CHAPTER 14.0 - INITIAL TEST PROGRAM

TABLE OF CONTENTS

CHAPTER 14.0 - INITIAL TEST PROGRAM

LIST OF TABLES

LIST OF TABLES (Cont'd)

LIST OF TABLES (Cont'd)

CHAPTER 14.0 - INITIAL TEST PROGRAM

LIST OF FIGURES

CHAPTER 14.0 - INITIAL TEST PROGRAM

14.1 SPECIFIC INFORMATION TO BE INCLUDED IN PSAR

This section is not applicable to the Byron/Braidwood UFSAR.

14.2 SPECIFIC INFORMATION TO BE INCLUDED IN UFSAR

14.2.1 Summary of Test Program and Objectives

Commonwealth Edison conducted a comprehensive initial test program at the Byron/Braidwood Stations which demonstrated that structures, systems, and components perform satisfactorily in service. The principal objectives of this program were to provide assurance that:

a. the plant was properly designed and constructed and was ready to operate in a manner that would not endanger the health and safety of the public;

b. the procedures for operating the plant safely were verified by trial use to be adequate; and

c. the plant operating personnel and technical staffs are knowledgeable about the plant and procedures and are fully prepared to operate the facility in a safe manner.

The initial test program included preoperational and initial startup testing. Administrative controls were implemented during the initial test program to maintain the level of cleanliness in accordance with Regulatory Guide 1.39 in effect at the time of the initial test program. Preoperational testing consisted of system performance tests performed prior to core load on essentially completed systems (exceptions were identified in the facility operating licenses). These tests demonstrated the capability of structures, systems, and components to meet safety-related performance requirements.

Initial startup testing consisted of those single and multisystem tests that occur during or after fuel loading and which demonstrate overall plant performance. This included such activities as precritical tests, low-power tests (including critical tests), and power ascension tests. This testing confirmed the design bases and demonstrated, where possible, that the plant is capable of withstanding the anticipated transients and postulated accidents.

14.2.2 Organization and Staffing

At Byron Station, the station operating and technical staffs managed and executed the Unit 1 initial test program in accordance with the Quality Assurance Program as outlined in the QA Topical Report referenced in Chapter 17.0. The Technical Staff Supervisor was the senior participant of the Onsite Review Group. The senior participant chose the necessary participants for a particular review from designated individuals qualified in the disciplines listed in Technical Specification 6.5.2.f. The station technical staffs were responsible for writing and conducting the initial test program. The Test Review Board was responsible for the onsite review and approval of the test procedures and test results.

At Byron Station, the station operating and Unit 2 testing staffs managed and executed the Unit 2 initial test program in accordance with the Quality Assurance Program as outlined in the QA Topical Report referenced in Chapter 17.0. The Unit 2 testing staffs were members of the Project Startup Organization and reported to the Startup Superintendent. The Unit 2 Testing Staff Supervisor was the senior participant of the Onsite Review Group. The senior participant chose the necessary participants for a particular review from designated individuals qualified in the disciplines listed in Technical Specification 6.5.2.f. The Unit 2 testing staffs were responsible for writing and conducting the Unit 2 initial test program. The Test Review Board, which included Unit 2 testing staff personnel, was responsible for the onsite review and approval of the test procedures and results.

At Braidwood, two Commonwealth Edison organizations were established to execute the initial testing program. These two organizations were the Station and the Project Startup Organizations. For initial startup testing, the Braidwood Station's Operating Department Technical Staffs and the Project Startup Organization managed and executed the initial startup test program in accordance with the Quality Assurance Program as outlined in the QA Topical Report referenced in Chapter 17.0. The Technical Staff Supervisor was the senior participant of the Onsite Review Group. The senior participant chose the necessary participants for a particular review from designated individuals qualified in the disciplines listed in Technical specification 6.5.2.f. The station technical staffs and the Project Startup Organization were responsible for writing and conducting the initial startup test program. The Test Review Board was responsible for the onsite review and the approval of the startup test procedures and startup test results.

Beginning in April 1984, responsibility for preoperational testing at the Braidwood Station rested with the Project Startup Organization. The preoperational test program was executed in accordance with the Quality Assurance Program as outlined in the QA Topical Report referenced in Chapter 17.0. For tests performed during and after fuel load, the Technical Staff Supervisor was the senior participant of the Onsite Review Group. The senior participant chose the necessary participants for a particular review from designated individuals qualified in the disciplines listed in Technical specification 6.5.2.f. The Project Startup Organization's Testing Staff (as and when applicable) was responsible for writing and conducting the Preoperational Test program. A Test Review Board, organized consistent with the Quality Assurance Manual from the Station or from the Project Startup organization (as and when appropriate), was responsible for the onsite review and approval of the preoperational test procedures and test results.

The Braidwood project startup group was a part of the Project Management organization. This arrangement resulted in Quality Assurance/Quality Control responsibilities similar to those implemented at Byron and La Salle County Stations during the preoperational test phase. As such, the Quality Assurance activities related to the project startup organization, with the sole exception of preoperational testing activities, were the responsibility of Site Construction Quality Assurance. Audit and surveillance functions as well as other responsibilities related to 10 CFR 50 Appendix B, with the sole exception of preoperational testing activities, were performed by Site Construction Quality Assurance in accordance with the existing Commonwealth Edison Quality Assurance Manual. Due to the close relationship with plant operation, the audit and surveillance function for preoperational testing activities was the responsibility of Operating Quality Assurance. The details and interface of QA activities covering preoperational activities were described in the Commonwealth Edison Company Quality Assurance Manual Section QP 11-2.

At Braidwood, the startup testing activities were conducted by the Station organization and the Project Startup Organization and Operating Quality Assurance provided audit and surveillance functions for these activities.

The Commonwealth Edison Operational Analysis and Station Construction Departments provided technical support or participated in the test program as required. The Project Engineering Department (PED) had overall responsibility for the successful review, approval, and completion of the initial test program. PED conducted its review in accordance with an approved procedure (PED Procedure Q.19). PED also provided the interface between the test personnel at the stations and the architect-engineer and the nuclear steam supply vendor.

The nuclear steam supply system vendor (Westinghouse) and the architect-engineer (Sargent & Lundy), as required, provided technical assistance during testing of systems. The authority and responsibility of each organizational unit involved in the initial test program was as specified in the Quality Assurance Program, Quality Assurance Procedures Manual, Section 11.

The organizational structure that implemented the test program is discussed in FSAR Section 13.1. Personnel who conducted the testing were qualified by experience and training as described in FSAR Chapter 13.0.

14.2.3 Test Procedures

The initial test program was conducted using detailed written procedures for each individual test. Tests of safety-related systems and specially designated non-safety-related systems (for purposes of initial plant startup only) are called Preoperational or Startup Tests. The Quality Assurance Program for the Commonwealth Edison Company (referred to in Chapter 17.0) describes the procedures for administration of Preoperational and Startup Tests. All other tests are called System Demonstrations or Operational Demonstrations. Preoperational Tests and System Demonstrations were performed during the "preoperational test phase." Startup Tests and Operational Demonstrations were performed during the "startup test phase."

Sargent & Lundy or Westinghouse, as appropriate, and as directed by Commonwealth Edison, prepared rough draft test procedures. The station staff and the Byron Unit 2 testing staff (Project Startup's Testing Staff as and when applicable for preoperational tests at the Braidwood Station) prepared final draft test procedures based on the rough draft and on comments received from appropriate Commonwealth Edison departments. Sargent & Lundy and/or Westinghouse reviewed the final draft procedures as directed by Project Engineering. The final draft of Preoperational Test and Startup Test procedures were reviewed and approved by the Project Engineering Department. Revisions to Preoperational Tests or Startup Tests were prepared by the station staff and the Byron Unit 2 testing staff (or Project Startup's Testing Staff as and when applicable for tests at the Braidwood Station) and submitted to the Project Engineering Department for review and approval.

System Demonstration and Operational Demonstration test procedures were written, reviewed, and approved by the station staff and the Byron Unit 2 testing staff (or Project Startup's Testing Staff as and when applicable for tests at the Braidwood Station) in accordance with station or the Byron Unit 2 testing staff procedures.

Individual test procedures specified prerequisites, data to be obtained, and requirements and acceptance criteria to be fulfilled. Table 14.2-1 identifies the information typically provided in the individual test procedures.

14.2.4 Conduct of Test Program

The initial preoperational and startup test programs were conducted using detailed written procedures that included provisions for assuring that prerequisites have been completed. Test personnel were instructed to initial and date the prerequisites included in each test procedure. Data was examined as each test proceeded and out-of-tolerance conditions were recorded and described in adequate detail to permit post-test analysis. Test data that was unsuccessful was recorded, evaluated during post-test review, and resolved within the Quality Assurance program.

Modification of preoperational test procedures was accomplished by the System Test Engineer for minor changes. Minor changes were defined as those which did not change the intent of the test procedure. Subsequent review of minor changes was conducted by the Onsite Review Board during post-test review.

Major test procedure modifications required the approval of the Onsite Review Board, Project Manager (Byron) and Project Engineering (Braidwood) prior to implementation. Major and minor modifications to startup test procedures were performed in accordance with Technical Specifications which require two signatures, at least one of which holds an SRO license on the affected unit.

14.2.5 Review, Evaluation, and Approval of Test Results

Initial preoperational and startup tests that fall within the scope of the Quality Assurance program were subject to two stages of evaluation. First, a detailed and comprehensive review by Station or Project Startup personnel (as applicable) was made. The Project Engineering Department project personnel performed a second and final review and evaluation. Modifications or rework of systems or equipment required to resolve deficiencies was accomplished in accordance with controlled procedures. Retesting, if required because of modification or rework, was documented and filed with the initial test record.

The initial core loading procedure specified the startup tests that had to be completed prior to commencement of fuel load. All testing identified as falling within the preoperational test phase was completed and the results evaluated prior to core load, with exceptions as identified in the facility operating licenses.

Modification and rework on systems that was required to resolve test deficiencies was controlled by the Test Review Board during post-test review and by Project Engineering who had responsibility for final test acceptance and approval. Project Engineering may have specified additional test requirements to resolve test deficiencies prior to final test approval.

The power ascension procedures specified those startup tests or portions of startup tests that had to be completed as a prerequisite for commencing each phase. The data obtained at each power test plateau was evaluated and approved by the Onsite Test Review Board and Station Manager before increasing power level.

14.2.6 Test Records

The initial startup test procedures and test data are retained and maintained in accordance with the Quality Assurance program described in Chapter 17.0. The original test records were reviewed for completeness, identified, and indexed to establish them as part of a permanent record to be retained. These records include data sheets completed during the test.

14.2.7 Conformance of Test Programs with Regulatory Guides

Appendix A to the UFSAR identifies those Regulatory Guides applicable to Byron/Braidwood and describes the degree of conformance to each.

14.2.8 Utilization of Reactor Operating and Testing Experiences in Development of Test Program

The initial test program at Byron/Braidwood was similar to the programs conducted at the Quad-Cities, Dresden, Zion, and La Salle County Stations.

The Zion Station startup and operating experience in particular was drawn upon in the design of the Byron/Braidwood Stations and provided a basis for development of their initial test program. Engineers who participated in the La Salle or Zion Preoperational and Startup Test Program were involved with the development of the Byron/Braidwood test documents.

IE Bulletins, circulars, and information notices were used in the design phase. A complete review of procedures prepared for other facilities was implemented and used in the test draft writing program.

Personnel from other facilities made up a significant portion of both the operating technical and testing staffs. Their experience was utilized in both preparing and implementation of the test procedures.

14.2.9 Trial Use of Plant Operating and Emergency Procedures

The initial startup test program did, to the maximum extent practical, use the plant operating and emergency procedures to test those procedures and to provide additional training for the operating and technical staffs. Individual test procedures may have incorporated operating and emergency procedures by reference or by extraction of applicable sections. The operating and emergency procedures may have been changed based on the results of the test program and in some instances may not have been completed until after initial testing of the system.

Personnel from other facilities made up a significant portion of the Station's Operating and Technical Staffs as well as

Project Startup's Testing Staff at the Braidwood Station. Their experience was utilized in both preparing and implementation of the test procedures.

14.2.10 Initial Fuel Loading and Initial Criticality

The following is a description of the general methodology used in the course of preparing the reactor for fuel loading and initial criticality. Detailed procedures developed in accordance with the requirements of Chapter 17.0 governed the actual work.

Fuel loading began when all prerequisite system tests and operations were satisfactorily completed. Upon completion of fuel loading, the reactor upper internals and pressure vessel head were installed and additional mechanical and electrical tests were performed. The purpose of this phase of activities was to prepare the system for nuclear operation and to establish that all design requirements necessary for operation were achieved. The core loading and postloading tests are described below.

14.2.10.1 Fuel Loading

The reactor containment structure was completed and the containment integrity established and maintained prior to fuel loading.

Fuel handling tools and equipment were checked out and dry runs conducted in the use and operation of equipment.

The reactor vessel and associated components were in a state of readiness to receive fuel. Water level was maintained above the bottom of the nozzles and recirculation maintained to assure a uniform boron concentration. Boron concentration could be increased via the recirculation system or directly to the open vessel.

The overall responsibility and direction for initial core loading was exercised by the station management. The overall process of initial core loading was, in general, directed from the floor of the containment structure. Standard procedures for the control of personnel and the maintenance of containment security were established prior to fuel loading.

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

The core was assembled in the reactor vessel, submerged in reactor grade water containing enough dissolved boric acid to maintain a calculated core effective multiplication factor within Technical Specifications limits. The refueling cavity was dry during initial core loading. 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 prior to and during core loading operations.

Core loading instrumentation consisted of two permanently installed source range (pulse type) nuclear channels and two temporary incore source range channels (see Subsection 4.3.2.2.9). A third temporary channel was also used as a spare. The permanent channels, when responding, were monitored in the main control room by licensed station operators; the temporary channels were installed in the reactor vessel and were monitored by reactor engineering personnel. At least one permanent channel was equipped with an audible count rate indicator. Both plant channels have the capability of displaying the neutron flux level on a strip chart recorder. The temporary channels indicated on scalers with a minimum of one channel recorded on a strip chart recorder. Minimum count rates attributable to core neutrons were required on at least two of the four (i.e., two temporary and two permanent source range detectors) available nuclear source channels at all times following installation of the initial nucleus of eight fuel assemblies. A response check of nuclear instruments to a neutron source was performed prior to loading of the core.

At least two neutron sources were introduced into the core at appropriate specified points in the core loading program to ensure a detector response attributable to neutrons.

Fuel assemblies together with inserted components (control rod assemblies, 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 check sheets 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 to guard against possible inadvertent exchanges or substitutions of components and fuel assembly status boards were maintained throughout the core loading operation.

An initial nucleus of eight fuel assemblies, one of which contained a neutron source, was the minimum source-fuel nucleus which permitted subsequent meaningful inverse count rate ratio monitoring. This initial nucleus was determined by calculation to be markedly subcritical 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 before the next prescribed step was started. The final, as loaded core configuration was subcritical under the required loading conditions.

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

a. an unanticipated increase in the neutron count rates by a factor of 2 occurred on all responding nuclear channels during any single loading step after the initial nucleus of eight fuel assemblies were loaded;

b. an unanticipated increase in the count rate by a factor of 5 occurred on any individual responding nuclear channel after the initial nucleus of eight fuel assemblies were loaded; or

c. an unexplained decrease in boron concentration greater than 20 ppm was determined from two successive samples of reactor coolant water.

An alarm in the containment and main control room was coupled to the source range channels with a setpoint equal to or less than five times the current count rate. This alarm automatically alerted the loading operation personnel of high count rate and required an immediate stop of all operations until the situation was evaluated. Normally the alarm used for this purpose was the containment evacuation alarm. In the event the evacuation alarm was actuated during core loading and after it was determined that no hazards to personnel existed, preselected personnel were permitted to reenter the containment building to evaluate the cause and determine future action.

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

14.2.10.2 Postloading 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 test was conducted after filling and venting was completed to check the integrity of the vessel head installation.

Mechanical and electrical tests were performed on the control rod drive mechanisms. These tests included a complete operational checkout of the mechanisms and of the rod position indication.

Tests were performed on the reactor trip circuits to test manual trip operation. The actual rod assembly drop times were measured for each control rod assembly. The reactor control and protection system was checked with simulated signals to produce a trip signal for the various conditions that require plant trip.

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

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

After final precritical tests, nuclear operation of the reactor began. This final phase of startup and testing included initial criticality, low power testing and power level escalation. The purpose of these tests was to establish the operational characteristics of the unit and core, to acquire data for the proper calibration of setpoints, and to ensure that operation was within license requirements. A brief description of the testing is presented in the following sections. Subsection 14.2.12 summarizes the tests which were performed from initial core loading to rated power. All precritical tests had to be completed prior to initial criticality and the results evaluated. Prerequisites for performing a test were specified in the individual test procedure. The sequence of testing was outlined in a startup test sequence, such that required prerequisite testing was completed prior to performing subsequent testing. Any special test instruments required were specified to be installed, calibrated and checked in the test procedure that specified the test equipment. Where these test instruments were not left installed for future use, they were removed from the systems and removal was verified.

Initial criticality was achieved by a combination of shutdown and control bank withdrawal and reactor coolant system boron concentration reduction.

Inverse count rate ratio monitoring, using data from the normal plant source range instrumentation, was used as an indication of the proximity and rate of approach to criticality. Inverse count rate ratio data were plotted as a function of rod bank position during rod motion and as a function of primary water addition during reactor coolant system boron concentration reduction.

Initially, the shutdown and control banks of control rods were withdrawn incrementally in the normal withdrawal sequence leaving the last withdrawn control bank inserted far enough in the core to provide effective control when criticality was achieved.

The boron concentration in the reactor coolant system was then reduced by the addition of primary water. Criticality was achieved during boron dilution, or by subsequent rod withdrawal following boron dilution. The rate of primary water addition, and hence, the rate of approach to criticality was reduced as the reactor approached criticality to ensure that effective control was maintained. Throughout this period, boron concentration was measured.

Written procedures specified the plant conditions, precautions, and specific instructions for the approach to criticality.

14.2.10.3 Low Power Testing

A prescribed program of reactor physics measurements was undertaken to verify that the basic static and dynamic characteristics of the core were as expected.

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

Procedures were prepared to specify the sequence of tests and measurements to be conducted and the conditions under which each could be performed to ensure both safety of operation and the relevancy and consistency of the results obtained. If significant deviations from design predictions existed, unacceptable behavior was revealed, or apparent anomalies developed, the plant was brought to a stable condition and then the situation was reviewed to determine whether a question of safety was involved, and to determine the course of subsequent plant operation.

14.2.10.4 Power Level Escalation

When the operating characteristics of the reactor and unit were verified by the low power testing, a program of power level escalation in successive stages brought the unit to its full rated power level. During the power escalation, a predetermined test program was followed to verify that the reactor and unit were performing as expected. The minimum test requirements for each successive stage of power escalation were specified.

Measurements were made to determine the relative power distribution in the core as functions of power and control assembly bank position.

Secondary system heat balance measurements ensured that the indications of power level were consistent and provided bases for calibration of the power range nuclear channels. The ability of the reactor coolant 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 dynamic response characteristics of the reactor coolant and steam systems were evaluated. The responses of the systems were measured for design step load changes of ± 10%, rapid 50% load reduction and plant trips.

Adequacy of radiation shielding was verified by gamma and neutron radiation surveys at selected points inside the containment and throughout the station site at various power levels. Periodic sampling was performed to verify the chemical and radiochemical analysis of the reactor coolant.

14.2.11 Test Program Schedule

The initial test program consisted of a preoperational test phase and a startup test phase. The preoperational phase of testing for a system began after construction of the system was essentially complete and appropriate Construction Tests or Equipment Demonstrations were satisfactorily accomplished. Construction Tests or Equipment Demonstrations consisted of onsite component testing such as hydrostatic testing, pressure proof testing, pump and valve testing, actuation to verify proper installation and electrical continuity verification. Construction Tests are those construction phase component tests which are subject to the requirements of the Quality Assurance Program described in Chapter 17.0. All other construction phase tests are called Equipment Demonstrations.

Preoperational testing proceeded concurrently with construction testing as various systems reached completion and were turned over to the station startup staff. The principal milestones during this phase were the reactor coolant system hydrostatic test and the integrated hot functional test. Tests of other systems were scheduled as appropriate to support these tests. An intended schedule for Unit 1 testing is provided in Figure 14.2-1. Actual schedule completion dates varied from unit to unit.

Individual preoperational tests were conducted as early in the test program as practical and at no time was the safety of the plant totally dependent on the performance of untested systems, components and features. In general, preoperational test prerequisites included establishing plant communications, verifying proper system turnover by construction, verification that instruments used for acceptance criteria were within calibration intervals and that systems needed to support the test were ready. The preoperational and startup test abstracts included specific prerequisites for each test. Core load occurred only after the satisfactory completion and approval of all required preoperational tests.

Individual startup tests were conducted after core load and test data obtained at each power test plateau was evaluated and approved by the Onsite Test Review Board and Station Manager prior to increasing power level.

Any initial test schedule overlap at the Byron and Braidwood Stations did not result in significant divisions of responsibility or dilutions in the staff provided to implement the test program.

Preoperational test procedure drafts were available for review by I&E inspectors at least 60 days prior to their intended use and not less than 60 days prior to the core loading date for startup test procedure drafts.

14.2.12 Individual Test Description

A test abstract for each individual test that was conducted during the initial test program is provided in this section. All listed startup tests are essential.

An essentially identical test program was conducted for each unit. Initial tests conducted on common systems or startup tests conducted to prove acceptance of a prototype core were completed to the extent necessary to support Unit 1 operation. Operational components in common systems that were tested in the Unit 1 program were not retested in the Unit 2 test program.

All necessary requirements for the demonstration of operability of the systems and components, which are based on past power plant experiences, applicable regulatory guides, regulations, standards, and vendor specifications, were included in the procedures for the initial test program. It was not our intention to include all these requirements in the test summaries which follow. These summaries were meant only to outline the major objectives of any particular test.

14.2.12.1 Preoperational Test Abstracts

Preoperational test abstracts are given in Tables 14.2-2, 14.2-3, and 14.2-5 through 14.2-61.

14.2.12.2 Startup Test Abstracts

Startup test abstracts are given in Tables 14.2-62 through 14.2-91, and in Table 14.2-4.

The test abstracts listed describe the intended testing program for both the Byron and Braidwood Stations. The Byron Station program is complete and the Braidwood Station program is still in progress. The completed testing was conducted in accordance with descriptions contained in the abstracts. Any exceptions to the abstract descriptions were properly documented and dispositioned.

TABLE 14.2-1

TYPICAL FORMAT

PREOPERATIONAL TEST PROCEDURE

1. Title and Approval Sheet

2. Index

3. Test Objectives

   The test objective is a clear and concise statement of the purpose of the test.

4. Acceptance Criteria

   Acceptance criteria consists of appropriate standards against which the success or failure of the test may be judged.

5. References

   The reference sources used to prepare the test are provided.

6. Prerequisites

   Those conditions or requirements such as prior testing or calibration that must be accomplished prior to testing are specified.

7. Initial Conditions

   The plant conditions that must be achieved at the commencement of the test are specified.

8. Special Precautions

   Those precautions to be observed during the procedural portion of the test are set forth.

9. Test Procedure

   The procedure consists of a detailed set of steps to be followed in accomplishing the test.

10. System Restoration

    The system condition to be obtained at the conclusion of the test is specified.

TABLE 14.2-1 (Continued)

TYPICAL FORMAT

PREOPERATIONAL TEST PROCEDURE

11. Data Sheets

    Data sheets provide the means of recording information required to be obtained during the test.

12. Test Evaluation

    The test results are reviewed by the station staff who identify apparent deficiencies, determine whether additional testing is required, and ensure the test results are complete and meet the acceptance criteria.

13. Appendices

    Appendices are provided in the test copies to record significant events that occur during the test, verify operating procedures, perform complex data reductions and list miscellaneous information helpful for test execution.

14 Attachments

    A section is provided for attachment of supporting test documents.

TABLE 14.2-1a

TYPICAL FORMAT

INITIAL STARTUP TEST PROCEDURES

1.0 PURPOSE

(A short description of the intent and applicability of the test.)

2.0 REFERENCES

(References, including reference to Technical Specifications.)

3.0 PREREQUISITES

(A list of procedures or actions to be completed prior to the test.)

4.0 PRECAUTIONS

(Used to alert the cognizant engineer of important measures which should be taken to protect equipment and personnel. Also included are limitations on parameters being controlled and appropriate corrective measures to return to normal are specified.)

5.0 PROCEDURE

(A step-by-step instruction necessary to perform the test.)

6.0 ACCEPTANCE CRITERIA

(Those standards by which the test is to be judged against. Detailed referencing of the criteria is included.)

TABLE 14.2-2

EXCORE NUCLEAR INSTRUMENTATION

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core loading at ambient temperature and atmospheric pressure and during hot functional testing while heating up and cooling down.

Test Objective

To verify instrument alignment and source range detector response to a neutron source.

Test Summary

Prior to core loading the nuclear instruments will be aligned. All channels will be checked to verify high level trip functions, alarm setpoints, audible count rates where applicable, and operation of strip chart recorders and any auxiliary equipment.

Acceptance Criteria

The nuclear instruments are aligned and respond to a source of neutrons and trip, alarm and indicate in accordance with Technical Specification B.2.2.1 and UFSAR Sections 7.5 and 7.7.

TABLE 14.2-3

INCORE THERMOCOUPLE SYSTEM

(Preoperational Test)

Deleted (See Table 14.2-90)*

*Upgraded thermocouple system will be tested.

TABLE 14.2-4

AUXILIARY STARTUP INSTRUMENTATION

(Startup Test)

Plant Condition or Prerequisite

Prior to and during initial core loading operations.

Test Objective

To verify response of each temporary startup source range channel to a neutron source prior to core loading.

Test Summary

Two separate temporary source range detectors will be installed in the core during core loading operations. An additional channel will serve as a spare to the other two channels. During the core loading operations these detectors will be relocated at specific loading steps to provide the most meaningful neutron count rate. The response of each channel to a neutron source will be verified prior to core loading.

Acceptance Criteria

Each temporary source range channel responds to a neutron source by indicating a positive change in count rate as the neutron level is increased near its associated detector.

TABLE 14.2-5

SEISMIC INSTRUMENTATION

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, RCS at ambient temperature and pressure.

Test Objective

To demonstrate operability of the seismic instrumentation.

Test Summary

The equipment to be tested will be the triaxial acceleration sensor at the free field location; four more triaxial acceleration sensors located at counting room of auxiliary building; containment wall; base slab of containment; and, operation floor of containment. Further equipment to be tested, located in the auxiliary electrical equipment room, is the time-history accelerograph, triaxial play back system, triaxial response spectrum analyzer (also known as a recorder), and the seismic warning panel. There are also three peak recording accelerometers located on SI piping in containment, auxiliary building essential service water return piping, and on an accumulator tank which, due to their nature, are not testable.

Acceptance Criteria

The instrumentation is aligned and operable in accordance with Subsection 3.7.4.

TABLE 14.2-6

REACTOR PROTECTION

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, RCS at ambient temperature and pressure.

Test Objective

To verify operation of the reactor protection channels from each protection sensor through to tripping of the reactor trip breakers.

Test Summary

Prior to core loading the operation of the reactor trip system will be verified under all conditions of logic utilizing outputs or simulated outputs from each of the nuclear and process and other protection sensors. It will demonstrate that both Train A and Train B are independent and a loss of one train will not affect the other. The individual protection channels will be tested to check the redundance of the systems and to demonstrate safe failure on loss of power. The protection channels will be verified through to tripping of the reactor trip breakers. The trip time of each reactor protection signal will be measured from the output of the sensor to tripping of the reactor trip breaker.

Verification that the control rod drive mechanisms will unlatch upon opening of the trip breakers will be part of the Initial Criticality Procedure. Other items such as simulated trip signals, bypass breaker operation, interlocks, rod blocks, and turbine runbacks are verified in the Reactor Protection Preoperational Test.

Acceptance Criteria

The reactor protection system operates in accordance with Section 7.2.

TABLE 14.2-7

ENGINEERED SAFETY FEATURES

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, RCS at ambient temperature and pressure.

Test Objective

To verify operation of the safeguards logic systems for all conditions of trip logic.

Test Summary

Prior to core loading the operation of the Engineering Safety Features will be demonstrated. It will include actuation of containment systems, emergency core cooling systems (ECCS), habitability systems, fission product removal, and control systems. It will demonstrate redundancy, coincidence, and safe failure on loss of power. The trip time of each reactor protection signal will be measured from the output of the sensor to tripping of the reactor trip breaker.

Acceptance Criteria

The safeguards logic system operates in accordance with Section 7.3.

TABLE 14.2-8

AREA RADIATION MONITORS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate that area radiation monitors function properly.

Test Summary

The preoperational test will include operation of the check sources, annunciation and alarm on high radiation, test of indicating and recording features, and functioning of interlocks, if applicable.

Acceptance Criteria

The area radiation monitors alarm and indicate high radiation setpoint exceeded and interlock setpoint exceeded conditions.

TABLE 14.2-9

PROCESS RADIATION MONITORS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate that process radiation monitors function properly.

Test Summary

The preoperational test will include operation of the check sources, annunciation and alarm on high radiation, tests of indicating features, and functioning of interlocks, if applicable. This will include effluent monitors with isolation functions.

Acceptance Criteria

The process radiation monitors alarm and indicate high radiation setpoint exceeded and interlock setpoint exceeded conditions.

TABLE 14.2-10

COMMUNICATION SYSTEM

NOT USED

TABLE 14.2-11

AUXILIARY POWER SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, auxiliary power system powered from offsite power supplies.

During preoperational testing of the AP system, the reserve feed breakers, 1414, 1424, 2414 and 2424, (unit cross-ties), will be deenergized.

Test Objective

To verify proper operation of the auxiliary power transformers, breakers, switchgear, and other components.

Test Summary

Prior to core loading the auxiliary power system will be tested and verified that all interlocks, protective features, alarms, and indications are operational. It will demonstrate that a loss of offsite power will transfer to onsite power and function as per its design capabilities. Tests of the vital buses will be performed as early as the necessary components become available for testing, but not during the period when electrical separation requirements are in effect for Unit 1 operation and Unit 2 construction. It will also demonstrate that the two ESF Divisions 11 and 12 are completely independent. Voltages and proper phase rotations will be demonstrated to perform as per its design. Full accident load testing will be performed using the system auxiliary transformer, reserve feed, and diesel-generator. During full load accident testing, voltage readings of the offsite power source and voltage readings of the vital buses will be taken.

The voltage levels at the vital buses are predicted throughout the anticipated range of voltage variation of the offsite power source by an engineering analysis. Unit 1 readings will be taken at a threshold level equal to 30% of startup loading, include transient recordings for both safety and nonsafety motors, and at an initial minimum steady-state loading. Unit 2 readings will only be taken at 30% loading in order to verify transformer tap selection.

Acceptance Criteria

Each 480V or 4-kV auxiliary power bus can be supplied with power in accordance with Subsection 8.3.1.1.1.

TABLE 14.2-12

INSTRUMENT POWER SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, RCS at ambient temperature and pressure, instrument power buses powered from their normal power supplies.

Test Objective

To demonstrate proper operation of the instrument power system including the inverters and constant voltage transformers.

Test Summary

A preoperational test will demonstrate that the instrument power buses can be supplied from the appropriate power sources. It will demonstrate the capability of the inverters to transfer to the alternate power source on loss of normal power and maintain an uninterrupted source of power to the instrument bus. The inverters and constant voltage transformers will be verified to maintain the proper voltage and frequency output while varying the voltage input and loading. Setpoints of associated alarms, relays, and instrumentation will be verified.

Acceptance Criteria

The instrument power system supplies power to the instrument power buses in accordance with Subsection 8.3.1.1.2.

TABLE 14.2-13

D-C POWER

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, RCS at ambient temperature and pressure, battery chargers are powered from their normal power supplies.

Test Objective

To verify proper operation of the batteries, battery chargers, switchgear and alarms of the 125-Vdc system.

Test Summary

A preoperational test will be run on the 125-Vdc system including the batteries, chargers, and distribution centers. The battery capacity will be verified with the battery charger electrically disconnected. Individual cell voltage readings will be taken at periodic intervals during the capacity test to ensure that individual cell limits are not exceeded. A performance test will be conducted on the battery chargers to verify its voltage regulation. Each battery charger will be demonstrated to be capable of charging its associated battery within 24 hours while simultaneously supplying the largest combined demands of the expected steady-state loads under all normal plant operating conditions. The test will verify the proper settings of the low voltage alarm, high d-c output voltage trip of ac input breaker, ac fail alarm, bus undervoltage alarm, ground detector alarm, and breaker trip alarms.

Acceptance Criteria

Each battery can carry its design load in accordance with Subsection 8.3.2.

TABLE 14.2-14

VITAL BUS INDEPENDENCE VERIFICATION

(Preoperational Test)

Plant Condition or Prerequisite

Prior to plant operation.

Test Objective

To verify the existence of independence among redundant onsite power sources and their load groups.

Test Summary

The plant electric power distribution system, not necessarily including the switchyard and unit and system auxiliary transformers, will be isolated from the offsite transmission network. The onsite electric power system will then be functionally tested successively in the various combinations of power sources and load groups with all d-c and onsite a-c power sources for one load group at a time completely disconnected. Each test will include injection of simulated accident signals, startup of the diesel generator and load group under test, sequencing of loads, and the functional performance of the loads. Each test will be of sufficient duration to achieve stable operating conditions. During each test the d-c and onsite a-c buses and related loads not under test will be monitored to verify absence of voltage at these buses and loads.

Acceptance Criteria

Each redundant onsite power source and its load group are independent of any other redundant load group in accordance with Subsection 8.1.1.

TABLE 14.2-15

ESSENTIAL SERVICE WATER SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, prior to and during integrated hot functional testing. All loads supplied by the system shall be functional.

Test Objective

To verify acceptable service water flow to all components cooled by the system.

Test Summary

The essential service water system will be operationally checked to verify pressures and flows. Service water flow will be verified to all components in the system. Functional operation of pump discharge strainers will also be verified. Operation will be demonstrated from normal and emergency power sources. Pump head and flow characteristics will be determined. Controls, interlocks, and instrumentation will be demonstrated. During hot functional testing the system will be verified to maintain adequate component temperatures. At Byron, proper operation of cooling tower fans and tower level control in normal and backup modes will be verified.

The adequacy of NPSH and the absence of vortexing over the range of basin levels anticipated in Byron's essential service water cooling towers will be demonstrated.

Byron's essential service water cooling towers will be tested during the residual heat removal (RHR system) phase of the plant cooldown from the integrated hot functional test. This will be a part-load test, together with an extrapolation, to prove full-load power performance.

Acceptance Criteria

The essential service water system supplies water to all components in the system under all modes of operation in accordance with Subsection 9.2.1.2.

TABLE 14.2-15

ESSENTIAL SERVICE WATER SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, prior to and during integrated hot functional testing. All loads supplied by the system shall be functional.

Test Objective

To verify acceptable service water flow to all components cooled by the system.

Test Summary

The essential service water system will be operationally checked to verify pressures and flows. Service water flow will be verified to all components in the system. Functional operation of pump discharge strainers will also be verified. Operation will be demonstrated from normal and emergency power sources. Pump head and flow characteristics will be determined. Controls, interlocks, and instrumentation will be demonstrated. During hot functional testing the system will be verified to maintain adequate component temperatures.

Acceptance Criteria

The essential service water system supplies water to all components in the system under all modes of operation in accordance with Subsection 9.2.1.2.

TABLE 14.2-16

COMPONENT COOLING SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, prior to and during integrated hot functional testing. All loads supplied by the system shall be functional, essential service water system shall be functional.

Test Objective

To verify that adequate cooling is supplied to each component including containment penetrations and that temperature limits are maintained.

Test Summary

The component cooling supply to the various components in the system will be adjusted. During hot functional testing and during cooldown, data will be taken to verify that adequate cooling is supplied to each component and that temperature limits are maintained. For those penetrations not cooled by the component system, a representative sample of the concrete surface temperatures will be measured and evaluated. Pump characteristics will be determined, valve operation demonstrated, and system control, indication, and alarm functions verified.

Automatic start feature of the standby CCS pump will be verified. Automatic isolation of the RCS pump thermal barrier cooling lines on high flow will be demonstrated. Automatic closure of valves on Phase A and Phase B isolation will be demonstrated. Auto isolation feature of the surge tank atmospheric vent will be demonstrated.

Acceptance Criteria

The component cooling system supplies cooling to all components in the system in accordance with Subsection 9.2.2.3.

TABLE 14.2-17

RESIDUAL HEAT REMOVAL SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, prior to and during integrated hot functional testing and during ECCS full flow testing, RCS will be at various temperatures and pressures.

Test Objective

To verify adequate flow in all modes of operation.

Test Summary

The residual heat removal (RHR) system will be operationally checked prior to initial core load by verifying pressures and flows for the various flow paths. During the cooldown phase of hot functional testing, the cooldown capability of the system will be demonstrated. Pump characteristics will be determined, valve interlocks and controls verified, and system control and alarm functions verified.

Use of the residual heat removal system for the refueling mode will be tested by verification of the following operating procedures during performance of the RHR preoperational testing: preparation for refueling, pumping from the refueling cavity to the RWST, and pumping from the refueling cavity to the recycle holdup tanks. Plant startup and isolation of RHR from the RCS will be tested during heatup for hot functional testing by monitoring reactor coolant temperature and pressure. Plant shutdown and initiation of RHR will be tested during the cooldown phase of hot functional testing by reducing the temperature and pressure of the reactor coolant.

Testing for RHR pump automatic start on a safety injection signal will be performed during logic testing of the RHR pumps and preoperational testing of the ECC system. RHR miniflow recirculation and proper operation of the miniflow line isolation valve will be tested during logic and integrated testing of RHR. RHR pump curve data, vibration data, running current, etc. will be taken while on recirculation. Operation of RHR on miniflow recirculation will also be tested during ECCS preoperational testing. RHR pump automatic suction switch over to the containment sump will be tested as part of the valve logic testing of the safety injection system.

Acceptance Criteria

The RHR system operates in accordance with Subsection 5.4.7.

TABLE 14.2-18

CONTAINMENT SPRAY SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, and during ECCS full flow testing period.

Test Objective

To verify that the containment spray system can deliver water at proper flow and pressure to the containment spray headers.

Test Summary

All modes of containment spray pump operation will be tested to verify flow paths and pump flow and pressure characteristics. System response to a containment high-high-high pressure signal will be demonstrated. Spray nozzles will be tested using hot air injected into the nozzles and infra-red thermography or alternative methods to verify proper nozzle flow. Water injection through the spray nozzles is not planned. Spray pump "Head vs. Flow Curves" will be obtained while the pumps are in a recirculation mode back to the refueling water storage tank. Valve operability, interlocks, and indication will be verified. The paths for the air flow test of the containment spray nozzles will overlap the water flow test paths of the pumps at the connecting spool pieces.

The spray additive tank will be filled with demineralized water and with the containment spray pumps operating adjustment of valves CS018A or CS021A and CS018B or CS021B will be made to yield 55 gpm flow across the respective flow indicator, corrected for specific gravity to simulate a 30% NaOH solution.

Acceptance Criteria

The containment spray system operates in accordance with Subsections 6.5.2.2 and 7.3.1.1.13.

TABLE 14.2-19

AUXILIARY FEEDWATER SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, prior to and during integrated hot functional testing, and during ECCS full flow testing, RCS will be at various temperatures and pressures.

Test Objective

To verify the ability of the auxiliary feedwater system to respond to a feedwater demand under any plant condition.

Test Summary

The auxiliary feedwater system will be tested prior to hot functional testing to verify pump performance over extended periods on recirculation, and at various flow rates. Motor and diesel-driven pumps will be verified to start under any safeguard situation under any possible control lineup, including restart capability, from any control station, following a protective trip. Control logic and interlocks for both manual and automatic operation and protective features for motor- and diesel-driven pumps and all power-operated valves will be verified for setpoint, indication, and alarms.

All motor- and diesel-driven pumps will be tested for five consecutive, successful cold starts per pump.

All motor-operated valves will be verified to position or reposition to the required lineup from any plant condition, safeguard situation or suction requirement. Air-operated valves will be verified to position or reposition to the required lineup from any plant condition, safeguard situation, suction requirement, or loss of power. Essential service water booster pumps attached to the diesel prime movers will be verified for flow and cooling requirements of the engine and cubicle cooler. All flow limiting devices will be verified by line flow checks and identification tab data.

Acceptance Criteria

The auxiliary feedwater system supplies feedwater in accordance with Subsection 10.4.9.3.1.

TABLE 14.2-20

PRIMARY SAMPLING SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

During hot functional testing, prior to and during integrated hot functional testing, RCS will be at various temperatures and pressures.

Test Objective

To demonstrate that samples may be taken from the primary system.

Test Summary

Liquid and gas sample from primary systems will be sampled in normal operating and accident modes. Containment air samples will be obtained in the accident mode.

Acceptance Criteria

The process sampling system operates in accordance with Subsections 9.3.2.1.1 and 9.3.2.1.2.

TABLE 14.2-21

LEAK DETECTION SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, RCS shall be at ambient temperatures and pressure.

Test Objective

To ensure the containment sump and reactor cavity sump leak detection systems are functional.

Test Summary

Reactor cavity sump and containment sump level and flow monitoring instrumentation shall be functionally tested to verify proper operation.

Acceptance Criteria

The leak detection system operates in accordance with Subsection 5.2.5.1.

TABLE 14.2-22

FUEL POOL COOLING AND CLEANUP SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, RCS shall be at ambient temperature and pressure.

Test Objective

To ensure the proper operation of all equipment, controls, interlocks and alarms associated with the fuel pool cooling and cleanup system. To ensure the operation of the skimmer loop. To perform a spent fuel pool leak inspection using the leak detection sight glasses and measure any leakage detected. To demonstrate flow through the spent fuel pool demineralizers and heat exchanger loops.

Test Summary

Tests will be performed to verify flow through the spent fuel pool demineralizers, heat exchanger loops plus the loop from the refueling water storage tanks through the spent fuel pool demineralizers and filters and back to the refueling water storage tanks. The line from the refueling water storage tank to the fuel cask fill will also be tested. The spent fuel pool will be filled using the refueling water storage tank and the refueling water purification pumps. Alarm setpoints will be checked and valves, instruments and controls tested. The leakage detection system will be used to measure any leakage detected. The antisiphon device will be tested using a low point drain on the heat exchangers.

Acceptance Criteria

The fuel pool cooling and cleanup system operates in accordance with Subsection 9.1.3.

TABLE 14.2-23

FUEL HANDLING AND TRANSFER SYSTEMS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, RCS shall be at ambient temperature and pressure.

Test Objective

To demonstrate functioning of the fuel transfer system and of the fuel handling tools.

The fuel handling system consists of the fuel building equipment crane, spent fuel pit bridge and hoists, and manipulator crane.

The fuel transfer system consists of the transfer cart and upenders.

Test Summary

All components, including special handling tools, will be tested prior to first use on new fuel. These tests will be conducted using dummy fuel assemblies to verify interlocks, setpoints, indexing, load capacity, and other indications.

The spent fuel pit bridge and hoists and the manipulator crane will be statically tested at 125% of rated load. They will be tested operationally at 100% of rated load and indexed using the dummy fuel assemblies. Special handling tools will be statically tested at 125% of rated load and operationally tested at 100% of rated load using a dummy fuel assembly. The fuel transfer system will be tested at 100% of rated load using a dummy fuel assembly. The fuel building equipment crane (fuel cask handling crane) will be verified to statically withstand 125% of rated load and to operationally withstand 100% of rated load.

Acceptance Criteria

The fuel handling equipment will transfer fuel assemblies in accordance with Subsection 9.1.4.

TABLE 14.2-24

RADIOACTIVE WASTE GAS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load and for plant degassing capabilities during startup testing.

Test Objective

To verify system operation. (Some sections of the test will be performed during the startup test for reactor coolant system degassing.)

Test Summary

Tests will be performed to demonstrate gas transfer from vent header to gas decay tanks and to verify valve operation, and interlocks. Alarms and pressure setpoints will be checked.

Acceptance Criteria

The radioactive waste gas system and its components operates in accordance with Table 11.3-1 for compressor suction pressure, discharge pressure, and normal operating temperature, and Subsection 11.3.2.4 for switchover pressure on the gas decay tanks and backup waste gas compressor auto-start pressure.

TABLE 14.2-25

BYRON DIESEL GENERATORS 1A, 1B, AND 2A

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate that each diesel generator can start and assume its rated load and to verify operation of alarms, indications, controls, and safety features.

Test Summary

Each diesel will be started and loaded a number of times under normal and simulated accident conditions to prove conformance to Regulatory Guide 1.108, Revision 1, Regulatory Positions C.2.a, parts (1), (3), (4), (6), and (9), and C.2.b during this test. Conformance to Regulatory Position C.2.a, parts (2), (5), (7), and (8) will be demonstrated in other preoperational tests or in plant surveillance. Data collected during this test to prove conformance includes voltage, frequency, and current.

Acceptance Criteria

Each diesel generator will be tested to prove conformance to Regulatory Guide 1.108, Revision 1, Regulatory Positions C.2.a, parts (1), (3), (4), (6), and (9), and C.2.b.

TABLE 14.2-25a

BYRON DIESEL GENERATOR 2B AND BRAIDWOOD DIESEL GENERATORS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate that each diesel generator can start and assume its rated load and to verify operation of alarms, indications, controls, and safety features.

Test Summary

Each diesel will be started and loaded a number of times under normal and simulated accident conditions to prove conformance to Regulatory Guide 1.108, Revision 1, Regulatory Positions C.2.a, parts (1), (3), (4), (5), (6), (8), (9), and C.2.b during this test. Conformance to Regulatory Position C.2.a, part (2) will be demonstrated in the ECCS full flow test (Table 14.2-33). Data collected during this test to prove conformance includes voltage, frequency, and current.

Acceptance Criteria

Each diesel generator will be tested to prove conformance to Regulatory Guide 1.108, Revision 1, Regulatory Positions C.2.a, parts (1), (3), (4), (5), (6), (8), (9), and C.2.b.

TABLE 14.2-26

DIESEL FUEL OIL TRANSFER SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load.

Test Objective

To demonstrate that diesel fuel oil can be delivered to each diesel day tank.

Test Summary

Tests will be conducted to demonstrate that diesel fuel oil can be received, and stored, in the diesel fuel oil storage tanks. Alarms, controls and indications will be checked. Demonstration of the ability of the system to supply fuel for an adequate time to operating engines will be accomplished.

Acceptance Criteria

The diesel fuel oil transfer system will receive, store, and deliver fuel oil to each diesel generator.

Each diesel fuel oil transfer pump will deliver fuel oil to each diesel generator in excess of the maximum demand, as indicated in Subsection 9.5.4.

TABLE 14.2-27

ECCS - EXPANSION AND RESTRAINT

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core loads during integrated hot functional testing at specific steps during plant heatup and cooldown.

Test Objective

To verify ECC systems can expand unrestricted with acceptable clearances.

To confirm acceptability of system piping movements under system heatup and cooldown conditions and during steady-state operation.

Test Summary

During heatup to operating temperature selected points on components and piping of the ECC system are checked at various temperatures to verify that they can expand unrestricted with acceptable clearance. Baseline data is established at cold plant condition for making measurement during heatup. Any potential points of interference detected during heatup will be corrected prior to increasing temperature. Following cooldown to ambient temperature, the piping and components will be checked to confirm that they return to their approximate baseline position to verify unrestricted movement during cooldown.

Acceptance Criteria

The ECC system components and piping can expand to operation temperature and return to ambient unrestricted in accordance with the response to Question 110.37.

TABLE 14.2-28

ECCS - SAFETY INJECTION PUMPS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with reactor vessel open and flooded and reactor coolant system at essentially ambient pressure and temperature conditions.

Test Objective

To demonstrate system and component capability by injecting water from the refueling water storage tank into the reactor vessel through various combinations of injection lines and Safety Injection (SI) pumps.

Test Method

The reactor vessel will be open with provision made to remove excess water. Separate flow tests will be made for each pump to check proper runout rates, proper flow balancing in branch injection headers, and capability for sustained operation. Data will be taken to determine pump head and flow. Pumps will be run on miniflow paths to determine a second point on the head flow characteristic curve.

These tests will be conducted with water in the reactor vessel below the nozzles to simulate discharging to atmospheric pressure.

Acceptance Criteria

The SI pumps inject water into the vessel in accordance with Section 6.3.

TABLE 14.2-29

ECCS - CENTRIFUGAL CHARGING PUMPS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the reactor vessel open and flooded and reactor coolant system at relatively ambient pressure and temperature conditions.

Test Objective

To demonstrate system and component capability by injecting water from the refueling water storage tank into the reactor vessel using various combinations of injection lines and charging pumps.

Test Method

The reactor vessel will be open with provisions made to remove excess water. Separate flow tests will be made for each pump to check proper runout rates, proper flow balancing in branch injection headers, and capability for sustained operation. Data will be taken to determine pump head and flow. Pumps will be run on miniflow paths to determine a second point on the head flow characteristic curve.

These tests will be conducted with water in the reactor vessel below the nozzles to simulate discharging to atmospheric pressure.

Acceptance Criteria

The pumps should operate according to Table 6.3-1, for pump capability.

TABLE 14.2-30

ECCS - RHR PUMPS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the reactor vessel open and flooded and reactor coolant system at essentially ambient pressure and conditions.

Test Objective

To demonstrate system and component capability by injecting water from the Refueling Water Storage tank into the reactor vessel using various combinations of injection lines and Residual Heat Removal (RHR) pumps.

Test Method

The reactor vessel will be open with provisions made to remove excess water. Separate flow tests will be made for each pump to check proper runout rates and capability for sustained operation. Data will be taken to determine pump head and flow. Pumps will also be run on miniflow paths to determine a second point on the head flow characteristic curve. Tests will be conducted on valves associated with the RHR portion of the SI system to verify that valves installed for redundant flow paths operate as designed, that the proper sequencing of valves occurs on initiation of safety injection signal, and that the fail position on loss of air for each air operated valve is as specified. Proper operation of the centrifugal charging pumps and safety injection pumps while aligned to take suction from the RHR pumps discharge will be tested as part of the full flow emergency core cooling test.

Acceptance Criteria

The RHR portion of the emergency core cooling system (ECCS) operates in accordance with Section 6.3.

TABLE 14.2-31

ECCS - ACCUMULATORS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the reactor vessel open and in a cold condition.

Test Objective

To demonstrate proper system actuation and to verify that the flow rate is as expected for the test conditions.

To demonstrate that the accumulator isolation valves will open under the maximum differential pressure condition of zero RCS pressure and maximum expected accumulator precharge pressure.

Test Method

Each accumulator will be filled with water from the RWST and pressurized to the maximum expected accumulator pressure with the MOV on the discharge line closed. The valve is then opened and the accumulator allowed to discharge into the reactor vessel with the reactor cold and the vessel head removed. Provisions will be made to remove excess water. Proper operation of the nitrogen fill, vent valves, accumulator drains and accumulator makeup will be verified.

Acceptance Criteria

Motor-operated valves and check valves are free to open. Blowdown response is in accordance with Section 6.3.

TABLE 14.2-32

ECCS - RECIRCULATION PHASE

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the reactor vessel open and flooded and reactor coolant system at essentially ambient pressure and temperature conditions. The containment recirculation sump will be filled and the refueling cavity will be flooded.

Test Objective

To demonstrate recirculation mode of emergency core cooling system (ECCS) operations under conditions of full flow, discharging to an open reactor vessel. Reactor coolant system back pressure will be only that created by the height of water above the vessel nozzles.

Test Method

Demonstrate that the RHR pumps can take suction from the containment sump to verify vortex control and that acceptable pressure drop occurs across screening and suction lines and valves. The test will be initiated by starting an RHR pump while a valve (in a temporary line from the refueling cavity to the sump) is opened to maintain level in the sump. To avoid RCS contaminations, the sump water may be discharged to external drain or other systems.

Acceptance Criteria

The available net positive suction head of the RHR pump is in accordance with Section 6.3.

TABLE 14.2-33

ECCS - SAFETY INJECTION PUMPS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the reactor vessel open and flooded and reactor coolant system at essentially ambient pressure and temperature conditions.

Test Objective

To demonstrate system and component capability by injecting water from the refueling water storage tank into the reactor vessel through various combinations of injection lines and Safety Injection (SI) pumps.

Test Method

The initial condition for the full flow ECCS test will be an "at power" line up. The discharge and suction lines to the centrifugal charging pumps will be in the normal "at power" configuration. An "s" signal will be manually initiated. At this point, the automatic suction switchover to the RWST and the automatic isolation of the miniflow bypass and normal charging lines will be verified.

The head will be removed from the vessel and the refueling boot installed allowing the ECCS to flood the refueling cavity. A temporary line and throttle valve will be installed between the refueling cavity and the containment recirculation sumps. Upon reaching the auto switchover level alarm in the RWST, the automatic suction switchover for the RHR pumps from the RWST to the containment recirculation sumps will be verified. The containment recirculation sumps will be kept full by manual operator actions with the throttle valve in the temporary installed line between the refueling cavity and the sumps. The suction for the charging pumps and SI pumps will be realigned by manual operator action to the discharge of the RHR pumps. Pump parameters will be monitored to ensure high pressure injection systems function as designed with the suction aligned to the RHR discharge.

Acceptance Criteria

The SI pumps inject water into the vessel in accordance with Section 6.3.

TABLE 14.2-34

ECCS - CHECK VALVE OPERABILITY

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the reactor coolant system hot and pressurized.

Test Objective

To verify that check valves in the emergency core cooling system are functional.

Test Summary

Back leakage tests will be performed on cold and hot leg injection lines' series check valves. Flow tests will be performed using the safety injection pumps to verify the operability of those check valves which experience higher-than-ambient temperatures at this higher temperature. During this test, the injection ability of the safety injection pumps to inject small amounts of water into the primary system conditions will be verified. Also the capability of the safety injection to deliver under accident conditions will be verified by pump and system head-capacity curves without subjecting the system to extreme thermal shocks.

Each accumulator injection train will be tested by decreasing RCS pressure and temperature until accumulator check valves operate, as indicated by a drop in the accumulator water level.

Acceptance Criteria

Each check valve operates in accordance with Section 6.3.

TABLE 14.2-35

AUXILIARY BUILDING HVAC

(Preoperational Test)

Plant Condition or Prerequisite

With the RCS at ambient temperature and pressure.

Test Objective

To demonstrate operation of the auxiliary building heating, ventilation, and air conditioning (HVAC) system, including the fire protection interface.

Test Summary

The system will be operated to verify air flow, motor currents, instrument setpoints, and to check alarms. The system will be operated to verify operation of dampers, fans, and equipment interlocks. The system will be operated to verify that the auxiliary building and the fuel handling building are maintained at negative pressure with respect to atmosphere. The fire protection system interlocks with the HVAC system will be verified.

The system will be demonstrated capable of maintaining ESF equipment within its design temperature range by measuring air and cooling water temperatures and flows and making engineering extrapolations to postaccident design heat loads.

Acceptance Criteria

The auxiliary building HVAC system supplies ventilation in accordance with Subsections 9.4.5.1, 6.5.1.1.2, and 9.2.7.3, respectively, and testing of HVAC system filter units will be in accordance with Regulatory Guide 1.52 (with comments and exceptions as stated in Appendix A, Item A1.52).

TABLE 14.2-36

CONTROL ROOM HVAC

(Preoperational Test)

Plant Condition or Prerequisite

With the RCS at ambient temperature and pressure.

Test Objective

To demonstrate operation of the control room heating and ventilation system, including the fire protection interface.

Test Summary

The system will be operated to verify air flows, motor currents, instrument setpoints, and to check alarms. The system will be operated to verify operation of dampers, fans, and equipment interlocks with high radiation or ESF signals. The system will be operated to verify that the control room is maintained at positive pressure. The fire protection system interlocks with the HVAC system will be verified.

The system will be demonstrated capable of maintaining ESF equipment within its design temperature range by measuring air and cooling water temperatures and flows and making engineering extrapolations to postaccident design heat loads.

Acceptance Criteria

The control room HVAC system supplies ventilation in accordance with Subsections 9.4.1 and 6.5.1.1.1, 7.3.1.1.9, and 6.4 respectively, and testing of the makeup air filter unit is in accordance with Regulatory Guide 1.52 (with comments and exceptions as stated in Appendix A, Item A1.52).

TABLE 14.2-37

DIESEL-GENERATOR ROOM VENTILATION SYSTEM

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the RCS at ambient temperature and pressure and the diesel generators available for operation.

Test Objective

To demonstrate operation of the diesel-generator room ventilation system, including the fire protection interface.

Test Summary

The system will be operated to verify air flows, motor currents, instrument setpoints, and alarms. The system will be operated to verify the operation of dampers, fans, and equipment interlocks. The fire protection system interlocks with the HVAC system will be verified.

The system will be demonstrated capable of maintaining ESF equipment within its design temperature range by measuring air and cooling water temperatures and flows and making engineering extrapolations to postaccident design heat loads.

Acceptance Criteria

The diesel-generator ventilation system supplies ventilation in accordance with Subsection 9.4.5.2.

TABLE 14.2-38

ESF SWITCHGEAR HVAC

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the RCS at ambient temperature and pressure.

Test Objective

To demonstrate operation of the engineered safety feature (ESF) switchgear heating and ventilation system, including the fire protection interface.

Test Summary

The system will be operated to verify air flows, motor currents, instrument setpoints, and alarms. The system will be operated to verify operation of dampers, fans, and equipment interlocks. The fire protection system interlocks with HVAC system will be verified.

The system will be demonstrated capable of maintaining ESF equipment within its design temperature range by measuring air and cooling water temperature and flows and making engineering extrapolations to postaccident design heat loads.

Acceptance Criteria

The ESF switchgear HVAC system supplies ventilation in accordance with Subsection 9.4.5.4.1.1.f.

TABLE 14.2-38a

MISCELLANEOUS ELECTRIC EQUIPMENT ROOM HVAC

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the RCS at ambient temperature and pressure.

Test Objective

To demonstrate operation of the miscellaneous electric equipment room ventilation system, including the fire protection system interface.

Test Summary

The system will be operated to verify air flows, motor currents, and alarms. The system test will verify the operation of dampers and equipment interlocks. The fire protection system interlock with the HVAC system will be verified.

The system will be demonstrated capable of maintaining ESF equipment within its design temperature range by measuring air and cooling water temperatures and flows and making engineering extrapolations to postaccident design heat loads.

Acceptance Criteria

The miscellaneous electric equipment room HVAC system supplies ventilation in accordance with Subsection 9.4.5.3.

TABLE 14.2-39

CONTAINMENT PURGE

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the RCS at ambient temperature and pressure.

Test Objective

To demonstrate proper operation of the containment purge system, including fire protection interfaces.

Test Summary

The system will be operated to verify flows, motor currents, instrument setpoints, and alarms. The system will be operated to verify the operation of dampers and equipment interlocks. The fire protection system interlocks with the HVAC system will be verified.

The system will be demonstrated capable of maintaining ESF equipment within its design temperature range by measuring air and cooling water temperatures and flows and making engineering extrapolations to postaccident design head loads.

Acceptance Criteria

The containment purge system supplies ventilation in accordance with Subsections 6.2.4.2.5, 9.4.9, 9.4.10, and Tables 9.4-25 and 9.4-26. Filter testing will be done in accordance with Regulatory Guide 1.140 (with comments and exceptions as stated in Appendix A, Section A1.140).

TABLE 14.2-40

HYDROGEN RECOMBINER

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the RCS at ambient temperature and pressure.

Test Objective

To demonstrate operation of the post-LOCA hydrogen control system recombiner.

Test Summary

The hydrogen recombiner system is operated to demonstrate proper flows and to verify design power to the heater units of the recombiner.

Acceptance Criteria

The hydrogen recombiner system operates in accordance with Subsection 6.2.5.

TABLE 14.2-41

CONTAINMENT VENTILATION

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the RCS at ambient temperature and pressure.

Test Objective

To demonstrate containment ventilation system operation.

Test Summary

The following subsystems are contained in the containment ventilation system: reactor containment fan coolers, control rod drive mechanism ventilation, reactor cavity ventilation and containment charcoal filtration. These systems will be operated to verify air flows, instrument setpoints, and alarms. The system test also verify operation of dampers, fans, and equipment interlocks.

The system will be demonstrated capable of maintaining ESF equipment within its design temperature range by measuring air and cooling water temperatures and flows and making engineering extrapolations to postaccident design heat loads.

Acceptance Criteria

The containment ventilation system supplies ventilation in accordance with Subsections 3.1.2.4.9, 3.1.2.4.10, 3.1.2.4.11, 3.11.4.5, 7.3.1.1.12, 7.3.2.2.12, 7.4.1.2.2, and 9.4.8.

TABLE 14.2-42

MAIN STEAM ISOLATION VALVES

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, prior to and during integrated hot functional testing with the RCS at normal operating temperature and pressure.

Test Objective

To verify operation of the main steam isolation valves.

Test Summary

Operation of the main steam isolation valves will be verified at hot conditions at pressure. The closure time of each valve will be measured. Functional tests will be performed on the main steam isolation valve (MSIV) hydraulic units. Local and remote alarms, indicators, and actuation circuits will be tested.

Acceptance Criteria

Hydraulic circuits function and MSIV closure times are in accordance with Subsections 10.3.4.2 and 16.3.7.1.5.

TABLE 14.2-43

PRESSURIZER RELIEF TANK

NOT USED

TABLE 14.2-44

REACTOR COOLANT PUMPS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core loading, prior to and during integrated hot functional testing with the RCS at various temperatures and pressures.

Test Objective

To place the reactor coolant pumps in service.

Test Summary

Vibration sensors on the reactor coolant pumps will monitor the amplitude of vibration during startup and operation. The pump motors will be tested to verify power supply voltage and power requirements. The pump direction of rotation, flow, and pressure characteristics will be verified. Lubrication, cooling flow, and seal water flow will be checked. Interlocks, controls, and indicators will be tested. The antirotation device for each reactor coolant pump will be checked.

Acceptance Criteria

Flow and pressure parameters can be maintained during 240 hours of full flow operation.

TABLE 14.2-45

REACTOR COOLANT ISOLATION VALVES

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core loading and during integrated hot functional testing (IHF) with the RCS at various temperatures and pressures.

Test Objective

To determine the opening and closing times of the main coolant isolation valves during IHF. To perform a logic test of the associated alarms, indications, and interlocks.

Test Summary

To verify the control interlocks and indications for each isolation valve. Each valve will be verified to cycle.

Acceptance Criteria

The main coolant isolation valves and interlocks operate in accordance with Subsection 7.6.8.

TABLE 14.2-46

CVCS - RCP SEAL WATER SUPPLY

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core loading, prior to and during integrated hot functional testing with the RCS at various temperatures and pressures.

Test Objective

To establish flow to the reactor coolant pump seals and to verify flow at temperature and pressure.

Test Summary

Design flow to and from the reactor coolant pump seals will be verified.

Acceptance Criteria

RCP seal water flows are in accordance with Table 9.3-2.

TABLE 14.2-47

CVCS - CHARGING AND LETDOWN

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core loading, prior to and during integrated hot functional testing with the RCS at various temperatures and pressures.

Test Objective

To demonstrate the charging and letdown functions of the chemical and volume control system (CVCS).

Test Summary

Tests will be performed to demonstrate that the CVCS can maintain a programmed water level in the pressurizer during heatup and cooldown of the reactor coolant system. Charging flow into the RCS will be demonstrated using both centrifugal charging pumps and the positive displacement pump. Flow to the reactor coolant system via auxiliary pressurizer spray line will be verified. The automatic diversion of letdown flow and automatic switch of charging pump suction on volume control tank levels will also be verified.

Acceptance Criteria

The CVCS maintains programmed level in the pressurizer during heatup and cooldown and normal operation of the reactor coolant system in accordance with Subsection 9.3.4.1.2.1.

TABLE 14.2-48

CVCS - REACTOR MAKEUP CONTROL

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core loading, prior to and during integrated hot functional testing with the RCS at various temperatures and pressures.

Test Objective

To demonstrate the boration and dilution functions of the chemical and volume control system (CVCS).

Test Summary

Operations will be conducted with the CVCS to check out blending operations and verify flows in the different modes of boration and dilution. Proper operation of the batching controls and totalizer, auto makeup, dilution, alternate dilution, boration, and manual modes will be demonstrated.

Acceptance Criteria

Flows through the CVCS piping and operation both in manual and auto mode are in accordance with Subsection 9.3.4.1.2.3.

TABLE 14.2-49

CVCS - PURIFICATION

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load during hot functional testing at temperature and pressure.

Test Objective

To verify operation of the purification function of the chemical and volume control system (CVCS).

Test Summary

During hot functional testing with the demineralizers charged with resin, operation of the purification system will be demonstrated by verification of flow, pressure drops, and temperature.

Acceptance Criteria

The CVCS purification is in accordance with Subsection 9.3.4.1.2.2.

TABLE 14.2-50

PRIMARY SAFETY AND RELIEF VALVES

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load and during integrated hot functional testing.

Test Objective

To verify the setpoints and measure the seat leakage of the pressurizer safety valves. To verify proper actuation and operation of the power operated relief valves.

Test Summary

Setpoint verification and seat leakage will be determined on site by bench testing for the pressurizer safety valves.

Three specific features of the power operated relief valve logic will be tested. They are the low temperature control, valve response time and enable functions from the pressurizer pressure transmitters.

Acceptance Criteria

The valve setpoints are in accordance with Technical Specifications.

TABLE 14.2-51

STEAM GENERATOR SAFETY AND RELIEF VALVES

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core loading, prior to and during integrated hot functional testing with the RCS at various temperatures and pressures.

Test Objective

To verify setpoints of the steam generator pressure relief and safety valves.

Test Summary

The setpoints of safety valves will be verified from in-plant tests at pressure and temperature. Setpoints will be checked by using a pressure assist device which adds to the force due to pressure. Once the valve leaves the sealed position, the assist device will be vented, allowing the valve to reseat immediately. Main steam power-operated relief valves will be set during instrument alignment and verified by plant transient tests. Local and remote alarms, indicators, and actuation circuits will be tested for the power-operated relief valves. Safety and relief valve capacities will be verified from vendor certification data due to the large amounts of steam flow and severe conditions involved.

Acceptance Criteria

The alarms, indicators, and actuation circuits for the power operated relief valves, and steam generator relief and safety valve setpoints, are in accordance with the Westinghouse Precautions, Limitations, and Setpoints document, and Subsection 10.3.1.

TABLE 14.2-52

PRESSURIZER

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core loading, prior to and during integrated hot functional testing with the RCS at various temperatures and pressures.

Test Objective

To demonstrate the capability of the pressurizer to control the reactor coolant system pressure.

Test Summary

Prior to hot functional testing, the pressurizer heaters and spray functions will be checked. During hot functional testing, the pressure controlling capability will be demonstrated. Pressurizer spray flow and bypass spray flow controls will be tested.

Acceptance Criteria

The heaters, power-operated relief valves, and spray valves function at the setpoints specified in the Westinghouse Precautions, Limitations, and Setpoints document.

TABLE 14.2-53

STEAM GENERATOR

(Preoperational Test)

Plant Condition or Prerequisite

At ambient conditions and during hot functional testing during heatup and at temperature.

Test Objective

To demonstrate the operability of instrumentation and control systems, the ability to cooldown the plant using the steam generators to dump steam, and the functioning of the blowdown system.

Test Summary

The steam generator level and pressure and flow instruments will be aligned and operable prior to heat up. During heatup and at temperature the instrumentation and control systems of the steam generators are checked under operating conditions. The ability to cooldown the plant using the steam generators to dump steam will be demonstrated. The steam generator blowdown system will be operationally tested.

Acceptance Criteria

The steam generator level alarm trip and control setpoints function at the values specified in the Westinghouse Precautions, Limitations, and Setpoints document.

TABLE 14.2-54

REACTOR COOLANT SYSTEM EXPANSION AND RESTRAINT

(Preoperational Test)

Plant Condition or Prerequisite

During hot functional testing prior to core load.

Test Objective

To verify that components and piping of the reactor coolant system can expand unrestricted with acceptable clearances.

Test Summary

Baseline data will be taken at cold plant conditions prior to heatup. During the heatup to operating temperatures, selected points on components, piping, and snubbers will be checked at various temperatures to verify that they can expand unrestricted with acceptable clearances. Any potential points of interference detected during the heatup will be corrected prior to increasing the temperature. Following cooldown to ambient temperature, the piping and components will be checked to confirm that they return to their approximate baseline positions to verify unrestricted movement during cooldown.

Acceptance Criteria

The piping and components are verified to expand without restricted movement.

Table 14.2-55 has been deleted intentionally

TABLE 14.2-56

CONTAINMENT LEAK RATE

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the RCS at ambient temperature and pressure.

Test Objective

To verify components structures and systems used for the containment isolation.

Test Summary

Type A, B, and C leak rate tests will be conducted in accordance with the requirements of 10 CFR 50 Appendix J.

Acceptance Criteria

The leak rates L_a are in accordance with Subsection 6.2.6.1.

TABLE 14.2-57

REACTOR COOLANT SYSTEM HYDROSTATIC

NOT USED

TABLE 14.2-58

INTEGRATED HOT FUNCTIONAL HEATUP

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load following hydrostatic testing of primary and secondary systems with essentially all associated systems preoperational testing completed.

Test Objective

To demonstrate ability to heat primary system to normal operating temperature and pressure.

Test Summary

The reactor coolant system will be taken to normal operating temperature and pressure using reactor coolant pump heat input. Tests will be performed to demonstrate operation of excess letdown and seal water flow paths and letdown flow rates. Thermal expansion checks including snubbers will be conducted.

Acceptance Criteria

Preoperational tests to be performed during plant heatup are accomplished and the reactor coolant system taken to normal operating temperature and pressure in accordance with the Westinghouse NSSS Startup Manual and the Westinghouse Precautions, Limitations, and Setpoint document.

TABLE 14.2-59

INTEGRATED HOT FUNCTIONAL AT TEMPERATURE

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load, RCS at hot no-load temperature and pressure using RCP heat input and steam dumping to maintain temperature. Essentially all preoperational tests complete on associated systems.

Test Objective

To verify proper operation of instrumentation, controls and alarms, and provide design operating conditions for testing auxiliary systems to maintain the RCS at hot no-load temperature with full RCS flow for subsequent internals vibration inspections.

Test Summary

The reactor coolant system will be maintained at the hot no-load operating temperature and pressure using reactor coolant pump heat input as required. Tests will be conducted to demonstrate the response of the system to changes in pressurizer level. Steam generator level instrumentation response to level changes will be demonstrated. Equipment used for maintaining the plant in hot shutdown outside the control room will be verified.

Acceptance Criteria

Preoperational tests to be performed while the plant is at temperature and pressure are performed and reviewed.

The pressurizer level control system, steam generator level instrumentation, steam generator levels, and hot shutdown conditions can be maintained in accordance with the Westinghouse Precautions, Limitations, and Setpoints document.

TABLE 14.2-60

INTEGRATED HOT FUNCTIONAL TESTING COOLDOWN

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the RCS at normal no-load temperature and integrated hot functional testing at temperature completed.

Test Objective

To demonstrate the ability to cooldown the plant from normal operating temperature and pressure to cold shutdown conditions.

Test Summary

The plant will be taken from hot to cold conditions using steam generator steam dump and the residual heat removal system as applicable. The thermal contraction of piping systems including snubbers will be monitored. Auxiliary systems required for cooldown will be operationally demonstrated.

Acceptance Criteria

The preoperational tests required to be performed during cooldown of the RCS are completed and reviewed.

Steam dump and residual heat removal systems cool the plant from hot no-load temperature to cold shutdown conditions in accordance with Subsection 5.4.7.1.

Thermal contraction of piping systems, and auxiliary systems required for cooldown, are in accordance with Subsection 3.9.2.1.

TABLE 14.2-61

REACTOR CONTAINMENT CRANE AND HOISTS

(Preoperational Test)

Plant Condition or Prerequisite

Prior to core load with the RCS at ambient temperature and pressure.

Test Objective

To verify operation of reactor containment polar crane, main hoist, and auxiliary hoist used for handling reactor equipment.

Test Summary

Tests will be performed to demonstrate the functioning of polar crane and hoists used to handle reactor equipment. Protective interlocks will be verified for proper operation.

Acceptance Criteria

The polar crane and hoists operate in agreement with the crane rating.

TABLE 14.2-62

INITIAL CORE LOAD

(Startup Test)

Plant Condition or Prerequisites

All systems necessary to support fuel loading shall be operable with appropriate preoperational tests completed, reviewed, and approved.

Test Objective

To assemble the reactor core in the vessel in a cautious and deliberate manner to preclude inadvertent criticality.

Test Summary

Initial fuel loading will be conducted as described in Subsection 14.2.10.1.

In addition to the summary offered in Subsection 14.2.10.1, the following items will be carried out prior to or during the performance of the test:

a. A response check of the nuclear instruments to a neutron source will be conducted within 8 hours of fuel loading.

b. Boron samples to determine boron concentration will be taken at least once every 4 hours throughout the core loading program.

c. Continuous voice communication links will be maintained between the control room and fuel loading personnel throughout the core loading program.

d. Prior to core loading the radiation monitoring system and associated ventilation interlocks will be aligned, calibrated and placed in service. Prior to core loading the plant nuclear instrumentation will be calibrated and placed in service. Prior to core loading containment evacuation alarms will be installed and satisfactorily tested, evacuation procedures will be explained and alarms demonstrated to all personnel involved. Throughout core loading containment evacuation alarms will be verified operable at least once per 8 hours.

TABLE 14.2-62 (Cont'd)

INITIAL CORE LOAD

(Startup Test)

e. RCS boron concentration shall be increased immediately in accordance with Plant Emergency Procedures if the RCS boron concentration decreases to a value lower than that required by Technical Specifications, or if after fuel movement has ceased, the nuclear monitoring channels indicate that the reactor is critical or continues to approach criticality. Concentrated boric acid from the boric acid tanks shall be added to the vessel through the emergency boration valve and the RCS charging pumps. Boration shall continue until the required shutdown status is achieved. Containment evacuation will be carried out in accordance with evacuation procedures.

Acceptance Criteria

The initial core loading is completed in accordance with Subsection 4.3.2.1.

TABLE 14.2-63

CONTROL ROD DRIVES

(Startup Test)

Plant Conditions or Prerequisites

Prior to initial criticality, RCS at 350 psig with control rods fully inserted.

Test Objective

To check the controlling features, verify setpoints, and to verify rod speeds and sequencing of power to the rod drives.

Test Summary

During rod withdrawal, following core loading and installation of the control rod drive mechanisms, operation of the control rod drive mechanisms will be verified under cold (pumps off) conditions and plant heatup (pumps on) conditions.

Acceptance Criteria

The control rod drive mechanisms operate over the full range of travel and that rod speeds are in accordance with Subsections 3.9.4.2 and 4.2.4.3.

TABLE 14.2-64

ROD POSITION INDICATORS

(Startup Test)

Plant Condition or Prerequisites

Prior to initial criticality, RCS at hot shutdown no load operating temperature and pressure.

Test Objective

To verify that the digital rod position indication system operates as designed.

Test Summary

Following core loading and installation of the rod mechanisms, the control rods will be operated over their full range of travel. The rod position indicators will be checked for accuracy over the rod full travel range. Also bank insertion alarms, deviation alarms and rod bottom setpoints and alarms will be demonstrated to be within limits specified in the FSAR.

Acceptance Criteria

The control rod position indicators are checked for accuracy in accordance with Subsection 7.7.1.3.2.

TABLE 14.2-65

REACTOR TRIP CIRCUIT

(Startup Test)

Plant Conditions or Prerequisites

Prior to initial criticality. Reactor protection preoperational testing completed, associated systems available to support reactor trip signal generation.

Test Objective

To verify the reactor protection circuits in the various modes of tripping.

Test Summary

Operational testing will be conducted to verify the reactor protection circuits in the various modes of tripping, including manual reactor trip up to the tripping of the reactor trip breakers.

Acceptance Criteria

The reactor trip circuits operate in accordance with Subsection 7.2.1.1.2. The purpose of this test is to demonstrate that the various reactor trip circuits are operational.

TABLE 14.2-66

ROD DROP MEASUREMENTS - BYRON UNIT 1

(Startup Test)

Plant Condition or Prerequisites

Core loading has been completed and prior to initial criticality with various RCS temperatures, pressures and flow condition.

Test Objective

To measure rod drop times at cold no-flow, cold full-flow, hot no-flow, and hot full-flow plant conditions following core loading.

Test Summary

The drop time for each control rod will be measured at cold no-flow, cold full-flow, hot no-flow, and hot full-flow conditions. All rods falling outside the two-sigma limit will be retested a minimum of three additional times each. The drop time will be measured from the decay of the stationary gripper coil voltage until the rod enters the top of the dashpot. The RCCA drop traces will confirm proper operation of the decelerating devices.

Acceptance Criteria

The rod drop time is verified to be less than the maximum value specified in Subsection 3.9.4.3.

TABLE 14.2-66a

ROD DROP MEASUREMENTS - BYRON UNIT 2;

BRAIDWOOD UNITS 1 AND 2

(Startup Test)

Plant Condition or Prerequisites

Core loading has been completed and prior to initial criticality with RCS at or near operating temperature, pressure, and flow conditions.

Test Objective

To measure rod drop times at hot full-flow plant conditions following core loading.

Test Summary

The drop time for each control rod will be measured at hot, full-flow conditions. All rods falling outside the two-sigma limit will be retested a minimum of three additional times each. The drop time will be measured from the decay of the stationary gripper coil voltage until the rod enters the top of the dashpot. The RCCA drop traces will confirm proper operation of the decelerating devices.

Acceptance Criteria

The rod drop time is verified to be less than the maximum value specified in Subsection 3.9.4.3.

TABLE 14.2-67

INCORE FLUX MONITOR SYSTEM

(Startup Test)

Plant Condition or Prerequisites

Initial core loading has been completed and the plant is at hot standby prior to initial criticality for initial system checkout.

Test Objective

To verify indexing and to ensure free passage of detectors into all positions.

Test Summary

Following core loading and insertion of the detector thimbles, the system will be operationally checked out by ensuring the free passage of detectors into all insertion thimbles. During physics measurements the system is operationally checked while obtaining flux maps.

Acceptance Criteria

The incore flux monitor system operates in accordance with Subsection 7.7.1.9.3.

TABLE 14.2-68

NUCLEAR INSTRUMENTATION

(Startup Test)

Plant Condition or Prerequisites

After core loading, during startup prior to power escalation, during power escalation, at or near full power, and after shutdown from power operation.

Test Objective

To verify overlap between the source, intermediate and power range channels, and to verify alarm and protective functions.

Test Summary

Data will be taken to verify overlap between source and intermediate, and between intermediate and power range channels after initial criticality and during power escalation. This data will be collected until the overlaps are firmly established. Alarm and protective functions will be verified. During low power escalation, the power range detector currents will be monitored and compared with the intermediate range currents to verify response of the power range detectors. The power range nuclear channels will be calibrated to reactor thermal output based on measurement of secondary plant feedwater flow, feedwater temperature, and steam pressure.

Acceptance Criteria

Approximately 1 1/2 decade overlap is observed between source, intermediate, and power range channels, during power escalation to full power, and trip setpoints are in accordance with the Technical Specifications.

TABLE 14.2-69

REACTOR COOLANT SYSTEM PRESSURE

(Startup Test)

Plant Condition or Prerequisites

Following core load and installation of the reactor vessel head and vessel head stud torquing.

Test Objective

To verify that there is no leakage past the reactor vessel head and seal.

Test Summary

A pressure test will be performed following core loading, installation of the reactor vessel head, and torquing of the reactor vessel head studs.

Acceptance Criteria

The pressure test indicates no leakage past the reactor vessel head and seal.

TABLE 14.2-70

REACTOR COOLANT SYSTEM FLOW

(Startup Test)

Plant Condition or Prerequisites

Following core loading with the RCS in hot standby, all RCPs available.

Test Objective

To determine reactor coolant flow and flow coastdown times.

Test Summary

At hot standby conditions following core loading, measurements of loop elbow differential pressure drops are made at normal flow conditions. The loop elbow differential pressure drops are compared to ΔP vs. flow curves to determine actual loop flows. Actual flows will be compared to their required minimum and maximum flows. It will be verified flow coastdown times are in accordance with accident analysis assumptions.

Vibration monitoring of the reactor coolant pumps will be done using two IRD pickups mounted to the motor supports (90 degrees apart in the horizontal plane). In addition, baseline vibration data on the pumps will be obtained using a portable IRD vibration measurement unit. These have been taken at bearing points on the motor (in three directions, where possible) during the preoperational test.

Acceptance Criteria

The coastdown times are verified conservative with respect to Subsection 5.4.1.3.2.

The total RCS flow rate as determined by elbow tap ΔP prior to criticality must be equal to or greater than 339,840 gpm, which is 90% of the thermal design flow.

TABLE 14.2-71

PRESSURIZER EFFECTIVENESS

(Startup Test)

Plant Condition or Prerequisites

Following core loading with the RCS in a hot shutdown condition. Pressurizer heaters and spray available.

Test Objective

To demonstrate the ability of the pressurizer heaters to maintain and increase system pressure, and of the spray system to reduce system pressure.

Test Summary

At hot no load temperature and pressure, the effectiveness of the pressurizer heaters in maintaining and increasing system pressure will be demonstrated. The heaters will be energized and the pressure compared to the predicted pressure rise. The ability of the spray system to reduce system pressure will be demonstrated. The spray valves are opened and the pressure decrease compared to the expected pressure decrease.

Acceptance Criteria

The pressurizer is able to maintain, increase, or lower system pressure in accordance with Subsection 7.7.1.

TABLE 14.2-72

WATER CHEMISTRY

(Startup Test)

Plant Condition of Prerequisites

Prior to heatup following core load, prior to criticality, at criticality, and during power level changes at approximately 30%, 50%, 75%, and 100% reactor power.

Test Objective

Chemical analyses of the reactor coolant are performed to verify that plant chemistry is within specification and can be maintained within specification.

Test Summary

Water for reactor coolant system fill and makeup will be analyzed for chloride, fluoride, suspended solids, silica, aluminum, calcium, and magnesium in order to verify coolant purity.

Sampling ability and analysis techniques will be demonstrated. The ability to control RCS hydrogen, oxygen, and pH concentrations will be demonstrated.

Acceptance Criteria

Water chemistry is in accordance with Westinghouse PWR guidelines.

TABLE 14.2-73

RADIATION SURVEYS

(Startup Test)

Plant Condition or Prerequisite

At steady-state conditions during power escalation.

Test Objective

To determine dose levels at preselected points throughout the plant and to ascertain the effectiveness of radiation shielding.

Test Summary

Radiation surveys will be made during power escalation to determine dose levels at preselected points throughout the plant due to neutron and gamma radiation. Instruments used will be calibrated to known sources and the calibration re-checked following the survey. Surveys will be conducted at steady-state conditions at approximately 3% to 10%, 48% to 52%, and 90% to 100% power.

Acceptance Criteria

Gamma radiation dose levels are in accordance with Table 12.3-2. Neutron radiation measurements taken during these surveys will be used to construct a set of "Neutron Dose Maps."

TABLE 14.2-74

EFFLUENT RADIATION MONITORS

(Startup Test)

Plant Condition or Prerequisites

During or prior to lower power tests and during power escalation.

Test Objective

To verify proper operation of process and effluent radiation monitors using radioactive samples.

Test Summary

Process, effluent, and failed fuel monitors will be checked for proper response at 30% and 100% power. Samples will be verified by laboratory analysis or using source assay values.

Acceptance Criteria

The monitors are accurate within ±20% of the analyzed sample activity.

Note: Area radiation monitors are covered by a preoperational test.

TABLE 14.2-75

INITIAL CRITICALITY

(Startup Test)

Plant Condition or Prerequisites

Plant at hot standby, and RCS boron concentration consistent with the shutdown margin requirements of technical specifications. Nuclear instrumentation aligned, and conservative reactor trip setpoints made.

Test Objective

To bring the reactor critical for the first time.

Test Summary

All rods will be withdrawn except the last controlling bank, which is left partially inserted for control after criticality is achieved. The all-rods-out boron concentration will be measured.

The following procedure limitations will be observed prior to and during the performance of the approach to critical test:

a. A neutron count rate of at least 1/2 count per second must be observed on the source range instrumentation channels with a signal-to-noise ratio greater than 2.

b. Predictions of critical boron concentration and control rod positions will be provided by the vendor in the initial core loading nuclear design report.

   During the approach to initial criticality, RCC bank withdrawal and RCS boron concentration reduction will be accompanied by nuclear monitoring using inverse count rate ratio plots through which criticality can be predicted.

   If nuclear monitoring data indicate that criticality will be achieved before the RCC banks are fully withdrawn, further bank withdrawal will be terminated. Bank withdrawal may be resumed after it has been verified that a continuation will not result in reducing the shutdown margin to a value less than Technical Specifications requirements.

TABLE 14.2-75 (Cont'd)

INITIAL CRITICALITY

(Startup Test)

If, during RCS boron dilution, the nuclear monitoring data indicate a significant departure from expected response, dilution will be terminated until the source of the unexpected response is corrected, or understood and considered not to adversely affect the safety of continued operations.

c. The following reactivity addition sequence will be used to assure that criticality will not be passed through on a period shorter than approximately 30 seconds:

Nuclear monitoring data will be analyzed concurrent with RCS boron dilution to permit accurate predictions of the conditions under which criticality is expected to occur.

If, during RCS boron dilution, the nuclear monitoring data indicate a significant departure from expected response, dilution will be terminated until the source of the unexpected response is corrected, or understood and considered not to adversely affect the safety of continued operations.

When the inverse count rate ratio (ICRR) from any nuclear monitoring channel reaches approximately 0.1 (0.3 was used at Byron Unit 2 and Braidwood Units 1 and 2 based on Byron Unit 1 testing experience), the RCS dilution rate will be reduced to approximately 30 gpm, and nuclear monitoring ICRR data will be obtained and renormalized to 1.0. Dilution at this new rate will be continued until criticality is achieved.

If criticality will be achieved by withdrawing control rods, the following will be followed:

When the ICRR reaches approximately 0.3 (after renormalization), the dilution will be terminated and approximately 15 to 30 minutes of waiting will be undertaken to permit RCS mixing. Control bank D will then be withdrawn incrementally until criticality is achieved.

Control bank D will be positioned as required to achieve a stable startup rate of approximately 0.1 to 0.2 decades per minute and to allow the neutron flux level to increase until approximately 1 x 10^{-8} amp is indicated on the intermediate range nuclear channels.

TABLE 14.2-75 (Cont'd)

INITIAL CRITICALITY

(Startup Test)

Control bank D position will be adjusted as required to maintain criticality at the flux level established until the reactivity effects of RCS mixing are negligible.

Acceptance Criteria

The plant is critical with the flux level at approximately 1×10^{-8} amps on the intermediate range nuclear channels.

TABLE 14.2-76

POWER ASCENSION

(Startup Tests)

Plant Condition or Prerequisites

The reactor is critical at the nominal no-load values. Reactor power is in the zero power testing range with control banks positioned near the hot zero power insertion limit.

Test Objective

To conduct low power physics testing and testing at various power level plateaus while increasing power to 100%.

Test Summary

Following initial criticality, low power physics testing will be accomplished. At approximately 30%, 50%, 75%, 90% and 100% reactor power, the unit will be held for other systems testing.

Acceptance Criteria

The plant is taken to approximately 100% power and all startup tests completed and reviewed.

TABLE 14.2-77

MODERATOR TEMPERATURE REACTIVITY COEFFICIENT MEASUREMENT

(Startup Test)

Plant Condition or Prerequisites

Reactor is critical with neutron flux level in a predetermined range for zero power physics testing. RCS temperature and pressure at a hot no-load value.

Test Objective

To obtain the isothermal temperature coefficient of reactivity.

Test Summary

At normal no load temperature with no nuclear heating, reactor coolant system cooldown and heatup will be accomplished using steam dump and reactor coolant pump operation as required. An approximate 3°F change in temperature will be initiated and, during these changes, reactivity and primary system temperature will be recorded. From these data the isothermal temperature coefficient will be determined, from which the moderator temperature coefficient will be inferred.

Acceptance Criteria

The isothermal and moderator temperature coefficients are in agreement with the nuclear design report.

TABLE 14.2-78

CONTROL ROD REACTIVITY WORTH MEASUREMENT

(Startup Test)

Plant Condition or Prerequisite

Reactor is critical with the neutron flux level in the zero power physics testing range. RCS temperature and pressure are at hot no-load values.

Test Objective

To determine selected rod worths by differential individual and bank integral rod worth measurements, and to verify rod worth for shutdown capability.

Test Summary

Under zero power conditions at approximately operating temperature and pressure, the nuclear design predictions for rod cluster control assembly (RCCA) banks' differential worth will be validated. The validation will be made from boron concentration sampling data, RCCA bank positions and recorder traces of reactivity. From this data the integral RCCA bank worths will be determined. The minimum boron concentration for maintaining the reactor shutdown with the most reactive RCCA stuck in the full out position will be determined. The determination will be made from analysis of boron concentration and RCCA worths.

Acceptance Criteria

The control rod reactivity worths are in agreement with those given in the nuclear design report where such worths can be safely and practicably demonstrated by testing. Overall shutdown margin for the plant will be verified, if individual shutdown bank worths cannot be fully established by testing, to conform to the nuclear design report.

TABLE 14.2-79

BORON REACTIVITY WORTH MEASUREMENT

(Startup Test)

Plant Condition or Prerequisite

Reactor is critical with the neutron flux level in the zero power physics testing range. RCS temperature and pressure are at hot no-load values.

Test Objective

To determine the differential boron reactivity worth.

Test Summary

The reactor coolant boron concentration will be increased or decreased and the control rods inserted or withdrawn to maintain the moderator average temperature and reactor power level constant. The resultant accumulated change in core reactivity corresponding to the successive rod movements will be used with the change in boron concentration to determine the differential boron worth.

Acceptance Criteria

The differential boron reactivity is within values used in Subsection 4.3.2.3.

TABLE 14.2-80

FLUX DISTRIBUTION MEASUREMENTS

(Startup Test)

Plant Condition or Prerequisite

The reactor is critical at less than 5% power.

Test Objective

To measure the reactor core flux distribution with normal rod patterns.

Test Summary

Flux distribution measurements will be made with normal rod patterns and reactor power at approximately 3% to 5%. Flux mapping will be accomplished using the incore flux monitoring system.

Acceptance Criteria

The flux distribution is within values used in Subsection 4.3.2.2.

TABLE 14.2-81

PSEUDO ROD EJECTION

(Startup Test)

Plant Condition or Prerequisites

Reactor is critical with the neutron flux level in the zero power physics testing range. RCS temperature and pressure are at hot no-load values. Testing will be repeated at 30% reactor power.

Test Objective

To verify hot channel factors and rod worth with a rod cluster control assembly (RCCA) withdrawn from its bank position.

Test Summary

Incore measurements will be made with the most reactive RCCA withdrawn from its bank position to determine the resulting hot channel factors. The worth of the most reactive RCCA will be verified to be conservative with respect to the accident analysis. Measurements will be made using the incore flux monitoring system. Tests will be run at hot zero power and at approximately 30% reactor power.

Acceptance Criteria

F^T_q hot channel factors and rod worths are less than the values given in Table 15.4-3.

Note: This test is performed on Byron Unit 1 only. Performance of this test on Byron Unit 1 provides the necessary design information for all four Byron and Braidwood units with regard to this specific event. Nuclear design parameters for the three remaining units will be verified by additional startup tests such as control rod bank worths, boron worth, and core flux distribution.

TABLE 14.2-82

POWER REACTIVITY COEFFICIENT MEASUREMENT

(Startup Test)

Plant Condition or Prerequisites

During power level changes at approximately 30%, 50%, 75%, and 90% reactor power.

Test Objective

To verify the power coefficient of reactivity.

Test Summary

During power level changes when the reactivity effects of xenon can be adequately accounted for, measurements will be made of reactor power and associated reactivity changes as follows:

> Reactor thermal power will be determined using calorimetric data. Associated reactivity changes will be measured by the response of T_{avg} and delta T recorders.

The power coefficient of reactivity will be verified from these measurements.

Acceptance Criteria

The absolute value of the difference between the absolute value of the measured power coefficient verification factor and the absolute value of the predicted power coefficient verification factor is less than or equal to 0.5 degrees Fahrenheit per percent power.

TABLE 14.2-83

CORE PERFORMANCE EVALUATION

(Startup Test)

Plant Condition or Prerequisite

At approximately 30%, 50%, 75%, 90%, and 100% reactor power.

Test Objective

To verify that core performance margins are within design predictions for expected normal and abnormal rod configurations.

Test Summary

Incore data will be obtained at steady-state power levels of approximately 30%, 50%, 75%, 90%, and 100% reactor power.

Acceptance Criteria

The core performance margins are within values used in Section 4.4.

TABLE 14.2-84

FLUX ASYMMETRY EVALUATION

(Startup Test)

Plant Condition or Prerequisites

Reactor power at approximately 50% power.

Test Objective

To verify that core performance margins are within the plant Technical Specification limits as an RCCA is inserted into the core from its normal bank position, and to determine the response of excore nuclear detectors under asymmetric power distributions.

Test Summary

A pseudo rod drop test will be performed at approximately 50% reactor power. A slow RCS dilution will be performed with the selected RCCA stepped fully into the core.

Acceptance Criteria

The DNBR will be demonstrated to be in accordance with Subsection 4.4.1.1.

Note: This testing is performed on Byron Unit 1 only. The design confirmation obtained from this test applies to the other three Byron and Braidwood units, which have identical designs.

TABLE 14.2-85

FULL-POWER PLANT TRIP

(Startup Test)

Plant Condition or Prerequisites

Plant at normal steady state full power condition with the electrical loads aligned for normal full power operation.

Test Objective

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

Test Summary

The plant will be brought to normal steady-state full power conditions with the electrical loads aligned for normal full power operation. The plant will be tripped by manual trip of the generator breakers or by initiation of an automatic trip of the generator main breakers.

The parameters to be monitored will include nuclear flux; reactor coolant loop temperature; pressurizer pressure and level; steam generator level, steam flow, and feed flow; turbine trip operation; reactor trip breaker operation; and controlling group rod position indication. The parameters will be selected to determine the response of the plant control systems.

Acceptance Criteria

The acceptance criteria that must be met to successfully complete the turbine test are:

a. the pressurizer safety valves shall not lift;
b. the steam generator safety valves shall not lift;
c. safety injection shall not be initiated; and,
d. no unacceptable water hammer in the steam generators and/or feedwater system shall occur.

TABLE 14.2-86

SHUTDOWN FROM OUTSIDE THE CONTROL ROOM

(Startup Test)

Plant Condition or Prerequisites

Above 10% reactor power.

Test Objective

To demonstrate that the plant can be maintained in hot standby from outside the control room.

Test Summary

Data will be obtained at locations outside the control room to verify that the plant has achieved hot standby status and that the plant can be maintained at stable hot standby conditions for at least 30 minutes. Also, data will be obtained at locations outside of the control room to demonstrate a potential capability for cold shutdown by partially cooling down the plant from the hot standby condition.

Acceptance Criteria

Data obtained from outside the control room demonstrates:

1. The plant is tripped and in a stable hot standby condition for at least 30 minutes.

2. The potential for cold shutdown from the hot standby condition:

    a. Reactor coolant temperature and pressure can be lowered to permit operation of the core decay heat removal system.

    b. Operation of the decay heat removal system can be initiated and controlled.

    c. A heat transfer path to the ultimate heat sink can be established.

    d. Reactor coolant temperature can be reduced approximately 50° F using the decay heat removal system at a rate in accordance with the Technical Specifications.

TABLE 14.2-87

LOSS OF OFFSITE POWER

(Startup Test)

Plant Condition or Prerequisites

Above 10% reactor power with offsite power unavailable and emergency diesels available.

Test Objective

To demonstrate starting of emergency diesels, stripping of vital buses, and sequencing loads on vital buses following a trip of the plant without an available offsite source of power.

Test Summary

At above 10% power, a generator trip will be initiated without an offsite source of power being available. Starting of the emergency diesels, stripping of vital buses, and sequencing of emergency loads on the vital buses will be demonstrated. The test will be of sufficient duration to ensure that the necessary equipment, controls and indication are available following the loss of nonemergency a-c power to remove decay heat from the core using only emergency power supplies.

Acceptance Criteria

The plant is shown to respond to a plant trip concurrent with loss of offsite power in accordance with Subsection 8.3.1.1.1. The duration of the loss of nonemergency a-c power will be at least 30 minutes.

TABLE 14.2-88

10% LOAD SWING

(Startup Test)

Plant Condition or Prerequisites

During power escalation at 35%, 75% and 100% reactor power.

Test Objective

To demonstrate automatic plant response to a $\pm$10% step load change.

Test Summary

Demonstrate plant response to a 10% load reduction from 35%, 75%, and 100% reactor power. A 10% load increase from the respective lower power levels will then be performed. Initiation of the load swing will be accomplished with the DEH turbine generator controls. The test will be conducted with the major control systems in automatic.

Acceptance Criteria

a. Reactor and turbine will not trip.

b. Unacceptable levels of water hammer will not occur in the steam generator or feedwater system due to the 10% load change.

c. Steam generator safety valves do not lift.

d. Pressurizer safety valves do not lift.

e. No manual intervention will be required to bring plant conditions to steady state.

f. Plant variables (i.e., T_{ave} , pressurizer pressure, feed flow, steam flow, steam generator level, pressurizer level) will not incur sustained or diverging oscillations.

g. Nuclear power overshoot (undershoot) will be less than 3% for turbine load increase (decrease).

TABLE 14.2-89

50% LOAD REDUCTION - BYRON UNIT 1

(Startup Test)

Plant Condition or Prerequisites

Reactor power will be at 75% and at 100%.

Test Objective

To demonstrate manual and automatic plant response to a 50% step load reduction.

Test Summary

Demonstrate plant response to a 50% step load reduction from 75% and 100% reactor power. With plant systems in their automatic modes of control, the 50% load reduction is initiated from the turbine control panel.

Acceptance Criteria

a. Reactor and turbine do not trip.

b. Unacceptable levels of water hammer do not occur in the steam generator or feedwater system due to the 50% load rejection.

c. Steam generator safety valves do not lift.

d. Pressurizer safety valves do not lift.

e. No manual intervention is required to bring plant conditions to steady state.

TABLE 14.2-89 (Cont'd)

50% LOAD REDUCTION - BYRON UNIT 2

BRAIDWOOD UNITS 1 and 2

(Startup Test)

Plant Condition or Prerequisites

Reactor power will be at 100%.

Test Objective

To demonstrate manual and automatic plant response to a 50% step load reduction.

Test Summary

Demonstrate plant response to a 50% step load reduction from 100% reactor power. With plant systems in their automatic modes of control, the 50% load reduction is initiated from the turbine control panel.

Acceptance Criteria

a. Reactor and turbine do not trip.

b. Unacceptable levels of water hammer do not occur in the steam generator or feedwater system due to the 50% load rejection.

c. Steam generator safety valves do not lift.

d. Pressurizer safety valves do not lift.

e. Some minimal manual intervention may be required to bring plant conditions to steady state.

TABLE 14.2-90

RTD CROSS-CALIBRATION

(Startup Test)

Plant Condition or Prerequisites

RCS in hot shutdown and hot standby conditions with all RCPs running prior to initial criticality.

Test Objective

To provide data for the wide range RTDs, narrow range RTDs, and incore thermocouple calibration and to compare the incore thermocouples to the average reactor coolant system temperature.

Test Summary

At various plant temperatures, the average RTD temperature will be compared to each RTD and incore thermocouple temperature to provide correction factors for their calibration.

Acceptance Criteria

The incore thermocouple and RTD correction factors are determined and their accuracy is checked in accordance with Subsection 7.2.2.3.2.

TABLE 14.2-91

TURNINE TRIP FROM 25% POWER
(Startup Test)

Plant Condition or Prerequisites

Plant at 25% ± 3% or normal steady-state full power condition with the auxiliary electrical loads supplied from the unit auxiliary transformer.

Test Objective

To verify the ability of the primary and secondary plant and the plant automatic control systems to sustain a trip from 25% power without the turbine bypass to condenser system available, and to bring the plant to a stable condition following the transient.

Test Summary

The plant will be brought to normal 25% steady-state power conditions with the auxiliary loads supplied from the unit auxiliary transformer. The plant will be tripped by manually tripping the turbine from the turbine control station.

The parameters to be monitored will include nuclear flux; reactor coolant loop temperature; pressurizer pressure and level; steam generator level, steam flow, and feed flow; turbine trip operation; reactor trip breaker operation; and controlling group rod position indication. The parameters will be selected to determine the response of the plant control systems.

Acceptance Criteria

The acceptance criteria that must be met to successfully complete the turbine test are:

a. The pressurizer safety valves shall not lift;

b. The pressurizer power-operated valves shall operate as designed to remove energy;

c. The steam generator power-operated valves shall operate as designed to remove energy;

TABLE 14.2-91 (Cont'd)

TURBINE TRIP FROM 25% POWER

(Startup Test)

d. Safety injection shall not be initiated; and,

e. No unacceptable water hammer in the steam generators and/or feedwater system shall occur.

Note: This design verification test is run only on Byron Unit 1. The specific components and systems involved will be individually tested on subsequent units.

14.3 ADDITIONAL TESTING FOR THE UNIT 1 STEAM GENERATORS

This section describes the test program for the replacement Unit 1 steam generators. Although this program is not within the scope of the initial test program, it is included in the UFSAR because the tests are similar in scope to many of the tests described in Section 14.2.

14.3.1 Summary of Test Program and Objectives

Commonwealth Edison conducted a comprehensive test program following replacement of the Unit 1 steam generators that demonstrated that modified structures, systems, and components perform satisfactorily in service. The principal objective was to provide assurance that the modification was properly designed and constructed and was ready to operate in a manner that would not endanger the health and safety of the public.

14.3.2 Organization and Staffing

A team representing a cross-section of station, corporate, and vendor personnel managed and executed the testing following replacement of the Unit 1 steam generators. The test program was established in accordance with the Quality Assurance Program as outlined in the QA Topical Report referenced in Chapter 17.0.

The Quality Assurance activities related to the steam generator replacement project were the responsibility of Quality and Safety Assessment Department. This included audit and surveillance functions as well as other responsibilities related to 10 CFR 50, Appendix B, in accordance with the Commonwealth Edison Quality Assurance Manual.

When required, vendors provided technical assistance during testing. The authority and responsibility of each organizational unit involved in the test program was as specified in the Quality Assurance Program.

14.3.3 Test Procedures

Test procedures were developed using station administrative programs. Individual test procedures specified prerequisites, data to be obtained, and requirements and acceptance criteria to be fulfilled. All test procedures and results were reviewed and approved as required by the QA Topical Report.

14.3.4 Conduct of Test Program

Tests were conducted using station administrative programs. The test program was conducted using detailed written procedures that included provisions for assuring that prerequisites have been completed. Data were examined as each test proceeded, and out-of-tolerance conditions were recorded and described in adequate detail to permit post-test analysis. Such data were evaluated during post-test review and resolved within the Quality Assurance program.

14.3.5 Review, Evaluation, and Approval of Test Results

Test results were reviewed and approved in accordance with station procedures and the QA Topical Report.

14.3.6 Test Results

The test procedures and test data are retained and maintained in accordance with the Quality Assurance program described in Chapter 17.0. The original test records were reviewed for completeness, identified, and indexed to establish them as part of a permanent record. These records include data sheets completed during testing.

14.3.7 Conformance of Test Programs with Regulatory Guides

Appendix A to the UFSAR identifies those applicable Regulatory Guides and describes the degree of conformance to each.

14.3.8 Development of the Test Program

The modification test program was developed based on inputs such as the current licensing basis requirements, the FSAR initial test program, procedures prepared for other utilities performing similar testing, and documents associated with the steam generator replacement project.

A sequencing document was written to guide and coordinate plant events and testing. The document served as an interface procedure for mode, temperature, and power changes to ensure requirements were met prior to proceeding. The procedure sequenced the modification and surveillance testing necessary to return to full power following the outage.

14.3.9 Individual Test Description

Test abstracts for individual tests that were conducted following steam generator replacement are provided in Tables 14.3-1 through 14.3-16.

All requirements for demonstrating operability of the systems, structures and components associated with the replacement steam generators, which are based on utility experiences, applicable codes, regulatory guides, regulations, standards, and vendor specifications, were included in the procedures for the test program. It is not Commonwealth Edison's intention to include all these requirements in the test summaries that follow. These summaries are meant only to outline the major objectives of any particular test.

The test abstracts listed describe the intended testing program for both the Byron and Braidwood Stations. The Byron Station Unit 1 program is complete and the Braidwood Station Unit 1 program is still in progress. The completed testing was conducted in accordance with descriptions contained in the abstracts. Any exceptions to the abstract descriptions were properly documented and dispositioned.

TABLE 14.3-1

CONTAINMENT PRESSURE TEST/INTEGRATED LEAK RATE TEST

Test Objective

To demonstrate the operability of the primary containment structure and containment liner following restoration of the temporary construction opening used during the Unit 1 steam generator replacement project.

Test Summary

A containment pressure test is required by ASME Section XI, 1992 Edition, 1992 Addenda, Article IWL-5210 following repairs or replacement of concrete containments. An integrated leak rate test is required by ASME Section XI, 1992 Edition, Articles IWL-5230 and IWE-5221 following repair or replacement of the containment metallic liner.

During the containment pressure test, crack mapping is performed in the area of the temporary construction opening concrete placed during repair/replacement activities. Visual examination is conducted prior to start of pressurization, at peak accident pressure, and following completion of depressurization per ASME requirements.

Acceptance Criteria

The maximum measured increase of the width of a crack on the outside surface of containment during the test is less than 0.060 inch; and there also must be no indication of gross deformation.

TABLE 14.3-2

STEAM GENERATOR BLOWDOWN FLOW RATE MEASUREMENT

Test Objective

To measure the steam generator blowdown flow rate.

Test Summary

The total steam generator blowdown flow rate was measured. Additionally, the steam generator blowdown flow rate for each flow path for each steam generator was established and then measured.

Acceptance Criteria

The steam generator blowdown flow meets minimum flow requirements for both total flow and flow through each steam generator blowdown flow path.

TABLE 14.3-3

RECIRCULATION PUMPS PERFORMANCE TEST

Test Objective

To obtain selected initial pump data for the wet lay-up recirculation pumps and verify the pumps' capability to recirculate the steam generator water inventory in a cold shutdown condition.

Test Summary

There is one wet lay-up recirculation pump installed per steam generator. Data were collected to determine the recirculation rate of the steam generator water inventory, as well as to obtain baseline pump performance data.

Acceptance Criteria

Each recirculation pump must have the capability to recirculate the associated steam generator secondary side water inventory at least once per eight hours.

Pump performance is verified to agree with the manufacturer's pump curve.

TABLE 14.3-4

AUXILIARY FEEDWATER FLOW VERIFICATION

Test Objective

To verify that Auxiliary Feedwater (AF) system flow capability to the Unit 1 steam generators has not been adversely affected by the modified configuration of the AF system piping, including the modifications in the valve internal trim to the AF flow control valves (1AF005A-H).

Test Summary

Both AF trains were tested to verify that adequate flow was delivered to various combinations of steam generators with the control valves failed open. The flow control valves also were tested to demonstrate flow control. The data verified pump performance for each AF train and that the AF system was capable of delivering flow in accordance with the requirements of the Chapter 15 accident analyses.

Acceptance Criteria

The performance data (differential pressure vs. pump flow) of the motor-driven AF pump and the diesel-driven AF pump are within the bounds of the specified test limits. The suction pressure for both pumps is within the specified limits.

During single and dual branch line testing, final branch line flows (i.e., flows through individual AF flow control valves), recirculation flow, and suction pressure are within specified limits. Flow control valves demonstrate the ability to control flow and no external leakage is observed.

TABLE 14.3-5

STEAM GENERATOR THERMAL EXPANSION TEST

Test Objective

To verify by visual observation, measurement, and evaluation (as applicable) that specified steam generator components (e.g., the steam generator upper lateral restraints, snubbers, and lower lateral restraint) and specified portions of the feedwater, main steam, and steam generator blowdown system piping and components are free to expand without restriction of movement.

Test Summary

Verification was accomplished at designated reactor coolant system (RCS) temperature plateaus. Verification included visual observation and/or measurement (as appropriate) and engineering evaluation. Visual observation and/or measurements (as applicable) were accomplished at ambient temperature (RCS temperature less than or equal to 140 °F) and at the following RCS temperature plateaus: 170 °F, 340 °F, 450 °F, and 557 °F. Temperature was held for a minimum of four hours prior to observation. In addition, lines that were walked down were visually verified to preclude interference with surrounding equipment, supports, restraints and structures. Following any support adjustment, inspections were performed in accordance with station programs.

Acceptance Criteria

The equipment, piping, and components addressed in the procedure are verified to expand during heatup without obstruction or restriction. All piping and components shall not cause interference with surrounding equipment, supports, restraints and structures. Thermal movements for each support, restraint, and/or component shall be within the anticipated ranges or evaluated as acceptable on a thermal expansion problem sheet.

TABLE 14.3-6

LOAD REDUCTION TEST

Test Objective

To demonstrate the ability of the plant to sustain a rapid load reduction.

Test Summary

Plant stability was verified at a specified power level. Recording equipment was set up for various plant parameters, with an emphasis on steam generator parameters. The turbine control system was set up for a 10% and a 25% turbine load decrease. The load change was initiated, plant parameters were monitored, and results were evaluated.

Acceptance Criteria

Plant parameters, particularly the steam generator levels and the feedwater system response, stabilize without significant manual intervention, and none of the following occur: reactor trip, turbine trip, safety injection initiation, or pressurizer or steam generator safety valve actuation.

TABLE 14.3-7

STEAM GENERATOR LEVEL CONTROL TEST

Test Objective

To demonstrate the ability of the steam generator level control system to respond to a mismatch between steam generator level and setpoint and the ability of the feedwater pump master controller to respond to a small differential pressure transient.

Test Summary

The test for the steam generator level/setpoint mismatch is conducted in Mode 1 at power levels of approximately 50% and 75%. For each steam generator, a -5% level setpoint change was initiated and the response of the level control system was monitored. A +5% level setpoint change was then initiated and the response of the level control system was monitored.

The test for the feedwater pump controller response was conducted in Mode 1 at a power level of approximately 50%. The feedwater pump speed control testing was initiated by a manual perturbation of approximately +25 psid (difference between feedwater header and steam header pressure). Plant parameters were monitored and results were evaluated.

Acceptance Criteria

Steam generator narrow range level automatically adjusts to within specified limits of the new level setpoint following a level setpoint change. Steam generator narrow range levels stabilize within specified limits of their setpoint following a feedwater pump speed transient.

TABLE 14.3-8

STEAM GENERATOR MOISTURE CARRYOVER TEST

Test Objective

To demonstrate the capability of the steam separators to maintain steam quality in accordance with design.

Test Summary

Moisture carryover was determined by injecting radioactive tracer (Na-24) into the feedwater system and analyzing samples from the condensate system.

Acceptance Criteria

The average moisture carryover is less than or equal to design specification at nominal full power.

TABLE 14.3-9

FEEDWATER SYSTEM TEST

Test Objective

To monitor and collect data on the steam generator water level control system during plant evolutions and at steady state power levels.

Test Summary

Data were collected during the following conditions: 1) synchronization of the main generator to the grid, 2) transfer from the bypass feedwater regulating valves to the main feedwater regulating valves, and 3) steady-state power levels of approximately 30%, 50%, 75% and 100%. At steady-state power levels, feedwater pump turbine speed was adjusted to obtain optimum feedwater regulating valve positions. Collected data were then compared with design values.

Acceptance Criteria

The actual steam generator levels and feedwater to steam header differential pressure are within specified limits of the programmed values. The main feedwater regulating valve positions are between the maximum and minimum valve position curves specified for the test. The main feedwater pump turbine speed is less than the design limit.

TABLE 14.3-10

STEAM GENERATOR THERMAL PERFORMANCE TEST

Test Objective

To verify the performance of the Unit 1 steam generators at or near full power operation.

Test Summary

Precision measurements are made to obtain values for steam pressure, reactor power, feedwater flow, and reactor coolant system temperature. These are used to calculate full power steam generator pressure for comparison with the manufacturer's design performance value. The calculations correct for actual power and temperature conditions during the test.

Acceptance Criteria

For each steam generator, the full-power steam generator pressure is greater than or equal to the manufacturer's specified steam pressure at the biased hot leg temperature.

TABLE 14.3-11

REACTOR COOLANT SYSTEM FLOW VERIFICATION

Test Objective

To verify the calibration of the RCS flow transmitters and indications. To verify RCS flow rate is near predicted values.

Test Summary

Flow transmitters were calibrated prior to heatup. A calibration check and flow measurement was performed in Mode 3. A flow indication check was performed prior to exceeding 30% power. Flow measurements using the surveillance procedure were performed between 65% and 75% power, and above 90% power. Transmitter calibration was performed as necessary.

Acceptance Criteria

The RCS flow rates are greater than minimum requirements and less than maximum design flows.

TABLE 14.3-12

PLANT PERFORMANCE BASELINE DATA

Test Objective

To collect steady-state baseline data at various power levels and to verify that the selected indications are consistent with plant conditions.

Test Summary

Steady-state baseline data are collected and reviewed. The data include pressures, levels, temperatures, flows, and power level indications, with emphasis on parameters related to the replacement steam generators.

Acceptance Criteria

For the final evaluation of RCS ΔT power, each RCS ΔT power indication is within specified limits of the calorimetric power.

TABLE 14.3-13

CALIBRATION OF STEAM FLOW TRANSMITTERS

Test Objective

To verify the calibration of the steam flow transmitters.

Test Summary

Data were collected at power levels of approximately 0%, 30%, 50%, 75%, and 100% and used to verify proper scaling of steam generator steam flow instrumentation. Transmitter recalibrations were performed to normalize steam flow with feedwater flow.

Acceptance Criteria

For the final test performance for each steam flow transmitter, the difference between transmitter steam flow and actual steam flow is within the specified limits.

TABLE 14.3-14

LOOSE PARTS MONITOR BASELINE IMPACT DATA

Test Objective

To record the sensor response of the loose parts monitoring (LPM) system to impacts of known masses and to record the normal broadband background noise frequency response of the LPM system during plant operation.

Test Summary

While in cold shutdown, the sensor response to impacts from 1/4-lb, 3-lb, and 30-lb hammers was recorded to measure LPM system response. LPM baseline (broadband background noise) data were collected at approximately 0%, 30%, 50%, 75%, and 100% power.

Acceptance Criteria

There are no acceptance criteria for this test since it is a baseline data collection activity only.

TABLE 14.3-15

STEAM GENERATOR STEADY STATE PIPE VIBRATION

(VISUAL INSPECTION - INSIDE AND OUTSIDE CONTAINMENT)

Test Objective

To inspect the steady state pipe vibration level of 1) the steam generator primary head drain piping for each steam generator, 2) the main feedwater piping inside containment from each of the four containment penetrations to the respective secondary shield wall, and 3) the modified main feedwater piping installed outside the containment.

Test Summary

The procedure required a visual inspection and at least one local hand-held measurement taken to document system response at the location of maximum displacement (i.e., a peak-to-peak displacement amplitude measurement). 1) Steam generator primary head drain piping vibration testing is performed in Mode 3; 2) Main feedwater piping inside containment vebration testing is performed in Mode 1 with the plant at 90-100% power; 3) Main feedwater piping outside containment vibration testing is performed in Modes 1 and 2/3.

Acceptance Criteria

The piping is qualified for steady-state vibration by a separate engineering evaluation in accordance with the criteria contained in EMD-052640, "Criteria for Qualification of Piping Steady State Vibration."

TABLE 14.3-16

STEAM GENERATOR INSERVICE LEAKAGE INSPECTIONS

Test Objective

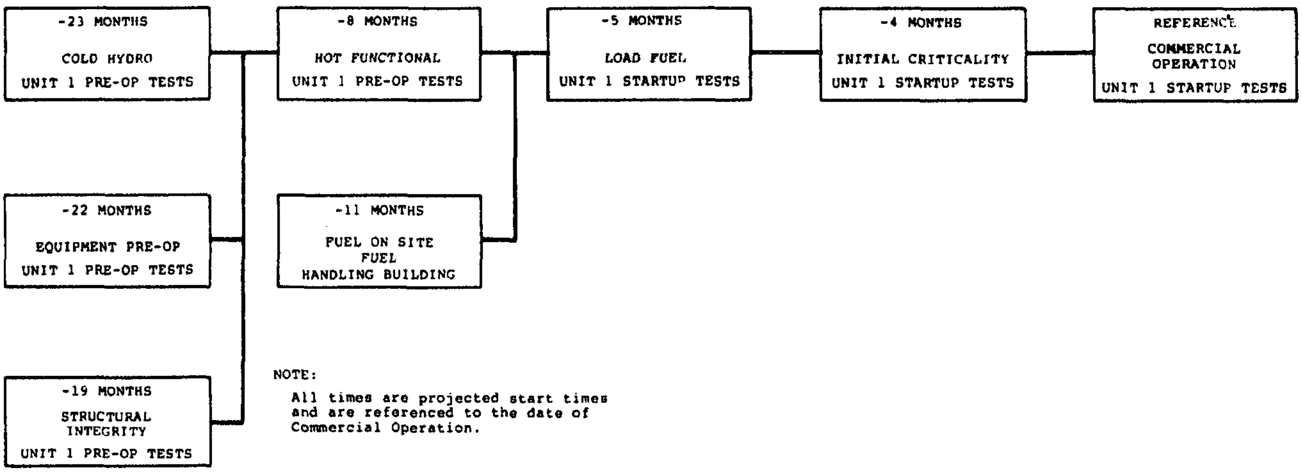
To inspect plant pressure boundary components involved with the replacement of the Unit 1 steam generators for leakage in conjunction with existing plant surveillance procedures for nonroutine visual examination (VT-2) of ASME Class 1, 2, and 3 components at normal operating pressures.

Test Summary

The procedure required a visual inspection of piping components to verify structural integrity. The inspections were specified by ASME Code Case N-416-1, "Alternate Pressure Test Requirements for Weld Repairs or Installation of Replacement Items by Welding, Class 1, 2 and 3." Hydrostatic testing was used for small sections of the steam generator wet layup system.

Acceptance Criteria

The replacement Unit 1 steam generators and all pressure boundary piping associated with the replacement activities are leak tight and show no indications of degraded or abnormal conditions. The specific acceptance criteria that must be met to successfully complete the inservice leakage test program are documented in station surveillance procedures.



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UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 14.2-1

PRE-OPERATIONAL/STARTUP TEST SCHEDULE
(UNIT 1)