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13.0 SITE SURVEILLANCE AND TESTING PROGRAMS (Historical)

This section pertains to the original plant construction and pre-operational and start-up testing. The entire chapter is considered to be historical information as defined and discussed in NEI 98-03, Revision 1.

13.1 OBJECTIVES AND SCOPE (Historical)

These programs were the final portions of the Owner's Overall Surveillance Program, and as such have the same objectives as the Design and Vendor Surveillance Programs described in Chapter 1.0; namely “to insure that the owners will procure a safe, complete, licensable, well designed and operable plant that can be operated without undue risk to the health and safety of the public.”

These objectives are met at the site location by the proper functioning of the owners' and contractors' groups, as described below. These groups must perform their functions at the site during four distinct phases of plant construction. These phases are described as follows:

1. Construction - Installation, Surveillance and Test Program.
2. Startup Surveillance and Pre-Core Loading Functional Testing.
3. Core Loading and Low Power Physics Testing Programs.
4. Power Testing.

The Site Surveillance and Testing Organization consisted of a General Superintendent in overall charge of the project. Reporting to the Superintendent were the respective group heads including: Operations Superintendent, I&C Supervisor, Reactor Engineer, Resident Engineer, Maintenance Superintendent, and Southwest Research Institute.

The Electrical Startup group reported to the Electrical Design Engineer under the Maintenance Superintendent while the various Operations group Supervisors reported directly to the Operations Superintendent.

13.2 GENERAL (Historical)

The owner's and contractor's programs during each phase consisted of the following:

CONSTRUCTION - INSTALLATION, SURVEILLANCE, AND TESTS

The objective of this phase was to provide a clear, logical, and documented surveillance program during the actual on-site construction period up to the point defined as “End of Construction.” “End of Construction” was defined as occurring after the systems and equipment have been hydro-statically tested, initially filled and drained, the motors bumped, instruments calibrated, and equipment adjustments made.

This phase covers the construction of buildings and installation of mechanical and electrical systems and associated equipment. The following basic areas fall within its scope:

1. Receipt and storage of equipment and material at the plant site.
2. Construction of buildings and structures.
3. Installation, initial cleaning, flushing, and pressure testing of piping systems including the associated pumps, pressure vessels and valves.
4. Installation, wiring, and operation of electrical equipment including motors, controllers, switchgear, transformers, etc.
5. Installation of instrumentation and control systems.

Owners Program

The structures, systems, and equipment under construction were divided into clearly defined sections using the contractor's drawings and specifications. The various systems were assigned to specific supervisory personnel of Wisconsin Michigan Power Co. who implemented and conducted this surveillance program for this assigned systems under the overall direction of the General Superintendent.

In order to provide history, records and continuity to the job with its expanding numbers of new supervisors and employees, Wisconsin Michigan Power Company established and maintained a central plant file for each system at the job outset. This central file contained a technical section, a specification section, and a drawing file section. The technical section contained a complete history of all correspondence between the owner and the contractor concerning the system and a copy of all instruction manuals for the equipment in the system. The specification section contained a current copy of the latest specification, records to indicate the location of obsolete specifications, and, to a limited extent, information on procurement effort associated with the system. This phase of the Surveillance and Test Program used the central file records and built upon and added to them with the records of:

1. Weekly Reports.
2. Weekly Comment Reports on Bechtel Quality Assurance.
3. Discrepancy Reports.
4. Construction-Installation Surveillance and Test Reports.
5. Equipment Record Cards.
6. Surveillance Test Folders.

The owners' plant Construction-Installation, Surveillance and Test Program was divided into areas of specific individual supervisory responsibility as follows:

1. <u>Resident Engineer</u>

   A. Receipt and storage of construction materials.

      1. Concrete components, including concrete testing.
      2. Structural steel.
      3. Piping and conduit, etc.

   B. Structures and their components.

   C. Electrical

      1. The Electrical Design Engineer and assigned startup personnel were responsible for accepting the installation of equipment in the following systems:

         a. 345 KV equipment directly associated with the plant. (The balance of the 345 KV switchyard was the responsibility of the Wisconsin Electrical Power System Electrical Department).
         b. 15 KV, 4.16 KV, 480 volt, 120 volt AC, and 125 volt DC.
         c. Generators and associated excitation.
         d. Protective relaying of plant equipment with the exception of reactor control systems, generator, isolated phase bus and unit transformers.
         e. Electrical system controls.
         f. Cathodic protection and station ground grid (non-buried portion).

         The plant maintenance group assisted the Electrical Design Engineer during this phase. All equipment was visually inspected for cleanliness and handling damage, and the method of storage was evaluated. Installation surveillance assured that equipment was properly handled and that equipment was installed according to specification and drawings.

      2. After equipment was in place, the Installation and Test Program assured that the following was done on each type of major equipment and obtained pertinent test data from the contractor:

         a. Transformers

            1. Oil sample test and proper procedures used in filling the transformers.
            2. Insulation tests
            3. Polarity and phasing checks
            4. Current transformer ratio checks

b. Motors

   1. Insulation tests
   2. Rotation
   3. Lubrication system check
   4. Phase balance

c. Switchgear

   1. Operations check
   2. Insulation tests
   3. Current transformer ratio checks
   4. Overload settings

d. Generators (Main), Emergency Diesel, Gas Turbine and Power Supply

   1. Insulation checks
   2. Phase rotation checks
   3. Current transformer ratio checks
   4. Brushes
   5. Excitation
   6. Balance

e. Protective Relaying

   1. Calibration tests
   2. Circuitry checkout
   3. Phasing

f. Wiring

   1. Proper insulation types
   2. Proper sizing
   3. Termination inspection

g. Electrical Equipment Control and Instrumentation

   1. Interlocking checks
   2. Alarm checks
   3. Instrument calibration

D. Records

The following records comprised the commissioning and maintenance history of equipment:

1. Equipment Record Cards

   These cards contain data on the equipment item of a general nature, and tabulated routine maintenance call up cards issued on the item. Data relating to initial assembly of the item was filed together with the equipment record card and is part of the permanent record.

2. Construction-Installation Discrepancy Reports

   A copy of this report was filed with the equipment record card where it related to a particular equipment item.

3. Tests carried out by the contractor which were part of the commissioning procedure were endorsed by owner's representatives, and such records became an integral part of the plant records for that equipment or system.

2. Instrument and Control Engineer

A. The Instrument and Control Engineer was responsible for accepting the installation of equipment in the following systems:

1. Reactor control and protection
2. Nuclear instrumentation
3. In-core instrumentation
4. Rod position indication
5. Rod control
6. Pressurizer instrumentation and control
7. Radiation monitoring
8. Feedwater control
9. Digital computer
10. Chemical and volume control
11. Safeguards instrumentation
12. Containment instrumentation
13. Miscellaneous primary and secondary systems
14. Electro-hydraulic turbine governor (electrical portion)
15. Turbine supervisory instrumentation
16. Miscellaneous secondary instrumentation
17. Communications equipment

B. The Installation and Test Program assured that the following was done on each instrumentation and control system:

1. Checks against specifications and drawings

2. Operational checks
3. Proper installation
4. Proper calibration

C. All inspections and calibrations were filed in the Instrumentation Calibration and Maintenance Record Files. This filing system consisted of a file folder for each instrumentation channel and contained all necessary specifications, procedures, records, etc.

D. Installation discrepancies were noted on Construction-Installation Discrepancy Reports.

3. <u>Operations Superintendent</u>

The Operations Group was responsible for accepting the installation cleanliness, pressure testing, and operational checkout of all piping, valves, pumps and motors of the following systems:

A. Reactor coolant
B. Chemical and volume control
C. Waste disposal
D. Safety Injection
E. Sampling system
F. Auxiliary coolant
G. Main and reheat steam
H. Condensate and feedwater
I. Extraction steam
J. Feedwater heater vents, reliefs, and miscellaneous drains
K. Feedwater heater drains
L. Gland steam and drains
M. Service water
N. Fire water (non-buried portion)
O. Instrument and service air
P. Plant makeup water and treatment
Q. Heating and ventilation air flow
R. Circulating water, condenser air removal and priming (M-212)
S. Lube oil system
T. Heating system
U. Heating and ventilation
V. Turbine plant chemical treatment
W. Auxiliary feedwater
X. Hydrogen and seal oil system
Y. Fuel oil system
Z. Turbine governing system
AA. Sewage treatment plant
BB. Circulating water piping
CC. Fuel handling equipment
DD. Potable water

The plant systems listed above were assigned to individual operating supervisory personnel. It was the responsibility of the specified supervisor to implement and conduct the initial acceptance program for his assigned systems under the overall direction of the Operations Superintendent.

A system file was established and maintained for each system that included the necessary drawings, specifications, inspection records, etc. Any condition that indicated an actual or possible discrepancy was promptly reported to the Operations Superintendent on a Construction-Installation Discrepancy Report. If the condition required action by the contractor, the Operations Superintendent assigned a number to the report and forwarded it to Westinghouse via the General Superintendent. Surveillance on each system encompassed the following general areas:

A. Storage Surveillance - All plant equipment other than that assigned to the responsibility of the Resident Engineer, was checked by the assigned supervisory personnel for the following conditions:

   1. Shipping damage
   2. Method of storage
   3. Protective covers
   4. Adequacy of inert atmosphere, if required
   5. Protection of carbon steel parts against corrosion
   6. Protection of stainless steel parts from possible chloride- bearing materials or liquids

B. Installation Surveillance - This area covered the actual installation of the equipment such as piping, pumps, motors, valves, wiring, etc.

   1. Piping
      a. Specification - compliance in regard to schedule, type and pressure rating
      b. Piping drawing (including hangers).
      c. Process drawing
      d. Installation and removal of special connections for testing and/or flushing
   2. Equipment
      a. Pumps
         1. Specification
         2. Piping connections
         3. Foundations
         4. Alignment
         5. Rotation
         6. Packing (material and procedures)

7. Maintainability
8. Lubrication (amount and type)
9. Vibration

A check of the maintenance group records was conducted for items 3, 4, 5, 6, 7, 8, and 9.

b. Valves

1. Specification and drawings
2. Direction of flow
3. Operability
4. Maintainability
5. Packing (Materials and procedure)
6. Materials of construction

Results of this evaluation were recorded on the Construction-Installation Surveillance Test Report Forms.

c. Cleanliness

All equipment piping was inspected to insure removal of any dirt or foreign material which could have adversely affected the operation of the system.

This inspection was performed prior to initial filling and flushing of the system. Results were recorded on Construction-Installation Surveillance and Test Report Forms.

d. Flushing and hydrostatic testing

This area of surveillance was closely related to the Startup Surveillance and Pre-Core Loading Functional Testing Program of the Owners Surveillance and Test Program, and in some cases the testing performed fell into both programs.

Flushing procedures clearly defined the systems or portions of systems involved, flushing points, strainer locations, etc. The procedures further defined the exact conditions to be established after the flushing operation (i.e. removal of temporary strainers, fittings, etc).

The hydrostatic, or system integrity, tests clearly defined the systems or portions of systems under test, the test condition, conditions of acceptance, etc. Results of this evaluation were recorded on Construction-Installation Surveillance and Test Report Forms.

4. <u>Southwest Research Institute</u>

This company was retained by the owner to function as their agent in the following critical welding areas:

A. Containment Liner

B. Primary Coolant Piping

C. Primary System Tanks

D. Reactor Vessel, Steam Generators, and Reactor Coolant Pump Supports.

Their surveillance consisted of reviewing welding procedures, records, welder qualifications, and nondestructive testing.

Contractor's Program

A. Inspection and Installation of Equipment in the Field

For components and equipment supplied by Westinghouse or its subcontractors, specifications were prepared not only for design, manufacturing, cleanliness requirements, and shipment, but also specifications and procedures were provided for on-site storage, erection, quality control, and testing.

During component installation, the Westinghouse project organization provided a capable and experienced group of specialists to monitor all construction related activities on the Nuclear Steam Supply System, Engineered Safeguards and Critical Structures. This group was staffed to provide coverage in all phases of construction such as welding, mechanical, electrical, systems, instrumentation and control and startup. The primary responsibility of this staff was to insure proper erection of the Nuclear Steam Supply System, Engineered Safeguards and Critical Structures as outlined by Westinghouse specifications and procedures. This surveillance included visits to selected shops of suppliers to ensure that established procedures of inspection and documentation were properly followed. Secondary functions of this staff were to provide technical direction and assistance to the constructor during critical operations and to ensure that adequate documentation was maintained. This staff was responsible for quality and documentation of all construction activities on the Nuclear Steam Supply System. This documentation was monitored by qualified quality assurance personnel operating independently of the construction group and reporting to the Project Manager. Such personnel provided additional surveillance of critical operations, followed problems or deficiencies until disposition, aided staff specialists in the performance of their duties when necessary, and monitored construction records for completeness.

B. Nonconforming Components or Material

All nonconforming components or material, whether discovered at the supplier's facility or at the construction site, were documented, reviewed and disposed of in accordance with approved procedures.

In all cases, the nonconforming component or material was positively identified and separated where applicable from acceptable items or items awaiting inspection. All cases of nonconforming components or material were reviewed by Westinghouse Design and Quality Control engineers for resolution. Westinghouse's management was kept informed of all cases of major importance with recommendations for proper disposition.

Constructor's Program

In the capacity of Architect-Engineer, Bechtel was responsible for the design of all systems and structures which were not designed by Westinghouse as a part of the Nuclear Steam Supply System and associated Engineered Safeguard System, and Turbine Generator. In addition, Bechtel specified and purchased all equipment within their scope of design responsibility. Furthermore, they prepared all construction drawings and specifications and managed all construction work.

In its construction management capacity, Bechtel carried out much of the "first line" on-site quality compliance, including receipt inspection, identification, on-site storage, and initial inspection and testing during erection. Receipt inspection was carried out to determine whether the particular item was ready for installation, including checking for damage, sealing, completeness and cleanliness. Equipment was labeled or segregated, where appropriate, to assure that proper identification was maintained.

If erection could not proceed immediately, the small items were placed in a temporary warehouse, and the very large items were stored outdoors, off the ground, and covered when appropriate for quality control reasons. Openings remained sealed until erection, except when further inspection or preerection work was required; afterwards, they were resealed until installed.

Desiccants were used and periodically monitored in components which were susceptible to damage by moisture. Heaters installed in equipment for moisture control were kept energized when required. Special precautions were taken to assure that the desiccant was removed prior to system operation.

The requirements for the highest grade commercial cleanliness which could be obtained practically were observed during construction. Cleanliness specifications were prepared with full awareness of the constraints imposed by the field conditions. The necessity of removing foreign material which could cause difficulties during operation was stressed. Gross dirt and debris were removed continually from the building area during erection. Equipment was protected as required and kept reasonably clean. Systems that would contain main coolant or were connected to the main coolant system were cleaned and rinsed with demineralized water as the final cleaning operation. Temporary screens were installed in pump suction lines during the initial flush utilizing demineralized water, as required.

The equipment and materials were installed in accordance with prescribed erection procedures. These procedures included such items as sequence of installation and specifications for welding, which included paying particular attention to methods that were not standard to the construction industry. Included in the welding specifications were nondestructive tests, such as liquid dye penetrant and radiography.

The work was done by craftsmen skilled in their respective trades. Welders were given the necessary qualification tests as required by the applicable codes. Bechtel maintained an on-site quality compliance group which was independent of construction management and which monitored the construction activity at the site.

STARTUP SURVEILLANCE AND PRECORE LOADING FUNCTIONAL TESTING

Test Procedures

The following tabulation is the sequence of major start up tests and operations performed to place all equipment in the specified system in service. The systems and items tested are listed below. Wisconsin Michigan Power Company and Westinghouse Electric Corporation prepared detailed test procedures prior to scheduled initial testing of systems. Table 13.2-1 lists the test objective, deviation from design operating conditions, if any, and the acceptance criteria for each test.

1. Switchgear System
2. Reactor Protection System
3. Service Water System
4. Fire Protection System
5. Circulating Water System
6. Feedwater System
7. Auxiliary Coolant System
8. Condensate Circulation System
9. Feedwater Control System
10. Chemical & Volume Control System*
11. Safety Injection System
12. Fuel Handling System
13. Steam Dump Control System
14. Reactor Containment High Pressure Test
15. Cold Hydrostatic Tests
16. Instrument and Service Air Systems
17. Reactor Control System
18. Rod Control System
19. Reactor Containment Air Circulation System
20. Radiation Monitoring System
21. Nuclear Instrumentation System
22. Radioactive Waste Disposal System
23. Sampling System*
24. Reactor Coolant System*
25. Primary System Safety Valves Tests
26. Control Room Ventilation System
27. Rod Position Indication System
28. Emergency Diesel-Electric System
29. In-Core Instrumentation System

* Performed during the Hot Functional Testing period.

Owners' Program

The objective of this phase was to ensure that the necessary systems and subsystems were properly prepared and tested so that the initial fuel loading and subsequent power operation could be safely performed. Where feasible, the systems were operated at full load conditions of pressure, temperature, flow, or voltage prior to core loading.

Wisconsin Michigan Power Company had the ultimate responsibility of preparing the plant for core loading and was significantly involved in the testing and performance evaluation of the plant systems. This involvement was in all portions of the plant since economic reasons required the owner to ensure that the contractors delivered an efficient and well-designed plant, but even more important was the need to ensure that the sensitive portions of the plant that could affect the safety of its operations were tested in depth so that the remaining phases of construction and testing could be performed safely.

WMPCo personnel prepared detailed test procedures for each portion of the plant using the following sources of information:

1. Design drawings and Process Flow Sheets
2. Design specifications for specific equipment and systems
3. System descriptions supplied by the Contractor
4. Component instruction books
5. General test procedures supplied by Westinghouse Electric Corporation and Bechtel
6. Surveillance reports obtained from the Construction-Installation, Surveillance and Test Program
7. Experience gained on previous nuclear power plant construction, startup, and operation.

Those WMPCo personnel who were responsible for the construction phase were, in most cases, the ones responsible for preparing the test procedures, check-off lists, and other supportive documents, necessary to evaluate the same systems during this program. Each procedure was reviewed and approved by Wisconsin Michigan Power Company through the General Superintendent Supervisory Staff. Prior to test performance, WMPCo submitted the detailed test procedures to Bechtel or Westinghouse for review. Bechtel Corporation or Westinghouse Electric Corporation provided technical direction for testing; however, all tests and procedures were performed by qualified WMPCo personnel. The General Superintendent, or designated alternate, ensured that each test was reviewed by all responsible parties, that initial plant conditions and prerequisites to the test were met, that proper personnel were available and understood the test procedures and precautions, and that proper emphasis was placed on safety during the tests.

If at any time during testing the reactor operators or other responsible cognizant personnel felt that an unsafe condition prevailed or could occur or the test was not done in accordance with procedure, they advised the appropriate person of this condition such that steps could be taken to interrupt the test and put the plant in a safe condition. The questionable condition would then be reviewed by WMPCo through the General Superintendent's Supervisory Staff with assistance from Bechtel Corporation or Westinghouse Electric Corporation as needed. If the questionable condition was considered unsafe, the appropriate procedure was rewritten in a safe manner before the test could be continued or reperformed. If substantial revision was required, the General Superintendent, or designated alternate, reviewed the change with the same approach as a new test procedure before the test could be continued or reperformed.

The primary organizational positions are described below:

Operations Manager (Westinghouse)

Maintained total Westinghouse project responsibility for startup and testing. He coordinated the overall startup program between the site groups and Westinghouse in Pittsburgh, PA. He was responsibile for approval of test procedures and startup program scheduling.

Shift Startup Engineer (Westinghouse)

Carried out the directions of the Operations Manager. Provided continuous coverage at the site for Westinghouse representation during testing of the plant initial operations phase. Coordinated the startup effort between the WMPCo shift supervisor and all Bechtel and Westinghouse personnel, including their vendor's representatives.

Project Startup Engineer (Bechtel)

Carried out the technical directions of the Operations Manager. Directed all startup effort relative to the scope of Bechtel. (In general, this was the portion of the plant outside the scope of the Nuclear Steam Supply System.)

Startup Engineers (Bechtel)

Carried out the directions of the Project Startup Engineer. For startup activities, coordinated the efforts of Bechtel Construction, Engineering and vendors personnel.

GENERAL SUPERINTENDENT - Nuclear Power Division
(Wisconsin Michigan Power Company)

Administratively responsible for all primary and secondary plant operation. He exercised direct supervisory control over licensee's personnel and their support groups. He controlled execution of startup programs and tests with the coordination and technical advice of the Westinghouse Operations Manager. He had final authority on operating safety and assignment of Licensee plant and headquarters staff personnel assigned to the site.

Table 13.2-1 PREOPERATIONAL TESTS

Sheet 1 of 7

System	Deviations from Design Conditions	Objectives	Acceptance Criteria
Reactor Coolant*	None	To verify that all instrumentation and control functions of the system were operating properly and that system flows were correct.	Technical Specifications. Precautions, Limits and Set-Points.
Auxiliary Coolant			
Component Cooling System	None	To verify component cooling flow to components served by the system and proper operations of valves, instrumentation and alarms associated with the system.	Technical Specifications. Precautions, Limits and Set-Points.
Residual Heat Removal System	None	To verify proper operation of valves, instrumentation and alarms associated with the system and the ability of the system to cool the plant from 350°F to 140°F in 20 hours.	Technical Specifications. Precautions, Limits and Set-Points.
Spent Fuel Pool Cooling	Spent fuel will not be in pool	To verify proper operation of valves, instrumentation and alarms associated with the system and proper flow paths for cooling.	Technical Specifications. Precautions, Limits and Set-Points.
Chemical and Volume Control System*	None	To verify that the system performed the following functions: maintain reactor coolant system water inventory, borate and dilute the reactor coolant system, supply reactor coolant pump seal water, maintain primary water chemistry within acceptable limits.	Technical Specifications. Precautions, Limits and Set-Points.
Sampling System*	None	To verify that a specified quantity of representative fluid and gases could be obtained safely at design conditions from each sampling point.	Westinghouse design drawings. Precautions, Limits and Set-Points.

*Performed during the Hot Functional Testing period.

Table 13.2-1

(Sheet 2 of 7)

System	Deviations from Design Conditions	Objectives	Acceptance Criteria
Waste Disposal System	None	To demonstrate that the system was capable of processing all radioactive liquids, gases and solids associated with plant operation.	Technical Specifications. Westinghouse design drawings. Westinghouse and Bechtel specifications.
Safety Injection System	Not necessarily at normal operating temperature and pressure	To verify proper response of the system to actuating signals in regards to pump, valve, instrumentation and alarms associated with system. Specifically that: a) all manual and remotely operated valves were operable manually and/or remotely, b) pumps performed their design functions satisfactorily, c) redundant flow path valves were operable if one valve in pair was disabled, d) proper sequencing of valves and pumps on receipt of a safety injections signal, e) failure position on loss of power for each remotely operated valve was verified, f) instrumentation, alarms, and controls functioned properly, g) setpoints and time required to actuate within design specifications.	Technical Specifications. Precautions, Limits and Set-Points.
Fuel Handling	None	To demonstrate that the system was capable of handling fuel in all circumstances which would occur from receipt of fuel to return of fuel in a safe and orderly manner.	Westinghouse Specifications.
Reactor Protection System	None	To verify the reactor tripping circuitry by operationally checking the analog system tripping and the A and B logic trains.	Technical Specifications. Precautions, Limits and Set-Points.
Rod Control System	None	To verify the rod control system satisfactorily performed the required stepping operations for each individual rod under both cold and hot shutdown conditions and to determine the rod drop time for each full length RCCA, and to check out the part-length rod drive system.	Rod Control System technical manual. Part-Length Rod Control System technical manual.
Rod Position Indication System	None	To verify the rod position indication system satisfactorily performed the required indication and control for each individual rod under hot shutdown conditions.	Precautions, Limits and Set-Points. Component instruction manual.

Table 13.2-1

(Sheet 3 of 7)

System	Deviations from Design Conditions	Objectives	Acceptance Criteria
Feedwater Control System	None	To demonstrate that the steam generator water level could be controlled in the manual and the automatic mode of operation and to insure that all alarms and trips were functioning properly.	Precautions, Limits and Set-Points.
Steam Dump Control System	None	To verify proper settings of the steam dump control system and the capability of the steam dump system to reduce the transient conditions imposed as a result of a load cutback or rejection up to 50% without a reactor trip.	Precautions, Limits and Set-Points.
Nuclear Instrumentation System	None	To verify the proper operation of the Nuclear Instrumentation System.	Technical Specifications. Nuclear Instrumentation System Manual. Precautions, Limits and Set-Points.
Radiation Monitoring System	None	To verify that all channels were operable and alarm and recording functions were responding properly.	Technical Specifications.
In-Core Instrumentation System	None	To perform checkout and demonstration of the in-core thermocouple system and the in-core flux mapping system.	Component Instruction Manual.
Service Water System	None	To verify that the system would supply the required water flow through all equipment supplied with service water and that all instrumentation and controls functioned as designed.	Technical Specifications. Bechtel Functional Description.
Fire Protection System	As required by insurance inspectors. Sprinkler head will not be tested.	To verify proper operation of the system and to check all automatic functions.	Bechtel Functional Description. As designated by the manuals of the National Fire Protection Assoc.
Circulating Water System	None	To verify proper operation of pumps, valves and control circuitry; proper priming of the system, and proper flow through the condensers and the condensate cooler.	Bechtel Functional Description.

Table 13.2-1

(Sheet 4 of 7)

System	Deviations from Design Conditions	Objectives	Acceptance Criteria
Instrument and Service Air System	None	To verify: a) the proper operation of all compressors to design specifications, b) the manual and automatic operation of controls at design setpoints, c) design air dryer cycle time and moisture content of discharge air, d) proper air pressure to each instrument and equipment served by the system.	Technical manuals. Bechtel Functional Description.
Reactor Containment Air Circulating System	Unable to test at design temperature and pressure	To verify the proper operation of: a) all fans, filters, heating and cooling coils, b) automatic and manual controls to maintain containment atmosphere within design specifications, c) proper operation of recirculation fans and coolers on a safety injection signal, d) purge valve isolation, e) all interlocks and alarms.	Technical Specifications.
Feedwater and Condensate System	None	To verify pump, valve, and control operability and set-points. Functional testing was performed when a steam supply was available.	Technical Specifications.
Control Room Ventilation System	None	To demonstrate the control room ventilation system could perform its designed function during normal plant operations and during postaccident plant conditions by checking out each mode of operation.	Component Instruction Manual. Bechtel Functional Description.
Emergency Diesel Electric System	None	To assure that the emergency diesel-generators were installed in accordance with the design specifications and operated as described in the functional description to satisfactorily accept the safeguard system load upon failure of the normal power supply.	Approved Schematic Circuit Diagrams . Vendor's instructions. Bechtel Functional Description.
Switchgear System	None	To verify that the electrical, auxiliary, and safeguard systems were installed and operated in accordance with accepted electrical standard and design and thereby provided reliable power to auxiliaries required during any normal or emergency mode of plant operation.	ASA and IEEE Standards. Approved schematic circuit diagrams. Manufacturer's equipment instructions.
Primary System Safety Valves Tests	Tested at room temperature	To ascertain the popping and reseat pressure settings of the valves and establish that zero leakage conditions existed across the seating face.	Westinghouse Equipment Specifications.

Table 13.2-1

(Sheet 5 of 7)

System	Deviations from Design Conditions	Objectives	Acceptance Criteria
Reactor Containment High Pressure Test and Leakage Test	Tested at room temperature	To verify the structural integrity and leak tightness of containment.	Technical Specifications. Precautions, Limits and Set-Points.
Cold Hydrostatic Tests	Pressure above design	To verify the structural integrity and leak tightness of the particular system.	Technical Specifications. Precautions, Limits and Set-Points.
RCC Unit Drop Tests	a. Cold, Shutdown b. Hot, Shutdown	To measure the drop times of all RCC units from loss of coil voltage to dashpot entry at cold and hot conditions with full flow. Selected rods will be dropped at no flow conditions.	Drop times less than 1.85 seconds from loss of coil voltage to dashpot entry for all rods at full flow and operating temperature.
Thermocouple/RTD Intercalibration	Various temperatures during initial system heatup.	To verify RTD calibration data and to determine in-place isothermal correction constants for all core exit thermocouples.	Acceptable behavior within manufacturer's tolerances of ±2°F for the RTD measuring system ±3/8% of the reading for the thermocouples.
Nuclear Design Check Tests	All RCC control and shut-down group configurations at hot, zero power	To verify that the nuclear design predictions for endpoint boron concentrations, isothermal temperature coefficients, RCC bank differential and integral worths and power distributions are valid.	Reasonable agreement with design values. FFD and SAR limiting values of $F^N = 2.72$, $F^N_\Delta H = 1.58$, Sp/ST = -5.0 pcm/°F, and Sp/ST = 60 pcm/sec will not be exceeded at applicable conditions.
Plant Trip	Full load rejection from approximately 30% and 100% of rated power.	To verify reactor control performance control and steam dump performance.	No safety criteria applicable. Reasonable agreement with setpoint study responses. Turbine overspeed 132% or less.

Table 13.2-1

(Sheet 6 of 7)

System	Deviations from Design Conditions	Objectives	Acceptance Criteria
Plant Calormetric and Power Range Instrumentation Calibration	During static and/or transient conditions at approximately: 40%, 70%, 90%, 100%	To calibrate power range channels such that total core thermal output is indicated and that the detectors indicated the relationship between incore and excore axial offsets and quadrant tilts.	Encore detectors indicate incore distribution within reasonable agreement, the even function of the indicated difference between top and bottom detectors used in the overpower and overtemperature ΔT protection can be set such that: a. for measured incore power in the top minus power in the bottom within 20% of rated power, no change in ΔT setpoints occur b. for each percent that the incore power difference exceeds 20%, setpoint is reduced by 2% power.
Load Swing and Load Reduction Test	a. ± 10% at approximately 25%, 60% and 100% of rated power b. Load reduction of approximately 50% from 55% and 100% power level c. Ramp load increase and decrease between 40% and 90% at the rate of 5%/minute.	To verify reactor control performance.	No safety criteria applicable. Reasonable agreement with setpoint study responses.
Dynamic RCC Drop Test	Approximately 50% of rated power	To verify automatic detection of dropped rod by bottom and power range detector indication for selected rods. A minimum of one drop be accompanied with turbine runback and automatic rod withdrawal stop.	Proper indication of a dropped rod, blocking of automatic rod withdrawal and turbine power reduction.

Table 13.2-1

(Sheet 7 of 7)

System	Deviations from Design Conditions	Objectives	Acceptance Criteria
Static RCC Insertion and Drop Tests	Approximately 50% of rated power	To verify that a single RCC unit when misaligned with the control bank can be detected by individual rod position indication or by incore instrumentation if required. To determine the effect of a single full inserted RCC unit on core reactivity and core power distribution.	Misaligned rod detectable by individual rod position indication and incore instrumentation when out of position by 24 steps or greater. The worth of the highest inserted rod would not cause a reduction in power greater than the turbine runback power reduction. The flux tilt, coolant temperature, and pressure response to dropping the worst rod, when extrapolated to rated power, will not result in a condition of DNB.
Radiation Shielding Effectiveness Test	a. 10^{-8} - 10^{-7} amps b. 1 - 3% c. 30 - 40% d. 100%	Measure neutron and gamma shielding effectiveness in the containment.	The desired areas of the containment are within design and personnel exposure limits.

13.3 FINAL PLANT PREPARATION (Historical)

Staffing

The initial five Shift Supervisors had 46 man-years of nuclear experience and related technical training not associated with the Point Beach Nuclear Plant programs. Four of the five had U.S. Nuclear Navy backgrounds and one of these also had Argonne National Laboratory background. The fifth was a graduate of the Westinghouse off-site training school for Point Beach Nuclear Plant Supervisors. In addition, all had completed nearly 600 hours of on-site formal training prior to startup. On the job training was not logged here as it was not needed for qualification requirements.

The initial five Operating Supervisors had a total of 50 man-years of nuclear experience and related technical training not associated with the Point Beach Nuclear Plant programs. All five of these had U.S. Nuclear Navy background and one had completed the Westinghouse off-site school for Point Beach Nuclear Plant Supervisors. These supervisors completed the identical 600 hours of on-site formal training described for the Shift Supervisors.

Two supervisors were assigned to each of the five shift teams. The total man-years of experience and related technical training (including Point Beach Nuclear Plant) for the teams, ranged from a minimum of 13 to a maximum of 25½.

All Westinghouse and Bechtel personnel who participated in or acted as support personnel during the initial tests and operation of the reactor exceeded the qualification criteria as set forth by the Atomic Energy Commission.

The General Superintendent had overall responsibility and direction of all phases of testing. Technical responsibility at each individual phase of actual startup rested with the functional group most directly concerned with the results of the phase. Westinghouse Electric Corporation had on-site representatives of supporting functional groups to provide technical advice, recommendations, and assistance in planning and executing the respective phases of plant startup.

The Test and Operations Management Group, consisting of the General Superintendent - Wisconsin Michigan Power Company Nuclear Power Division, the Operations Superintendent and the Reactor Engineer made the final acceptance of plant components, systems, and operating characteristics. The Operations Superintendent with the General Superintendent was responsible for accepting the final installation and performance of mechanical systems and components. The Reactor Engineer with the General Superintendent was responsible for accepting and for approving performance characteristics of the nuclear cores, computers and in-core instrumentation. The Test and Operations Management Group reviewed the test results as well as consulted with Wisconsin Michigan Power Company surveillance supervisors, technical assistants and applicable Westinghouse startup and construction personnel.

Core Loading

The overall responsibility and direction for initial core loading was exercised by the General Superintendent. The overall process of initial core loading was, in general, directed from the charging floor of the containment. The Wisconsin Michigan Power Company Senior Reactor Operator licensed Shift Supervisor had direct supervision over and responsibility for the operation of core loading which included: fuel handling in the new and spent fuel storage areas, transfer of fuel from these areas to the containment, fuel handling by the manipulator crane, and placement of the fuel in the proper core location. The Wisconsin Michigan Power Company Reactor Engineering personnel were responsible for core loading procedures and loading monitoring. Westinghouse Electric Corporation provided technical advisors to assist Wisconsin Michigan Power Company personnel during the initial core loading operation.

The as-loaded core configuration was specified as part of the fuel core design studies conducted well in advance of plant startup. In the relatively unlikely event that mechanical damage would be sustained during core loading operations by a fuel assembly of a type for which no spare was available on-site, a previously examined alternate core loading scheme whose characteristics closely approximate those of the initially prescribed pattern would have been invoked.

The core was assembled in the reactor vessel in water containing enough dissolved boric acid (at least 2000 ppm boron) to maintain the core effective multiplication constant at 0.90 or lower. Core moderator chemistry conditions (particularly boron concentration) were prescribed in the core loading procedure document and were verified periodically by chemical analysis of moderator samples taken during core loading operation.

Core loading instrumentation consisted of two permanently installed plant source range (pulse-type) nuclear channels and two temporary in-core source range channels plus a third temporary channel used as a spare. The permanent channels were monitored in the control room by a licensed plant operator; the temporary channels were installed in the containment and were monitored by Licensee personnel. At least one plant channel and one temporary channel were equipped with audible count range indicators. Both plant channels and both regular temporary channels displayed neutron count rate on count rate meters and strip chart recorders. Minimum count rates attributable to core neutrons were required on at least two of the four available nuclear channels at all times during core loading operations.

Two 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 (RCC units, burnable poison inserts, source spider, or thimble plugging device) were placed in the reactor vessel one at a time according to a previously established and approved sequence which had been 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 positions 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 eight fuel assemblies was determined to be the minimum source-fuel nucleus which would permit subsequent meaningful inverse count rate monitoring. This initial nucleus was known by calculation and previous experience to be markedly subcriticality (k_{eff}<0.90) under the required conditions of loading.

Each subsequent fuel addition, one fuel assembly at a time, was accompanied by detailed neutron count rate monitoring to determine that the just loaded fuel assembly had not greatly increased the count rate and that the extrapolated inverse count rate ratio, as plotted, was not decreasing for unexplained reasons. The results of each loading step was evaluated by Licensee Reactor Engineering personnel or technical advisors of Westinghouse Electric Corporation before the next prescribed step could be started.

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 eight fuel assemblies had been loaded.

2. The neutron count rate on any individual nuclear channel increased unexpectedly by a factor of five during any single loading step.

An alarm in the containment and control room was coupled to the plant source range channels with a set point at five times the current count rate. This alarm automatically alerted the loading operation to an indication of high count rate and required an immediate stop of all operations until the incident had been evaluated.

In the event that the licensed plant operator in the control room determined that an unacceptable increase in count rate was being observed on any or all responding nuclear channels, he would execute one of, or combinations of, the special procedures which may involve fuel withdrawal from the core, manually actuating the containment evacuation alarm or charging of concentrated boric acid into the moderator.

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 would proceed, identified chains of responsibility and authority and provided for continuous and complete fuel and core component accountability.

Postloading Tests

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

Mechanical and electrical tests were performed on the RCC unit drive mechanisms. Tests included a complete operational checkout of the mechanisms. Checks were made to ensure that the rod position indicator coil stacks were connected to their proper position indicators. Similar checks were made on the RCC unit drive coils.

Tests were performed on the reactor trip circuits to test manual trip operation. Actual RCC unit drop times were measured for each rod control cluster. 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. Complete electrical and mechanical check was made on the in-core nuclear flux mapping system and the in-core thermocouples.

13.4 INITIAL TESTING IN THE OPERATING REACTOR (Historical)

Initial Criticality

Initial criticality was established by withdrawing the shutdown and control groups of RCC units from the core, leaving the last withdrawn control group inserted far enough 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 RCC group withdrawal and of boron concentration reduction were monitored by observing change in neutron count rate as indicated by the regular plant source range nuclear instrumentation as functions of RCC group position and, subsequently of primary water addition to the reactor coolant system and reactor coolant boron concentration during dilution.

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

Relevant procedures specified alignment of fluid systems to allow controlled start and stop and adjustment of the rate of which the approach to criticality proceeded, indicated values of core conditions under which criticality was expected and identified chains of responsibility and authority during reactor operations.

Initial Plant Verification Tests

Upon establishment of criticality, a series of tests was initiated to determine the overall unit behavior and systems performance under operating conditions. The initial tests consisted of selected low power physics measurements and power escalation tests to insure safe reactor operation while performing the overall unit checkout.

The low power measurements were made at or near operating temperature and pressure and consisted of the worth of the control bank, boron concentration worth determined from data taken during the RCC measurement, an isothermal temperature coefficient, and all rods out critical boron concentration and power distribution. Concurrent tests were conducted on the plant instrumentation including the source and intermediate range nuclear channels. RCC unit operation and the behavior of the associated control and indicating circuits were demonstrated and the adequacy of the control and protection systems were verified under low power operating conditions. The results of these tests and measurements were compared to the expected design behavior and a decision could be made whether to continue with the Initial Plant Verification Tests or to do the complete low power testing to better verify design values. The remainder of the initial plant verification tests were performed during power escalation to no more than 40% of rated power level.

The main purpose of the above tests was to determine and locate possible inadequate design and faulty construction work which could be rectified during the low power physics measurements program if required. Detailed procedures specified the sequence of tests and measurements to be conducted and the conditions under which each was to be performed. Should deviations from design predictions exist, unacceptable behavior be revealed, or apparent anomalies develop during this phase or subsequent phases of testing, the situation would be reviewed by the General Superintendent's Supervisory Staff to determine action in consideration of the facility license, the technical specifications, and the expertise of each group in the Supervisory Staff. If necessary, the tests themselves would be carefully repeated or supporting tests made to verify the results.

If the apparent discrepancy or anomaly was found to be real and it was outside the scope of the Supervisory Staff for resolution, the situation would be evaluated at the appropriate level of review.

Low 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 expected and that the values of the kinetic coefficients assumed in the safeguards analysis were indeed conservative.

The measurements were made at low or nearly zero power and primarily at or near operating temperature and pressure. Measurements included verification of calculated values of RCC group and unit worths, of isothermal temperature coefficient under various core conditions, of differential boron concentration worth and of critical boron concentrations as a function of RCC control group configuration. Relative power distribution checks were made in normal and abnormal RCC unit configurations.

Detailed procedures specified the sequence of tests and measurements to be conducted and the conditions under which each was to be performed to ensure the relevancy and consistency of the results obtained.

Power Level Escalation

After the operating characteristics of the reactor and plant had been verified by the Initial Verification and Low Power Tests, a program of power level escalation in successive stages was undertaken to bring the plant to its full rated power level. Both reactor and plant operational characteristics were closely examined at each stage and the relevance of the safeguards analysis was verified before escalation to the next programmed level was effected. Based upon data obtained from low power tests, the first escalation was to approximately 40% reactor thermal power. The data obtained at each level was analyzed to determine what indications would be when reactor thermal power was at the next escalation level. Succeeding levels were at approximately 70% power, 90% power and 100% core thermal power (1518 MWt).

Reactor physics measurements were made to determine the magnitudes of the power coefficient of reactivity, of xenon reactivity effects, of RCC control group differential worth and of relative power distribution in the core as functions of power level and RCC control group position.

Concurrent determinations of primary and secondary heat balances were made to ensure that the several indications of plant power level were consistent and to provide bases for calibration of the power range nuclear channels. The ability of the reactor control and protection system to respond effectively to signals from plant 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 were evaluated. The responses of system components were measured for 10% loss of load and recovery, 40% loss of load and recovery, turbine trip, loss of flow and trip of a single RCC unit.

A series of load follow tests were performed at selected power level escalation steps and after rated power level had been achieved. The results of these tests gave actual reactor and plant behavior under operating conditions and were used to verify predicted load follow capabilities.

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

The sequence of tests, measurements and intervening operations were prescribed in the power escalation procedures together with specific details relating to the conduct of the several tests and measurements. The measurements and test operations during power escalation were similar to normal plant operations.