Chapter 13: Initial Test and Operation

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CHAPTER 13
INITIAL TEST AND OPERATION

Note: The information presented in this section summarizes construction, pre-operational, and initial startup testing activities. As such, Chapter 13 is considered historical and should not be revised or updated.

Kewaunee Startup Test Program

General

The Kewaunee Startup Test Program consisted of all testing activities commencing at the completion of the construction work, and ending with the completion and acceptance of the test program prior to commercial plant operation. The startup Test Program was categorized into three "Phases":

- Phase I: Tests Prior to Initial Reactor Fueling
- Phase II: Final Plant Preparation
- Phase III: Initial Testing of the Operating Reactor

These tests were intended to demonstrate the functional performance of the safety-related systems and the overall plant. The test results provided assurance that the plant can be operated and that performance levels can be maintained in accordance with the safety requirements established in the USAR.

13.1 TESTS PRIOR TO INITIAL REACTOR FUELING (PHASE I)

The comprehensive testing program (Phase I) included construction and pre-operational tests including hot functional tests, and ended with fuel loading. Phase I testing ensured that equipment and systems performed in accordance with design criteria prior to fuel loading.

13.1.1 Construction Tests

Construction tests were performed as the individual components and systems were completed. The following objectives were accomplished by these tests:

- demonstration of completeness of the equipment installation;
- provided a basis for acceptance of equipment from contributing contractors by the Architect-Engineer for the Applicant (WPS);
- established prerequisites for the subsequent pre-operational tests that were performed.

There were six distinct activities, which were carried out during the construction test program; these were:

- Installation Inspection
- Mechanical Equipment Operability Check
- Electrical Equipment Operability Check
- Instrumentation and Control Check
- Fluid System Cleaning
- Fluid System Integrity Test

The tests were performed in accordance with approved written procedures. Field and Engineering Analyses of the test results were made to verify that the systems and components had been properly installed and to recommend any corrective action, if necessary.

13.1.2 Pre-Operational Tests

Pre-operational tests were functional and operational tests of systems and equipment performed prior to integrated operation of the entire plant. They served two basic objectives:

1. to determine whether or not equipment and systems performed as designed;
2. to obtain initial (or baseline) equipment and system performance data.

Specific attention was given to safety-related systems, such as core cooling, since these are not used in normal operation. The pre-operational tests were designed to verify that equipment and systems would function under design conditions, and subsequent surveillance testing during the operating life of the plant continues to provide assurance that systems will fulfill their function in the unlikely event that they are required.

The contents of the test procedure, as noted in Section 13.4.3, provided sufficient information to denote complete understanding of the test requirements and the data collected permitted a thorough analysis of the system as well as a determination that the acceptance criteria have been satisfied.

The pre-operational test program in general included adjustments, calibrations, determination of pump head characteristics, heat exchanger efficiencies, and overall system capability under actual or simulated plant conditions. The test involved actual operation of the systems and equipment where possible. Where plant parameters were not available and could not be simulated, the systems were operationally tested as far as possible without these parameters; the remainder of the tests were performed when the parameters were available; for example, during hot functional testing.

Abnormal plant conditions were simulated during testing when such conditions did not endanger personnel or equipment, or contaminate clean systems. The detailed procedure took into account possible emergency or abnormal conditions involved in the test program, and appropriate safety measures were included in the procedure.

Table 13.1-1 includes a listing of actual pre-operational tests along with subcategories to show the extent and detail which was incorporated into each procedure. The requirements for each system or component determine the manner in which the procedure was prepared consistent with the construction test program and the preparation of the plant for initial fuel loading.

13.1.3 Hot Functional Tests

These were pre-operational tests which were performed on major plant systems prior to initial fuel loading with the reactor coolant system at the temperature and pressure which were maintained by the operation of the reactor coolant pumps and the pressurizer heaters.

The Startup Program schedule, including the pre-operational and hot functional tests, was such that all these tests were completed prior to initial fuel loading. Table 13.1-2 contains a listing of the tests of systems and components, which were performed and accepted prior to initial fuel loading. These tests cover those systems or components, which had to be operational during fuel loading or operational on a standby basis. Additional information of pre-operational testing of specific components and systems is contained in the Inspection and Test subsections of the appropriate USAR sections. The Quality Assurance Program Description contained supplemental information concerning procedural and organizational matters, with respect to the division of responsibility between Wisconsin Public Service Corporation, Westinghouse Electric Corporation, and Pioneer Service and Engineering Company for ensuring that the equipment and systems performed in accordance with design criteria.

This information is HISTORICAL and is not intended or expected to be updated for the life of the plant.

Table 13.1-1

Kewaunee - Preoperational Tests (Typical)

Title and Sub Tests
Plant General
Set Point Verification
Composite Hot Functional Tests
Station Instrument Air System
Functional Test
Loss of Instrument Air Test
Condensate System
Functional Test
Circulating Water System
Functional Test
Feedwater System
Functional Test
Main Steam and Steam Dump System
Main Steam Safety Valve Test
Steam Dump Control
Hot Functional Test
Blowdown Treatment
Functional Test
Fire Protection System
Functional Test
Complete Component Test
Air Removal System
Functional Test
Diesel Generator System
Functional Test
Mechanical and Electrical
Automatic and Manual

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Table 13.1-1

Kewaunee - Preoperational Tests (Typical)

Title and Sub Tests
Auxiliary Building Special Ventilation
Initial Operation Functional Test Reactor Building Ventilation System
Functional Test Turbine Oil Purification System
Functional Test Spent Fuel Pool Cooling System
Functional Test Internal Containment Spray System
Functional Test - Pump and Nozzle Verification Tests Shield Building Ventilation System
Functional Test Control Room Air Conditioning
Functional Test Emergency Operation Chemical Injection
Functional Test Component Cooling System
Functional Test Waste Disposal Systems
Functional Tests Liquid System Gaseous System Solid System Safety Injection System
Functional Test

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Table 13.1-1
Kewaunee - Preoperational Tests (Typical)

Title and Sub Tests
Residual Heat Removal System
Functional Test
Normal and Emergency Power
Chemical And Volume Control System
Functional Test
Makeup Control - Blending - Mixing
Charging Pump Control
Boron Recycle - Heat Tracing, etc.
Reactor Coolant System
Filling, Venting, and Hydro
Hot Functional Test - Heat-Up
Hot Functional Test - At Temperature
Hot Functional Test - Cool Down
Hot Functional Test - Thermal Expansion
Hot Functional Test - Vibration
Hot Functional Test - RTD Calibration
RCS Heat Loss Measurement
Reactor Coolant Pump
Functional Test
Pressurizer
Pressurizer Relief Valve Test
Pressurizer Safety Valve Test
Pressurizer Pressure Control
Pressurizer Level Control
Pressurizer Relief Tank
Functional Test
Steam Generator

This information is HISTORICAL and is not intended or expected to be updated for the life of the plant.

Table 13.1-1
Kewaunee - Preoperational Tests (Typical)

Title and Sub Tests
Hydro Test, Primary and Secondary Side
Steam Generator Level Control
Primary Sampling System
Functional Test
D-C Supply and Distribution System
Functional Tests
4160 V Supply and Distribution System
Functional Tests
Circuit Breaker Test
Integrated Logic
Synchronizing and Energization
Emergency A-C Power Test
480 V Supply and Distribution System
Functional Tests
Circuit Breaker Test
Integrated Logic
Synchronizing and Energization
Emergency A-C Power Test
Lighting System
Emergency Lighting
Electrical Generation System
Functional Test
Communication System
Functional Test
Radiation Monitoring System
Area Monitoring Functional Test
Process Monitoring Functional Test

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Table 13.1-1
Kewaunee - Preoperational Tests (Typical)

Title and Sub Tests
Reactor Control and Protection System
Functional Tests
Nuclear Instrumentation System
Source Range Functional Test
Intermediate Range Functional Test
Power Range Functional Test
Control Rod Drive System
Functional Test
Rod Control System
Rod Drop Test
Position Indication Test
In-Core Instrumentation System
Functional Test
In-Core Set Point Determination
In-Core Thermocouple Functional Test
Miscellaneous Gas System
Hydrogen Supply Functional Test
Nitrogen Supply Functional Test
Sequential Event Recorder and Annunciators
SER Functional Test
Fuel Handling System
Fuel Handling and Storage Functional Test
Preparation for Initial Core Loading
Fuel Transfer System Functional Test
Manipulator Crane Functional Test
Spent Fuel Elevator Functional Test
Auxiliary Feedwater System

Table 13.1-1
Kewaunee - Preoperational Tests (Typical)

Title and Sub Tests
Functional Test
Leak Detection System
Functional Test
Containment Vessel
Functional Test
Leak Rate
Integrity
Penetration Pressure Test
Containment Isolation Test

Table 13.1-2
Objectives of System Test Prior to Initial Reactor Fueling

System Tests	Test Objectives
1. Electrical System	To ensure continuity, circuit integrity, and the correct and reliable functioning of electrical apparatus. Electrical tests were performed on transformers, switchgear, turbine-generator, motors, cables, control circuits, excitation switchgear, dc systems, annunciator systems, lighting distribution switchboards, and miscellaneous equipment. Special attention was directed to the following tests: 1. High voltage switchgear breaker interlock test. 2. Plant loss of voltage auto-transfer test. 3. Emergency power transfer test. 4. Tests of protective devices. 5. Equipment automatic-start tests. 6. Exciter check for proper voltage build-up.
2. Communication System	Verified proper communication between all local stations for interconnection to commercial phone service and load dispatch center, and to balance and adjust amplifiers and speakers.
3. Service Water System	Verified the design head-capacity characteristics of the pumps, that the system supplies design flow rate through heat exchangers, and the specified requirements when operated in the safety features mode. (This system was used during construction. Its extensive use was accepted as a pre-operational test.)
4. Fire Protection System	Verified proper operation of the system by ensuring the design specifications were met for the fire pumps, verified that automatic start functions operate as designed, and verified that level and pressure controls met specifications.
5. Instrument Air System	Verified leaktightness of the system, proper operation of all compressors, the manual and automatic operation of controls at design setpoints, design air-dryer cycle time and moisture content of discharge air, and proper air pressure to each controller served by the system.

Table 13.1-2
Objectives of System Test Prior to Initial Reactor Fueling

System Tests	Test Objectives
6. RCS Cleaning	Flushed and cleaned the reactor coolant and related systems to obtain the degree of cleanliness required for the intended service. Provisions to maintain cleanliness and protection from contaminated sources were made after system cleaning and acceptance. After systems were flushed clean of particulate matter, the cleanliness of the system was maintained. Coolant was analyzed for chloride content, solids, pH, and conductivity. Oxygen content was analyzed and brought to specifications prior to exceeding 250°F.
7. Ventilation System	Verified proper operability of fans, controls, and other components of the Reactor Building Ventilation System, Auxiliary Building Special Ventilation Systems and Shield Building Ventilation System.
8. Condensate and Feedwater System	To verify valve and control operability and setpoints, an inspection was made. Functional testing is performed when the Main Steam System is available.
9. Auxiliary Coolant	Verified component cooling flow to all components, and verified proper operation of instrumentation, controllers, and alarms. Specifically, each of the three systems; i.e., Component Cooling System, RHR System, and Spent Fuel Pool Cooling System, were tested to ensure: 1. All manual and/or remotely operated valves were operable manually and/or remotely. 2. All pumps performed their design functions satisfactorily. 3. All temperature, flow, level, and pressure controllers functioned to control at the required setpoint when supplied with appropriate signals. 4. All temperature, flow, level, and pressure signals provided alarms when the required alarm set-point when the reset-point was reached. 5. Design flow rates were established through the principal heat exchangers.

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Table 13.1-2
Objectives of System Test Prior to Initial Reactor Fueling

System Tests	Test Objectives
10. Chemical and Volume Control System	Verified that the Chemical and Volume Control System functioned as specified in the system description. More specifically that: 1. All manual and/or remotely operated valves were operable manually and/or remotely. 2. All pumps performed to specifications. 3. All temperature, flow, level, and pressure controllers functioned to control at the required setpoint when supplied with appropriate signal(s). 4. All temperature, flow, level, and pressure signals provided alarms when the required alarm setpoint was reached, and clear when the reset point was reached. 5. The reactor makeup control regulated blending, dilution, and boration as designed. 6. The design seal water flow rates were attainable at each reactor coolant pump. 7. Chemical Addition Subsystem functioned as specified.

Table 13.1-2

Objectives of System Test Prior to Initial Reactor Fueling

System Tests	Test Objectives
11. Safety Injection System	Verified response to control signals and sequencing of the pumps, valves, and controllers of this system as specified in the system description and checked the time required to actuate the system after a safety injection signal was received. More specifically that: 1. All manual and/or remotely operated valves were operable manually and/or remotely. 2. Each pair of valves installed for redundant flow paths operated as designed. 3. All pumps performed their design functions satisfactorily. 4. The proper sequencing of valves and pumps occurred on initiation of a safety injection signal. 5. The fail position on loss of power for each remotely operated valve was as specified. 6. Valves requiring signals, such as high containment pressure, operated when supplied with these signals. 7. All level and pressure instruments were set at the specified points and provided alarm and reset at the required location(s).
12. Containment Vessel	Verified response to control signals and sequencing Internal Spray System of the pumps, valves, and controllers as specified in the system description and checked the time required to actuate the system after a containment high-high pressure signal was received. More specifically, refer to the test objectives for Safety Injection System given above.

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Table 13.1-2
Objectives of System Test Prior to Initial Reactor Fueling

System Tests	Test Objectives
13. Fuel Handling Systems*	Showed that the system design was capable of providing a safe and effective means of transporting and handling fuel from the time it reaches the plant until it leaves the plant. In particular, the tests were designed to verify that: 1. The major structures required for refueling, such as the reactor refueling cavity, new fuel and spent fuel storage, and decontamination facilities, were in accordance with the design intent. 2. The major equipment required for refueling such as the manipulator crane, fuel handling tools, spent fuel transfer system, operated in accordance with the design specifications. 3. All auxiliary equipment and instrumentation functioned properly.
14. Radiation Monitoring System	Verified the calibration, operability, and alarm setpoints of all area radiation monitors, air particular monitors, gas monitors, and liquid monitors which were included in the Process Radiation Monitoring System and the Area Radiation Monitoring System.
15. Reactor Control and Protection System	Verified calibration, operability, trip and alarm settings of the Reactor Control and Protection System and tested its operability in conjunction with other systems. As an example, the Nuclear Instrumentation System tests are detailed below.

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Table 13.1-2
Objectives of System Test Prior to Initial Reactor Fueling

System Tests	Test Objectives
16. Nuclear Instrumentation System	Ensured that the instrumentation system was capable of monitoring the reactor leakage neutron flux from source range through full power and that protective functions were operating properly. In particular, the tests were designed to verify that: 1. All system equipment, cabling, and interconnections were properly installed. 2. The source range instrumentation operated properly, and that the source range (high flux level reactor trip) as well as alarm features and audible count rate operated properly. 3. The intermediate range instrumentation operated properly, the reactor protective and control features such as high level reactor trip and high level rod stop signals operated properly, and the permissive signals for blocking source range trip and source range “high voltage off” operated properly. 4. The power range instrumentation operated properly, the protective features such as the overpower trips, permissive and dropped-RCCA functions operated with the required redundancy and separation through the associated logic matrices; and the nuclear power signals to other systems were available and operating properly. 5. All auxiliary equipment such as the startup rate channel recorders and indicators operated properly. 6. All instruments were properly calibrated and all setpoints and alarms were properly adjusted.

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Table 13.1-2

Objectives of System Test Prior to Initial Reactor Fueling

System Tests	Test Objectives
17. Waste Disposal System	Verified satisfactory flow characteristics through the equipment, demonstrated satisfactory performance of pumps and instruments, checked for leaktightness of piping and equipment, and verified proper operation of monitors, alarms, and controls. 1. All equipment in the waste disposal system, which may be required during fuel loading was checked for proper operation and was in operation or on standby. 2. All alarms were operable at required locations. 3. Pumps, valves, and controllers required in (1) above were operable.
18. Sampling System	Verified that a specified quantity of representative fluid could be obtained safely from each sampling point. In particular, the tests were designed to verify that: 1. All system piping and components were properly installed. 2. All remotely and manually operated valving operated in accordance with the design specifications. 3. All sample containers and quick-disconnect couplings functioned properly.
19. Emergency Power System	Demonstrated that the system was capable of providing power for operation of vital equipment under failure of normal power supply. In particular, the tests were designed to verify that: 1. All system components were properly installed. 2. Each diesel generator functioned according to the design specification under emergency conditions. 3. The diesel generators were capable of supplying the power to vital equipment as required under emergency conditions. 4. All redundant features of the system functioned according to the design intent.

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Table 13.1-2
Objectives of System Test Prior to Initial Reactor Fueling

System Tests	Test Objectives
20. Hot Functional Tests	Using pump heat and pressurizer heaters, the Reactor Coolant System was tested to check heatup and cooldown procedures demonstrating satisfactory performance of components that were exposed to the reactor coolant temperature; verified proper operation of instrumentation, controllers and alarms, and provided design operating conditions for checkout of auxiliary systems. The Chemical and Volume Control System was tested to determine that water can be charged at rated flow against normal RCS pressure; checked letdown flow against design rate for each pressure reduction station; determined the response of the system to changes in pressurizer level; checked operation of the reactor makeup control; checked operation of the excess letdown and seal water flow path; and verified proper operation of instrumentation, controls and alarms. The Sampling System was tested to determine that a specified quantity of representative fluid could be obtained safely and at design conditions from each sampling point. The Auxiliary Cooling System was tested to evaluate its ability to remove heat from systems containing radioactive fluid and other special equipment; verified component cooling flow to all components; and verified proper operation of instrumentation, controllers and alarms. The ventilation systems were tested to adjust proper flow characteristics of ducts and equipment; to demonstrate satisfactory performance of fans, filters, and coolers; and to verify proper operation of instruments and alarms.
21. Rod Drive Electrical Checkout	Checked the system's electrical response to test signals and verified control functions. Prior to fuel loading and after the position indication coils were installed, a calibration and complete operational check was performed.
22. Primary and Secondary System	Tested and set pressurizer and secondary system Safety and Relief Valves safety and relief valves to check lifting pressure.
23. Cold Hydrostatic Tests	Verified the integrity and leaktightness of the RCS and related systems with the performance of a hydrostatic test at the specified test pressure.
24. Containment Pressure Test	Verified the structural integrity and leaktightness of the containment.

This information is HISTORICAL and is not intended or expected to be updated for the life of the plant.

Table 13.1-2

Objectives of System Test Prior to Initial Reactor Fueling

System Tests	Test Objectives
25. Nitrogen System	Verified system integrity, valve operability, regulating and reducing station performance and the ability to supply nitrogen to interconnecting systems as required.

* Tests were conducted with a dummy fuel element.

13.2 FINAL PLANT PREPARATION (PHASE II)

Phase II of the Startup Test Program included the initial fuel loading, final placement of the reactor vessel head, and post-fuel loading tests which were required prior to initial criticality.

13.2.1 Core Loading

The overall responsibility and direction for initial core loading was exercised by the Plant Superintendent. The overall process of initial core loading was supervised from the refueling floor of the containment structure. Prior to fuel loading, standard procedures were established for control of access by personnel; control and accountability for fuel, equipment and tools; and the maintenance of containment integrity. Westinghouse provided technical advisors to assist during the initial core loading operation.

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

The Reactor Coolant System (RCS) was isolated and applicable tagging and administrative procedures were used to prevent unauthorized change in the boron concentration. The boric acid tank was filled with concentrated boric acid solution and the Residual Heat Removal (RHR) System was in service and available to provide moderator mixing and temperature control.

A detailed pre-loading checkoff list was followed to ensure that all requirements for the systems, equipment, and the loading operation were met. Periodically, the checkoff list was reviewed to ensure that systems and equipment continued to meet requirements of the core loading operation.

The core loading sequence followed a step-by-step procedure to insure at each loading step that:

1. Neutron sources and neutron detectors were properly located in the core during fueling. Continuous radiation monitoring was provided at the core loading stations during fuel handling and core loading operations.
2. Rod cluster control assemblies (RCCAs) and other components were inserted into the proper fuel assemblies prior to fuel loading.
3. Fuel assemblies with identifying marks corresponding to the correct enrichments were installed in the proper locations.

The core was assembled in the reactor vessel, which was filled with water containing enough dissolved boric acid to maintain a calculated core effective multiplication constant of 0.90 or lower. The refueling cavity was dry during initial core loading. Core moderator chemistry conditions (particularly boron concentration) was prescribed in the core loading procedure document and was verified periodically by chemical analysis of moderator samples taken prior to and during core loading operations.

Core loading instrumentation consisted of two permanently installed source range (pulse type) nuclear channels and two temporary in-core source range channels, plus a third temporary channel which was used as a spare. The permanent channels were monitored in the Control Room by a licensed operator; the temporary channels were installed in the containment structure and monitored by engineering or operating personnel. At least one permanent channel and one temporary channel were equipped with audible count rate indicators. Both permanent channels and one temporary channel displayed neutron count rate on strip chart recorders. The temporary channels had local indication. Minimum count rates of two counts per second, attributable to core neutrons, were required on at least two of the four available nuclear channels at all times during core loading operation.

At least two artificial neutron sources were introduced into the core at appropriate specified points in the core loading program to ensure a neutron population large enough for adequate monitoring of the core.

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

An initial nucleus of approximately eight fuel assemblies, the first of which contained an activated neutron source, was the minimum source-fuel nucleus, which permitted subsequent meaningful inverse count rate monitoring. This initial nucleus was determined by calculation and previous experience to be markedly sub-critical ($k_{eff} \leq 0.90$) under the required conditions of loading.

Each subsequent fuel addition was accompanied by detailed neutron count rate monitoring to determine that the just-loaded fuel assembly did not excessively increase the count rate and that the extrapolated inverse count rate ratio was not decreasing for unexplained reasons. The results of each loading step were evaluated by Wisconsin Public Service personnel and technical advisors before the next fuel assembly was loaded.

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

1. The neutron count rates on all responding nuclear channels doubled during any single loading step after the initial nucleus of approximately eight fuel assemblies are loaded.
2. The neutron count rate on any individual nuclear channel increased by a factor of five during any single loading step, except for cases where this increase had been predicted, such as loading the source bearing assembly on the initial step.

A containment evacuation alarm (the Hi Flux at Shutdown alarm) was coupled to the permanent source range channels, with an adjustable set point at five times the count rate to provide automatic indication of high-count rate during fuel addition.

In the event that an unacceptable increase in count rate was observed on any or all responding nuclear channels special procedures involving fuel withdrawal from the core, or detector relocation or charging of additional boric acid into the moderator would have been put into effect by licensed operational personnel of the Wisconsin Public Service Corporation, with concurrence of Westinghouse technical specialists.

Core loading procedures specified alignment of fluid systems to prevent inadvertent dilution of the reactor coolant, restricted the movement of fuel to minimize the possibility of mechanical damage, prescribed the conditions under which loading could proceed, identified chains of responsibility and authority and provided for continuous and complete fuel and core component accountability.

13.2.2 Post-Loading Tests

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

Mechanical and electrical tests were performed on the RCC drive mechanisms. These tests included a complete operational checkout of the mechanisms. Checks were made to ensure that the RCC assembly position indicator coil stacks were connected to their respective position indicators. Similar checks were made on RCCA drive mechanism coils and the in-core instrumentation.

Tests were performed on the reactor trip circuits to verify manual trip operation and actual drop times were measured for each RCCA. By use of dummy signals, the Reactor Control and Protection System was made to produce trip signals for the various plant abnormalities that required tripping, and trip delay times were measured.

At all times that the RCC drive mechanisms were being tested, the boron concentration in the coolant-moderator was large enough that criticality could not be achieved even with all RCCAs fully withdrawn.

Intentionally Blank

This information is HISTORICAL and is not intended or expected to be updated for the life of the plant.

13.3 INITIAL TESTING OF THE OPERATING REACTOR (PHASE III)

After satisfactory completion of fuel loading and final pre-critical tests, nuclear operation of the reactor began. This final phase of startup and testing included Initial Criticality, Zero Power Testing and Power Level Escalation. The purpose of these tests was to establish the operational characteristics of the plant and core, to acquire data for the proper calibration of set points, and to ensure that operation was within license requirements. A brief description of the testing is presented in the following sections. Table 13.3-1 summarizes the tests, which were performed from initial core loading to rated power.

13.3.1 Initial Criticality

Initial criticality was established by sequentially withdrawing the shutdown and control groups of RCCAs from the core, leaving the last withdrawn control group inserted far enough in the core to provide effective control when criticality was achieved, and then slowly and continuously diluting the heavily borated reactor coolant until the chain reaction was self-sustaining.

Successive stages of RCCA group withdrawal and of boron concentration reduction were monitored by observing changes in neutron count rate as indicated by the regular source range nuclear instrumentation as functions of RCCA group position and, subsequently, of reactor makeup water addition to the RCS during dilution.

Primary safety reliance was based on count rate monitoring. The inverse count rate ratio was used as an indication of the nearness and rate of approach to criticality of the core during RCCA group withdrawal and during reactor coolant boron dilution. The rate of approach could have been reduced as the reactor approached extrapolated criticality to ensure that effective control was maintained at all times.

Written procedures specified alignment of fluid systems to allow controlled start and stop and adjustment of the rate at which the approach to criticality could proceed, indicated values of core conditions under which criticality was expected, specified allowed deviations in expected values, and identified chains of responsibility and authority during reactor operations.

13.3.2 Zero Power Testing

A prescribed program of reactor physics measurements was undertaken to verify that the basic static and kinetic characteristics of the core were as predicted and that the values of the kinetic coefficients assumed in the safety features analysis were indeed conservative.

The measurements were made at low power and primarily at or near operating temperature and pressure. Measurements were made to permit verification of calculated values of RCC assembly group and reactivity worths, of isothermal temperature coefficient under various core conditions and of differential boron concentration reactivity worth. Relative power distribution checks were made.

Concurrent tests were conducted on the instrumentation including the source and intermediate range nuclear channels. A complete electrical and mechanical check was made on the in-core nuclear flux mapping system at the operating temperature and pressure.

Detailed procedures were prepared to specify the sequence of tests and measurements that were conducted and the conditions under which each was to be performed to ensure both safety of operation and the validity and consistency of the results obtained. If unacceptable deviations from design predictions existed, unacceptable behavior was revealed, or apparent anomalies developed, the testing would have been suspended and the situation reviewed by the Nuclear Safety Review and Audit Committee of Wisconsin Public Service Corporation to determine whether a question of safety was involved, prior to resumption of testing. Procedures also identified chains of responsibility and authority during zero power testing.

13.3.3 Power Level Escalation

When the operating characteristics of the reactor at zero power had been verified by the preliminary zero power tests, a program of power level escalation in successive stages brought the plant to its full rated power level.

Plant operational characteristics were closely examined at each stage and the validity of the safety features analysis was verified before escalation to the next programmed level was effected. Reactor physics measurements were made to determine the magnitudes of power coefficient of reactivity and of relative power distribution of the core as functions of power level and RCCA group position.

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

At prescribed power levels the response characteristics of the reactor coolant and steam systems to dynamic stimuli was evaluated. The responses of system components were measured for 10 percent reduction of load and recovery, 50 percent reduction of load and recovery, turbine trip, and trip of a single RCCA, as detailed in Table 13.3-1.

Adequacy of radiation shielding was verified by gamma and neutron radiation surveys inside the containment and throughout the plant site.

The sequence of tests, measurements and intervening operations was prescribed in the power escalation procedures together with specific details relating to the conduct of the several tests and measurements and chains of responsibility and authority.

13.3.4 Post-Startup Surveillance and Testing Requirements

Post-startup surveillance and testing requirements were designed to provide assurance that essential systems, which included equipment components and instrument channels, were always capable of functioning in accordance with their original design criteria. These requirements were separated into two categories:

1. The system had to be capable of performing its function, i.e., pumps deliver at design flow and head, and instrument channels respond to initiating signals within design calibration and time responses;
2. Reliability was maintained at levels comparable to those established in the design criteria and during early plant life.

The testing requirements, as described in the Technical Specifications, established this reliability and, in addition, provided the means by which this reliability was continually reconfirmed. Verification of operation of complete systems was checked during scheduled shutdowns, such as refueling intervals, or during plant operation when means were provided to permit operation and test. Individual checks of components and instrumentation were made at more frequent intervals as outlined in the Technical Specifications.

The techniques used for the testing of instrument channels included a pre-operational calibration which confirmed values obtained during factory test programs. These reconfirmed calibration values became the reference for recalibration maintenance at refueling intervals or other scheduled shutdowns during plant life. Periodic testing, as defined in the Technical Specifications, included the insertion of a predetermined signal that tripped the channel bistable. Indication of the operation was confirmed and recorded.

Testing of components was initiated through manual actuation. If response times were important, they were measured and recorded. The capability to deliver design output was checked by instrumentation and compared against design data. Allowable discrepancies were established in the Technical Specifications. Components were operated for enough time to allow equalization of operating temperatures in bearings, seals, and motors. Checks were made on these parameters. Components were surveyed for excessive vibration. Readings were recorded.

Wisconsin Public Service Corporation verified that testing in accordance with the above-described program provided a realistic basis for determining or verifying maintenance requirements and, as such, ensured continued system capabilities, including reliability equal to that established in the original criteria.

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13.3.5 Procedure Preparation and Checkout

Normal and emergency operating procedures were prepared by WPS Operations personnel and reviewed internally by at least two members of the Operations staff. In addition, all procedures pertaining to the Nuclear Steam Supply System were reviewed by Westinghouse, and procedures pertaining to the balance-of-plant were reviewed by Pioneer Service and Engineering. Checkout of normal operating procedures was done each time the plant was started up or shut down and when power levels were changed as required by system demand. There were other procedures which were checked when specific operations, such as fuel handling, were performed when the plant was shut down. Emergency operating procedures are checked out periodically during planned shutdown of the plant and when the plant is down for refueling and maintenance.

Table 13.3-1
Phase III Testing Summary

Test	Conditions	Objectives	Acceptance Criteria
RCCA Drop Tests	1. Cold, shutdown 2. Hot, shutdown	Measured the drop time of RCCAs under full-flow and no-flow	Droptime less than value assumed in safety analysis conditions
Thermocouple/RTD Inter-calibration	Various temperatures during system heatup at zero power and/or cooldown	Determined in-place isothermal correction constants for all core exit thermocouples and reactor coolant RTDs	Sensors showing excessive deviations from average were removed from service
Nuclear Design Check Tests	Normal control group configurations at hot zero power	Verified that nuclear design predictions for endpoint boron concentration and isothermal temperature coefficient were valid, to verify power distribution	Technical Specification limiting values
Control Group Calibration	All RCCA groups at hot zero power	Verified that nuclear design predictions for RCCA group differential worths were valid	Technical Specification limiting values
Power Coefficient Measurement	10% to 100% of rated power	Verified that nuclear design predictions for differential power coefficients were valid	SAR Criteria Applicable
Automatic Control System Checkout	Approximately 20% of rated power	Verified control system response characteristics for the: 1. Steam generator level 2. RCCA automatic control system 3. Turbine control system	Not Safety-Related

Table 13.3-1
Phase III Testing Summary

Test	Conditions	Objectives	Acceptance Criteria
Power Range Instrumentation Calibration	During static and/or transient conditions at the following nominal percentages of rated power: 30% 50% 75% 90% 100%	Verified all power range instrumentation consisting of power range nuclear channels, in-core exit thermocouple system, and reactor coolant RTDs were responsive to changes in reactor power distribution and inter-calibrated the several systems	Calibrate instruments to agree with thermal power measurements
Load Swing Test	± 10% steps at the following nominal percentages of rated power: 30% 75%	Verified control system's performance as evidenced by plant parameter variations	Plant parameter variations were within acceptable limits
Load Rejection Test	Load rejection from the following nominal percentages of rated power: 30% 50%	Verified control system's performance as evidenced by plant parameter variations	Plant parameter variations were within acceptable limits
Pressurizer Spray Effectiveness Test	Hot, shutdown	Verified that pressurizer pressure was reduced at the required rate by pressurizer spray actuation	Acceptable rate of pressure decrease
Minimum Shutdown Verification	Hot, zero power	Verified the nuclear design prediction of the minimum shutdown boron concentration with one "stuck" RCCA	Verify "stuck" RCCA shutdown criteria

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Table 13.3-1
Phase III Testing Summary

Test	Conditions	Objectives	Acceptance Criteria
Static RCCA Test	50% of rated power	Verified that a single RCCA inserted fully or part way below control bank resulted in hot channel factors below design values	USAR limiting values for dropped RCCA analysis
Step Load Reduction Test	Reduction from 75% to 25% of rated power, 50% reduction from 100% of rated power	Verified control system's performance as evidenced by plant parameter variations	Plant parameter variations were within acceptable limits
Part-Length Group Operational Maneuvering	50% to 80% of rated power	Verified that the part-length RCCA maneuvering scheme was effective in controlling and suppressing axial power distribution transients	Operability of plant under transient conditions without actuating runback or trip
Dynamic RCCA Drop Test	< 50% of rated power	Verified automatic detection of dropped RCCA	Required power reduction and RCCA withdrawal block accomplishment
Turbine Generator Startup Tests	Pre- and Post-Synchronization	Verified that the turbine generator unit and associated controls and trips were in good working order and ready for service	Successful completion of all mechanical, electrical, and control functional checks
Turbine Generator Trip	> 30% of rated power	Verified normal trouble free performance of the turbine generator at low power	Performance within manufacturers' limitations
Acceptance Run	100 Hours at rated power	Verified reliable steady-state full power capability	100 Hours reliable equilibrium operation at full power

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13.4 STARTUP TEST PROGRAM ORGANIZATION AND RESPONSIBILITIES

13.4.1 Organization and Responsibility[1]

Wisconsin Public Service Corporation (WPSC) had overall responsibility for supervising, directing, and ensuring that all phases of plant testing were accomplished in accordance with established criteria. Technical responsibility for each phase of testing resided with the functional group most directly concerned with the results of that phase. The WPSC Manager, Power Engineering, had responsibility for ensuring that all required construction tests were accomplished and accepted. The actual performance of construction testing was within the scope of work assigned to the Architect-Engineer, Pioneer Service and Engineering Company (PS&E). The WPSC Superintendent-Nuclear Power had responsibility for ensuring that all required pre-operational and startup testing was accomplished and accepted. The WPSC Startup Group and Kewaunee Plant Staff were responsible to the Superintendent-Nuclear Power for planning and accomplishing the pre-operational and startup testing program. The organization for construction, pre-operational testing and startup testing is shown in Figure 13.4-1. The construction testing description and organization are shown mainly to indicate that a smooth and orderly transition of work and responsibility was carried out within the WPSC organization. The current organization of the Engineering and Plant Staff can be found in Dominion Nuclear Facility Quality Assurance Program Description.

13.4.2 Preoperational and Startup Testing

The WPSC Startup Group was responsible to the Superintendent Nuclear Power for planning, scheduling and coordinating and performing the pre-operational and startup testing. The Plant Test Coordinator was responsible for the supervision of personnel assigned to the testing program. All system operations in the testing program were performed by plant operators in accordance with the approved written procedures. These procedures included such items as delineation of administrative procedures and test responsibilities, test purpose, conditions, precautions, limitations and sequence of operation. Procedural changes were made only in accordance with an approved standard operating procedure that required review and approval of the changes by experienced supervisory and advisory personnel.

13.4.2.1 **Startup Group**

Figure 13.4-2 shows the functional organization of the Startup Group. Specific responsibilities of the Startup Group are delineated below:

1. During construction testing, the Startup Group provided assurance that all construction tests required by the USAR were conducted.

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1. Note: Titles used herein reflect those positions in effect at time of startup testing.

2. Monitoring construction testing by:
    - reviewing and approving construction test procedures and results;
    - maintaining a file of completed construction test documentation as part of the "Master Test File."
3. Planning of pre-operational and startup tests to determine all testing requirements on plant systems and equipment.
4. Reviewing and approving all test procedures.
5. Determining personnel requirements for each test.
6. Scheduling to determine the sequence and dates of all tests based on the construction scheduling and test requirements.
7. Providing approved test procedures to test and operating personnel for use in conducting the tests.
8. Maintaining an up-to-date record on the progress of the test program.
9. Coordinating between Plant Test Coordinator and Plant Test Engineers on progress of test requirements.
10. Conducting meetings with plant test personnel, NSSS supplier, A-E and other technical representatives as required during the test program.

The Startup Group consisted of test engineers, each having responsibility of specific systems and reporting to the Superintendent-Nuclear Power. The Startup Group Test Coordinator had the responsibility for coordinating the efforts of all Test Engineers that had been assigned to work with him in performing the assigned tests. The Systems Test Engineer, as Startup Group Test Coordinator, had the transitional responsibility between the Construction Test Coordinator and the Plant Test Coordinator in scheduling, planning, communicating, and maintaining the progress of the startup program to assure a smooth and orderly transition of the testing program from Construction to Steam Plant Operations.

13.4.2.2 **Plant Management Staff**

Superintendent-Nuclear Power, responsible to the Superintendent-Steam Plants, had administrative and technical responsibility of the Kewaunee Nuclear Power Plant. The Kewaunee Plant Superintendent and the Startup Group were responsible to the Superintendent-Nuclear Power for the conduct of the test program, the smooth transition of the plant from test status to operating status and for the health and safety of the public and the plant staff.

Kewaunee Plant Superintendent was responsible for the Operations phase of the plant and formally accepted and assumed responsibility for the plant systems and equipment, which had successfully passed all construction tests.

The Assistant Plant Superintendent as the Plant Test Coordinator and reporting to the Plant Superintendent, was responsible for:

1. overall supervision of personnel performing the tests;
2. coordination with the Startup Group Test Coordinator in maintaining the progress of the test program;
3. ensuring that necessary preparations were made for scheduled tests.

The Plant Test Coordinator designated one or more supervisory personnel as “Plant Test Engineers” whose responsibility it was to assume direct supervision of assigned personnel for the specific tests to be performed.

The Shift Supervisor was responsible for the safe operation of that portion of the plant under the operational jurisdiction of the Plant Superintendent. The Shift Supervisor had direct responsibility for the operation of systems and operational equipment under test and, as such, the Plant Test Engineer coordinated his effort through the Shift Supervisor for the successful completion of the various tests.

13.4.2.3 **Technical Advisors and Consultants**

Technical advisors and consultants from the Nuclear Steam Supplier (Westinghouse) and the Architect-Engineer (PS&E.) and others, as required, provided assistance as requested by the Superintendent-Nuclear Power or his designate.

13.4.2.4 **Safety Review Organization**

Wisconsin Public Service Corporation had established a safety review organization, which included managerial, supervisory and technical personnel to provide proper administrative control and review of all aspects of operation. During the testing phase, the Kewaunee Plant Superintendent, had the responsibility and authority to operate the plant within the guidelines set forth by the Wisconsin Public Service Corporation Management and the Technical Specifications and to take whatever action was necessary to assure the health and safety of the public. Within the plant organization, responsibilities for review and supervision of all activities, procedures, operations and test had been established. A Plant Operations Review Committee and a Nuclear Safety Review and Audit Committee, described in Section 6.0 of the Technical Specifications, had been formed to review or audit all matters of plant operation, nuclear safety, industrial health and safety, procedures and changes to procedures, and all other matters pertaining to safe operation of the plant. Matters pertaining to nuclear safety became evident during and after the initial fuel loading.

13.4.3 Procedural Mechanics

13.4.3.1 Preparation

Test Procedures for the Three-Phase Test Program had been prepared by the following groups:

Construction Tests	Pioneer Service and Engineering[a]
Pre-operational Tests	Southern Nuclear Engineering
Startup Tests	Wisconsin Public Service (Startup Group and Plant Staff)

a. Now Fluor Power Services, Inc.

Detailed written test procedures were required for all tests of the Startup Program. The content was sufficient to ensure a complete understanding of the purpose and method of the test by the test personnel and assurance that the test could be performed without undue risk to the test personnel, equipment, and the public.

13.4.3.2 Content

Each test procedure included, if applicable, the following basic elements:

- Purpose
- References
- Summary of Procedure
- Prerequisites
- Special Equipment
- Safety Precautions
- Initial Conditions
- Procedure
- Terminal Instructions
- Acceptance Criteria
- Attachments (Data Sheets and Sketches)

Table 13.1-1 and Table 13.1-2 provide the listing for some of the types of tests, which were performed on the plant.

The acceptance criteria as noted in the test procedure were derived from the detailed information, which is described in the respective sections of the USAR covering the functional requirements of systems or equipment. The acceptance criteria as written in the pre-operational test procedure were reviewed and approved by the responsible design organization. The procedure signature sheet, as it was prepared, provided for the signature of a responsible engineer in the design organization.

The Startup Test Program included the necessary tests and the sequence in which these tests were performed consistent with the construction-testing program and with the operational requirements of the plant. Some systems were required early in plant life and were, therefore, tested prior to testing of other systems. Each procedure was provided with a "Prerequisites Section" which listed all tests and conditions that had to prevail prior to the performing of the specific test. Prerequisites included, among other things, provisions for any unusual conditions, which may have existed during the test.

13.4.3.3 **Review**

Several reviews of each test procedure were conducted, each fulfilling a unique objective to provide assurance that the tests were planned and conducted within the guidelines of the Startup Program Manual.

A review of each procedure was made to provide assurance that it satisfies all requirements of applicable Federal Regulations, Codes, Quality Standards, and safety requirements as stated in the USAR. The procedure was considered approved when the review was complete and the procedure was signed off.

A test performance review was made of raw data as it was completed and documented to determine whether all steps were performed and all data properly recorded. It was the responsibility of the Plant Test Coordinator to perform this review prior to releasing the test results for complete review and analysis.

A thorough review and analysis was made of the data recorded for each test procedure to determine whether or not all test requirements and the acceptance criteria had been met. The results of the analysis were recorded for each procedure, which served as the documentation that the system or equipment had been tested, accepted and ready for the next phase of testing or operation.

13.4.3.4 **Approvals**

Each test procedure was accompanied by an approval signature sheet, signed and dated by the individuals responsible for the review. The same sheet was also used for the signatures of the individuals responsible for supervising the test and approving the test results.

The responsibility for approving the procedures, test data, and the results was placed upon personnel in the following disciplines: Technical, Design, Test, Operations, and Quality Assurance. The Quality Assurance engineer was responsible for the review of the test procedure to determine that the test would be performed within the guidelines of the Operations Quality Assurance Manual, Applicable Federal Regulations, Codes, and Standards. The test results were audited by him or his designate.

13.4.3.5 **Changes to Approved Procedures**

Requests for changes to approved test procedures were made to the document originator through the responsible Startup Group Test Engineer. Normally, all changes to the approved test procedures were reviewed and approved prior to the performance of the test by the same individuals or groups that reviewed and approved the previous issue.

In special instances, when the normal process of initiating a change to an approved procedure as noted above would result in a significant delay in the schedule of the test program, the procedure followed is described below.

The test procedure requiring a change was provided with a special form "Test Procedure Field Revision." The required change was noted on the form and approved by the responsible Plant Test Engineer and the responsible Startup Group Test Engineer. Once approved, this form became a part of the test procedure. During the test results analysis, the test procedure revision was reviewed to determine whether the change had any effect on the validity of the test and appropriate action recommended, if necessary.

13.4.4 Technical Assistance - Test Program

The Kewaunee Nuclear Power Plant Startup Group was responsible for the planning and execution of the pre-operational and startup test program. The six engineers had worked very closely with Southern Nuclear Engineering (SNE) personnel in the preparation of the pre-operational test procedures. The Startup Group's expertise covered core physics, chemistry and chemical engineering, electrical engineering, instrumentation and control, and nuclear plant operations. The Startup Group had developed a schedule for the test program and scheduled the requirement for the technical support personnel. Personnel from the General Steam Plant Engineering Group to assist operations personnel in the acceptance and testing program of the balance of plant systems. Additional trained personnel, for example instrument technicians, were used to assist on an as required basis. To further assist the Startup Group, technical consultants from the following companies were available during the test program.

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13.4.4.1 **Westinghouse**

The Westinghouse site technical assistance that was provided for startup testing was dependent upon the tests being performed and the level of testing activity. Westinghouse Nuclear provided WPS a Systems/Startup Engineer on site to follow major systems and hot functional testing.

In addition, support personnel were available to the Systems/Startup Engineer. The support engineers covered mechanical, process control, and nuclear instrumentation engineering. To augment these engineers, Westinghouse provided specialists as required in areas such as transient analysis, chemistry, thermal and hydraulics, and fuel. A reactor physicist was on site to assist and evaluate reactor core performance from fuel loading through the zero power and power ascension testing. Westinghouse personnel reviewed the NSSS procedures prior to their implementation and assisted in on-site review of test results and, if required, further evaluation of the results by the home office staff was available. Westinghouse Instrument Services Company had personnel on site and additional personnel were available as required to assist in the further calibration and testing of instrumentation systems.

13.4.4.2 **Pioneer Service and Engineering**

Pioneer had five technical personnel on site assisting in the test program. These were augmented, on an as required basis, with five technical specialists. The five specialists had responsibilities during design and construction and covered such disciplines as structural and hydraulic engineering, mechanical engineering, steam plant and turbine auxiliaries engineering, electrical engineering, and process control engineering. They were available to the Startup Group to assist in interpreting procedures, test results and any problems that could have arisen, during the test program.

13.4.4.3 **Southern Nuclear Engineering**

SNE had prepared the pre-operational test procedures for the Kewaunee Nuclear Power Plant. The procedures were prepared in close cooperation with the WPS Startup Group requiring review by both Pioneer and Westinghouse. The SNE engineers developing the procedures had experience in preparing procedures, had been involved in testing programs, or had been licensed operators on other nuclear power plants. SNE had seven technical consultants available for support during the test program. The disciplines which these support personnel covered were power plant, electrical, core design, control rod drive, process control, nuclear instrumentation, and reactor protection system engineering.

SNE had been involved with the Kewaunee Project for over two years and had become thoroughly familiar with all aspects of the plant design. In addition, SNE had available other technical staff members who provided assistance as necessary.

13.4.4.4 **Foxboro Instrument Company**

Foxboro had provided the bulk of the process instrumentation for the Kewaunee Plant. They provided at least two engineers to assist in the further calibration of the instrument systems and to train WPS personnel. They were available to perform trouble shooting of instrument systems during the test program. Foxboro had provided instrumentation systems for many nuclear power plants and, therefore, was well qualified in understanding the needs of the utility during the startup test program.

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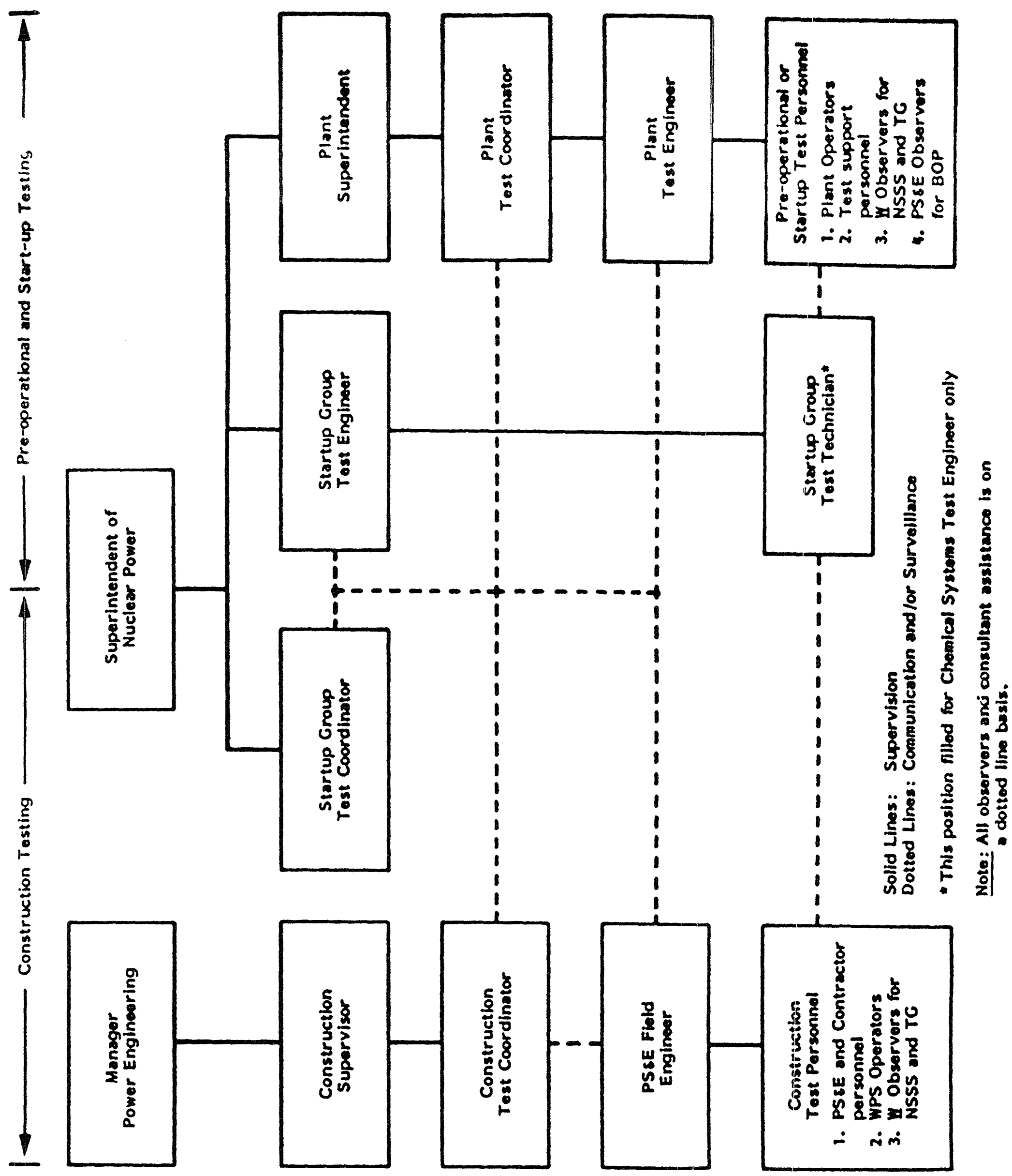

Figure 13.4-1
Kewaunee Nuclear Plant
Organization - Test Program

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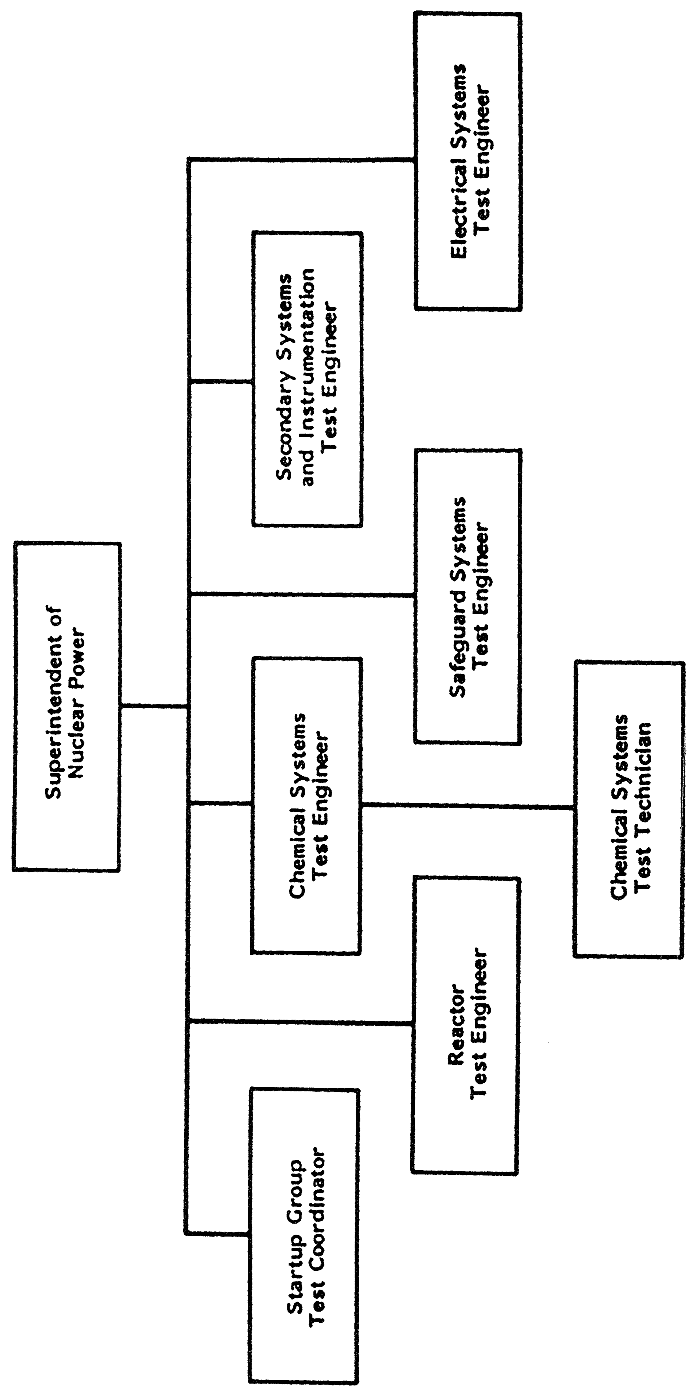
Figure 13.4-2
Kewaunee Nuclear Plant
Startup Group Functional Organization



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13.5 CORRECTIVE ACTION

Repair, modification, and adjustment of equipment necessitated by construction testing were performed by the construction contractors under the supervision of the Construction Manager (PS&E). This work was done under the existing Quality Assurance guidelines in effect during construction.

Repair, modification and adjustment of equipment under the operational jurisdiction of WPS were performed by WPS maintenance and operational personnel. The guidelines for work of this nature were covered under the Quality Assurance Program Description. The QA procedures employed had been prepared, approved, and authorized for use by WPS Management.

Any deficiencies, which were discovered as a result of testing, were noted by the responsible Test Engineer on a Deficiency Report. The Plant Test Coordinator maintained a deficiency file for all operational equipment. This file contained deficiency reports resulting from construction, pre-operational and startup testing. These reports remained active until the deficiency had been corrected. Items requiring resolution by the contractor, Architect-Engineer, Nuclear Steam Supplier, or Turbine-Generator Supplier, were brought to his attention immediately. Notification of correction of the deficiency was made to the Plant Test Coordinator so that the correction could be verified and the Deficiency Report removed from the active file.

Temporary Changes

Temporary equipment changes made for testing, such as electrical jumpers, terminal disconnections, temporary piping connections, abnormal valve or electrical lineups, abnormal instrument settings and removal of normal interlocks, were detailed as precautions in the written test procedure. They were further noted in the Terminal Instructions portion of the Pre-operational Test Procedure to make certain the system or equipment was returned to its normal condition following the test.

Administrative procedures requiring the signatures of numerous responsible staff personnel provided assurance that temporary actions taken during or prior to the performance of a test were corrected, noted and documented. In addition, a "Temporary Change Log" was maintained by the Shift Supervisor which listed all temporary changes which were made during the performance of a test and not restored to the original condition at the conclusion of the test; or changes which were not removed because the test procedures did not call for removal of the temporary changes. All temporary changes which were specifically spelled out in the test procedure and restored to their original condition during the performance of the test were not logged in the "Temporary Change Log" since the procedure already documented this fact.

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13.6 DOCUMENTATION

Documentation commenced with the written test procedure. Each procedure was accompanied with a signature sheet, which denoted that the procedure had been prepared, reviewed, and approved by responsible personnel. It further noted that the test was supervised and test results approved by responsible staff and design personnel as required.

Additional documentation consisted of the following items:

- Test Procedure Field Revision
- Equipment Operational Release (used after Construction Testing)
- Deficiency Reports
- Deficiency File
- Temporary Change Log
- Quality Assurance Surveillance and Audit Reports

The above have been discussed previously with the exception of (b), Equipment Operational Release covered release of equipment or systems following the Construction Testing. Boundary tag requirements were used during construction. The tags denoted condition of the equipment, whether it was on “HOLD,” “OPERATIONAL,” (authorizing only WPS Kewaunee Nuclear Power Plant Operations personnel the right to operate it), or “SYSTEM UNDER TEST,” which was used in construction testing. The test data, results, and all related reports were maintained on file in the site Master Test File.

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13.7 SCHEDULING

13.7.1 Construction Tests

Construction tests were scheduled in such a manner as to permit testing any major component or system as soon as construction had been completed to permit evaluation of the test results to determine installation, contractual, and procurement specification agreement. In some instances, the results of the construction test were adequate to permit use of the component or system as a service system during the remaining construction and testing phase.

13.7.2 Preoperational Tests

The pre-operational tests were scheduled to follow construction tests, so as to minimize the time between system testing and initial fuel loading. These included the hot functional tests. The pre-operational tests demonstrated the functional performance of all safety-related systems as well as tests on systems, which were required for plant operation but were not safety-related. During the pre-operational testing phase, the systems were tested under the conditions of the plant existing at the time of test. In many instances, certain tests were delayed, as noted in Table 13.1-2, until proper conditions of pressure and temperature were achieved. In still other instances, complete system performance was not checked out until the plant was at some power level and the systems operational. These delayed tests are noted in Table 13.3-1.

WPS had set a time limit of six months as a maximum time between performance of the test and operational use of the equipment or system. If a system or piece of equipment, which had been tested, sat idle for a period of six months or longer, consideration was given to complete or partial re-testing, prior to that system being placed into service.

13.7.3 Post Core Loading and Initial Tests

Initial core loading followed the hot functional tests. Following the core loading, the initial testing of the operating reactor, as discussed in Section 13.3, commenced. The tests were scheduled to allow sufficient time to proceed from initial criticality through zero power to power level escalation.

Table 13.3-1 summarized the tests, which were performed. The power plateaus at which various tests were performed are from hot zero power to 100 percent full power, with intermediate power levels between 10 percent and 100 percent used to verify performance of specific systems and to determine whether the acceptance criteria had been met. The tests had been designed to permit a smooth transition from initial core loading to escalation in power, enabling Steam Plant Operations to perform various tests, to obtain data which would further determine the plant capability as far as safety-related requirements were concerned. The test results were analyzed to ascertain that the plant was capable of responding to accident conditions and transients, as described in the USAR, and further provided with reasonable assurance that the design bases had been met.

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