CHAPTER 14 - INITIAL TEST PROGRAM

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INITIAL TEST PROGRAM

14.1 SPECIFIC INFORMATION TO BE INCLUDED IN PRELIMINARY SAFETY ANALYSIS REPORTS

Not applicable.

14.2 SPECIFIC INFORMATION TO BE INCLUDED IN FINAL SAFETY ANALYSIS REPORTS

14.2.1 Summary of Test Program and Objectives

The Oyster Creek Nuclear Generating Station (OCNGS) has been subjected to preoperational testing, and to a series of startup and power tests at 1600 and 1690 MW (thermal) and at the full design rating of 1930 MW (thermal). The testing at 1600 MW was performed by Jersey Central Power and Light Co. personnel under the direction of General Electric Co.

14.2.1.1 Preoperational Test Program

An extensive Preoperational Test Program was conducted at Oyster Creek during a period of approximately six months prior to initial fuel loading. This program had the following principal objectives:

a. Certain plant systems were sequenced for early construction completion and testing and place in routine operation because they provided necessary auxiliary services for subsequent tests on other systems.

b. Wherever practical and consistent with the overall schedule, preliminary acceptance tests were performed before fuel loading on all systems which were to be subsequently exposed to radioactive contamination in order to provide maximum accessibility and to impose minimum penalties on correction work.

c. The Preoperational Test Program was an important phase in the training of operating personnel. Operating experience and understanding of plant systems and components was gained with a minimum of risk to the equipment or personnel.

d. Insofar as was possible without a large energy source, proper functional performance of all plant systems was demonstrated. Particular attention was given to protective instrumentation circuits and to Engineered Safety Feature Systems.

e. Plant equipment and systems were operated for a sufficient period of time to discover and correct design, manufacturing, or installation deficiencies.

f. Plant and systems operating procedures were verified for correctness and suitability during the test program.

14.2.1.2 Startup and Power Test Program

The purpose of the Startup and Power Test Program was to verify that the plant design and operating characteristics had been met and that the plant would operate in a safe and predictable manner within the criteria for which it had been designed and constructed.

The Startup and Power Test Program was divided into four phases:

a. Core Loading and Criticality Testing (Near Zero Power at Atmospheric Pressure)

Accurate knowledge of reactor parameters and characteristics, as required for the safe operation of the facility, were determined by an extensive program of tests and measurements executed before the initial fuel loading.

The fuel, control curtains (no longer in use) and control rods were subjected to extensive quality control tests and measurements during manufacturing to ensure that their physical properties were those specified. The reported nuclear characteristics of these components were calculated with methods continuously compared with results of experiments conducted in the Vallecitos Atomic Laboratory's critical facilities, including measurements of similar or identical components. In addition, startup tests and operating data from other boiling water reactors in commercial operation at the time of the tests, and other measurements throughout the nuclear industry, were used to confirm the applicability of the analytical methods.

The objective was to obtain the necessary quality and completeness of the knowledge about the core prior to and during the experiments, with emphasis on nuclear safety.

Chemical and Radiochemical Tests were initiated to determine and establish proper plant water conditions prior to initial operation and to maintain these throughout the test program. Control Rod Drive System tests were performed on all drives previous to fuel loading to assure proper operability and to measure and adjust operating speeds. The Reactor Protection System was functionally tested prior to fuel loading to assure all necessary sensors and system components were available and operating properly. After core loading, the reactivity characteristics of the core, and the adequacy of the nuclear instrumentation and of the reactivity control systems was verified by testing.

b. <u>Heating from Ambient to Rated Temperature</u>

Following satisfactory completion of the core loading and low power test program, the core components were visually verified for proper installation, and the additional in-vessel hardware was installed. This included special monitoring instrumentation, and the steam separator and dryer assembly. The reactor pressure vessel head was installed. This was followed by a hydrostatic test to assure satisfactory sealing of the vessel head. The drywell head was installed and shield plugs placed over it. A sequence of tests was performed to confirm some of the Nuclear Steam Supply System characteristics, as the temperature and pressure were increased. Sufficient tests were performed at each incremental step increase in power or change in pressure, and the tests and operating procedures were evaluated, to assure that the succeeding change in operating conditions could be made safely.

c. <u>Heatup from Rated Temperature to 50 Percent Power (Rod Control Only)</u>

Reactor power was increased to 50 percent power in increments of approximately 10 percent. The turbine was placed in service at this time. Again, sufficient tests were performed and their results evaluated to assure that each succeeding change in operating conditions could be made safely.

d. Full Power Demonstration Run

This was a demonstration test, consisting of a 100 hour run at base rated load to show that the plant met design and contractual requirements.

NEDE-13109, "Oyster Creek Startup Test Results" (Proprietary), was prepared by General Electric and submitted as an amendment to the Application for an Operating License to demonstrate the ability of the plant to perform as designed at 1600 MW thermal power and validated the analytical techniques used to evaluate certain accidents and transients. Later, the test program conducted when the plant was first operated at the increased power rating of 1690 MW thermal in December 1970 demonstrated the stability of the plant at this higher power density and the acceptability of the core performance at 1690 MW. The full design power test program was designed to demonstrate the stability of the plant and the acceptability of core performance at a core thermal power of 1930 MW. The startup test programs at these different power levels were essentially similar, except that procedures for the test were slightly modified in some cases.

14.2.2 Test Program Description

Preoperational tests at Oyster Creek were initiated approximately six months before initial fuel loading. An outline of these tests is presented in Subsection 14.2.2.1.

Initial fuel loading started on April 10, 1969 and was completed two and one half weeks later, on April 28, 1969. Initial criticality was achieved at 2:17 p.m. on May 3, 1969, and low power physics testing was completed soon thereafter. The Startup Test Program is described in Appendix 14.2A. The results of the tests conducted during the power ascension program were reported in General Electric's NEDE-13109 (PROPRIETARY), dated May 1970. With the completion of the testing program and the 100 hour warranty run, commercial operation at 530 MW (electrical, net), began on December 23, 1969.

On May 7, 1970, an application for an increase in licensed thermal power level from 1600 MW to 1690 MW was filed with AEC. The request was granted on December 2, 1970. The test program in support of this application is summarized in Subsection 14.2.2.3. Several Reactor Protection System setpoint changes were made to accommodate the new power level and an anticipatory trip was added which would cause an immediate scram upon sensing a turbine trip or generator load rejection.

On January 26, 1971, an application for an increase in licensed thermal power level from 1690 MW to the full design power of 1930 MW was filed, and granted on November 5, 1971. Again, Reactor Protection System setpoints were changed to accommodate the higher power level and a fifth Electromatic Relief Valve was installed to mitigate the transient pressure increase should a turbine trip occur without bypass valve action. The Full Design Power Test Program is summarized in Subsection 14.2.2.4.

14.2.2.1 Summary of Preoperational Test Content

Station Grounding - Construction Tests

Adequate grounding of all major structures and electrical equipment was demonstrated before energizing the electrical system. This test was performed by construction personnel and was characterized more as a construction test than a preoperational test.

<u>125 Volt DC System - Construction Test</u>

This system was placed into service to the extent required to provide auxiliary power to the plant in a safe manner. Other portions of the DC system were completed later as required. Equipment in the Reactor Protection System and vital bus power supply required functional preoperational testing to verify adequacy of design and installation. Generally, the testing in this system was in the nature of construction tests on wiring and individual components such as the following:

a. Continuity checks.

b. Megger wiring.

c. Calibration of meters.

d. Proper operation of controls and interlocks.

These tests were performed by construction personnel and data sheets and formal test records were completed.

<u>230 KV Electrical System - Construction Tests</u>

This system had to be operational to provide adequate power for large motors. Most of the early scheduled preoperational tests were completed without operating large motors, but the cumulative effect of placing systems into routine service, performing preoperational tests, and continuing construction work would have eventually exceeded the capability of the 34.5 KV transmission system.

Preoperational test requirements for this system included the following:

a. Check continuity and phasing.

b. Megger all control and power wiring.

c. Relay tests and adjustments.

d. Test for proper operation of transformer cooling and instrumentation.

e. Check circuit breaker operation.

f. High potential tests, as required.

g. Calibration of meters.

h. Proper operation of all controls.

These tests were performed by construction personnel, and data sheets and formal test records were completed.

34.5 KV System - Construction Tests

Test requirements were similar to those for the 230 KV Electrical System. Tests were performed by construction personnel, and data sheets and formal test records were completed.

4160 Volt Electrical System - Construction Tests

After DC control power was available, the 4160 Volt circuit breakers were functionally tested and the system was energized.

Test requirements were similar to those for the 230 KV Electrical System. Tests were performed by construction personnel, and data sheets and formal test records were completed.

480 Volt Electrical System - Construction Tests

The 480 Volt power centers were then energized and individual motors started or motor control centers energized as required by the detailed schedule. Other test requirements were similar to those for the 230 KV Electrical System. Tests were performed by construction personnel, and data sheets and formal test records were completed.

220 Volt and 120 Volt AC Systems - Construction Tests

These systems were tested and energized as required. Other test requirements were similar to those for the 230 KV Electrical System. Tests were performed by construction personnel, and data sheets and formal test records were completed.

Makeup Water System

The Makeup System, including the deep well pump, storage pond pumps, and Demineralized Water and Condensate Storage Tanks and associated pumps, were then placed in service to provide demineralized water for cleaning, flushing, hydrotesting, and initial filling of plant systems. Instrument air was required extensively for control valve operation in this system and was provided by a separate portable unit.

Service Water System

The service water pumps were placed into service to provide cooling for the Reactor and Turbine Cooling Water System. Instrumentation was calibrated and placed in service. During initial operation of the pumps, they were monitored for proper meter current, temperatures and vibration and verified to be delivering the appropriate flow by using the manufacturer's curves and the installed system instrumentation.

For the test, control and power wiring was completed to the intake structure, the intake canal was completed and in service, the screen and trash racks were installed and operational, and the service water overflow return to the discharge canal was completed.

Turbine Building Closed Cooling Water System

This system was cleaned, flushed, hydrotested, filled with inhibited water, relief valves checked, pumps and valves tested, and the system placed in normal service. Some lines were valved closed and/or capped to permit the partially completed system to be placed into service supplying cooling water for the earliest scheduled preoperational tests. The first requirement was for instrument air compressors, then for various system pumps which were used during chemical cleaning and flushing. Originally, the system contained chromated water; the use of chromated water has been discontinued at the site.

Fire Water System

Prior to the test, all piping was completed and hydrotested, the batteries for the diesel driven fire pumps were charged and battery charging and control power circuits were completed. For the test, the pumps were operated and their performance was checked against manufacturer's curves, all interlocks, remote controls and automatic start features were checked.

Instrument Air and Service Air

These systems were required as early as possible to permit normal operation of valves and instrumentation during the performance of other system preoperational tests. Construction and installation was completed on the central portion of the system first: air compressors, receivers, dryers, and main headers up to isolating block valves. Tests on the compressors and dryers were completed as soon thereafter as possible, without waiting for all air piping to be installed.

The following conditions were met prior to the test:

a. Volt auxiliary power was available.

b. Volt AC or 120 Volt DC control power was provided, as required.

c. Cooling water (and service water) was connected.

d. Instruments were calibrated, interlocks and controls were checked, and all other construction tests were completed.

Test Summary:

a. Checked set points for compressor control: on, off, standby start, mechanical unloading, and annunciator alarms.

b. Measured the capacity of each compressor.

c. Checked dryer performance.

d. Performed the blow out of air piping.

e. Checked system for leak tightness. A final test was required when system was completed. This included a soap bubble test on all joints and fittings and a bleed down measurement.

Condensate Demineralizer System

This system was not required early, but completion was scheduled such that available personnel could move from the Makeup System to this one and then be in a position to regenerate resins from radwaste or the cleanup system. This test covered the demineralizers, regeneration equipment, and recycle pump and associated controls. Piping was completed from the main inlet to the main outlet valves.

The following conditions were met prior to the test:

a. Volt Auxiliary power was available.

b. Volt AC control and instrumentation power was provided.

c. The condensate transfer water supply was connected.

d. Instrument (and service) air was available.

e. Construction tests were completed on piping, valves, instruments, controls, pumps, and other components.

Test Summary:

a. Checked calibration of all instruments.

b. Checked operation of all valves.

c. Checked all controls - automatic and remote control.

d. Verified proper operation of the recycle pump.

e. Simulated resin transfer from the demineralizer to the regeneration system (without resin).

f. Simulated all phases of regeneration with actual water and air flow, but without resin.

g. Simulated the return of resins to the demineralizers.

h. Added resins to the demineralizers. Regenerated, the resins if required (at least one charge was provided even if resins did not require regeneration).

i. Simulated, with plain water, the transfer of resins from the cleanup, fuel pool and radwaste demineralizers and the return operation to the proper demineralizer.

j. Repeated the resin transfer operation with an actual full charge of resins.

<u>Plant Heating Boiler</u>

The plant heating boiler was placed in service to supply steam for reactor vessel testing and for subsequent chemical cleaning.

Standard acceptance tests were performed to verify that the boiler capacity and heat rate met specifications, and that all auxiliary equipment and controls were working properly.

Reactor Building Closed Cooling Water System

This system was required before operation and testing could begin on the variable speed MG sets, the control rod drive hydraulic pumps, and the Old Radwaste Building, and for cooling the process pumps which were used for chemical cleaning and flushing.

The following conditions were met prior to the test:

a. Volt electrical power was available.

b. Instrument air (for surge tank level control) was provided.

c. Main system headers to individual block valves were completed and connected.

Test Summary:

a. After hydrotesting and chemical cleaning, the system was filled with inhibited water (chromated water is no longer in use at the site).

b. Operated the pumps to verify their proper performance.

c. Checked the operation of the surge tank level controls and alarms.

d. Checked all interlocks, alarms, controls and remote indicating devices. Used simulated inputs such as manometers, test pressure signals, and temperature baths where cold system conditions would otherwise restrict the test.

The system was then operated routinely to provide services for other preoperational tests.

Reactor Vessel and Primary System Hydrotest (Construction Test)

This test was completed at the earliest possible date to permit installation and testing of control rod drive mechanisms and reactor internals. For this reason the test could not be delayed until the nuclear steam auxiliary systems were sufficiently completed to permit concurrent testing and it was necessary to install the reactor vessel head two times during the preoperational test program. While preoperational tests were not possible at this time on the auxiliary systems, the piping was complete to the point which would permit flushing and chemical cleaning immediately after the hydrotest.

The following conditions were met prior to that test:

a. Installation of the reactor vessel, all drive and instrument thimbles and blind flanges was completed.

b. All interconnecting piping to the first valve was installed. The Shutdown Cooling System and the Emergency Core Cooling Systems, which are closed loops, were completed to permit their chemical cleaning concurrently with the Primary System.

c. Recirculation piping was completed with blank flanges installed on the pump bowls.

d. A source of heating was available for heating reactor metal temperatures to approximately 100°F.

e. A core spray pump was used to fill the reactor vessel with demineralized water for the hydrotest.

f. Other interconnected systems were completed to at least the first valve isolation to include the entire system in the chemical cleaning immediately following reactor hydrotesting. The interconnected systems completed included:

    1. The Reactor Cleanup System (in and out to first gate valve).

    2. The Liquid Poison System.

    3. The main steam lines to the turbine stop valves, since the isolation valve would not withstand the steam line hydrotest pressure from the downstream side.

    4. The two Core Spray System loops to the first gate valve.

    5. Instrumentation connections to the root valves.

    6. The Control Rod Hydraulic System return line to the reactor.

    7. Two Feedwater System supply lines up to the manual gate valve inside the drywell.

Test Summary:

a. Heated the reactor to the required temperature by using the plant heating boiler steam supply to the shutdown cooling heat exchangers and recirculating the reactor water with the shutdown cooling pumps (this connection has since been removed).

b. Hydrotested the reactor, the Isolation Condenser System, the main steam lines and the recirculation loops to a pressure of 1800 psig.

c. Inspected all field welds to reactor vessel nozzles, piping and valves included in the limits of this hydrotest.

<u>Chemical Cleaning</u>

The reactor vessel, recirculation piping, and other connected stainless steel systems were chemically cleaned by alkaline flush. Other systems of particular concern during chemical cleaning were the Shutdown Cooling, Isolation Condenser, Reactor Cleanup, and Core Spray Systems, since these systems tie into the reactor vessel.

The feedwater line was jumpered across to the main steam inside the reactor vessel, permitting coolant recirculating through these two carbon steel systems without filling the reactor vessel at that time.

Control Rod Drive Hydraulic System

Prior to testing the Control Rod Drive Hydraulic System, the following conditions were met:

a. All piping and wiring was installed and connected.

b. The system was flushed and cleaned.

c. A supply of demineralized water was available in the Condensate Storage Tank.

d. The CRD Hydraulic system supply pumps were operational.

e. Instrument air was available.

f. 440-Volt AC, 115-Volt AC and 120-Volt DC power was available.

g. Power was available through the reactor safety circuit to energize the CRD scram valves.

Test Summary:

a. Calibrated instruments.

b. Checked alarms, controls, and interlocks.

c. Obtained pump performance data, e.g., head, flow, suction pressure, bearing and cooling water temperatures, motor current, RPM, for both CRD hydraulic supply pumps as per manufacturer's instructions.

d. Adjusted the flow control valves.

e. Checked the operation of valves from the appropriate selector switches, and interlocks or trip signals.

f. After the drives were installed, adjusted the individual flow control valves for proper drive speeds.

g. Monitored and recorded total system performance data with all the drives installed, including information on:

    1. Cooling water flow.

    2. Total system flow.

    3. Flow returned to reactor.

    4. System pressures.

5. Transient operational response of the CRD Hydraulic System during insert and withdraw operations, or following a scram.

h. Verified the proper operation of both CRD hydraulic supply pumps simultaneously, one aligned to supply the CRD system and one for the Head Cooling System (the Head Cooling System is not used during normal operations).

<u>Drywell, Absorption System Leak Rate Measurement and Isolation Valves</u>

Prior to this test, the following activities were completed:

a. All isolation valves and connected piping were installed and hydrotested from the reactor vessel to their outboard isolation valve.

b. All bellows seals were installed.

c. All piping hangers, guides and anchors which affect the containment joint were installed and set properly.

d. Downcomer caps were maintained in place to separate the drywell from the torus for the 62 psi strength test, and were then removed for the combined leak rate test.

e. All electrical penetrations were installed and their wire and cable were in to the first terminal inside the drywell.

f. Pressure reference systems inside the drywell and torus were installed.

Test Summary:

a. Measured leakage across the seats (inside the process line) of all the isolation valves which open directly into the Primary Containment. Adjusted their limitorques or operators, as required to obtain proper seating. Lapping of valve seats was performed as required to reduce leakage to acceptable values.

b. Soap bubble tests checked all penetrations which were added since the previous test at 5 psig.

c. Leak tested electrical penetrations at 62 psig.

d. Strength tested the drywell at 62 psig and the torus at 35 psig. Repeated the soap bubble tests.

e. Measured the leak rate of the drywell and torus simultaneously at 20 psig.

f. Measured the leak rate of each bellows seal at 35 psig.

During the test, the reactor vessel and the absorption chamber were filled with water to their normal operating level and a humidity correction was applied to the measured leak rate. This same condition existed in all subsequent tests.

Following installation of the Spent Fuel Pool Cooling System, the system was tested in preparation for fuel loading operations.

Prior to the test, the condenser and the Condensate and Feedwater Systems were placed in service.

Test Summary:

a. Calibrated all instrumentation.

b. Checked alarms, controls and interlocks.

c. Filled the spent fuel storage pool with demineralized water (after cleaning thoroughly).

d. Recirculated cooling water flow through the heat exchangers, bypassing the filter and the demineralizer.

e. Checked the operation of filter valves, and precoat and filter aid pumps using demineralized water (without precoat material). Checked the semi automatic backwash operation. After filter operation was found acceptable, added precoat material and placed the filter into service.

f. Simulated the resin sluicing operation to and from the demineralizer, using demineralized water only (and air as required).

   After satisfactory simulation of the sluicing operation and when cleaning of the fuel pool and Reactor Building were completed, charged the resins and placed demineralizer into routine service. Verified system flow rates from pump head flow characteristics.

g. Checked level alarms in the fuel pool surge tanks by making actual changes in level.

h. Filled the reactor cavity and the dryer/separator storage pool. Observed that water circulation and surface skimming was adequate.

i. Drained the reactor cavity and the dryer/separator pool by rejecting the water to the Condensate Storage Tank via the hotwell and condensate demineralizers. Checked that all seal crevices drained adequately and efficiently.

<u>Fuel Handling System</u>

Equipment covered in this category was tested with dummy fuel and blade guide assemblies through dry run simulations of the required operations. This was not one coordinated test of a system, but consisted of many separate operations using different pieces of equipment. The equipment was tested on the operating floor, in and over the fuel storage pool and in the reactor vessel.

Test Summary: (Not necessarily in chronological order).

a. Tests in the storage pool.

1. Installed the fuel pool gates and filled the pool with water.

2. Checked operation of the fuel preparation machine with a dummy fuel assembly. This check included the performance test for auxiliary tools such as channel handling tool and channel bolt wrench.

3. Set up the inspection scope and checked it with a dummy fuel assembly.

4. Checked visibility during fuel and blade handling and transfer operations using fixed lights and the movable underwater lights.

5. Checked operation of the underwater vacuum cleaner.

6. Operated the refueling platform over storage pool. Checked all equipment on the refueling platform using the grapple, transferred fuel assemblies and control blades between storage racks.

7. Used the jib crane to transport dummy fuel assemblies from the storage racks to the fuel preparation machine work areas.

b. Tests over the reactor vessel

1. Set service platform assembly on the vessel flange. Mounted a jib crane on the service platform and used it for installing, removing, or shuffling dummy fuel assemblies, control blades and poison curtains.

2. Raised the water level in the reactor cavity and checked for leaktightness the vessel to drywell seal and the drywell to pool seal. Lowered the water level and checked the ability of the spent fuel pool cooling system to drain these seals or associated low points.

3. Verified the best procedural methods and tools for:

   a. Removal and replacement of the steam dryer.

   b. Removal and replacement of the steam separator head.

   c. Removal of poison curtains.

   d. Removal and replacement of fuel support castings and control rod blades.

   e. Removal and replacement of incore flux monitor strings.

   All of the above tests were performed with proper recognition of the shielding requirements in doing the job "Hot" and attempted to simulate "Normal" operating conditions.

4. Transferred dummy fuel assemblies and control blades between the storage pool and the reactor vessel, simulating a refueling operation.

5. Obtained representative values of the time required to do all operations normally in the critical path of a refueling outage.

6. Checked the installation and removal operations of support plugs in the designated peripheral positions.

Control Rod Drive System

Control Rod Drive Hydraulic System and manual (electrical) control system tests were completed before beginning tests of individual control rod drive mechanisms. All internals were placed in the reactor, including the guide tubes and thermal sleeves. Blades and dummy fuel assemblies were also installed. The tests were required on each individual drive.

Test Summary:

a. Inserted the drive - continuous and by notch modes.

b. Withdrew the drive - continuous and by notch modes.

c. Checked stroke timing.

d. Performed friction measurements.

e. Measured scram time.

f. Measured multiple scram times.

g. Checked the proper operation of the position indication and in/out limit lights.

h. Repeated those tests of the hydraulic system and manual control system which are required to verify total system performance. Rechecked the performance of flow and pressure control valves and instrumentation.

i. Rechecked rod control interlocks.

j. Removed several control rod blades for examination after all tests were completed.

k. Removed several drive mechanisms for inspection of screens and strainers, after tests were completed.

l. Tested the safety circuits in conjunction with the Control Rod Drive System to verify scram signals and rod withdrawal interlocks from all safety circuit sensors.

Cleanup Demineralizer System

The system was flushed, cleaned and initially checked out while the reactor vessel was empty for the installation of drive mechanisms. The flushing was accomplished by supplying condensate and routing the discharge to radwaste or to the hotwell. The reactor was available to complete the tests and the system was not completely checked during the preoperational phase because full temperature and pressure conditions were required in the reactor for "normal" system operation.

Prior to performing the final tests, the following conditions were met:

a. Volt auxiliary power was available.

b. Volt auxiliary power was provided.

c. Volt AC or 120 Volt DC control power was available.

d. The reactor was available to supply auxiliary pump suction.

e. Instrument air was connected.

Test Summary:

a. Checked the operation of the auxiliary pump.

b. Checked the operation of the pressure control station with simulated pressure input signals.

c. Checked the operation of the main cleanup pumps, pumping first to the hotwell or radwaste, and then to the reactor. Pumping to the reactor was not permitted until the filters and demineralizer were fully checked out to prevent injecting poor quality water into the reactor.

d. Checked the operation of filters and associated equipment. Performed all required operations, such as precoating, normal operation, standby recirculation, filter and addition, and backwashing. It was assured that system was set up such that filter breakthrough would not dump impurities into the reactor.

e. Simulated pumping of the sludge to the radwaste system (the fluid was non radioactive sludge water generated during preoperational testing program).

f. Checked the operation of the demineralizer and all associated equipment:

    1. Checked transfer to and from the condensate demineralizer system - first without, then with resins.

    2. Checked dumping of resins to the resin storage tank.

g. Checked the operation of all valve and pump interlocks by simulated signals to appropriate instrumentation.

h. Checked the calibration and alarm or trip (interlocks) setpoints of all instrumentation.

i. Checked the operation of the surge tank by interrupting flow to main pumps with the pressure control valve or isolation valve, for a short period of time.

j. After the system was proven to be operational in all modes of operation which are possible to demonstrate without pressure or temperature in the reactor, the demineralizers were charged with resins and the system was placed in normal service when the reactor was filled with water during preoperational testing.

Isolation Condenser System

This system was not tested for performance adequacy until the reactor was operated at rated temperature and pressure. However, all components and instruments were verified to be operating properly during the preoperational period.

The following conditions were met prior to the test:

a. Volt auxiliary power was available.

b. Volt AC and 120 Volt DC control power was provided.

c. The Condensate Transfer System was operational.

Test Summary:

a. Checked operation of all valves.

b. Verified the proper setpoint for the reactor pressure instrumentation.

c. Verified the automatic actuation of the system using a test signal simulating high reactor pressure.

d. Drained some water from the shell side of the condenser and verified the proper operation of level alarms and the makeup system.

e. Verified availability of the backup water supply. This low purity water was not discharged to the condenser.

f. Verified the automatic closure of the system isolation valves following a high vent radiation or high elbow differential pressure signal.

Shutdown Cooling System

The test required that water be placed in reactor vessel. The system was not sufficiently complete at the time of reactor vessel hydrotest to do preoperational test at that time, but performance tests on the pumps were accomplished.

Test Summary:

a. Calibrated all instrumentation and check setpoints.

b. Checked the operation of all motor operated valves.

c. Checked interlocks in the valve and pump control circuits.

d. Operated pumps for one, two and all three loops at the same time. Measured system pressures where possible and determined flow rate from the pump characteristic curve.

e. Determined the effectiveness of the flow control valves on the cooling water circuit and the reactor water circuits. Again, estimated flow from system pressures.

f. Checked the operation of the minimum flow recirculation circuits by closing the loop outlet valve slowly. Verified that the circuit permits pump operation in order to "exercise" mechanical seals.

g. Measured the closing time of isolation valves.

h. Added steam to the heat exchangers, from plant heating boiler, and raised reactor water temperatures to approximately 180-F. This was done concurrently with the Primary System expansion tests.

i. After the expansion tests, the reactor was cooled down to ambient temperatures. Recorded the temperature of reactor water, cooling water, and reactor pressure vessel.

j. The Head Cooling System was tested at the same time.

Liquid Poison System

All portions of this test, except the actual pumping rate into the reactor could have been done at any time regardless of the status of the reactor vessel (full or empty, head on or off).

Test Summary:

a. Calibrated instruments and checked all setpoints.

b. Filled the poison tank with demineralized water and operated the poison injection pumps, recirculating the flow back to the poison tank.

c. Checked the setpoint of the pump discharge relief valves.

d. Checked the control circuits for the poison injection valves thoroughly before connecting to the valves. (Used a dummy resistance to simulate the valve).

e. Fired the injection valves and measured pumping rates into the reactor. Replaced the firing cartridge.

f. Checked the interlocks with the Cleanup Demineralizer System that ensure isolation of the Reactor Cleanup system when the poison system is actuated.

g. Checked the operation of the poison tank temperature controls and air sparger.

h. Filled the test tank with demineralized water and operated the poison injection pumps in a simulated test mode, by recirculating the flow to the test tank.

i. After the system was demonstrated operable by the foregoing tests, added the required poison to the poison tank. Mixed and sampled. This was done very shortly before fuel loading.

Reactor Head Cooling System

For this test, the reactor vessel had to be available to receive water, and the head was installed. This test was coordinated with the Primary System expansion test.

Test Summary:

a. Calibrated the instrumentation.

b. Verified the ability to raise the water level into the top region of the vessel and head flanges, and to monitor and control the level in this region using the Reactor Cleanup System for letdown.

c. Repeated the system test at elevated temperatures after the primary system expansion test was completed.

d. Verified the capability of the head cooling operation with one control rod drive hydraulic supply pump while the other pump was used for control rod operation, or for cooling.

Reactor Vessel Components

These items are more appropriately covered in other tests:

a. Calibrated and tested the reactor vessel O-ring leak detection instrumentation.

b. Set the reactor vessel stabilizers.

c. Checked all the reactor vessel thermocouples.

d. Checked the stud tensioner operation.

e. Noted that the reactor vessel internals were installed in accordance with specifications.

f. Installed the reactor vessel surveillance capsules.

Reactor Vessel Instrumentation

This test included the reactor temperature detectors, flange leak detection, stabilizer adjustments and pressure, level, and flow instrumentation not included in the safety circuit tests.

Test Summary:

a. Calibrated all instrumentation.

b. Checked the response of thermocouples with temperature baths.

c. Checked the proper installation of the reactor vessel stabilizers.

d. Observed the response of the thermocouples during reactor heatup during the primary system expansion tests.

Primary System Expansion

For this test it was necessary that the reactor vessel had insulation in place, and that the Shutdown Cooling, Reactor Cleanup and Recirculation Systems were operational. The Condensate and Feedwater Systems were available for fill and makeup to the reactor.

Test Summary:

a. While supplying steam from the plant heating boiler to the shutdown heat exchangers, brought up the temperature of the reactor vessel and recirculation loops to approximately 200°F. Then, continued heating the system to operating temperature using the five variable speed recirculation pumps.

b. Recorded and monitored the reactor vessel, recirculation pumps and water temperatures. Measured the system and vessel heating and cooling rates.

c. Monitored the reactor vessel stabilizers.

d. Checked the motion of reactor vessel, recirculation loops and major piping connected to the vessel.

e. Checked all piping hangers and supports for proper setting.

f. Checked the motion of all drywell bellows penetrations and verified that the forces or motion were not excessive.

Reactor Vessel Safety and Relief Valves

This system was not required for fuel loading but access to the valves was to be restricted during and after fuel loading so the test was scheduled before this time.

The safety valves were installed as received from the factory, where setpoints were adjusted, verified, and indicated on the valve.

Test Summary:

a. Verified proper operation of the piston operated valves from Control Room.

b. Calibrated the reactor pressure sensors and verified proper operation of the piston operated valves using test pressure signals to the pressure sensors.

Reactor Recirculation System

This test was performed following completion of the reactor hydrotest and the chemical cleaning operation. The following conditions were met prior to the test:

a. Volt electrical power was available.

b. Volt electrical power was available.

c. There was water in the vessel for the pump tests.

Test Summary:

a. Operated all recirculation loop valves and verified that seat leakage was small enough to allow pump maintenance.

b. Calibrated the loop instrumentation and checked controls and interlocks.

c. Operated the recirculation pumps and MG sets at reduced speed.

d. Checked the flow control transient operation within the range permitted by cold water and atmospheric pressure in the reactor.

Core Spray System

After the drywell proof pressure test was completed and the downcomer caps removed, the Core Spray System was tested. The reactor vessel was available to receive water, and the vessel head and shroud head were removed for observation.

Test Summary:

a. Calibrated all instrumentation.

b. Checked alarms, controls and interlocks including complete verification of automatic system starting controls.

c. Operated the pumps recirculating to the torus in the test mode. Verified pump and system performance from the manufacturer's head-flow curves and measured system pressures.

d. Checked the operation of all motor operated valves.

e. With the valves closed and locked out of service initiated the system automatically and verified pump start.

f. With the pumps locked out of service, initiated the system automatically and verified that the valves would open. Repeated this check for the system in test configuration.

g. Isolated the pump suction line from the torus and aligned it to provide pump supply directly from the Condensate Storage Tank. Sprayed condensate into the reactor vessel. Verified proper flow rates and observed the spray pattern.

h. Verified the capability to lay-up the system while wet, and filled it with water from the torus. Verified the capability to flush water from the system prior to the routine test, spraying into reactor.

i. Simulated the accident condition simultaneous with a power failure and observed whether proper sequential operation of system pumps and valves was achieved. This test was run concurrently with the containment cooling system automatic operation test and the diesel generator automatic starting test.

j. Simulated component failures by locking one pump out of service and initiating the system. Verified that the condition is detected and the next pump is automatically started.

Containment Spray System

The drywell proof pressure test was completed and the downcomer caps were removed prior to this test. There was water in the torus.

Test Summary:

a. Calibrated all instrumentation.

b. Checked alarms, controls and interlocks.

c. Demonstrated the operation of the pumps, by recirculating the spray flow in the test mode. Verified proper performance using installed pressure and flow instrumentation.

d. Flow tested several fog spray nozzles before installation on the spray headers. Inspected all nozzles before installation to verify cleanliness and proper opening size.

e. Air tested the spray headers to verify that all nozzles were installed properly.

f. With the containment spray valves closed, initiated the system automatically and verified proper pump starting for normal power and emergency power modes of operation. This latter test was combined with the appropriate portion of the diesel-generator test, and the core spray test. Locked one selected pump out of service to verify the capability of the automatic control system to detect this situation, and initiate appropriate corrective action. Repeated for several different pumps (but not necessarily all possible combinations).

g. Verified that emergency service water pressure exceeded containment spray pressure in either normal or run out conditions.

Liquid Radwaste Disposal System

After fuel was loaded in the reactor, all drains from the reactor, fuel pool cooling systems, or interconnecting auxiliary systems were considered to be potentially radioactive. Therefore, most of the Liquid Radioactive Waste Disposal System was tested and operational before fuel loading.

Liquid Waste Disposal Test Summary: (Most components of this system are not presently in use)

a. Calibrated instrumentation.

b. Checked all controls and interlocks.

c. Rechecked all air operated valves.

d. Tested the tanks as follows:

- Cleaned the tanks mechanically.
- Filled with demineralized water.
- Checked pump operation in recirculation, wherever possible.
- Simulated operations associated with the particular tank, such as draining or filling, recirculating, sampling, and processing to a filter, demineralizer, another tank, or overboard discharge.

e. Tested the filters (Waste collector, fuel pool and floor drain) as follows:

1. Checked the operation of filter components without precoat material, using demineralized water only, until system operation was found acceptable.
2. Performed all required operations such as precoating, normal operation, recirculation, filter and addition and backwashing.
3. Added precoat and repeated the operations in step (2) above.

f. Tested the demineralizers (fuel pool and waste) as follows:

1. Checked the operation of the demineralizer valves, controls, and instrumentation.
2. Simulated resin transfer to spent resin tank and to and from condensate regeneration systems, using demineralized water only.

g. Tested Waste Concentrator:

1. Simulated the waste concentration operation by pumping demineralized (or relatively clean) water from the waste neutralizer tanks to the concentrator. Checked all modes of operation; startup, equilibrium, shutting down, condensate collection, and sludge transfer to the concentrated waste tank.

2. Pumped from the concentrated waste tank to the concrete mixer.

h. Checked the sumps (Drywell, Reactor, Turbine and Radwaste Buildings) as follows:

1. Filled the sumps with water.

2. Checked the operation of the sump pumps and the proper functioning of level controls, including functioning of isolation valves on Containment.

3. Verified the discharge to proper collection tank in radwaste and that no back flow or leakage occurred enroute.

i. Tested the Waste Neutralizer System as follows:

1. Pumped to the waste neutralizer tanks from the condensate demineralizer regenerant collection tank. Verified proper operation of interlocks.

2. Tested the chemical addition equipment with demineralized water initially, then added chemicals and demonstrated the neutralizing operation.

3. Demonstrated all pumping operations with demineralized water only: recirculation, sampling, transfer to floor drain filter.

j. Tested the Spent Resin System as follows:

1. Simulated the transfer of resins from the fuel pool, waste, condensate and cleanup demineralizers to the spent resin tank.

2. Verified cleanup and condensate resin transfer capability by actual transfer of resins. (Performed near end of test program with little or no radioactivity present).

3. Verified the capability to pump spent resins to the centrifuge.

k. Checked filter sludge processing as follows:

1. Simulated transfer of sludge from the waste, floor drain and fuel pool filters to the sludge storage tank using water only.

2. Repeated the sludge transfer operation with actual filter and material.

3. Pumped the filter sludge to the centrifuge.

4. Pumped the cleanup filter sludge to the centrifuge.

Solid Waste Handling, Storage and Disposal

Test Summary:

a. Checked the loading operations from the mixer and centrifuge hoppers.

b. Checked the drum handling, loading, capping and transfer to storage operations. Used sand, drying material and filter aid material to represent solid wastes.

c. Checked drum removal operations for offsite shipment.

d. Checked baler.

Instrumentation Systems

This included the following systems:

a. Source Range Monitor/Intermediate Range Monitor.

b. Source Range Monitoring (SRM) System.

c. Intermediate Range Monitoring (IRM) Systems.

d. Average Power Range Monitoring (APRM) System.

e. Local Power Range Monitoring (LPRM) Systems.

f. In-core flux monitor calibration (TIP).

g. Area Radiation Monitoring (ARM) System.

h. Environs station monitors.

i. Process monitor, Offgas and Air Ejector monitors.

The following types of preliminary testing were performed (where applicable) prior to fuel loading:

a. Installed dummy in-core string in several positions in the core.

b. Checked continuity and resistance to ground of the signal and power cable.

c. Checked the response and calibration of all channels with simulated input signals.

d. Checked alarm and trip set points.

e. Checked the chamber response to bugging sources.

f. Checked all interlocks with the reactor safety circuit and the control rod electrical control system.

g. Checked the operation and position indication of all SRM/IRM chamber drives.

h. Using a dummy TIP chamber, inserted a calibration probe in each incore string tube. Verified the capability to insert more than one calibration probe in a particular in-core string.

i. Installed all in-core, SRM and IRM chambers and verified final system operability.

j. Installed, calibrated, and checked the temporary neutron monitoring instrumentation.

Reactor Safety System

The Reactor Safety system was checked in all sensors installed and calibrated, and with all wiring installed and checked for continuity.

Test Summary:

a. Operated the MG sets with a resistance load to check capacity and regulation.

b. Energized the buses; checked the controls and power source transfer.

c. Checked relay operation (pick up and drop out voltages).

d. Checked each safety sensor for operation of proper relay.

e. Using test signals, verified scram set points. Rechecked, i.e., performed the reactor level check with water in the reactor vessel measuring the actual water level against a suitable reference point such as the vessel flange.

f. Checked all positions of the reactor mode switch for proper interlocks and bypass functions.

g. Checked all control rod permissive interlocks for proper function.

h. Checked the automatic closing of all isolation valves from proper signal.

i. Checked the automatic initiation of the Core Spray, Containment Spray, Isolation Condenser, and Emergency Ventilation System from proper signals.

Rod Worth Minimizer

After the Control Rod Drive System was operational, withdrawal of the control rods in various sequences was achieved to expose the Rod Worth Minimizer to simulated operational conditions. These withdrawal patterns simulated the following operations:

a. Checked all programmed normal rod withdrawal sequences for satisfactory performance.

b. Checked different short term sequences within the sequenced rod groups for satisfactory performance.

c. Attempted improper rod withdrawal and insertion at various points in the withdrawal sequences, and verified that the action was blocked.

d. Determined the capability to insert control rods out of sequence to the extent permitted by the Rod Worth Minimizer.

e. Checked all alarms by simulated, or actual error conditions:

   1. Low power alarm.

   2. Printing.

   3. Computer error.

   4. Input/Output error.

   5. Select error.

   6. Select block.

   7. Insert block.

   8. Withdraw block.

f. Checked all controls:

   1. Sequence A mode.

   2. Sequence B mode.

   3. Shutdown margin mode.

   4. Scan exit.

   5. Print log.

   6. Error clear.

g. Checked all displays and information print out:

   1. Group identification.

   2. Withdrawal error readout.

   3. Insertion error readout.

4. Print out rod position from scan and from memory for several rod withdrawal patterns.

Diesel Generator

One diesel generator needed to be operational before fuel was loaded in the reactor, to provide maximum reliability of power supply.

Test Summary:

a. Performed megger and high potential tests.

b. Calibrated instrumentation.

c. Checked the operation of diesel-generator auxiliaries.

d. Checked the automatic start sequence of the diesel generator, including closing of breaker and load pickup.

e. Simulated a design basis accident and demonstrated the capacity of the diesel generator to pickup core spray, containment spray, emergency ventilation and associated loads in sequence.

   Performed a simulation of power failure with normal reactor shutdown and demonstrated the capability of the diesel-generator to pickup normal shutdown loads.

f. Operated the diesel-generator at full rated load for four hours to demonstrate its load carrying capability. Operated for two hours at 10 percent overload (110 percent of rated).

Drywell Inerting System

The drywell was isolated prior to this test.

Test Summary:

a. Checked operation of all system valves.

b. Calibrated all instrumentation.

c. Inerted the drywell atmosphere and monitored oxygen concentration. Demonstrated the purging effectiveness and measured the gas volumes required to reduce oxygen concentrations and return to normal.

Drywell Ventilation System

Test Summary:

a. Calibrated all thermocouples and temperature alarms.

b. Operated all cooler fans.

c. Checked proper flow distribution with normal condition of four coolers in operation with drywell closed.

d. Verified adequate cooling of the recirculation pump motors to the extent possible under pump cold water speed limitations.

e. Verified the adequacy of the Drywell Ventilation System during system expansion tests with the Primary System at rated temperature and all five recirculation pumps in operation.

Emergency Ventilation and Reactor Building Leak Rate Test:

The Emergency Ventilation System is named the Standby Gas Treatment System at Oyster Creek.

Test Summary:

a. Calibrated instrumentation. Checked all controls and interlocks.

b. Checked the operation of equipment. Obtained heat balance data during the operation of the emergency ventilation blowers to check system capacity.

c. Checked the operation of pre-heater equipment.

d. Operated the blowers and verified design flow capability.

e. Operated the blowers until equilibrium negative pressure was achieved inside the Reactor Building. Evaluated building leak tightness from air volume flow rate, and measured pressures and temperatures.

f. Determined the efficiency of the charcoal filters by injecting freon into the flow stream and sampling the filter effluent.

Balance of Plant - Auxiliary Systems

In general, conventional performance tests were utilized for acceptance testing of these systems. These tests were formalized and documented to a greater extent than might be done in a conventional power plant to provide the necessary control and assurance of equipment or system operability before radioactive contamination or radiation exposure became a problem.

While most of the preoperational tests in this category were primarily individual component tests, instrument calibration, or checking of controls and interlocks, the following systems required somewhat more extensive simulation of normal operation conditions or more attention to detail in performance of the component tests in order to minimize later difficulties. The performance of extensive preoperational tests on the Nuclear Steam Supply System provided additional time which was used to advantage in pre-checking the Turbine-Generator and associated auxiliary systems.

Circulating Water System:

a. Checked operation of the butterfly valves

b. Checked operation of the circulating water pumps verifying that design flow was obtained

c. Operated the condenser vacuum priming and backwash valves

d. Calibrated all remote instruments

Condensate and Feedwater Systems:

These systems were not required for initial fuel loading, but certain phases of other preoperational tests required these systems for completion. Filling the reactor vessel and refueling well became easier when the condensate and feedwater system were used.

a. Calibrated instrumentation.

b. Checked all controls, alarms, and interlocks.

c. Operated all remote operated valves.

d. Checked the performance of the condensate and feedwater pumps by recirculating to the hotwell through an 8 inch connection downstream from the high pressure feedwater heaters.

e. Checked the operation of the minimum flow recirculation valves and their controls.

f. Checked the hotwell high level reject and low level makeup controls and valves.

g. Checked the operation of the feedwater flow control valves. When an actual level signal was not available from the reactor vessel, simulated signals were used.

Feedwater Heater Instrumentation:

This instrumentation was not required before fuel loading. But since access to key valves and instrumentation was restricted after nuclear steam was available, these components were tested before power operation.

a. Calibrated instrumentation.

b. Checked the response of level instruments by supplying demineralized water to the heaters and flash tanks.

c. Checked all controls, alarms and interlocks.

d. Checked the proper operation of valves using level and turbine trip signals.

Offgas System:

Gases from nuclear steam after fuel loading restrict access to offgas equipment, so these test were done before power operation.

a. Calibrated instrumentation.

b. Checked controls, alarms, and interlocks.

c. Checked the operation of valves from manual control switches and using automatic trip signals.

d. Checked the proper operation of mechanical equipment in the offgas and stack sampling and monitoring system.

Turbine Generator and Auxiliaries

Preoperational tests of the turbine generator and its auxiliary systems consisted essentially of individual component tests. In most cases, coordinated system tests were prevented by the lack of steam flow or associated sustained sources of pressure, temperature, energy, or other conditions of normal system operation. The objective of preoperational tests on the turbine-generator auxiliary systems was to obtain preliminary indication of acceptable system performance before radiation made test observation of performance cumbersome; since radioactive contamination would make a maintenance or deficiency correction difficult.

The systems listed below are covered in this category. Test procedures were prepared based on applicable requirements and manufacturer's instructions.

a. Turbine lube oil system.

b. Lube oil purification system.

c. Reheater valves and drains.

d. Reheater Protection System.

e. Steam seal system.

f. Gland exhaust system.

g. Hydrogen and carbon dioxide systems.

h. Stator cooling water system.

i. Turbine control system (including control valves).

j. Generator Seal Oil System.

k. Main exciter.

Ventilation for Reactor, Radwaste, and Turbine Buildings

Proper operation of supply and exhaust fans, dampers and controls was required in the Reactor Building and Radwaste Buildings before fuel loading. Balancing of air flows was checked to confirm that contamination control requirements were met.

14.2.2.2 Startup Test Program (1600 MW-Thermal)

Refer to Appendix 14.2A.

14.2.2.3 Startup and Power Test Program (1690 MW-Thermal)

The startup test program at 1690 MW-thermal was divided into five (5) phases; namely, I-Preoperational Testing; II-Open Vessel Testing with Fuel Installed; III-Plant Heatup; IV-Power Testing; and V-Warranty Run. The program was established by sequential tests that proved the plant design and operation in sequential steps up to licensed power operation, each step providing assurance that it was safe to proceed to the next step in the sequence until licensed power was attained. The first phase, Preoperational Testing, was completed for each system prior to the systems being required for safe and proper plant operation. The remaining four phases utilized a series of tests, some of which were repeated several times during the program at different operating conditions. These tests are listed in Table 14.2-1 and their numbering is the same as established in Appendix 14.2A. The sequence of tests is shown in Table 14.2-2. A summary of the purpose and description of each test is included in Table 14.2-3. Test results are documented in Reference 1.

14.2.2.4 Full Design Power Test Program

The full design power test program consisted of three phases. The first phase was designed to obtain a good set of base point data at the original licensed rating of 1600 MWt immediately prior to increasing power. This data was compared with the data collected as power is increased so that changes that occur can be clearly attributed to the increase in power and not to some long term effect associated with plant operation since the startup test program at 1600 MWt.

The second phase consisted of several tests at an intermediate power level of 1765 MWt. These tests verified proper operation at this level before proceeding to the full design rating.

The final phase consisted of tests at the full design rating of 1930 MWt and was designed to verify core performance and plant stability at this level. A summary of the tests included in each of the phases is included in Table 14.2-4.

The tests performed during this program are identical to those performed during the initial startup test program contained in GE Topical Report 22A2130 (see Appendix 14.2A).

14.2.3 References

(1) Oyster Creek Nuclear Power Plant Unit No. 1, Facility Description and Safety Analysis Report Docket No. 50-219, Amendment No. 55, Report in Support of Operation at 1690 MWt, May 1970.

TABLE 14.2-1
(Sheet 1 of 1)

STARTUP TESTS AT 1690 MW THERMAL

Test No.	Test Phase / Startup Test Title	II Open Vessel	III Plant Heatup	IV Power (MWt) 200	400	800	1200	1600	1200*	1600	V Warrant Run
1.	Chemical and Radiochemical	X	X	X	X	X	X	X			
2.	Control Rod Drives	X	X							X	
3.	Fuel Loading	X									
4.	Shutdown Margin	X									
5.	Radiation Measurements	X	X		X	X		X			X
6.	Vibration Measurements	X	X		X	X	X	X			
7.	Control Rod Sequence	X	X								
8.	SRM Performance	X									
9.	IRM Calibration		X								
10.	Reactor Vessel Temperatures		X								
11.	System Expansion		X								
12.	Main Steam Isolation Valves				X	X	X			X	
13.	Isolation Condenser			X							
14.	Recirculation Pumps					X	X	X			
15.	Flow Control					X	X	X			X
16.	Primary System Relief Valves				X						
17.	Turbine Trip					X	X	X	X		
18.	Generator Trip					X	X	X			
19.	Pressure Regulators				X	X	X	X	X		
20.	Bypass Valves				X	X	X	X	X		
21	Feedwater Pumps				X	X	X	X	X		
22.	Flux Response to Rods				X	X	X	X	X		
23.	LPRM Calibration			X	X	X	X		X		
24.	APRM Calibration			X	X	X	X	X			X
25.	Core Performance Evaluation		X	X	X	X	X	X	X	X	X
26.	Calibration of Rods				X	X		X			
27.	Axial Power Distribution				X	X	X	X	X	X	
28.	Rod Pattern Exchange									X	
29.	Steam Separator-Dryer		X			X	X	X	X		
30.	Electrical Output & Heat Rate										X
31.	Loss of Auxiliary Power Demonstration			X							
32.	LPRM Response				X	X	X	X			

* 1600 MWt rod pattern at reduced flow rate, other power plateaus at a recirculation flow rate of 61 x 10^6 lbs/hr.

TABLE 14.2-2
(Sheet 1 of 1)

SEQUENCE OF TESTS FOR OPERATION AT
1690 MW - THERMAL

PHASE 1 - 1600 MWt - Recirculation Flow = 61 X 10^6 lbs/hr

	Test Title	Description
25.	Core Performance Evaluation	Heat Balance
24.	APRM Calibration	Set to power level
27.	Axial Power Distribution	TIP traces
25.	Core Performance Evaluation	MCHFR and Heat Flux
23.	LPRM Calibration	Detailed calibration
24.	APRM Calibration	After LPRM adjustment

PHASE 2 - 1690 MWt - Recirculation Flow = 66.2 x 10^6 lbs/hr

	Test Title	Description
25.	Core Performance Evaluation	Heat Balance
24.	APRM Calibration	Set to power level
27.	Axial Power Distribution	TIP traces
25.	Core Performance Evaluation	MCHFR and Heat Flux
23.	LPRM Calibration	Detailed calibration
24.	APRM Calibration	After LPRM adjustment
26.	Calibration of Rod	Power and steam flow response
19.	Pressure Regulator	Step change and backup takeover
15.	Flow Control	Trace load following curve
5.	Radiation Measurements	Complete survey

TABLE 14.2-3
(Sheet 1 of 3)

SUMMARY TEST DESCRIPTION

Test No. 5 - Radiation Measurements

Purpose

Assure that safe and acceptable radiation levels exist in accessible locations and provide base data to evaluate activity buildup.

Description

A survey of natural background radiation throughout the plant was made prior to fuel loading. Gamma radiation level measurements, and where appropriate, thermal and fast neutron dose rate measurements were made at significant locations throughout the plant under reactor operating conditions.

Test No. 15 - Flow Control

Purpose

Demonstrate that the plant response to slow and fast ramp changes in recirculation flow rate is stable during and following the flow changes.

Description

Recirculation flow rate was decreased and increased from chosen flow rates in the full power rod pattern to determine power responses.

Test No. 19 - Pressure Regulators

Purpose

Determine the response of the reactor and the turbine governor system to the operating pressure regulator and the backup pressure regulator.

Description

A step change was made to the operating pressure regulator set point and the response of the system was measured. The backup regulator was tested by increasing the operating pressure regulator set point rapidly until the backup regulator took over control. The response of the system was measured and evaluated and regulator settings were optimized.

TABLE 14.2-3
(Sheet 2 of 3)

SUMMARY TEST DESCRIPTION

Test No. 23 - LPRM Calibration

Purpose

Calibrate the Local Power Range Monitoring System.

Description

The LPRM channels were calibrated to make the LPRM readings proportional to the average heat flux in the four corner fuel rods surrounding each chamber at the chamber elevations. The initial calibration factors were obtained from measurements of axial power distribution, precalculated local power distributions, and precalculated radial power distributions.

Test No. 24 - APRM Calibration

Purpose

To calibrate the Power Level Monitoring System.

Description

A heat balance was made at least once each shift and after each major power level change. The APRM system was adjusted as necessary to be consistent with the heat balance data.

Test No. 25 - Core Performance Evaluation

Purpose

Determine core power level, maximum heat flux, and minimum critical heat flux ratio.

Description

Core power level, maximum heat flux, recirculation flow rate, hot channel coolant flow, minimum critical heat flux ratio, fuel assembly power, and steam qualities were determined at existing power levels and assumed overpower conditions. Plant and in-core instrumentation, conventional heat balance techniques, and core performance work sheets and nomograms were used.

TABLE 14.2-3
(Sheet 3 of 3)

SUMMARY TEST DESCRIPTION

Test No. No. 26 - Calibration of Rods

Purpose

Obtain reference relationships between control rod motion and reactor power in standard sequences.

Description

Single rod and groups of four symmetric rods were moved in discrete steps, and electrical power and steam flow were recorded at each step. Up to four groups of rods were evaluated consistent with the operating sequence. LPRM and APRM response was measured.

Test No. 27 - Axial Power Distribution

Purpose

Obtain axial power distribution at various conditions of rod pattern, power, recirculation flow rate and subcooling.

Description

Axial flux distribution measurements were made with the TIP system before and after significant changes were made in control rod pattern, power, recirculation flow rate, or subcooling.

TABLE 14.2-4
(Sheet 1 of 2)

FULL DESIGN POWER TEST PROGRAM

PHASE 1 - 1600 MWt - Recirculation Flow - 61.0 x 10^6 lbs/hr

	Test Title	Description
25	Core Performance Evaluation	Heat Balance, MCHFR and Heat Flux
24	APRM Calibration	Set to Heat Balance
23	LPRM Calibration	Detailed Calibration
5	Radiation Measurements	Complete Survey

PHASE 2 - 1765 MWt - Recirculation Flow - 61.0 x 10^6 lbs/hr

	Test Title	Description
25	Core Performance Evaluation	Heat Balance, MCHFR and Heat Flux
24	APRM Calibration	Set to Heat Balance
23	LPRM Calibration	Detailed Calibration
21	Feedwater Pumps	Water Level Step Change and Feed System Response
22	Flux Response to Rods	Rod Moved and Response
19	Pressure Regulator	Power and Steam Flow Response

TABLE 14.2-4
(Sheet 2 of 2)

FULL DESIGN POWER TEST PROGRAM

PHASE 3 - 1930 MWt - Recirculation Flow - 61.0 x 10^6 lbs/hr

	Test Title	Description
25	Core Performance Evaluation	Heat Balance, MCHFR and Heat Flux
24	APRM Calibration	Set to Heat Balance
23	LPRM Calibration	Detailed Calibration
21	Feedwater Pumps	Water Level Step Change and Feed System Response
22	Flux Response to Rods	Rod Moved and Response
19	Pressure Regulator	Power and Steam Flow Response
5	Radiation Measurements	Complete Survey
1	Chemical and Radiochemical	Complete Sample Analysis
26	Calibration of Rods	Power and Steam and Flow Response to Rods
32	LPRM Response	Compare with TIP System
15	Flow Control	Trace Load Following Curve
14	Recirculation	5 Recirculation Pump Trip Transient
17	Turbine Trip	Plat Transient