and initial operations tests for the affected systems have been completed and the TRC or Onsite Review Organization (OSRO) has reviewed and approved the test procedure and the initiation of testing. The specific system tested must have readiness verification

c. General Test Method - Verification of acceptable performance is demonstrated by the following tasks:

   1. Check all hangers and snubbers for proper position and load indication after the system is filled with fluid or drained as appropriate to the system service
   2. Check for abnormal deflection or sag of piping
   3. Conduct vibration surveys during system operation and record and evaluate deflection and vibration data. A detailed discussion of the vibration operational test program is presented in Subsection 3.9.1.1. Table 3.9-1 presents a list of the systems to be tested. Certain vibration surveys will be performed after fuel load as part of the startup test program.

d. Acceptance Criteria - The piping system and its support system must be verified to be within established engineering design limits. The detailed acceptance criteria are provided in Subsection 3.9.1.1.

14.1.3.2.65 Primary Containment, Secondary Containment, and Auxiliary Building Equipment Drains and Floor Drains Preoperational Test

a. Test Objective - To verify the operation of the isolation valves in the drain lines that interconnect the two corner rooms of each division located in the subbasement

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The sump pumps in the reactor building and primary containment must have readiness verification

c. General Test Method - The proper operation of the floor drains is demonstrated by closure of the valves in the floor drain and equipment drain lines that interconnect the corner rooms

d. Acceptance Criteria - All flood control isolation valves shall be verified to close on hi-hi sump water level.

14.1.3.2.66 Containment Vacuum Breakers Preoperational Test

a. Test Objective - To verify the proper adjustment and operation of the containment vacuum breakers, including the drywell-to-torus and torus-to-reactor building vacuum breakers and the torus-to-reactor building isolation valves. (Individual vacuum breaker leakage is measured as part of the primary containment leak-rate preoperational test)

b. Prerequisites - The Checkout and Initial Operations Tests have been completed as required, and the TRC has reviewed and approved the test procedure and the initiation of testing

c. General Test Method - Verification of the vacuum breaker functionability is demonstrated by the following:

   1. Opening force tests on each vacuum breaker
   2. Operability tests of the vacuum breakers using the air operators
   3. Measurement of the close switch setpoint gap on the vacuum breakers
   4. Operability tests on the torus-to-reactor building isolation valves.

d. Acceptance Criteria - During operability tests, valve closing times, position indicating instrumentation, and the torus-to-reactor building isolation valve opening differential pressure meet the respective engineering design specifications. The vacuum breaker opening force measurement is less than the equivalent force exerted by the design opening differential pressure. The opening gap at the close switch setpoint is adjusted to less than, or equal to, 0.03 in.

14.1.3.2.67 Emergency Lighting System Preoperational Test

The emergency lighting system is designed to provide minimum adequate lighting during loss of normal lighting. The tests are designed to prove the independence of load groups of the emergency lighting system. The tests are designed to meet the requirements of Regulatory Guide l.4l.

a. Test Objective - To verify the operation of the emergency lighting system, including transformers, automatic transfer switchgear, and the related controls

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing. The system supply transformers, automatic transfer switches, and dc systems must have readiness verification

c. General Test Method - Verification of the emergency lighting system capability is demonstrated by the proper, integrated operation of the following:

   1. System supply transformers
   2. Automatic transfer switchgear and respective controls
   3. The lighting fixtures
   4. Annunciators.

d. Acceptance Criteria - All system components must be verified for proper load group assignment. All system components must be either verified for proper operation, or demonstrated to be within their respective engineering design specifications.

14.1.3.2.68 Personnel Monitoring, Survey Instruments, and Laboratory Equipment Preoperational Test

a. Test Objective - To verify proper operation of personnel monitoring, survey instruments, and the laboratory equipment

b. Methodology - Site procedures of chemistry and health physics are used to preoperationally test and verify the proper operation of personnel monitoring, survey instruments, and the laboratory equipment described in Section 12.3. This testing is performed by chemistry and health physics personnel. Test results are reviewed by group supervisors and maintained as a plant record. This program is described in the Plant Operating Manual and is audited by Quality Assurance. Although this program is somewhat different from other preoperational tests, the intent of Regulatory Guide 1.68 is fulfilled.

14.1.3.2.69 Reactor System Hydrostatic Preoperational Test

a. Test Objective - The test objective is to demonstrate the pressure-retaining integrity of the RPV and all connecting piping welds out to, and including, the welds connecting the first isolation valve in each connecting pipe

b. Prerequisites - The checkout and initial operations tests have been completed as necessary, and the TRC has reviewed and approved the test procedure and the initiation of testing. The related support system must be operable

c. General Test Method - The RPV hydrostatic test includes heatup, pressurization, inspection, and depressurization requirements

d. Acceptance Criteria - The test demonstrates zero leakage at all welded connections at test pressure.

14.1.3.2.70 Main Steam Line Isolation Valve Leakage Control System Preoperational Test

a. Test Objective - To verify the operation of the MSIV leakage control system, including controls, instrumentation, and all active components

b. Prerequisites - The checkout and initial operations tests have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing

c. General Test Method - Verification of system capability is demonstrated by the proper, integrated operation of the following:

   1. System logic, interlocks, and timers
   2. All valves and related controls and instrumentation, including the pressure regulators
   3. Pressure and flow monitoring devices
   4. Local and remote indication
   5. Proper system response to the loss of each of the leakage control system air supplies
   6. Proper system response will be functionally tested by manual initiation of each division using the applicable Plant Operating Procedure under conditions that simulate actual service conditions.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications.

14.1.3.2.71 Reactor Internals Flow-Induced Vibration Preoperational Test

a. Test Objective - To detect damage or excessive wear, loose parts, or other unacceptable vibration that could result from assembly errors or undesirable deviation from the previously qualified prototype plant. The test is performed consistent with the requirements of Regulatory Guide 1.20

b. Prerequisites - The reactor recirculation system must have readiness verification. Core support structures and components, fuel support castings, surveillance specimen holders and specimens, jet pumps, spargers, shroud head, steam separator, and reactor vessel head are installed during the flow test.

Temporary hardware is removed, and control rod blades either removed or fully redrawn

The core matrix must be empty; fuel assemblies, incore instrumentation tubes, and neutron source rods are not installed

c. General Test Method - Prior to the recirculation system flow excitation testing, a preliminary, internal, visual inspection of the vessel and components takes place. All or part of this inspection is by normal, visual fabrication inspection. After the preliminary visual inspections, the reactor recirculation system is operated at rated volumetric core flow for a minimum of 35 hr. Each reactor recirculation loop is operated independently for a minimum of 14 hr. The flow testing sequence is not important as long as the above flow conditions, totaling a minimum of 63 hr, are accumulated at some time between the preflow and postflow vessel internal inspection

Following completion of the flow testing, a reactor vessel water sample taken at bottom vessel drain line will be examined for wear products. The vessel will be drained, and the areas examined in the preflow inspection examined again

d. Acceptance Criteria - There must be no evidence of defects, loose parts, or wear resulting from the flow test. Flush cloths used for the bottom vessel drain sample must show no more than a slight particle speckling. Results of the vibration test are submitted to the NRC in accordance with Regulatory Guide 1.20.

14.1.3.2.72 Remote Shutdown Preoperational Test

a. Test Objective - To verify that systems to be used during a shutdown operation from outside the control room at the remote shutdown panel are operable in the manner in which they would be used during a shutdown

b. Prerequisites - The checkout and initial operations tests for the systems associated with the remote shutdown panel have been completed and the TRC has reviewed and approved the test procedure and the initiation of testing for each affected individual system

c. General Test Method - Verification of remote shutdown capability is demonstrated by the proper operation of the following:

1. Individual system or component preoperational tests associated with the remote shutdown panel
2. Each valve, pump, and logic that is controlled from the remote shutdown panel
3. Instruments at the remote shutdown panel displaying plant parameters
4. Annunciator alarms.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their engineering design specifications. Operation of all valves and pumps must be satisfactory. Analog instruments at the remote shutdown panel displaying plant parameters must mimic the corresponding main control room instruments.

14.1.3.2.73 Torus Water Management System Preoperational Test

a. Test Objective - To verify the operation of the torus water management system (TWMS), including pumps, valves, and controls and instrumentation

b. Prerequisites - The checkout and initial operations tests have been completed, and the TRC has reviewed and approved the test procedure and initiation of testing. The condenser must be available and ready to receive water. The torus must be available and contain water

c. General Test Method - Verification of TWMS capability is demonstrated by the proper, integrated operation of the following:

   1. Alarm and logic verification

   2. Pump performance and functional tests.

d. Acceptance Criteria - All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications; a total system operational capability must also be demonstrated.

14.1.3.2.74 Postaccident Sampling System Preoperational Test

a. Test Objective - The purpose of this test is to demonstrate proper operation of the postaccident sampling system. Specific objectives are to demonstrate the following:

   1. The ability to obtain a gas or liquid sample from the correct sample source

   2. The proper operation of the sample system control logic, including interlocks

   3. The proper operation of the sample panel graphic display lights.

b. Prerequisites - The checkout and initial operations tests have been completed, and the TRC has reviewed and approved the test procedure and the initiation of testing. The required support systems RHR system, reactor recirculation system, and RBCCWS must have readiness verification

c. General Test Method - Verification of the postaccident sampling system is demonstrated by the proper, integrated operation of the following.

   1. Sampling lines and sample isolation valves

   2. All sensing devices

   3. All motor-, solenoid-, and nitrogen-operated valves in the control panel, sample station, and piping station

   4. All control logic and interlocks

   5. Gas sample chiller

6. Gas sample heat tracing
7. All indicator lights and annunciators.

In addition, all cask and sample vial positioners shall be operated to verify ability to align with the sample station and to perform their functions in obtaining the desired liquid or gas sample.

d. Acceptance Criteria

1. All system components must be either verified for proper operation or demonstrated to be within their respective engineering design specifications
2. The postaccident sampling system shall be capable of obtaining both a gas and a liquid sample.

14.1.4 Fuel Load and Initial Operation - Startup Test Phase

At the time of fuel loading, the preoperational test results for all completed tests were approved by the TRC, and access control was established, and the startup test phase began. The startup test phase begins with preparation for fuel loading and extends to the completion of the warranty demonstration. This phase is subdivided into the following four parts:

a. Fuel loading and open vessel tests
b. Initial heatup
c. Power tests
d. Warranty demonstration.

This section describes each of the parts of the startup test phase, the tests to be conducted and their sequence, the administrative methods to be used for procedure and test control, and the functions of the Edison Startup Test Phase Group. Normal plant personnel responsibilities, authorities, and qualifications are given in Chapter 13. The startup test phase and all associated testing activities adhere closely to Regulatory Guide 1.68, "Preoperational and Initial Startup Test Programs for Water-Cooled Power Reactors."

The overall objectives of the startup test phase are as follows:

a. To achieve an orderly and safe initial core loading
b. To perform all testing and measurements necessary to determine that the approach to initial criticality and the subsequent power ascension are accomplished safely and orderly
c. To conduct low-power physics tests sufficient to ensure that physics design parameters have been met
d. To conduct initial heatup and hot functional testing so that hot integrated operation of all systems is shown to meet design specifications
e. To conduct an orderly and safe power ascension program, with requisite physics and systems testing, to ensure that the plant operating at power meets design intent

f. To conduct a successful warranty demonstration program.

Tests conducted during the startup test phase consist of major plant transients, stability tests, and a remainder of tests that are directed toward demonstrating correct performance of the nuclear boiler and numerous auxiliary plant systems while at power. Certain tests may be identified with more than one part of the startup test phase. Table 14.1-1 shows a general view of the startup test phase program and should be considered in conjunction with Figure 14.1-2, which shows, graphically, the various test areas as a function of core thermal power and flow.

14.1.4.1 Fuel Loading and Open Vessel Tests

Fuel loading began when the preoperational testing program described in Subsection l4.l.3 had been completed to the maximum extent practical and when the TRC and the augmented OSRO approved the initial fuel loading.

14.1.4.2 Initial Heatup

The heatup testing phase has been completed at Fermi 2. All required tests were completed successfully. A more detailed discussion of the testing performed during this period is given in the test abstracts (Subsection 14.1.4.8), which were applicable for this phase of testing.

14.1.4.3 Power Tests

Many of the tests of the power test phase are repeated several times at different test levels. Table 14.1-1 and Figure 14.1-2 show, in general, the planned order of execution for the full series of tests.

Coolant chemistry tests and radiation surveys are made at each principal test level to preserve a safe and efficient power increase. The effect of control rod movement on other parameters (e.g., electrical output, steam flow, and neutron flux level), is examined for different power conditions. Following the first reasonably accurate heat balance, the APRMs and IRMs are readjusted if necessary.

At major power levels, the LPRMs and APRMs are calibrated. Completion of the process computer checkout is made for all variables, and the various options are compared with independent calculations as soon as significant power levels are available. Further tests of the RCIC and the HPCI systems are made with and without injection into the RPV.

Collection of data from the system expansion tests is completed for those piping systems that had not previously reached full operating temperatures. The axial and radial power profiles are explored fully by means of the TIP system at representative power levels during power ascension.

Core performance evaluations are made at selected test points above the 10 percent power level; the work involves the determination of core thermal power, maximum linear heat generation rate, and minimum critical power ratio (MCPR).

Overall plant stability in relation to minor perturbations is shown by the following group of tests:

a. Pressure regulator setpoint change

b. Pressure regulator failure

c. Feedwater system setpoint change

d. Flow control setpoint change.

The category of major plant transients includes full closure of all the MSIVs, fast closure of turbine generator control/stop valves, loss of the main generator and offsite power, feedwater system heating loss, trip of a feedwater pump, and a recirculation pump trip. The plant transient behavior is recorded for each test, and the results are compared with the predicted design performance.

A test is made of the safety/relief valves (SRVs) in which leaktightness and general operability are demonstrated. At selected major power levels, the jet pump flow instrumentation is calibrated. The local control loop performance, based on the drive motor, fluid coupler, generator, drive pump, jet pumps, and control equipment, is checked. Vibration testing is conducted at several power conditions as the operating power level is raised.

Heat load performance of certain fluid and ventilation systems is demonstrated. These systems were tested previously during the preoperational test phase to demonstrate their operability and their ability to meet safety criteria, but could not be tested for heat load performance until normal plant operating conditions were available. The demonstration of heat load performance includes tuning of system controls and base line data acquisition for future performance evaluation. These continuations of preoperational tests will be treated, for administrative control purposes, as separate tests conducted in parallel with the startup tests.

14.1.4.4 Warranty Demonstration

The warranty test phase consists of a demonstration in which the steaming rate and steam quality are shown to comply with contractual obligations. This demonstration includes a 100-hr full-power run.

14.1.4.5 Startup Test Procedure Preparation, Approval, and Modification

Startup Test Procedures are prepared by Edison or their designated agents. These procedures are based on GE-supplied Startup Test Specifications and other source documents. Draft startup test procedures are reviewed by the Edison Startup Test Phase Group, then submitted to the augmented OSRO for review and approval.

Minor modifications to the approved procedures can be made if the modification does not change the intent of the test. The responsible Startup Test Phase Engineer and an Edison Senior Reactor Operator (SRO) can provide approval of the minor modifications. Minor changes are handled administratively in a manner similar to normal plant procedures as described in Section 13.5.

Major modifications to the approved procedures are those that change the intent of the startup test or that will change safety margins already approved. Such proposed modifications must undergo review and approval of the augmented OSRO prior to test performance. Major changes to procedures required after the start of testing necessitate a halt of the test until the augmented OSRO reviews and approves the proposed major modifications. If Startup Test Specification Level 1 Criteria are involved in the major change, the GE Site Operations Manager may be required to obtain approval of the intended change from GE Engineering.

14.1.4.6 Startup Test Execution

Startup test performance and supervision is the responsibility of the Startup Test Phase Engineer and plant personnel who obtain technical direction, where applicable, from the GE Operations Shift Engineers and Test Design and Analysis Shift Test Engineers. Startup Test Phase Engineers are assigned to follow startup tests on a shift basis.

All startup tests are performed according to approved startup test procedures.

14.1.4.7 Startup Test Results Approval and Approvals for Power Escalation

All startup tests are documented by the responsible Startup Test Phase Engineer. The test report is reviewed by the Startup Engineer - Test phase or his delegate before submittal to the augmented OSRO and Plant Manager for approval.

During startup testing, many of the tests are repeated several times at different test levels or test conditions. These test conditions are used for convenience to define the basic plant conditions of core power and core flow.

The sequence in which each test condition must be performed is shown below. An exception to this sequence is Test Condition 4, which may be conducted any time after the completion of Test Condition 3.

Individual tests within each test condition may be performed in any desired sequence. However, all testing within each test condition must be completed before proceeding to the next test condition except for justifiable exceptions approved by the augmented OSRO and Plant Manager.

Most of the test conditions are shown in terms of reactor power versus core flow on Figure 14.1-2. The test condition designations and sequence are further defined as follows:

Test Conditions

a. Pre fuel-load tests, fuel-load tests, and open vessel tests
b. Heatup testing
c. Test Condition 1
d. Test Condition 2
e. Test Condition 3
f. Test Condition 4 (may be performed at any time following Test Condition 3)
g. Test Condition 5
h. Test Condition 6 and warranty run tests.

Prior to initiating each test condition, the augmented OSRO reviews the test results of the previous test condition. It determines that the results are adequate and present no safety hazards to personnel, equipment, or the general public, and that any test exceptions have been properly dispositioned. The augmented OSRO presents its findings and recommendations to the Plant Manager. The Plant Manager, when satisfied that the test results are proper and that the conditions required for the next test condition of startup testing are available, will give approval to advance in the testing sequence.

14.1.4.8 General Discussion of Startup Tests

The startup test program is specified on the following pages. The general sequence planned can be obtained from Table 14.1-1. Start at the left side of the page and move to the right. The sequence of tests in a column is as follows:

a. Core performance analysis

b. Steady-state testing

c. Control system tuning

d. Major transients.

In describing the objectives of a test, an attempt is made to identify those operating and safety-oriented characteristics of the plant which are being explored.

Where applicable, a definition of the relevant acceptance criteria for the test is given and is designated either Level l or Level 2. A Level 1 criterion normally relates to the value of a process variable assigned in the design of the plant, component systems, or associated equipment. If a Level 1 criterion is not satisfied, the plant will be placed in a suitable hold-condition until resolution is obtained. Tests compatible with this hold- condition may be continued. Following resolution, applicable tests must be repeated to verify that the requirements of the Level 1 criterion are now satisfied.

A Level 2 criterion is associated with expectations relating to the performance of systems. If a Level 2 criterion is not satisfied, operating and testing plans would not necessarily be altered. The measurements and analytical techniques used for the predictions would be investigated.

Acceptance criteria values presented in the following test descriptions will be verified against the approved Technical Specifications prior to Startup Test Procedure performance. Where differences exist, the Technical Specifications shall take precedence.

A detailed and specific startup test procedure is written for each of the startup tests. The startup test procedure is the document which provides detailed instruction for each test when performed by the test personnel. A list of the startup tests presently planned, together with subsection sequence for use in locating a particular test discussion, follows.

STARTUP TESTS

Subsection	Test Title
14.1.4.8.1	Chemical and Radiochemical

STARTUP TESTS

Subsection	Test Title
14.1.4.8.2	Radiation Measurements
14.1.4.8.3	Fuel Loading
14.1.4.8.4	Full Core Shutdown Margin
14.1.4.8.5	Control Rod Drive System
14.1.4.8.6	Source Range Monitor Performance and Control Rod Sequence
14.1.4.8.7	Water Level Reference Leg Temperature Measurement
14.1.4.8.8	Intermediate Range Monitor Performance
14.1.4.8.9	Local Power Range Monitor Calibration
14.1.4.8.10	Average Power Range Monitor Calibration
14.1.4.8.11	Process Computer
14.1.4.8.12	Reactor Core Isolation Cooling System
14.1.4.8.13	High Pressure Coolant Injection System
14.1.4.8.14	Selected Process Temperatures
14.1.4.8.15	System Expansion
14.1.4.8.16	(Not Applicable)
14.1.4.8.17	Core Performance
14.1.4.8.18	Steam Production (Deleted)
14.1.4.8.19	(Not Applicable)
14.1.4.8.20	Pressure Regulator
14.1.4.8.21	Feedwater System
14.1.4.8.22	Turbine Valve Surveillance
14.1.4.8.23	Main Steam Isolation Valves
14.1.4.8.24	Relief Valves
14.1.4.8.25	Turbine Stop Valve and Control Valve Fast Closure Trips
14.1.4.8.26	Shutdown From Outside the Control Room
14.1.4.8.27	Flow Control
14.1.4.8.28	Recirculation System

STARTUP TESTS

14.1.4.8.1 Chemical and Radiochemical

Purpose

The principal objectives of this test are to secure information on the chemistry and radiochemistry of the reactor coolant, and to determine that the sampling equipment, procedures, and analytic techniques are adequate to supply the data required to demonstrate that the chemistry of all parts of the entire reactor system meet specifications and process requirements.

Specific objectives of the test program include evaluation of fuel performance, evaluations of filter-demineralizer operations by direct and indirect methods, confirmation of condenser integrity, demonstration of proper steam separator-dryer operation, measurement and calibration of the offgas system, and calibration of certain process instrumentation. Data for these purposes are secured from a variety of sources: plant operating records, regular routine coolant analysis, radiochemical measurements of specific nuclides, and special chemical tests.

Description

Prior to fuel loading, a complete set of chemical and radiochemical samples is taken to ensure that all sample stations are functioning properly, and to determine initial concentrations. Subsequent to fuel loading, during reactor heatup and at each major power level change, samples are taken and analyzed to determine the chemical and radiochemical quality of primary coolant, the amount of radiolytic gas in the steam, gaseous activities leaving the air ejectors, decay times in the offgas lines, and performance of filter-demineralizers. Calibrations are made on monitors in the stack, liquid waste system, and liquid process lines.

Criteria

Level 1

Chemical factors defined in the Technical Specifications and Fuel Warranty must be maintained within the limits specified. The activity of gaseous and liquid effluents must conform to license limitations. Water quality must be known at all times and remain within the guidelines of the Water Quality Specifications.

Level 2

Not applicable.

14.1.4.8.2 Radiation Measurements

Purpose

The purposes of this test are to determine the background radiation levels in the plant environs prior to operation for base data on activity buildup, and to monitor radiation at selected power levels to ensure the protection of personnel during plant operation.

Description

A survey of natural background radiation throughout the plant site is made prior to fuel loading. Subsequent to fuel loading, during reactor heatup and at major levels during the initial power ascension program, gamma radiation level measurements, and, where appropriate, thermal and fast neutron dose-rate measurements, are made at significant locations throughout the plant. All potentially high radiation areas are surveyed.

Criteria

Level 1

The radiation doses of plant origin and the occupancy times of personnel in radiation zones shall be controlled consistent with the guidelines of the standards for protection against radiation outlined in 10 CFR 20, "Standards for Protection Against Radiation," and NRC General Design Criteria.

Level 2

Not applicable.

14.1.4.8.3 Fuel Loading

Purpose

The purpose of this test is to load fuel safely and efficiently to the full core size.

Description

Prior to fuel loading, control rods and neutron sources and detectors are installed and tested. Fuel loading begins at the center of the core and proceeds radially to the fully loaded configuration. Control rod functional tests, subcriticality checks, and shutdown margin demonstrations are performed periodically during the loading.

Criteria

Level 1

The partially loaded core must be subcritical by at least 0.38 percent $\Delta k/k$ with the analytically determined strongest rod fully withdrawn.

Level 2

Not applicable.

14.1.4.8.4 Full Core Shutdown Margin

Purpose

The purpose of this test is to demonstrate that the reactor is subcritical throughout the first fuel cycle with any single control rod fully withdrawn.

Description

This test is performed in the fully loaded core in the Xenon-free condition. The shutdown margin is measured by withdrawing the control rods until criticality is reached. If criticality is not reached with in-sequence control rods in the configuration corresponding to the required shutdown margin reactivity, the shutdown margin is satisfied. Additional in-sequence control rods are then withdrawn until the reactor is critical. The difference between the measured K_{eff} and the calculated K_{eff} for the in-sequence critical will be applied to the calculated shutdown margin to obtain the true shutdown margin.

Criteria

Level 1

The shutdown margin of the fully loaded core with the analytically determined strongest rod withdrawn must be at least 0.38 percent $\Delta k/k$ plus an additional margin for exposure.

Level 2

Criticality should occur within ±1.0 percent $\Delta k/k$ of the predicted critical.

14.1.4.8.5 Control Rod Drive System

Purpose

The purposes of the CRD system test are to demonstrate that the CRD system operates properly over the full range of primary coolant temperatures and pressures from ambient to operating, and to determine the initial operating characteristics of the entire CRD system.

Description

The CRD tests performed during the open vessel, heatup, and power test parts of the startup test program are designed as an extension of the tests performed during the preoperational CRD system tests. Thus, after it is verified that all CRDs operate properly when installed, they are tested periodically during heatup to ensure that there is no significant binding caused by thermal expansion of the core components. A list of all CRD tests to be performed during startup testing is given in Table 14.1-2.

Criteria

Level 1

Each CRD must have a normal withdrawal speed less than, or equal to, 3.6 in./sec, indicated by a full 12-ft stroke in greater than, or equal to, 40 sec. The mean scram time of all operable

CRDs with functioning accumulators must not exceed the following times (scram time is measured from the time the pilot scram valve solenoids are deenergized).

Position Inserted From Fully Withdrawn	Scram Time (sec)
46	0.358
36	1.096
26	1.860
06	3.419

The mean scram time of the three fastest CRDs in a two-by-two array must not exceed the following times (scram time is measured from the time the pilot scram valve solenoids are deenergized):

Position Inserted From Fully Withdrawn	Scram Time (sec)
46	0.379
36	1.161
26	1.971
06	3.624

Level 2

Each CRD must have a normal insertion or withdrawal speed of 3.0 ± 0.6 in./sec, indicated by a full 12-ft stroke in 40 to 60 sec. With respect to the CRD friction tests, if the differential pressure variation exceeds 15 psid for a continuous drive-in, a settling test must be performed. In this case, the differential settling pressure should not be less than 30 psid, nor should it vary by more than 10 psid over a full stroke.

14.1.4.8.6 Source Range Monitor Performance and Control Rod Sequence

Purpose

The purpose of this test is to demonstrate that the operational sources, source range monitor (SRM) instrumentation, and rod withdrawal sequences provide adequate information to achieve criticality and increase power in a safe and efficient manner. The effect of typical rod movements on reactor power will be determined.

Description

The operational neutron sources will be installed and SRM count rate data will be taken during rod withdrawals to critical and compared with stated criteria on signal and signal count-to-noise count ratio. A withdrawal sequence has been calculated that completely specifies control rod withdrawals from the all-rods-in condition to the rated power configuration.

Movement of rods in a prescribed sequence is monitored by the rod worth minimizer (RWM) and rod sequence control system (RSCS), which will prevent out-of-sequence withdrawal. Also, not more than two rods may be inserted out of sequence. As the withdrawal of each rod group is completed through Test Condition 1 (see Figure 14.1-2), the electrical power, steam flow, control valve position, and average power range monitor (APRM) response are recorded.

Criteria

Level 1

There must be a neutron signal count-to-noise count ratio of at least 2:1 on the required operable SRMs or fuel-loading chambers. The minimum count rate, as defined by the Technical Specifications, must be met on the required operable SRMs or fuel-loading chambers.

Level 2

Not applicable.

14.1.4.8.7 Water Level Reference Leg Temperature Measurement

Purpose

The purpose of this test is to measure the reference leg temperature and recalibrate the instruments if the measured temperature is different from the value assumed during the initial calibration.

Description

To monitor the reactor vessel water level, four level instrument systems are provided. These are the following:

a. Shutdown (floodup) range

b. Narrow range

c. Wide range

d. Fuel (core level) range.

These systems are used, respectively, as follows:

a. Water level measurement, cold shutdown conditions

b. Feedwater flow and water level control functions, hot operating conditions

c. Safety functions, hot operating conditions

d. Safety functions, postaccident conditions.

This test will be done at rated temperature and pressure and under steady-state conditions and will verify that the reference leg temperatures of the instruments are the values assumed during initial calibration. If not, the instruments will be recalibrated using the measured value.

Criteria

Level 1

Not applicable.

Level 2

The difference between the actual reference leg temperature(s) and the value(s) assumed during initial calibration shall be less than that amount that will result in a scale endpoint error of 1 percent of the instrument span for each range.

14.1.4.8.8 Intermediate Range Monitor Performance

Purpose

The purpose of this test is to adjust the intermediate range monitor system (IRMS) to obtain an optimum overlap with the SRM and APRM systems.

Description

Initially, the IRM system is set to maximum gain. After the APRM calibration, the IRM gains are adjusted to optimize the IRM overlap with the SRMs and APRMs.

Criteria

Level 1

Each IRM channel must be on scale before the SRMs exceed their rod block setpoint. Each APRM must be on scale before the IRMs exceed their rod block setpoint.

Level 2

Not applicable.

14.1.4.8.9 Local Power Range Monitor Calibration

Purpose

The purpose of this test is to calibrate the LPRM system.

Description

The LPRM channels are calibrated to make the LPRM readings proportional to the neutron flux in the LPRM water gap at the chamber elevation. Calibration factors are obtained through the use of either an off-line or a process computer calculation that relates the LPRM reading to average fuel assembly power at the chamber height.

Criteria

Level 1

Not applicable.

Level 2

Each LPRM reading will be within 10 percent of its calculated value.

14.1.4.8.10 Average Power Range Monitor Calibration

Purpose

The purpose of this test is to calibrate the APRM system.

Description

Generally a heat balance is made each shift and after each major power level change. Each APRM channel reading is adjusted to be consistent with the core thermal power as determined from the heat balance. During heatup, a preliminary calibration is made by adjusting the APRM amplifier gains so that the APRM readings agree with the results of a constant heatup rate heat balance. The APRMs will be recalibrated in the power range by a heat balance as soon as adequate feedwater indication is available.

Criteria

Level 1

The APRM channels must be calibrated to read equal to, or greater than, the actual core thermal power. Technical Specification and fuel warranty limits on APRM scram and rod block shall not be exceeded. In the startup mode, all APRM channels must produce a scram at less than, or equal to, 15 percent of rated thermal power. Recalibration of the APRM system is not necessary from a safety standpoint if at least two APRM channels per RPS trip circuit have readings greater than, or equal to, core power.

Level 2

If the above criteria are satisfied, then the APRM channels will be considered to be reading accurately if they agree with the heat balance to within (+7, -0) percent of rated power.

14.1.4.8.11 Process Computer

Purpose

The purpose of this test is to verify the performance of the process computer under plant operating conditions.

Description

Computer system program verifications and calculational program validations at static and at simulated dynamic input conditions are tested preoperationally at the computer supplier's site and following delivery to the plant site. Following fuel loading, during plant heatup, and the ascension to rated power, the nuclear steam supply system (NSSS) and the balance-of-plant (BOP) system process variables sensed by the computer as digital or analog signals will become available. Verify that the computer is receiving correct values of sensed process variables, and that the results of performance calculations of the NSSS programs are correct. At steady-state power conditions the Dynamic System Test Case will be performed.

Criteria

Level 1

Not applicable.

Level 2

Programs OD-1, P1, and OD-6 are considered operational when

a. The MCPR calculated by the BUCLE computer code and the process computer either

    1. Are in the same fuel assembly and do not differ in value by more than 2 percent, or

    2. For the case in which the MCPR calculated by the process computer is in a different assembly than that calculated by the BUCLE code, for those two assemblies, the MCPR and the critical power ratio (CPR) calculated by the two methods shall agree within 2 percent.

b. The maximum linear heat generation rate calculated by the BUCLE code and the process computer either

    1. Are in the same fuel nodes and do not differ in value by more than 2 percent, or

    2. For the case in which the maximum linear heat generation rate calculated by the process computer is in a different node than that calculated by the BUCLE code, for those two nodes, the maximum linear heat generation rate and the linear heat generation rate calculated by the two methods shall agree within 2 percent.

c. The maximum average planar linear heat generation rate calculated by the BUCLE code and the process computer either

    1. Are in the same fuel nodes and do not differ in value by more than 2 percent, or

    2. For the case in which the maximum average planar linear heat generation rate calculated by the process computer is in a different node than that calculated by the BUCLE code for those two nodes, the maximum average planar linear heat generation rate and the average planar linear heat generation rate calculated by the two methods shall agree within 2 percent.

d. The local power range monitor system gain adjustment factors calculated by BUCLE and the process computer agree to within 2 percent.

The remaining programs will be considered operational on the successful completion of the static and dynamic testing.

14.1.4.8.12 Reactor Core Isolation Cooling System

Purpose

The purpose of this test is to verify the proper operation of the reactor core isolation cooling (RCIC) system over its expected operating pressure range.

Description

The RCIC system test consists of two parts: injection to the CST and injection to the reactor vessel.

The CST injections consist of manual and automatic mode starts at 150 psig and near rated reactor pressure conditions. The pump discharge pressure during these tests is throttled to be 100 psi above reactor pressure. The initial testing is for demonstrating operability and making initial controller adjustments. This is followed by vessel injections beginning with cold RCIC hardware. Cold is defined as a minimum of 3 days without any kind of RCIC operation.

The vessel injections verify the adequacy of the startup transient and also include steady-state controller adjustments. Two consecutive vessel injections starting from cold conditions and with the same equipment settings are necessary to demonstrate system reliability.

After final controller settings are determined, CST injections are done with initially cold RCIC equipment. These runs provide a benchmark for future surveillance testing.

A demonstration of an extended operation of 30 minutes of continuous running or until the pump and turbine oil temperature is stabilized, is scheduled at a convenient time during the test program.

Criteria

Level 1

The average pump discharge flow must be equal to, or greater than, 100 percent-rated value after 50 sec have elapsed from initiation on all auto start at any reactor pressure between 150 psig and rated. With pump discharge at any pressure between 250 psig and 100 psi above rated pressure, the required flow is 600 gpm. (The 100 psi is a conservatively high value for line losses. The measured value may be used if available.)

The RCIC turbine shall not trip or isolate during auto or manual starts. If any Level 1 criteria are not met, the reactor will be allowed to operate only up to a restricted power level defined in the Startup Test Procedure.

Level 2

The turbine gland seal condenser system shall be capable of preventing steam leakage to the atmosphere. The DP switch for the RCIC steam supply line high-flow isolation trip shall be adjusted to actuate at 300 percent of the maximum required steady-state flow, with the reactor assumed to be near the pressure for main relief valve actuation. For small speed or flow changes in either manual or automatic mode, the decay ratio of each recorded RCIC system variable must be less than 0.25.

To provide a margin on the overspeed trip and isolation, the first and subsequent speed peaks on the transient start shall not exceed the rated speed of the RCIC turbine by more than 5 percent.

14.1.4.8.13 <u>High Pressure Coolant Injection System</u>

<u>Purpose</u>

The purpose of this test is to verify the proper operation of the high pressure coolant injection (HPCI) system over its expected operating pressure range.

<u>Description</u>

The HPCI system test consists of two parts: injection to the CST and injection to the reactor vessel.

The CST injections consist of manual and automatic starts at 150 psi and at rated reactor pressure. The pump discharge pressure during these tests is throttled to 100 psi above reactor pressure. The initial testing is for demonstrating operability and making initial controller adjustments. This is followed by vessel injections beginning with cold HPCI hardware. Cold is defined as a minimum of 3 days without any kind of HPCI operations.

The vessel injections verify the adequacy of the startup transient and also include steady-state controller adjustments. Two consecutive vessel injections starting from cold conditions with the same equipment settings are necessary to demonstrate system reliability.

After final controller settings are determined, CST injections are done with initially cold HPCI equipment. These runs provide a benchmark for future surveillance testing.

A demonstration of an extended operation of 30 minutes of continuous running or until pump and turbine oil temperature is stabilized, is scheduled at a convenient time during the test program.

<u>Criteria</u>

<u>Level 1</u>

The average pump discharge flow must be equal to, or greater than, the 100 percent-rated value with a system response time of less than or equal to 30 sec as defined in the Technical Specifications at any reactor pressure between 150 psig and rated. With pump discharge at any pressure between 250 psig and 100 psi above rated pressure, the flow should be at least 5000 gpm. (The 100 psi is a conservatively high value for line losses. The measured value may be used if available.) The HPCI turbine shall not trip or isolate during auto or manual starts.

<u>Level 2</u>

The turbine gland seal condenser system shall be capable of preventing steam leakage to the atmosphere. The delta P switch for the HPCI steam supply line high flow isolation trip shall be adjusted to actuate at 300 percent of the maximum required steady-state flow with reactor assumed to be near the pressure for main relief valve actuation. For small speed or flow changes in either manual or automatic mode, the decay ratio of each recorded HPCI system variable must be less than 0.25.

The margin to avoid the overspeed trip shall be at least 10 percent of the nominal overspeed trip setpoint of 5000 rpm during all auto starts of the HPCI system.

14.1.4.8.14 Selected Process Temperatures

Purpose

The purposes of this procedure are to establish the proper setting of the low speed limiter for the recirculation pumps to avoid coolant temperature stratification in the reactor pressure vessel (RPV) bottom head region, to provide assurance that the measured bottom head drain temperature corresponds to bottom head coolant temperature during normal operations, and to identify any reactor operating modes that cause temperature stratification.

Description

During initial heatup while at hot-standby conditions, the bottom drain line temperature, recirculation loop suction temperature, and applicable reactor parameters are monitored as the recirculation pump flow is slowly lowered to minimum stable flow. The parameters above are recorded during pump trips as well. The effects of cleanup flow, CRD flow, and power level are investigated as operational limits allow. Utilizing these data, it can be determined if coolant temperature stratification occurs when the recirculation pumps are on and if so, what minimum pump speed will prevent it. A comparison of recirculation loop coolant temperature with bottom drain line temperature when core flow is 100 percent will be performed.

Criteria

Level 1

The reactor recirculation pumps shall not be started nor flow increased unless the coolant temperatures between the steam dome and bottom head drain are within 145°F. The recirculation pump in an idle loop must not be started, active loop flow must not be raised, and power must not be increased unless the idle loop suction temperature is within 50°F of the active loop suction temperature. If two pumps are idle, the loop suction temperature must be within 50°F of the steam dome temperature before pump startup.

Level 2

During operation of two recirculation pumps at rated core flow, the bottom head temperature as measured by the bottom drain line thermocouple should be within 30°F of the recirculation loop temperatures.

14.1.4.8.15 System Expansion

Purpose

The purpose of this procedure is to verify that major piping of the NSSS and related auxiliary systems is free and unrestrained with regard to thermal expansion, and to verify that the thermal movement of the piping and associated support system components is consistent with the analytical predictions of the piping system stress analyses.

Description

Observations and/or recordings of the thermal expansion movements of key points on the piping of the NSSS and related auxiliary systems are made as the piping systems are brought initially from ambient to operational temperature. The points ordinarily chosen to be monitored will be those points in each piping system that are expected to exhibit relatively large thermal deflections and/or experience large thermally induced stresses, as predicted by the piping system stress analysis.

Pipe position will be recorded or logged at the ambient, intermediate, and maximum expected temperature points described above.

One or more of the following methods of monitoring piping system thermal movement will be employed, depending on practicality and accessibility limitations:

a. Actual observation of piping system thermal behavior by a member or delegate of the Edison Startup Group

b. Installation of local mechanical recording devices (scratch or dial gages)

c. Installation of remote-indicating movement measuring devices (linear variable differential transformers and Lanyard potentiometers) used in conjunction with suitable indicating/recording instruments installed in accessible locations.

Extent of Testing

The piping systems subjected to thermal expansion test verification are listed in Table 3.9-1. Detailed discussion concerning thermal expansion testing is presented in Subsection 3.9.1.1.

Criteria

Acceptance criteria for this test are presented in Subsection 3.9.1.1.5.

14.1.4.8.16 (Not Applicable)

14.1.4.8.17 Core Performance

Purpose

a. To evaluate the core thermal power

b. To evaluate the following core performance parameters:

    1. Maximum linear heat generation rate (MLHGR)

    2. Minimum critical power ratio (MCPR)

    3. Maximum average planar linear heat generation rate (MAPLHGR).

Description

The core performance evaluation is employed to determine the principal thermal and hydraulic parameters associated with core behavior. These parameters are

a. Core flow rate

b. Core thermal power level

c. MLHGR

d. MCPR

e. MAPLHGR.

Those core performance parameters listed are evaluated as described below.

a. Core flow rate is read from the total core flow recorder in the control room, and a correction curve is used if necessary. During some transients, core DP will be used as an indication of core flow

b. Core thermal power is determined from a detailed reactor heat balance

c. The MLHGR is determined using the LPRM system, axial power distribution information, and calculated fuel assembly local power distribution information

d. The value of MAPLHGR in the core shall be restricted to the limits given in the Technical Specifications

e. The MCPR of a fuel assembly depends on the fuel assembly flow, the total fuel assembly power, the fuel assembly average exposure, the core inlet subcooling, and the fuel assembly peak axial power factor and location.

Criteria

Level 1

The MLHGR during steady-state conditions shall not exceed the allowable heat flux as specified in the Technical Specifications.

The steady-state MCPR shall be maintained greater than, or equal to, the value specified in the Technical Specifications.

The MAPLHGR shall not exceed the limits given in the Technical Specifications.

Steady-state reactor power shall be limited to full rated maximum values on or below the design flow control line.

Core flow should not exceed its rated value.

Level 2

Not applicable.

14.1.4.8.18 Steam Production (Deleted)

This subsection has been deleted because the test is performed only for warranty demonstration purposes unrelated to safety. The test will be conducted as a demonstration test.

14.1.4.8.19 (Not Applicable)

14.1.4.8.20 Pressure Regulator

Purpose

a. To determine the optimum settings for the pressure control loop by analysis of the transients induced in the reactor pressure control system by means of the pressure regulators

b. To demonstrate the takeover capability of the backup pressure regulator on failure of the controlling pressure regulator and to set spacing between the setpoints at an appropriate value

c. To demonstrate smooth pressure control transition between the control valves and bypass valves when the reactor generates more steam than is used by the turbine.

Description

The pressure setpoint is decreased rapidly and then increased rapidly by up to 10 lb/in.^{2}, and the response of the system will be measured in each case. It is desirable to accomplish the setpoint change in less than 1 sec. At specified test conditions, the load limit setpoint is set so that the transient is handled by control valves, bypass valves, or both. The backup regulator is tested by simulating a failure of the operating pressure regulator so that the backup regulator takes over control. The response of the system is measured and evaluated and regulator settings are optimized. The matrix of test mode and conditions is tabulated below.

		Test Condition Number				
Mode	Input	1	2	3	5	6
CV	Setpoint	No	Yes	Yes	Yes	Yes
CV	Fail to back up	No	Yes	Yes	No	Yes
BPV	Setpoint	Yes	Yes	No	Yes	Yes
BPV	Fail to back up	Yes	Yes	No	No	Yes
	Recirc. modes	Manual	Manual	Manual	Manual	Manual

Criteria

Level 1

The decay ratio must be less than 1.0 for each process variable that exhibits oscillatory response to pressure regulator changes.

Level 2

In all tests the decay ratio must be less than or equal to 0.25 for each process variable that exhibits oscillatory response to pressure regulator changes when the plant is operating above the lower limit setting of the master flow controller.

Pressure control deadband, delay, etc., shall be small enough for steady-state limit cycles, if any, to produce turbine steam flow variations no larger than 0.5 percent of rated flow.

During the simulated failure of the controlling pressure regulator along the 100 percent rod line (Figure 14.1-2), if the setpoint of the backup pressure regulator is optimally set, the backup regulator shall control the transient so that the peak neutron flux or peak vessel pressure remains below the scram settings by 7.5 percent and 10 lb/in.^{2}, respectively.

After a pressure setpoint adjustment, the time between the setpoint change and the occurrence of the pressure peak shall be 10 sec or less. (This applies to pressure setpoint changes made with the recirculation system in the master or local manual control mode.)

14.1.4.8.21 Feedwater System

Purpose

a. To adjust the feedwater control system for acceptable reactor water level control

b. To demonstrate stable reactor response to subcooling changes

c. To demonstrate the capability of the automatic core flow runback feature to prevent low water level scram following the trip of one feedwater pump

d. To demonstrate adequate response to feedwater heating loss

e. To determine the maximum feedwater runout capability.

Description

Reactor water level setpoint changes of approximately 3 to 6 in. will be used to evaluate and adjust the feedwater control system settings for all power and feedwater pump modes. The level setpoint changes will also demonstrate core stability to subcooling changes. One of two operating feedwater pumps will be tripped and the automatic flow runback circuit will act to drop power to within the capacity of the remaining pump. The worst single- failure case of feedwater temperature loss will be performed and the resulting transients recorded between 80 and 90 percent power and near full core flow rate. Data will be taken between 50 and 100 percent power to allow determination of the maximum feedwater runout capability.

Criteria

Level 1

The response of any level-related variable to any test input change, or disturbance, must not diverge during the setpoint changes.

For the feedwater temperature loss test, the maximum feedwater temperature decrease due to a single-failure case must be less than or equal to 100°F. The resultant MCPR must be greater than the fuel thermal safety limit.

For the feedwater temperature loss test, the increase in simulated heat flux cannot exceed the predicted Level 2 value by more than 2 percent. The predicted value will be based on the actual test values of feedwater temperature change and power level.

The feedwater flow runout capability must not exceed the assumed value in the FSAR.

Level 2

Level control system-related variables may contain oscillatory modes of response. In these cases, the decay ratio for each controlled mode of response must be less than or equal to 0.25, as a result of the setpoint change testing.

A scram must not occur from low water level following a trip of one of the operating feedwater pumps. There should be a greater than 3-in. water-level margin to scram for the feedwater pump trip.

For the feedwater temperature loss test, the increase in simulated heat flux cannot exceed the predicted value referenced to the actual feedwater temperature change and power level, which will be taken from the Transient Safety Analysis Design Report.

The average rate of response of the feedwater actuator to large (>20 percent of pump flow) step disturbances shall be between 10 to 25 percent of pump rated feedwater flow per second. This average response rate will be assessed by determining the time required to pass linearly through the 10 percent and 90 percent response points of the flow transient.

The dynamic flow response of each feedwater actuator (turbine or valve) to small (<10 percent) step disturbances shall be the following:

a. Maximum time to 10 percent of a step disturbance ≤1.1 sec

b. Maximum time from 10 to 90 percent of a step disturbance ≤1.9 sec

c. Peak overshoot (percentage of step disturbance) ≤15 percent.

14.1.4.8.22 Turbine Valve Surveillance

Purpose

To demonstrate acceptable procedures and maximum power levels for surveillance testing of the main turbine control and stop valves without producing a reactor scram.

Description

Individual main turbine control and stop valves are tested routinely during plant operation as required for turbine surveillance testing. At several test points, the response of the reactor is observed and the maximum possible power level for performance of these tests along the 100 percent load line established.

First actuation should be between 45 and 65 percent power, and be used to extrapolate to the next test point between 70 and 95 percent power and, ultimately, to the maximum power test condition, with ample margin to scram. Note proximity to APRM flow bias scram point. Each valve test is manually initiated and reset. The rate of valve stroking and the timing of the close-open sequence is such that the minimum practical disturbance is introduced.

If it is later decided to do bypass valve surveillance testing at power (present plans are to test these valves only when the plant is shut down), then these valves will be tested in the same manner as described above for control and stop valves.

Criteria

Level 1

Not applicable.

Level 2

Peak neutron flux must be at least 7.5 percent below the scram trip setting. Peak vessel pressure must remain at least 10 $lb/in.^2$ below the high-pressure scram setting. Peak heat flux must remain at least 5.0 percent below its scram trip point.

Peak steam flow in the high-flow lines must remain 10 percent below the high-flow isolation trip setting.

14.1.4.8.23 Main Steam Isolation Valves

Purpose

a. To check functionally the main steam line isolation valves (MSIVs) for proper operation at selected power levels

b. To determine reactor transient behavior during and after simultaneous full closure of all MSIVs

c. To determine isolation valve closure time.

Description

At selected power levels, both slow and fast single-valve closure is performed. A test of the simultaneous full closure of all MSIVs is performed at a level greater than or equal to 95 percent of rated thermal power. Should an inadvertent full closure of the MSIVs occur at a lower power level (≥70 percent), credit may be taken for this test if supporting analysis shows that the results can be extrapolated to the higher power condition. Correct performance of the RCIC (if L2 is reached) and relief valves is shown. Reactor process variables are monitored to determine the transient behavior of the system during and following the main steam line (MSL) isolation.

The MSIV closure times are determined from the MSL isolation data by multiplying the time increment between deenergizing the solenoids and actuation of the MSIV closed light by an extrapolation factor. The extrapolation factor will correct the time obtained to that of full closure and will be calculated for each MSIV based on previous, direct measurement data of valve full stroke length and actual position indicating switch actuation points.

The times to be determined are (a) the time from deenergizing the solenoids until the valve is 100 percent closed (t_{sol}) and (b) the valve stroke time (t_s). Time t_{sol} equals the interval from deenergizing the solenoids until the valve reaches 90 percent closed plus 1/8 times the interval from 10 to 90 percent closure. Time t_s equals the interval from when the valve starts to move until it is 100 percent closed and is based on the interval from 10 to 90 percent closure and linear valve travel from 0 to 100 percent closure.

Criteria

Level 1

The MSIV stroke time (t_s) shall be no faster than 3.0 sec (average of the fastest valve in each steam line) and for any individual valve 2.5 sec $\leq t_s \leq$ 5 sec. Total effective closure time for any individual MSIV shall be t_{sol} plus the maximum instrumentation delay time and shall be ≤5.5 sec.

The positive change in vessel dome pressure occurring within 30 sec after the simultaneous full closure of all MSIVs must not exceed the Level 2 criteria by more than 25 psi. The positive change in simulated heat flux shall not exceed the Level 2 criteria by more than 2 percent of rated value.

Flooding of the main steam lines shall not occur following the full MSIV closure test.

The reactor must scram during the full simultaneous MSIV closure test to limit the severity of the neutron flux and simulated fuel surface heat flux transient.

Level 2

During full closure of individual valves, peak vessel pressure must be at least 10 psi below scram, peak neutron flux must be at least 7.5 percent below scram, and steam flow in individual lines must be at least 10 percent below isolation trip setting. The peak heat flux must be at least 5 percent less than its trip point. The reactor shall not scram or isolate as a result of individual valve testing.

The relief valves must reclose properly (without leakage) following the pressure transient resulting from the simultaneous MSIV full closure.

The positive change in vessel dome pressure and simulated heat flux occurring within the first 30 sec after the closure of all MSIV valves must not exceed the predicted values in the Transient Safety Analysis Design Report. Predicted values will be referenced to actual test conditions of initial power level and dome pressure and will use beginning of life nuclear data. The predicted values will be corrected for the appropriate measured parameters.

After the full MSIV closure, the initial action of the RCIC and HPCI shall be automatic if L2 is reached, with RCIC capable of establishing an average pump discharge flow equal to or greater than 600 gpm within the first 50 sec after automatic initiation and HPCI capable of establishing an average pump discharge flow equal to or greater than 5000 gpm with a system response time of less than or equal to 30 sec as defined in the Technical Specifications.

If the low-low set pressure relief logic functions after the simultaneous full MSIV closure test, the open/close actions of the safety/relief valves (SRVs) shall occur within ±20 psi of the low-low set design setpoints. The total number of opening cycles, for the SRVs opening on low-low setpoint, after initial blowdown is not to exceed four times during the initial 5 minutes following isolation. If any SRVs open as a result of this test, only one valve may reopen after the first blowdown.

Recirculation pump trip shall be initiated if L2 is reached after the MSIV full closure test.

14.1.4.8.24 Relief Valves

Purpose

The purposes of this test are (a) to verify that the relief valves function properly (can be opened and closed manually), (b) to verify that the relief valves reseat properly after operation, and (c) to verify that there are no major blockages in the relief valve discharge piping.

Description

A functional test of each SRV shall be made as early in the startup program as practical. This is normally the first time the plant reaches 250 psig. The test is then repeated at rated reactor pressure. Bypass valve response is monitored during the low-pressure test, and the electrical output response is monitored during the rated pressure test. The test duration will be about 10 sec to allow turbine valves and tailpipe sensors to reach a steady state.

The tailpipe sensor response will be used to detect the opening and subsequent closure of each SRV. The bypass valve and MWe responses will be analyzed for anomalies indicating a restriction in an SRV tailpipe.

Valve capacity will be based on certification by ASME code stamp and the applicable documentation being available in the onsite records. Note that the nameplate capacity/pressure rating assumes that the flow is sonic. This will be true if the back-pressure is less than 55 percent of inlet pressure. The GE design specification requires the backpressure to be less than 40 percent of the inlet pressure, and present designs have backpressures on the order of 30 percent of the inlet pressures. The methods of calculating line losses and pressure drops are reliable enough to ensure that the 15 to 25 percent conservatism in the design more than offsets any slight inaccuracies in the calculation. A major blockage of the line would not necessarily be offset, and it should be determined that none exists through the bypass valve response signatures.

Vendor bench test data of the SRV opening responses will be available onsite for comparison with design specifications.

Criteria

Level 1

There should be a positive indication of steam discharge during the manual actuation of each valve.

Level 2

Variables related to the pressure control system may contain oscillatory modes of response. In these cases, the decay ratio for each controlled mode of response must be less than or equal to 0.25.

The temperature measured by thermocouples on the discharge side of the valves shall return to within 10°F of the temperature recorded before the valve was opened. If pressure sensors are available, they shall return to their initial state on valve closure.

During the 250 psig functional test, the steam flow through each relief valve, as measured by the initial and final bypass valve position, shall not differ by more than 10 percent from the average relief valve steam flow as measured by bypass valve position.

During the rated pressure test, the steam flow through each relief valve as measured by change in MWe is not to differ by more than 0.5 percent of rated MWe from the average of all the valve responses.

14.1.4.8.25 Turbine Stop Valve and Control Valve Fast Closure Trips

Purpose

To demonstrate the response of the reactor and its control systems to protective trips in the turbine and generator.

Description

The turbine stop valves and the main generator breakers are tripped at selected reactor power levels. Several reactor and turbine operating parameters are monitored to evaluate the response of the bypass valves, the relief valves, and the reactor protection system (RPS). In addition, the peak values and change rates of reactor steam pressure and heat flux are determined. The ability to ride through a load rejection within bypass capacity without a scram is demonstrated.

A turbine/generator trip is performed at Test Condition 6. Should an inadvertent turbine/generator trip occur at a lower power level (≥70 percent), credit may be taken for this test if supporting analysis shows that the results can be extrapolated to the higher power condition. Both line circuit breakers and the generator field breaker will open, and all the turbine valves will close at the maximum rate.

Criteria

Level 1

For turbine/generator trips, there should be a delay of no more than 0.1 sec following the beginning of control or stop valve closure before the beginning of bypass valve opening. The bypass valves should be opened to a point corresponding to greater than or equal to 80 percent of their capacity within 0.3 sec from the beginning of control or stop valve closure motion.

Flooding of the main steam lines shall not occur following the turbine/generator trips.

The positive change in vessel dome pressure occurring within 30 sec after either generator or turbine trip must not exceed the Level 2 criteria by more than 25 psi.

The positive change in simulated heat flux shall not exceed the Level 2 criteria by more than 2 percent of rated value.

Level 2

There shall be no MSIV closure in the first 3 minutes of the transient, and operator action shall not be required in that period to avoid the MSIV trip.

The positive change in vessel dome pressure and in simulated heat flux that occur within the first 30 sec after the initiation of either generator or turbine trip must not exceed the predicted values in the Transient Safety Analysis Design Report.

For the turbine/generator trip within the bypass valves capacity, the reactor shall not scram for initial thermal power values less than or equal to 25 percent of rated.

If the low-low set pressure relief logic functions, the open/ close actions of the SRVs shall occur within +20 psi of their design setpoints. If any SRVs open, only one valve may reopen after the first blowdown.

14.1.4.8.26 Shutdown From Outside the Control Room

Purpose

To demonstrate that the reactor can be brought from a normal, initial, steady-state power level to the hot shutdown condition and to verify that the plant has the potential for being safely cooled from hot shutdown to cold shutdown conditions from outside the control room using the remote shutdown panel.

Description

Hot Shutdown Demonstration:

The reactor will be shut down following a simulated main control room evacuation. The reactor will be scrammed, from outside the main control room, from a power level sufficiently high for the plant systems to be in normal operating configurations with the turbine generator in operation.

Reactor vessel water level and pressure will be controlled from a location outside the main control room. All other non-safety- related activities that would not be required during an actual remote shutdown will be performed from the main control room.

Data will be obtained at locations outside the control room to verify that the plant has achieved hot standby status and that the plant can be maintained in the stable hot standby condition.

This portion of the test will be performed with the minimum shift complement.

Cold Shutdown Demonstration:

The potential capability for cold shutdown will be demonstrated by partially cooling down the plant in the hot standby condition using controls and instrumentation located outside the control room. Cooldown can then proceed using normal procedures and operating modes from the control room to the point at which the shutdown cooling mode of residual heat removal (RHR) can be initiated. Operation of the RHR system in the shutdown cooling mode will then be initiated and controlled from outside the control room. Reactor coolant temperature will be partially reduced at a rate that will not exceed Technical Specifications limits. This demonstration will use additional personnel who can be made available to the plant before cooldown is initiated.

Approved operating procedures will be available for performance of a remote shutdown, including procedures for conducting all portions of the startup test.

Criteria

Level 1

Not applicable.

Level 2

During the cold shutdown demonstration, the reactor must be brought to the point where cooldown is initiated and under control.

During the simulated control room evacuation and hot shutdown demonstration, the reactor vessel pressure and water level are controlled using equipment and controls outside the control room.

14.1.4.8.27 Flow Control

Purpose

a. To determine the correct gain settings for the individual recirculation controllers

b. To demonstrate plant response to changes in circulation flow in both local manual and master manual mode

c. To set the limits of range of operation for the recirculation pumps.

Description

The testing of the recirculation flow control system follows a "building block" approach while the plant is ascending from low to high power levels. The time responses of the individual pump flow loops and speed loops will be optimized by adjusting the gains of the controllers. By far, the most extensive testing will be performed along the mid-power load line where most of the systems' final adjustments are determined.

Criteria

Level 1

The transient response of any variable related to the recirculation system to any test input must not diverge.

Level 2

The decay ratio of the speed loop response shall be <0.25 at any speed.

Flow control system limit cycles (if any) must produce a turbine steam flow variation no larger than ±0.5 percent of the rated steam flow value.

The APRM neutron flux trip avoidance margin shall be ≥7.5 percent, and the heat flux trip avoidance margin shall be ≥5.0 percent as a result of the recirculation flow control maneuvers.

14.1.4.8.28 Recirculation System

Purpose

a. To verify that the feedwater control system can satisfactorily control the water level without a resulting turbine trip/scram and obtain actual pump speed/flow

b. To verify recirculation pump startup under pressurized reactor conditions

c. To obtain recirculation system performance data

d. To verify that no recirculation system cavitation occurs in the operable region of the power flow map.

Description

The reactor coolant recirculation system consists of the reactor vessel and two piping loops. Each loop contains a centrifugal recirculation pump and two isolation valves located in the drywell and 10 jet pumps in parallel situated in the reactor downcomer. Each recirculation pump takes suction from the reactor downcomer and discharges through a manifold system to the nozzles of the 10 jet pumps. Here the flow is augmented by suction flow from the downcomer and delivered to the reactor inlet plenum.

A potential threat to plant availability is the high water level turbine trip scram caused by the level upswell that results after an unexpected trip of one recirculation pump. The change in core flow and resultant power decrease causes void formation, which the level-sensing system senses as a rise in water level. The one pump trip test is to prove that the water level will not rise enough to threaten a high-level trip of the main turbine or the feedwater pumps, while the pump restart demonstrates the adequacy of the restart procedure at the highest possible reactor power level.

Steady-state data will be collected several times during the startup test program in order to obtain a complete record of recirculation system performance.

Both the jet pumps and the recirculation pumps will cavitate at conditions of high flow and low power, where net positive suction head (NPSH) demands are high and little feedwater subcooling occurs. However, the recirculation pumps will automatically run back to minimum speed when feedwater flow decreases to 20 percent and the maximum recirculation flow is normally limited by the upper limit of the master flow controller which corresponds to the pump speed for rated flow at rated power. It will be verified that these limits are sufficient to prevent operation where recirculation pump or jet pump cavitation occurs.

Criteria

Level 1

The response of any level-related variables during pump trips must not diverge.

Level 2

The simulated heat flux margin to avoid a scram shall be greater than or equal to 5.0 percent during the one pump trip recovery.

The APRM margin to avoid a scram shall be greater than or equal to 7.5 percent during the one pump trip recovery.

During the noncavitation verification, runback logic shall have settings adequate to prevent operation in areas of potential cavitation.

During the one pump trip, the reactor water level margin to avoid a high-level trip (L8) shall be greater than or equal to 3.0 in.

14.1.4.8.29 Loss of Turbine Generator and Offsite Power

Purpose

a. To determine the reactor transient performance during the loss of the main generator and all offsite power

b. To demonstrate acceptable performance of the station electrical supply system.

Description

The loss-of-auxiliary-power test will be performed with the generator at least l0 percent of rated electrical output. The proper response of reactor plant equipment and automatic switching equipment, as well as the proper switching of loads to the diesel generator, will be checked.

Suitable provisions are made to facilitate continuous indicating and recording capability throughout the duration of the test (variables of interest are power, core flow, vessel pressure, and reactor water level).

The transient is extended for a minimum of 30 minutes.

Criteria

Level 1

The RPS, the diesel generator, RCIC, and HPCI must function properly without manual assistance. The HPCI and/or RCIC system action, if necessary, shall keep the reactor water level above the initiation level of low-pressure core spray, low pressure coolant injection (LPCI), and automatic depressurization systems.

Level 2

If the low-low set pressure relief logic functions, the open/ close actions of the SRVs shall occur within ±20 psi of their design setpoints. If any SRVs open, only one may reopen after the first blowdown.

14.1.4.8.30 Steady-State Vibration

Purpose

To determine the vibration characteristics of the primary pressure boundary piping (NSSS) and engineered safety feature (ECCS) piping systems for vibrations induced by recirculation flows, hot two-phase forces, and hot hydrodynamic transients; and to demonstrate that flow-induced vibrations, similar in nature to those expected during normal and abnormal operation, will not cause damage and excessive pipe movement and vibration.

Description

The systems subjected to the piping vibration testing during the startup test phase are listed in Table 3.9-1.

A complete, detailed discussion of the piping vibration and dynamic effect test program is presented in Subsection 3.9.1.1.

Criteria

Acceptance criteria for this test are presented in Subsection 3.9.1.1.5.

14.1.4.8.31 Recirculation System Flow Calibration

Purpose

To perform a complete calibration of the installed recirculation system flow instrumentation.

Description

During the testing program at operating conditions that allow the recirculation pumps to be operated at the speeds required for rated flow at rated power, the jet pump flow instrumentation is adjusted to provide correct flow indication based on the jet pump flow. After the relationship between drive flow and core flow is established, the flow-biased APRM/RBM system will be adjusted to match this relationship.

Criteria

Level 1

Not applicable.

Level 2

Jet pump flow instrumentation is adjusted so that the jet pump total flow recorder provides a correct core flow indication at rated conditions.

The APRM/RBM flow-bias instrumentation is adjusted to function properly at rated conditions.

The flow control system shall be adjusted to limit maximum core flow to 102.5 percent of rated flow by limiting motor-generator (M-G) set scoop tube position.

14.1.4.8.32 Reactor Water Cleanup System

Purpose

To demonstrate specific aspects of the mechanical operability of the reactor water cleanup (RWCU) system.

Description

With the reactor at rated temperature and pressure, process variables are recorded during steady-state operation in three modes as defined by the system process diagram: blowdown, hot standby, and normal. A comparison of the bottom head flow indicator and the RWCU inlet flow indicator will be made.

Criteria

Level 1

Not applicable.

Level 2

The temperature at the tube side outlet of the nonregenerative heat exchangers shall not exceed 130°F in the blowdown mode and shall not exceed 120°F in the normal mode.

The pump available NPSH is 13 ft or greater during the hot shutdown with loss of RPV recirculation pumps mode defined in the process diagrams.

The bottom head flow indicator will be recalibrated against the RWCU flow indicator if the deviation is greater than 25 gpm.

The cooling water supplied to the nonregenerative heat exchangers shall be less than 6 percent above the flow corresponding to the heat exchangers' capacity (as determined from the process diagram) and the existing temperature differential across the heat exchangers. The outlet temperature shall not exceed 180°F.

14.1.4.8.33 Residual Heat Removal System

Purpose

To demonstrate the ability of the RHR system to remove residual and decay heat from the nuclear system so that refueling and nuclear servicing can be performed.

Description

During the first suitable reactor cooldown, the shutdown cooling mode of the RHR system will be demonstrated. The torus cooling mode will also be demonstrated, if necessary.

Criteria

Level 1

Not applicable.

Level 2

The RHR system is capable of operating in the suppression pool cooling and shutdown cooling modes at the flow rates and temperature differentials indicated on the process diagrams.

14.1.4.8.34 Piping System Dynamic Response Testing

Purpose

To verify that piping system structural behavior under probable transient loadings is acceptable and within the limit predicted by analytical investigations.

Description

The following piping systems and dynamic transient events are evaluated by test during the startup testing sequence:

a. Behavior of the feedwater system piping from the feedwater pump discharge to the containment penetration following a trip of a feedwater pump

b. Behavior of the HPCI system piping from the HPCI pump discharge to the feedwater system tee connection in the steam tunnel after a rapid start of the HPCI pump turbine

c. Behavior of the main steam piping from the turbine stop valve to the containment penetration after a turbine stop valve and control valve fast closure trip. This test will be conducted during an inadvertent turbine trip after the startup test program is completed

d. Selected main steam SRV discharge piping during SRV operation

e. Recirculation piping for a pump trip at 100 percent-rated flow.

The tests described above have been selected for the following reasons:

a. The transient phenomena identified are normal/upset transients that may be reasonably expected to occur during the life of the plant (See Appendix B, Section B, for discussion of operation beyond the original design plant life)

b. The transients described are already planned during the system's tests to confirm system and equipment behavior in accordance with design

c. Evaluation of the results of these tests will aid in confirming that use of present design rules and stress analysis requirements produces system designs that are adequate for anticipated transient events.

The vibration surveys conducted during these transient events make up one portion of the piping vibration test program presented in Subsection 3.9.1.1.

Criteria

Acceptance criteria for this test are presented in Subsection 3.9.1.1.5.

TABLE 14.1-1 STARTUP TEST PROGRAM

Test No.	Test Name	Open Vessel or Cold Test	Heatup	Test Conditions[a] 1	2	3	4[b]	5	6	Warranty
1	Chemical and Radiochemical	X	X	X		X		X	X	
2	Radiation Measurements	X	X		X	X			X	
3	Fuel Loading	X								
4	Full Core Shutdown Margin		X							
5	CRD	X	X	X					X	
6	SRM Performance and Control Rod Sequence		X	X						
7	Water Level Measurements		X							
8	IRM Performance		X	X						
9	LPRM Calibration		X	X		X			X	
10	APRM Calibration		X	X	X	X		X	X	X
11	Process Computer	X		X[c]		X		X	X	
12	Reactor Core Isolation Cooling System		X	X	M					
13	High Pressure Coolant Injection System		X			M				
14	Selected Process Temperatures		X				X		X	
15	System Expansion	X	X						X	
16	(Deleted)									
17	Core Performance			X	X	X	X	X	X	X
18	(Deleted)									
19	(Deleted)									
20	Pressure Regulator - Setpoint Changes			M,BP	M	M		M	M	
	- Backup Regulator			M,BP	M	M			M	
21	Feedwater System - Feedwater Pump Trip								M(SP)	
	- Water Level Setpoint Changes		X	X	M	M		M	M	
	- Heating Loss							M[d]		
	- Maximum Runout Capability							M[d]		
22	Turbine Valve Surveillances							M[d],SP	M[e,f],SP	
23	MSIVs - Each Valve		X[g]	M[h],SP		X[g]			X[g]	
	- Full Isolation								M,SD[k]	
24	Relief Valves		X		M[i]					
25	Turbine Stop Valve and Control Valve Fast Closure Trips				M,SP[j]				M,SD[k,l]	
26	Shutdown from Outside Control Room			(SD)X[l]					X[m]	
27	Flow Control				M	M		M[d]		
28	Recirculation System - Trip One Pump								M(SP)	
	- System Performance				X	X	X		X	
	- Noncavitation Verification					M				
29	Loss of T-G Offsite Power				M,SD[l]					
30	Vibration Measurements		X		X	X			X	

TABLE 14.1-1 STARTUP TEST PROGRAM

Test No.	Test Name	Open Vessel or Cold Test	Heatup	Test Conditions[a] 1	2	3	4[b]	5	6	Warranty
31	Recirculation System Flow Calibration					X			X	
32	Reactor Water Cleanup System	X					X			
33	Residual Heat Removal System	X							X	
34	Piping Systems Dynamic Response	X		X		X			X	

Key: M = manual flow control mode; X = test independent of flow control; SP = scram possibility; SD = scram definite; BP = bypass valve response.

[a] See Figure 14.1-2 for test conditions region map.

[b] Testing at natural circulation on 100 percent load line can be done anytime following Test Condition 3.

[c] Between Test Conditions 1 and 3.

[d] Between Test Conditions 5 and 6.

[e] Determine maximum power without scram.

[f] Future maximum power test point.

[g] 10 percent slow closure-slow mode.

[h] Full closure-fast mode.

[i] Between Test Conditions 2 and 3.

[j] Within bypass valve capability.

[k] If an inadvertent full MSIV isolation or turbine/generator trip occurs at between 70 percent and 100 percent of core thermal power, credit may be taken for this test if supporting analysis shows that the results can be extrapolated to the higher power condition.

[l] Perform Test 5, timing four slowest control rods in conjunction with these scrams.

[m] RHR shutdown cooling mode demonstration.

TABLE 14.1-2 CONTROL ROD DRIVE SYSTEM TESTS

			Reaction Pressure With Core Loaded (psig)			
Test Description	Accumulator Pressure	Preop Tests	0	600	800	Rated
Position indication		All	All			
Normal stroke times insert/withdraw		All	All			4[a]
Coupling		All	All			
Friction			All			4[a]
Scram	Normal	All	All	4[a]	4[a]	All
Scram	Minimum		4[a]			4[a]
Scram	Zero					4[a]
Scram (scram discharge volume high level)[b]	Normal					
Scram	Normal					4[c]

[a] Refers to four CRDs selected for continuous monitoring based on slow normal accumulator pressure scram times, or unusual operating characteristics, at zero reactor pressure. The four selected CRDs must be compatible with rod worth minimizer, RSCS systems, and CRD sequence requirements.

[b] The scram discharge volume fill time will be determined at Test Conditions 1 and 6 during planned reactor scrams.

[c] Scram times of the four slowest CRDs will be determined at Test Conditions 1 and 6 during planned reactor scrams.

Note: Single CRD scrams should be performed with the charging valve closed (do not ride the charging pump head).

PROGRAM PHASE	RESPONSIBILITIES	MAJOR ACTIVITIES
Construction Test Phase Construction Complete and Equipment and System Jurisdictional Transfer	Detroit Edison Company — Primary Responsibility Surveillance Function Daniel International Corporation Performing Agent	1. Structures, Components, Systems Erected 2. Mechanical and Electrical Checks To Determine Equipment and Systems Installed as Designed 3. Review and Approve Tests and Check Results 4. System Hydro Tests
Checkout and Initial Operations Test Phase Checkout and Initial Operations Test Phase Complete	Detroit Edison Company — Primary Responsibility and Performing Agent SCO, GE, Consultants, Vendors as Necessary for Assistance	1. Initial Equipment Energization 2. Flushing and Cleaning 3. Initial Calibration of Instrumentation 4. Electrical Wiring and Equipment Tests 5. Valve and Mechanical Equipment Tests 6. Initial Equipment Operation 7. Equipment and System Maintenance 8. Review and Approve Test Results 9. Refurbishment of Equipment 10. System Hydro Tests
Preoperational Test Phase Preoperational Test Phase Complete; System Turnover to Nuclear Production	Detroit Edison Company — Primary Responsibility and Performing Agent SCO, GE, Consultants as Necessary for Assistance	1. Approve Prerequisites for Preop Testing 2. Perform Preop Tests 3. Return Systems to Normal Status 4. Review and Approve Preop Tests Results
Startup Test Phase Fuel Load	Detroit Edison Company — Primary Responsibility and Performing Agent GE, Consultants as Necessary for Assistance	1. Approve Readiness for Fuel Loading 2. Load Fuel 3. Perform Startup Tests From Initial Criticality to Full Power 4. Review and Approve Startup Test Results
Warranty Demonstration Phase Commercial Operation	Detroit Edison Company — Primary Responsibility and Performing Agent GE, Vendors, Consultants as Necessary for Assistance	1. Approve Readiness for Warranty Tests 2. Perform Warranty Tests 3. Review and Approve Warranty Test Results

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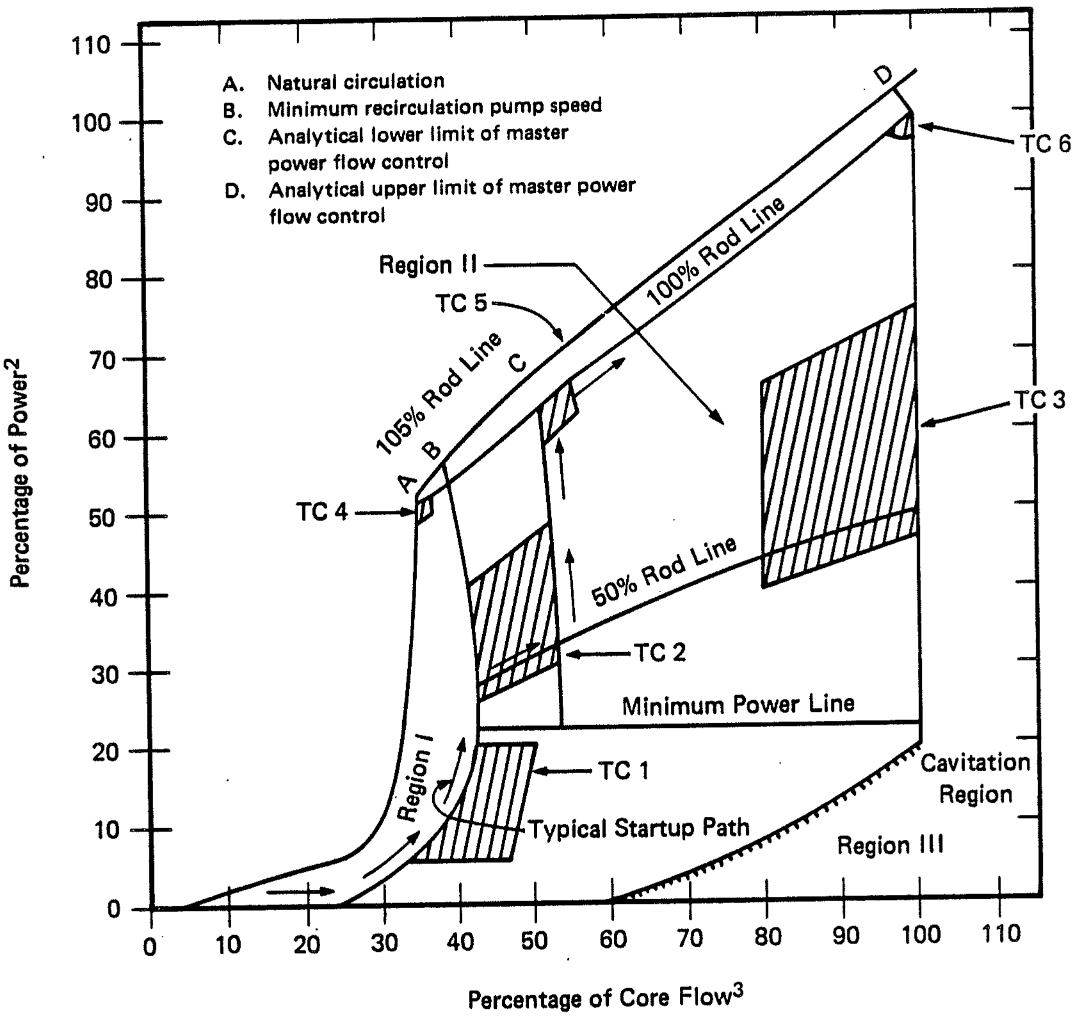
FIGURE 14.1-1

TEST PROGRAM OUTLINE



Notes:

1. See Table 14.1-1 for startup test titles.
2. Power in percentage of rated thermal power, 3292 MWT.
3. Core flow in percentage of rated core recirculation flow, 100.0 X 10^6 lb/hr.
4. TC = test condition.

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FIGURE 14.1-2

APPROXIMATE POWER FLOW MAP
SHOWING STARTUP TEST CONDITIONS

14.2 AUGMENTATION OF STAFF IN INITIAL TESTS AND OPERATIONS

14.2.1 Description of Augmented Staff

Since the normal complement of plant operating personnel was insufficient in number to staff the initial test and operation program, Edison augmented the staff for this initial test period, primarily with General Electric and English Electric test personnel.

The responsibility for the completion of the startup test program lies with the Edison Startup Test Phase Group, which is part of the Nuclear Production Organization. The detailed description of the organization, personnel qualifications, and responsibilities for the Startup Test Phase Group is covered by plant administrative procedures.