Chapter 14

INITIAL TESTS AND OPERATION

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INITIAL TESTS AND OPERATION

HISTORICAL INFORMATION IN ITALICS BELOW NOT REQUIRED TO BE REVISED.

Sections 14.1 and 14.2 are historical in nature; they reflect the preoperational and initial startup test program through the start of commercial operation. Section 14.3 addresses the postcommercial operational test program.

14.1 TEST PROGRAM

The preoperational and initial startup program for the Pacific Gas and Electric Company's (PG&E's) Diablo Canyon Power Plant (DCPP) will demonstrate that:

(1) The plant is ready to operate in a manner that, with reasonable assurance, will not endanger the safety of the public.

(2) The procedures for operating the plant safely have been tested and demonstrated.

(3) The operating organization is knowledgeable about the plant and the procedures and is fully prepared to operate the plant safely.

The program is designed to demonstrate that structures, components, and systems meet the appropriate design criteria and otherwise operate satisfactorily. The program includes construction tests, preoperational or functional tests, initial fuel loading, and startup tests. The program will culminate in the operation of the plant at maximum guaranteed load.

The discussion of tests in this chapter generally excludes construction tests and otherwise includes only testing associated with safety-related requirements. Testing excluded from this discussion is administered in a manner consistent with the program described in this chapter.

Construction tests include hydrostatic testing, system cleaning, valve leakage tests, control valve operations, electrical continuity checks, electrical performance tests, and control instrument alignment. Construction tests are usually conducted as the components and systems are completed to ensure readiness for preoperational testing.

Preoperational tests demonstrate, insofar as possible prior to loading nuclear fuel, that those plant structures, components, and systems related to safety have been properly installed and operate according to design requirements. Preoperational tests that cannot be completed prior to fuel loading because the necessary test conditions do not exist will be completed when conditions are suitable for testing.

Preoperational testing of a system begins whenever construction is sufficiently advanced to indicate the test may be completed. This phase of testing began in 1973 and has been integrated with other construction activities.

Startup tests demonstrate that the plant will perform satisfactorily in normal operation and that, with reasonable assurance, the plant is capable of withstanding the transients analyzed in this Final Safety Analysis Report (FSAR).

14.1.1 ADMINISTRATIVE PROCEDURES -- TESTING

14.1.1.1 Organizational Responsibilities

The overall responsibility for the preoperational testing and startup program is assigned to the Lead Startup Engineer.

The Lead Startup Engineer directs other Station Construction Department personnel in preparing and conducting the testing program with technical assistance from the Engineering Department, Nuclear Plant Operations (NPO), the nuclear steam supply system (NSSS) vendor, and other equipment suppliers as appropriate. The plant operating organization performs all operations during the testing program. The Assistant Plant Manager/Plant Superintendent will designate a Startup Coordinator who will be responsible for startup operational activities. In some cases there will be procedures, administratively controlled by the NPO Department, which will be included in the Preoperational and Startup Test Program. Their inclusion will occur when they satisfy the requirements and objectives of a test that would normally be prepared at the direction of the Lead Startup Engineer.

14.1.1.2 Preparation of Procedures

Test procedures are prepared under the direction of the Lead Startup Engineer for all preoperational and startup tests. Each procedure consists of the test purpose and description, references, prerequisites, initial conditions, instructions (including acceptance criteria), and data and calculation sheets as required. The status of all preoperational and startup tests is maintained in a Startup Status Report.

The sources of information for writing the test procedures include approved drawings, specifications, technical literature, system functional descriptions, similar completed tests from other pressurized water reactor nuclear power plants, manufacturers' testing recommendations, plant operating procedures, general operating orders and instructions, and any other design or technical information available.

Test instructions are established using design and technical information and include acceptance criteria established from the functional requirements specified in the appropriate sections of this FSAR or from documents approved by the Engineering Department. Space for documenting test results is also included.

14.1.1.3 Reviewing and Approving Procedures

The Lead Startup Engineer is responsible for the preparation of each test procedure and will request review of tests by the Assistant Plant Manager/Plant Superintendent and others as considered appropriate. The Assistant Plant Manager/Plant Superintendent is responsible for obtaining comments from NPO. The Lead Startup Engineer and the Assistant Plant Manager/Plant Superintendent will indicate their review is complete by signing off the test cover sheet.

The Plant Staff Review Committee (PSRC) will review approved procedures, prior to their conduct, for units with an operating license.

14.1.1.4 Conducting Tests

The Lead Startup Engineer is responsible for conducting all preoperational and startup tests and assigns the responsibility for conducting individual tests to a Startup Engineer who, in turn, verifies that all the necessary conditions are established. The Lead Startup Engineer requests the plant Startup Coordinator to perform the operations step-by-step, following the sequence specified in the test procedure. During and subsequent to preoperational testing, power plant operating personnel will operate all switches, breakers, and valves for controlling energized equipment under the direct supervision of the Shift Foreman in accordance with the startup program, and/or at the request of the Startup Engineer.

14.1.1.5 Evaluating and Approving Results

The Startup Engineer and the Assistant Plant Manager/Plant Superintendent's representatives make an evaluation of the test results. If the results satisfy the acceptance criteria, they sign off the test as completed. The completed test procedure is reviewed by both the Lead Startup Engineer and the Assistant Plant Manager/Plant Superintendent and is signed to indicate approval of the completed test.

The results of preoperational tests of safety-related systems will undergo plant staff review prior to receipt of an operating license. Subsequent to the receipt of an operating license, the results of all completed preoperational and startup tests will be reviewed by the PSRC.

14.1.1.6 Documentation

Completed procedures and related data and test sheets will be properly identified, indexed, and retained for the plant's permanent files. The Lead Startup Engineer is responsible for the distribution of all completed test procedures. Distribution will be made as individual preoperational and startup test procedures are completed.

14.1.1.7 Personnel Qualifications

Since 1958, Station Construction Department management has selected personnel to direct the startup of eleven fossil-fueled, eight geothermal, and one nuclear-fueled steam-electric generating units. Only in the latter case was the responsibility shared and authority subordinated to direction from the NSSS supplier. The timely startup and exceptionally trouble-free performance of these units in operation demonstrates management's ability to select qualified personnel and the success of the system.

Personnel assigned to DCPP startup have been selected to meet the anticipated needs of startup service and transfer of operations to the Nuclear Power Generation Department of the units that will provide additional trouble-free generating capacity for PG&E. Their selection is based on personal backgrounds requiring minimum supplementary technical education or field experience. The Lead Startup Engineer is responsible for requesting, and the Manager of Station Construction is responsible for providing, any additional training to ensure that members of the startup organization have the abilities to satisfy management objectives and the following:

14.1.1.7.1 Lead Startup Engineer

The Lead Startup Engineer shall have a minimum of 10 years of power plant experience. Graduation in an engineering discipline shall count for 2 of these years, and a minimum of 3 years of power plant startup experience is required. Of the remaining 5 years, a maximum of 2 may be fulfilled by academic or field training in nuclear subjects. The Lead Startup Engineer shall be familiar with the design and performance of all the DCPP systems.

14.1.1.7.2 Startup Engineer

Startup Engineers shall have a minimum of 6 years of power plant experience. Graduation in an engineering discipline shall count for 2 of these years, and a minimum of 1 year of power plant startup experience is required. Of the remaining 3 years, a maximum of 1 year may be fulfilled by academic or field training in nuclear subjects. Startup Engineers shall be familiar with the design and performance objectives of the DCPP systems.

14.1.1.7.3 Assistant Startup Engineer

Assistant Startup Engineers shall have a minimum of 4 years of power plant experience. Graduation in an engineering discipline shall count for 2 of these years, and a minimum of 1 year of power plant startup experience is required. Assistant Startup Engineers shall be familiar with the design and performance objectives of assigned DCPP systems.

14.1.1.7.4 Startup Engineer Trainee

Startup Engineer Trainees shall, as a minimum, have either a degree in an engineering discipline or 2 years of power plant experience. Experience needed to fulfill the requirements for other positions within the Startup Department shall be gained by on-the-job training that includes preparation of preoperational and startup procedures and personal participation in the execution of preoperational tests of DCPP systems under the supervision of a Startup Engineer. Startup Engineer Trainees shall be familiar with the design and performance objectives of assigned DCPP systems.

14.1.1.8 Additional Qualifications

In addition, appointees to any of the above assignments may have additional qualifications that will allow them to fill the following positions:

14.1.1.8.1 Nuclear Advisor

Nuclear advisors shall have a minimum of a bachelor's degree in engineering or in physical science and 2 of years experience in such areas as reactor physics, core measurements, core heat transfer, and core physics testing programs. One year of experience may be fulfilled by academic training beyond the bachelor's degree program on a one-for-one time basis.

14.1.1.8.2 Chemistry Advisor

Chemistry advisors shall have a minimum of a bachelor's degree in engineering or in physical science, and 1 year of experience in water or wastewater treatment.

14.1.2 ADMINISTRATIVE PROCEDURES -- MODIFICATIONS

Test procedure inadequacies discovered at any time are corrected using written changes. All test procedure changes are reviewed and approved according to the administrative procedure for the original test procedure before final acceptance of the test by the Plant Superintendent. If the test results do not satisfy the acceptance criteria, or are otherwise contrary to the expected results, the Lead Startup Engineer is responsible for documenting the problem and acts as coordinator between General Construction and the Engineering Departments in resolving such problems, including any necessary system modifications. Resulting test changes shall be handled as described above. Any required retesting shall be handled according to the administrative procedure for conducting the original test. All test procedure changes for units with an operating license require PSRC review within the time frame established by the Technical Specifications[(1)].

Temporary system modifications required for testing are documented in the procedures and, following completion of testing, restoration to normal conditions is made and documented.

14.1.3 TEST OBJECTIVES AND PROCEDURES

14.1.3.1 Preoperational Testing

The testing program performed prior to fuel loading ensures that performance of equipment and systems is in accordance with design criteria. The program includes tests, adjustments, calibrations, and system operations necessary to ensure that initial fuel loading, initial criticality, and subsequent power operation can be safely undertaken. As installation of individual components and systems is completed, each is tested according to approved written procedures. The tests are designed to verify, as nearly as possible, the performance of the components and/or systems under conditions expected to be experienced during plant operation. The prerequisites for these tests include written confirmation that construction activities are complete.

During system tests for which normal plant conditions do not exist and cannot be simulated, the systems are operationally tested to the maximum extent possible. The remainder of the tests are performed when conditions are suitable for testing. Abnormal plant conditions are simulated during testing, when required, and when such conditions do not endanger personnel or equipment.

Evaluations of test results are made to verify that components and systems are performing satisfactorily and, if not, to provide a basis for recommending corrective action.

Where required, simulated signals or inputs are used to verify the full operating range of a system and to calibrate and align the system and instruments at these conditions. Later, systems that are used during normal operation are verified and calibrated under actual operating conditions. Systems that are not used during normal plant operation, but must be in a state of readiness to perform safety-related functions, are checked under all modes and test conditions prior to plant startup. Examples of these systems are the reactor trip system and engineered safety features system logic. Correct operation and setpoints are verified during this testing.

Testing performed during preoperational testing will be completed before fuel loading. In some cases, it will be necessary to defer certain preoperational tests until after fuel loading. These include tests to be performed on the complete rod control system, rod position indication, and complete incore movable detector system. These tests have been identified in Table 14.1-2, Fuel Loading and Initial Startup Testing Summary. Prior to the performance of hot testing following core loading, prerequisite cold testing will have been performed. An example of these tests is the cold rod drop time measurement test. In any event, the surveillance requirements of the Technical Specifications will be met as required for each mode transition.

14.1.3.2 Startup Testing

After satisfactory completion of final precritical tests, nuclear operation of the reactor begins. This final phase of startup and testing includes initial criticality, low power testing, and power level escalation. The purpose of these tests is to establish the operational characteristics of the plant and the core, to acquire data for the determination of setpoints, to establish administrative controls during reactor operations, and to ensure that operation is within license requirements. A brief description of the test program is presented in the following sections. Table 14.1-2 summarizes the tests that will be performed from fuel load through plant operation at rated power, and Figure 14.1-1 shows the sequence in which these tests are performed.

14.1.4 FUEL LOADING AND INITIAL OPERATIONS

14.1.4.1 Fuel Loading

The overall responsibility and direction for initial fuel loading is exercised by PG&E personnel. Fuel loading begins when all prerequisite system tests and operations have been satisfactorily completed, an operating license has been obtained from the U. S. Nuclear Regulatory Commission, and a review by the plant staff has determined that the requirements in the Technical Specifications have been met.

Access to the containment will be controlled by written procedure during fuel loading. Fuel handling tools and equipment shall have been checked out and dry runs conducted in the use and operation of equipment. The reactor vessel and associated components will be in a state of readiness to receive fuel. Water level will be maintained above the bottom of the nozzles and recirculation maintained to ensure a uniform boron concentration. Boron concentration can be increased via the recirculation system.

The as-loaded core configuration is specified as part of the core design studies conducted well in advance of fuel loading. The core is assembled in the reactor vessel that is already filled with water containing enough dissolved boric acid to maintain an effective multiplication factor of 0.95, or less, or a boron concentration greater than 2000 ppm. For initial core loading, the 2000 ppm minimum is limiting and results in an effective multiplication factor of less than 0.90. The refueling cavity is partially filled with borated water during initial fuel loading to provide lubrication for the fuel handling equipment. Coolant chemistry conditions are prescribed in the fuel loading procedure and verified periodically by chemical analysis of moderator samples prior to and during fuel loading operations.

Fuel loading instrumentation shall consist of at least two source range monitors. Normally, two permanently installed excore source range neutron channels and three temporary incore source range neutron channels will be available. The permanent channels, when responding, are monitored in the control room by licensed operators. The temporary channels installed inside the containment structure are monitored by knowledgeable test personnel who, in turn, communicate with the senior licensed *operator in charge of fuel loading. At least one channel is equipped with an audible count rate indicator audible in the control room and loading area. Both permanent channels have the capability of displaying the neutron count rate on strip chart recorders. The temporary channels indicate on count rate meters with a minimum of one channel recorded on a strip chart recorder. Minimum count rates attributable to neutrons generated in the core are required on at least two of the five (i.e., three temporary and two permanent) available neutron source range channels at all times following installation of the primary sources and the first ten fuel assemblies to continue fuel loading.*

Two neutron sources are inserted into the core at locations and sequence specified in the fuel loading program to ensure a neutron population that produces a minimum of 1/2-count/sec for adequate monitoring of the core.

Fuel assemblies, together with inserted components (rod cluster control assemblies [RCCAs], burnable poison rods, source spider, or thimble plugging devices), are placed in the reactor vessel one at a time according to an approved sequence to provide reliable core monitoring that minimizes the possibility of core mechanical damage. The fuel loading procedure includes a tabular check sheet that prescribes the movements of each fuel assembly and its specified inserted components from its initial position in the fuel racks to its final position in the core. Checks are made of component serial numbers and types to guard against possible inadvertent exchanges or substitutions of components, and two reactor core fuel assembly tag boards are maintained throughout the core loading operation.

An initial increment of ten fuel assemblies, the first of which contains an active neutron source, is the minimum source-fuel increment that permits subsequent meaningful inverse count rate monitoring. This initial increment is determined by calculation and previous experience to be markedly subcritical $k_{eff} \leq 0.90$*) under the required conditions of loading.*

Each subsequent fuel loading increment is accompanied by detailed neutron count rate monitoring to determine that the just-loaded increment does not excessively increase the count rate and that the extrapolated inverse count rate ratio is not decreasing for unexplained reasons. The results of each loading step are evaluated according to written procedures before the next prescribed step is started.

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

(1) An unanticipated increase in the neutron count rate by a factor of two occurs on all operating nuclear channels during any single loading step (excludes anticipated changes due to source/detector geometry)

(2) The neutron count rate on any individual nuclear channel unexpectedly increases by a factor of three during any single loading step (excludes anticipated changes due to source/detector geometry)

A "high count rate" alarm in the containment and the control room is coupled to the source range channels with a setpoint equal to or less than five times the current count rate. This alarm automatically alerts the fuel loading crew to an indication of high count rate and requires an immediate stop of all operations until the situation is evaluated. If it is immediately determined that no hazards to personnel exist, preselected personnel may remain in the containment to evaluate the cause and determine future action.

Fuel loading procedures specify alignment of fluid systems to prevent inadvertent dilution of the boron concentration in the reactor coolant, restrict the movement of fuel to preclude the possibility of mechanical damage, prescribe the conditions under which loading can proceed, identify chains of responsibility and authority, provide for continuous and complete fuel and core component accountability, and establish procedures to be observed in case of emergency.

14.1.4.2 Postloading Tests

Upon completion of fuel loading, the reactor upper internals and the pressure vessel head are installed and additional testing is performed prior to initial criticality. The final pressure tests are conducted after filling and venting of the reactor coolant system (RCS) is completed. The purpose of this phase of the program is to prepare the system for nuclear operation and to establish that design requirements necessary for operation are achieved.

Mechanical and electrical tests are performed on the RCCA drive mechanisms. A complete operational check of the RCCA drive mechanisms and the RCCA position indicator systems is performed. Tests are performed on the reactor trip circuits to verify manual trip operation and actual RCCA drop times are measured for each assembly. Whenever the RCCA drive mechanisms are being tested, the boron concentration in the RCS is such that criticality cannot be achieved with all RCCAs fully withdrawn. A complete functional electrical and mechanical check is made of the incore nuclear flux mapping system at operating temperature and pressure.

14.1.4.3 Initial Criticality

Initial criticality is established by sequentially withdrawing the shutdown and control groups of control rod assemblies from the core, leaving the last withdrawn control group inserted far enough in the core to provide effective control when criticality is achieved. Then the heavily borated reactor coolant is diluted until criticality is achieved. Successive stages of control rod assembly group withdrawal and of boron concentration reduction are monitored by observing changes in neutron count rate. Periodically, samples of the primary coolant boron concentration are obtained and analyzed.

The inverse count rate ratio is used as an indication of the nearness and rate of approach to criticality of the core during RCCA group withdrawal and during reactor coolant boron dilution. The rate of approach is reduced as the reactor approaches extrapolated criticality to ensure that effective control is maintained at all times. Written *procedures specify alignment of fluid systems, control the rate at which the approach to criticality may proceed, and predict initial values of core conditions under which criticality is expected.*

14.1.4.4 Low Power Testing

A prescribed program of reactor physics measurements is undertaken to verify that the basic static and kinetic characteristics of the core are as expected and that the values of the kinetic coefficients assumed in the safety analysis are conservative.

The measurements are made at low power and at or near operating temperature and pressure. The measurements include verification of calculated control rod assembly group reactivity worths, isothermal temperature coefficient under various core conditions, differential boron concentration reactivity worth, and critical boron concentrations all as functions of control rod assembly group configuration. In addition, measurements of the power distribution are made. Concurrent tests are conducted on the instrumentation including the source and intermediate-range nuclear channels.

Written procedures specify the sequence of testing and the conditions under which each test is to be performed. This ensures both safety of operation and the relevancy and consistency of the results obtained. If significant deviations from design predictions exist, unacceptable behavior is revealed, or apparent anomalies develop, the testing is suspended while the situation is reviewed by PG&E to determine whether a question of safety is involved; the deviation is resolved prior to resumption of testing.

14.1.4.5 Power Level Escalation

When the operating characteristics of the plant have been verified by low power testing, a program of power level escalation in successive stages brings the unit to its full licensed power level. Reactor and unit operational characteristics are closely examined at each power level plateau and the relevance of the safety analysis is verified before escalation to the next programmed level.

Measurements are made to determine the relative power distribution in the core as functions of power level.

Secondary system heat balances ensure that the various indications of power level are consistent and provide a base for calibration of power range neutron channels. The ability of the reactor control system to respond effectively to signals from reactor plant and steam plant instrumentation under a variety of conditions encountered in normal operations is verified.

At prescribed power levels, the dynamic response characteristics of the reactor plant and steam plant are evaluated. The responses of system components are measured for design step and ramp changes in load, 50 percent reduction of load at design rate and normal recovery, net load rejection, and turbine trip.

Adequacy of radiation shielding is verified by gamma and neutron radiation surveys inside the containment and throughout the plant site at specified power levels. Periodic sampling of reactor coolant is performed to verify the chemical and radiochemical analysis of the reactor plant systems.

The functional performance requirements in some instances are described by specific quantitative acceptance criteria that are addressed in other sections of the FSAR. In other cases, acceptance standards may specify that a system or component perform a given action sequence. In either case, the detailed procedures or the referenced documents used in performing the test include specific acceptance criteria against which actual performance is measured. Plant conditions for each of the tests are listed in the test procedure.

When completed, this program provides assurance that plant performance is in accordance with the safety requirements established in the FSAR. The listing of the tests in Tables 14.1-1 and 14.1-2 includes specific identification of the objectives of each particular test that is required. Figure 14.1-1 gives a graphic presentation of the chronological sequence of startup testing.

14.1.5 ADMINISTRATIVE PROCEDURES -- SYSTEM OPERATION

14.1.5.1 Operating Procedures

Normal and emergency operation of all plant systems and/or major pieces of equipment are carried out in accordance with written procedures prepared by plant personnel and approved by the Plant Manager or his representative. These procedures are incorporated into the test program by the Lead Startup Engineer as appropriate. Where the prerequisite conditions for an operating procedure cannot be met during the test program, the procedure is demonstrated, under conditions simulating, as nearly as possible, the prerequisite conditions. The Assistant Plant Manager/Plant Superintendent reviews each startup test procedure to ensure that the operations specified in the test procedure are consistent with the normal and emergency operating procedures.

14.1.5.2 Safety Precautions

The measurements and operations during low power escalation testing are similar to normal unit operations at power and normal safety precautions are observed. Those tests that require special operating conditions are accomplished using test procedures that prescribe necessary limitations and precautions.

14.1.6 REFERENCES

1. Technical Specifications, Diablo Canyon Power Plant Units 1 and 2, Appendix A to License Nos. DPR-80 and DPR-82, as amended.

HISTORICAL INFORMATION IN ITALICS BELOW NOT REQUIRED TO BE REVISED.

14.2 AUGMENTATION OF APPLICANT'S STAFF FOR INITIAL TESTS AND OPERATION

The startup group, under the direction of the Lead Startup Engineer, is responsible for conducting the preoperational and startup testing programs. As such, the startup group may be considered the augmenting organization for the normal plant operating staff during the testing period. The NSSS supplier will furnish technical advice to the startup group during the initial testing period. In addition, the plant technical staff will augment the startup group during the initial test program. This augmentation will include shift supervision and shift staff engineer support.

14.2.1 ORGANIZATIONAL FUNCTIONS, RESPONSIBILITIES, AND AUTHORITIES

PG&E's organizational structure is shown in Figure 17.1-1. The Vice President-General Construction is responsible for construction of DCPP Unit 1 and Unit 2. This responsibility extends until the plant is running and released for operation, and includes the startup and acceptance of equipment.

The Nuclear Power Generation organizational structure is described in Chapter 13.

The plant operating organization, also described in Chapter 13, is responsible for the safety of operating personnel and the general public, for providing the necessary operating personnel for the power plant, for the training of those personnel, and for the direction and supervision of their work during the startup of new facilities. All activities that could affect the operation of the plant are done under the cognizance of licensed personnel as required by the Technical Specifications(1).

Technical advice furnished by Westinghouse Electric Corporation (Westinghouse), the NSSS designer and manufacturer, is advisory in nature since only PG&E's Operating Department plant staff will be licensed to direct or control plant operation.

14.2.2 INTERRELATIONSHIPS AND INTERFACES

The Lead Startup Engineer functions as the principal contact between the construction and operating organizations for startup activities.

The Startup Coordinator functions as the Assistant Plant Manager/Plant Superintendent's representative for startup operational activities.

The working interrelationship between the Lead Startup Engineer and the Startup Coordinator is described in Section 14.2.3.

Westinghouse will provide technical advice on site to PG&E during installation, startup, testing, and initial operation of the NSSS. This will provide additional assurance that the

NSSS is installed, started, tested, and operated in conformance with the design intent. Westinghouse personnel assigned to the site will provide technical advice and will provide technical liaison with the Westinghouse home office to promptly resolve problems within the Westinghouse scope of responsibility.

14.2.3 KEY PERSONNEL FUNCTIONS, RESPONSIBILITIES, AND AUTHORITIES

14.2.3.1 Station Construction Department

The Station Construction Department designates a Lead Startup Engineer who reports to the DCPP Senior Site Representative.

The Lead Startup Engineer is responsible for:

(1) Preparing the preoperational and startup testing programs and schedules; approval of these programs will be by the Lead Startup Engineer's signature

(2) Obtaining and preparing system test and acceptance criteria

(3) Providing necessary written test procedures

(4) Incorporating operating orders, procedures, and instructions prepared by the Assistant Plant Manager/Plant Superintendent into the test program

(5) Obtaining comments on test procedures from the Assistant Plant Manager/Plant Superintendent

(6) Arranging for startup personnel necessary to conduct the program and ensuring the adequacy of their preparation

(7) Ensuring that all prerequisites for performing tests are satisfactorily completed

(8) Directing individual preoperational and startup tests

(9) Verifying that each preoperational or startup test is satisfactorily completed

(10) Releasing accepted systems to the Assistant Plant Manager/Plant Superintendent

(11) Participating as a member in PSRC meetings during preoperational and startup testing

(12) Obtaining technical advice from Westinghouse as necessary

(13) Obtaining technical advice from PG&E's Engineering Department as necessary

14.2.3.2 Operating Department

The Plant Manager is responsible for serving as chairman of the PSRC meetings as discussed in Chapter 13.

The Assistant Plant Manager/Plant Superintendent is responsible for:

(1) Reviewing the schedules and test procedures developed by the Lead Startup Engineer and approving the overall startup schedule

(2) Preparing equipment operating orders, procedures, and instructions in accordance with standard PG&E operating practices for inclusion in the testing program

(3) Verifying that operating personnel are qualified to perform the operations required by the test program. Qualification of operating personnel is discussed in Chapter 13

(4) Supervising operation of controls of all components and systems during the test programs as requested by the Lead Startup Engineer and in accordance with the startup program

(5) Witnessing tests on apparatus and equipment and making recommendations on test results

(6) Determining that plant components and systems meet operating requirements as to safety, reliability, and economy of operation

(7) Accepting independent auxiliary equipment and systems for operation as needed after satisfactory performance has been demonstrated

The Assistant Plant Manager/Plant Superintendent designates an individual as Startup Coordinator, and that individual is responsible for startup operational activities under the Assistant Plant Manager/Plant Superintendent. For DCPP Unit 1 and Unit 2, the Operations Manager has been designated as Startup Coordinator.

14.2.3.3 Westinghouse

Early in construction, Westinghouse provided a site manager to represent Westinghouse at the site.

The site technical advice that will be provided for startup testing will be dependent upon the test being performed, the level of testing activity at any specific time, and requests by PG&E. Consequently, the personnel levels, categories, and schedules will be established by the site manager based on anticipated activities during each phase of the startup schedule. Westinghouse representatives will work in conjunction with the DCPP startup organization. A Westinghouse systems engineer will be assigned to the site for hot functional testing and other major systems testing activities. Supporting this engineer will be several field service engineers normally assigned on site during plant construction. These engineers will be augmented by specialists from the Westinghouse home office as required for adequate observation of the specific test being performed. The specialists will provide specific technical advice for specific tests.

A typical schedule for Westinghouse specialists follows:

(1) RCS Hydrotest - three specialists

(a) Reactor Coolant Pump Specialist

Scheduled to be on site 2 days prior to the hydrotest and for an approximate duration of 1 week or until satisfactory completion of the activity

(b) Chemist

Scheduled to be on site 2 days prior to the hydrotest and for an approximate duration of 1 week or until satisfactory completion of the activity

(c) Quality Assurance of Internals Inspector

Scheduled to be on site 2 weeks prior to the hydrotest and for an approximate duration of 2 weeks or until satisfactory completion of the activity

(2) Hot Functional Test - three specialists

(a) Reactor Coolant Pump Specialist

Scheduled to be on site 2 weeks prior to the hot functional test and for an approximate duration of 2 weeks or until satisfactory completion of the activity

(b) Chemist

Scheduled to be on site 2 days prior to the hot functional test and for an approximate duration of 1 week or until satisfactory completion of the activity

(c) *Quality Assurance of Internals Inspector*

Scheduled to be on site during the post-hot functional period and for an approximate duration of 1 week or until satisfactory completion of the activity

(3) *Core Loading - three specialists*

(a) *Physicist*

Scheduled to be on site 2 days prior to core loading and for an approximate duration of 1 week or until satisfactory completion of the activity

(b) *Chemist*

Scheduled to be on site 2 days prior to core loading and for an approximate duration of 1 week or until satisfactory completion of the activity

(c) *Fuel Handling Specialist*

Scheduled to be on site 1 week prior to core loading and for an approximate duration of 2 weeks or until satisfactory completion of the activity

(4) *Plant Startup - four specialists*

(a) *Nuclear Test Engineer*

Scheduled to be on site 1 week prior to startup and for an approximate duration of 8 weeks or until satisfactory completion of the activity

(b) *Chemist*

Scheduled to be on site 2 days prior to startup and for an approximate duration of 1 week or until satisfactory completion of the activity

(c) *Transient Analyst*

Scheduled to be on site prior to completion of each activity

(d) *Reactivity Computer Instrumentation Specialist*

Scheduled to be on site 1 day prior to startup and for an approximate duration of 2 weeks or until satisfactory completion of the activity

14.2.4 PERSONNEL QUALIFICATIONS

A resume for the Startup Coordinator (Operations Manager) is in the appendix to Chapter 13.

Qualifications of Westinghouse personnel providing technical advice include sufficient personal maturity, work experience, education, and specialized training to satisfy Westinghouse of their competence to adequately perform tasks assigned by the Westinghouse site manager. Due to the fluid nature of plant startup schedules, the individuals who will perform these assignments cannot be identified until specific milestones (i.e., hot functional, etc.) have actually occurred. Timing will be the principal factor in determining individual availability. Trainees and personnel with limited work experience are not used in positions of significant responsibility. Experience in the startup of nuclear power plants has indicated that the qualification of Westinghouse personnel assigned has been fully acceptable.

14.2.5 REFERENCES

1. *Technical Specifications, Diablo Canyon Power Plant Units 1 and 2, Appendix A to License Nos. DPR-80 and DPR-82, as amended.*

14.3 POSTCOMMERCIAL OPERATIONAL TEST PROGRAM

The following regulatory requirement is applicable to the Post-Commercial Operational Test Program:

10 CFR Part 50, Appendix B, Criterion XI – Test Control

DCPP is required to establish a test program to ensure that all testing required to demonstrate that structures, systems and components will perform satisfactorily in service is identified and performed in accordance with written test procedures, which incorporate the requirements and acceptance limits contained in applicable design documents. The test program is required to include, as appropriate, proof tests prior to installation, preoperational tests, and operational tests during nuclear power plant operation of structures, systems, and components. Test procedures are required to include provisions for assuring that all prerequisites for the given test have been met, that adequate test instrumentation is available and used, and that the test is performed under suitable environmental conditions. Test results are required to be documented and evaluated to assure that test requirements have been satisfied.

This section describes the program for testing modifications to DCPP systems per approved design changes. The program ensures design changes are reviewed for postmodification operational testing requirements and that all operational tests are developed and performed prior to returning affected equipment to service.

The engineering director has overall responsibility for postmodification testing.

The scope of a modification is evaluated against plant safety features, industry codes, regulatory requirements, etc. From this evaluation, the scope of required testing is determined. Temporary test procedures are prepared when existing plant procedures will not adequately test the modification. Procedures used for performance of operational testing of design changes are reviewed and approved by appropriate DCPP management. Operational testing ensures a modification will function in accordance with the design basis by simulating normal and transient conditions when practical.

DCPP defines testing based on work category. Post modification testing (PMT) consists of maintenance verification testing (MVT), operability verification testing (OVT), and design verification testing (DVT). These tests may consist of functional tests, dry-run tests, dynamic tests, and inspections. Qualified personnel review and evaluate the test results for acceptability prior to releasing the equipment for service.

HISTORICAL INFORMATION IN ITALICS BELOW NOT REQUIRED TO BE REVISED

PREOPERATIONAL TESTING SUMMARY

System Tests	*Test Objectives*
1. Electrical Systems	
1.1 Vital bus (4.16 kV, 480 V, 120 Vac)	*1. To demonstrate full plant load capability and interchangeability of all alternate power sources.*
	2. To verify automatic transfer of buses with and without offsite power available.
	3. To verify the 4.16 kV and 480 Vac vital bus load start logic.
1.2 Vital 125 Vdc system	*1. To verify proper operation in normal and emergency conditions of batteries, battery chargers, 125 Vdc switchgear, and distribution panels.*
	2. To verify battery capacities.
1.3 Communications systems	*1. To verify that the site evacuation signal can be heard from any location at the site.*
	2. To verify that the fire alarm signal can be heard from any location in the plant.
	3. To verify that communications stations for fuel loading are functional.
1.4 Emergency lighting	*1. To verify adequacy for operator transit from point to point.*
2. Diesel Engine Generator Units	*1. To verify the start signal setpoints and logic.*
	2. To verify the capability of the diesel engine generator units to supply power to vital equipment for plant cooldown during emergency conditions, such as loss of offsite power coincident with loss of turbine generator.
	3. To verify that redundant features of the system function according to the design intent.

System Tests	*Test Objectives*
2. (Continued)	*4. To verify that the diesel fuel oil transfer pump will supply fuel oil from the diesel fuel oil storage tank to the diesel engine fuel oil day tank.*
3. Fire Protection Systems	*1. To verify that the fire pumps will supply water from the fire water tank to selected stations within the DCPP and that the automatic start features operate as designed.*
	2. To verify that the low-pressure CO_2 system functions properly and that CO_2 is delivered to appropriate fire protection stations.
	3. To verify that the Halon system functions properly and that Halon is dispersed in the solid-state protection system room in acceptable concentrations.
4. Ventilation Systems	*1. To verify the operation of the containment fan coolers and dampers according to design and to measure heat removal capability during hot functional testing.*
	2. To verify that the auxiliary and fuel handling building exhaust and supply fans and the control room air conditioning units and their associated dampers, valves, and filters operate according to design.
	3. To verify the logic for postaccident condition initiation of containment pressure reduction.
	4. To verify the closure of containment purge supply and exhaust ducts and the pressure relief duct from a high radioactivity in containment signal.
5. Instrumentation and Control Systems	
5.1 Process instrumentation	*1. Applicable alarm and control set- points are checked for conformance with design values.*
5.2 Nuclear instrumentation	*1. Prior to core loading, nuclear instruments will have been aligned and source range detector response to neutron source checked.*

System Tests	*Test Objectives*
5.2 (Continued)	*2. All required channels will be checked to verify operability within the required Technical Specifications interval.*
5.3 Automatic reactor power control systems tests	*1. The system alignment is verified at preoperational conditions to demonstrate the response of the system to simulated inputs. These tests are performed to verify that the systems will operate satisfactorily at power.*
	2. At power, the alignment of the system is verified by programmed step changes and under actual test transient conditions.
5.4 Engineered safety features (ESF)	*1. To verify ESF, setpoints, logic, and response times.*
	2. To verify response of ESF equipment to a safety injection signal with and without offsite power available.
5.5 Reactor protection system	*1. To test redundancy, coincidence, independence, and safe failure on loss of power to process instrumentation and reactor protection equipment.*
	2. To verify reactor protection time response meets design requirements.
	3. To test automatic and manual reactor trip setpoints, logic, and reactor trip breakers.
5.6 Radiation monitoring systems	*1. To calibrate against known standards and verify the operability and alarm setpoints of all process monitors (air particulate monitors, gas monitors, and liquid monitors) located in the plant.*
6. System Functional Tests	
6.1 Reactor coolant system (RCS)	*1. To verify the integrity and leaktightness of the RCS and auxiliary primary systems at the specified test pressure and temperature.*
	2. To verify the capability of the pressurizer relief tank to function according to design.

System Tests	*Test Objectives*
6.1 (Continued)	*3. To verify proper operation of the nuclear steam supply system and auxiliary systems local and remote indicators, alarms, recorders, and controllers for pressure, temperature, flow, and level.*
	4. To verify resistance temperature detector (RTD) bypass loop flow and correct functional operation of control and indicating equipment and the detectors.
	5. To establish baseline data for inservice inspections and verify integrity of the system.
6.2 Chemical and volume control system (CVCS)	*1. To verify that the design charging, letdown, and excess letdown flowrates are attainable.*
	2. To verify that the reactor coolant purification equipment operates according to design parameters.
	3. To verify charging pump (CCP1 and 2) performance and response to a safety injection signal when the RCS is depressurized.
	4. To verify ability to control RCS water volume.
	5. To verify the ability to control chemical shim concentration.
	6. To verify the design seal water flowrates to each reactor coolant pump.
	7. To verify that pumps, filters, tanks, and heat tracing used for batching, storage, and transfer of 12% boric acid function satisfactorily as a system.
	8. To verify gas stripper and boric acid evaporator operation meets design requirements.
	9. To verify chemical addition and sampling features function according to design.
	10. To verify operating capability of process instrumentation and controls under normal conditions.

System Tests	*Test Objectives*
6.3 Safety injection system	*1. To verify the safety injection pump and accumulator performance and response to a safety injection signal when the RCS is depressurized.* *2. Test the systems to ensure capability of meeting design objectives.*
6.4 Containment spray system	*1. To verify the containment spray pump performance and response to a containment spray signal.* *2. Verify that the system can be tested to verify functional performance.*
6.5 Residual heat removal system (RHRS)	*1. To verify the RHR pump performance and response to a safety injection signal when the RCS is depressurized.* *2. To verify the system is capable of supplying emergency core cooling in the recirculation mode.* *3. To verify system capability for supplying cooling water during core loading.* *4. To verify the capability for plant cooldown assuming failure of a single active component.*
6.6 Component cooling water system (CCWS)	*1. To verify normal system operation according to the system description and design requirements.* *2. To verify the capability for plant cooldown assuming failure of a single active component.*
6.7 Makeup water system	*1. To verify the makeup water transfer pumps will transfer water from the condensate storage tank to the fire system, and to the CCW system surge tank.* *2. To verify the primary water makeup pumps will supply water from the primary water storage tank to the CCW system surge tank, to the boric acid blender, and to the chemical mixing tank in the CVCS system.*

System Tests	*Test Objectives*
6.8 Auxiliary saltwater system (ASWS)	*1. To verify normal system operation according to system description and design requirements.*
	2. To verify the capability for plant cooldown assuming failure of a single active component.
6.9 Liquid radwaste system	*1. To verify that liquids can be collected in the reactor coolant drain tank and transferred to other tanks per design.*
	2. To verify waste processing according to the system description (includes waste concentrator, waste concentrator pumps, and liquid radwaste filter and tanks).
	3. To verify that liquid radwaste releases can be controlled and excessive releases can be prevented.
	4. To verify proper operation of primary system leak detection features and to verify proper operation of miscellaneous equipment drain tank pumps, equipment drain receivers, and pumps.
6.10 Gaseous radwaste system	*1. To verify the collection and processing of gaseous radwaste is according to the system description.*
6.11 Auxiliary feedwater system	*1. To verify the turbine- and motor-driven auxiliary feedwater pumps deliver feedwater from the condensate storage tank to the steam generators at design flowrate and pressure and otherwise perform according to design in response to ESF signals.*
6.12 Condensate, feedwater, and main steam	*1. To check proper operation and indication of main feedwater regulating valves and main steam line isolation valves for the appropriate actuation signals.*
6.13 Hydrogen and nitrogen systems	*1. To verify valve operability, regulating and reducing station performance, and the ability to supply the appropriate gas to interconnecting systems as required.*

System Tests	*Test Objectives*
7. *Hot Functional Tests*	*The intent of planned testing shall include but not be limited to the following:* *1. To check RCS heatup and cooldown procedures.* *2. To demonstrate satisfactory performance of components and systems that are exposed to RCS temperature.* *3. To verify to the extent possible proper operation of instrumentation, controllers, and alarms.* *4. To provide design operating conditions for testing the following auxiliary systems:* *a. CVCS* *b. Sampling system* *c. CCWS* *d. RHRS* *e. ASWS* *5. To verify that water can be charged by the CVCS at rated flow against normal reactor coolant pressure.* *6. To check letdown design flowrate for each operating mode.* *7. To check operation of the excess letdown and seal water flowpaths.* *8. To check steam generator instrumentation and control systems.* *9. To verify the ability to cool down the plant using the steam generators.* *10. To check thermal expansion and restraint of RCS components and piping.* *11. To perform isothermal calibration of RTDs and incore thermocouples.* *12. To operationally test the RHRS.* *13. To check pressurizer level and pressure*

System Tests	*Test Objectives*
	instrumentation and control systems.
7. (Continued)	*14. To check RCS instrumentation and control systems.*
	15. To verify the ability of the auxiliary feedwater system to feed the steam generators.
	16. To verify that steam generator blowdown operates according to design.
	17. To verify the capability of emergency process control from a location remote to the control room.
	18. To verify correct plant response to a safety injection signal under hot operating conditions. Verify system alignments, automatic transfer of electrical systems, and automatic sequential start of ESF equipment.
	19. Following hot functional testing, the reactor internals are removed and inspected for signs of excessive vibration.
8. Relief and Safety Valve Tests	*1. To verify setpoints of the relief and safety valves.*
9. Containment Building	*1. To conduct structural integrity and integrated leakrate tests.*
	2. To verify proper operation and leaktightness of air locks.
	3. To verify closure of all containment isolation valves for the appropriate signals.

TABLE 14.1-2

HISTORICAL INFORMATION IN ITALICS BELOW NOT REQUIRED TO BE REVISED

FUEL LOADING AND INITIAL STARTUP TESTING SUMMARY

Tests	*Objectives*
1. Startup Program Master Document	*1. To define the sequence of tests and activities from preparation for fuel load through fuel loading, low power testing, and power ascension.*
	2. To establish hold points for administrative control over proceeding into significant areas of testing or power plateaus.
2. Fuel Loading Program	
2.1 Fuel loading prerequisites and periodic checkoffs	*1. To establish and maintain the prerequisite conditions for fuel loading.*
2.2 Initial fuel loading	*1. To specify the sequence of operation for fuel loading.*
3. Precritical Test Program	
3.1 Incore movable detectors	*1. To verify correct functional operation of control and indicating equipment.*
3.2 Rod drive mechanism timing	*1. To verify the proper timing for rod drive mechanism control equipment.*
	2. To operationally check each control rod drive mechanism with a control rod attached.
3.3 Incore thermocouple-loop RTD cross calibration	*1. To check and compare incore thermocouple readings with RCS RTD readings and calibrate the system if required.*
3.4 Pressurizer spray and heater capacity and continuous spray flow setting	*1. To establish the continuous spray flowrate.*
	2. To verify the pressure control capability using spray flow and heaters.
3.5 RTD bypass loop flow measurement	*1. To establish and verify acceptable flowrates.*

Tests	*Objectives*
3.6 Rod drop time measurement	*1. To determine the drop time of each control rod for selected conditions.*
3.7 Rod position indication	*1. To demonstrate satisfactory system performance of indication and alarm functions.*
	2. To demonstrate that control rods operate over their entire length of travel.
3.8 Rod control system operational test	*1. To demonstrate that the rod control system performs its required control and indication functions to verify availability for use just prior to criticality.*
3.9 RCS flow measurement	*1. To verify adequacy of RCS flow.*
3.10 RCS flow coastdown	*1. To verify the rate of change of reactor coolant flow subsequent to selective reactor coolant pump trips.*
4. Initial Criticality and Low Power Physics Program	
4.1 Initial criticality	*1. To bring the reactor critical for the first time.*
	2. To compare the measured critical boron concentration with the expected critical boron concentration.
	3. To establish upper limit of flux level for zero power physics measurements.
4.2 Nuclear design checks	*1. To verify the boron endpoint concentration, the isothermal temperature coefficient of reactivity, and zero power flux distribution for various rod configurations.*
4.3 Rod and boron reactivity worth measurements	*1. To verify design values of bank differential and integral worths during boron addition and dilution.*
4.4 Rod cluster control assembly (RCCA) pseudo-ejection	*1. To verify that the RCCA reactivity worth assumed in the accident analysis is conservative.*
4.5 Minimum shutdown verification	*1. To verify the reactivity worth of the shutdown banks.*
4.5 (Continued)	*2. To measure the critical boron concentration*

Tests	*Objectives*
	with all shutdown and control banks inserted, less the most reactive rod assembly.
4.6 Conduct special test program (Unit 1 only) consisting of the following tests:	
a) Natural circulation	*1. Provide supplementary technical information and operator training. (Tests a through g.)*
b) Natural circulation with loss of pressurizer heaters	*2. Determine capability of CVCS charging and letdown to cooldown the RCS. (Test f.)*
c) Natural circulation at reduced pressure	*3. Demonstrate ability to control RCS and steam generator parameters. (Test g.)*
(d) Natural circulation with simulated loss of offsite ac power	
(e) Effect of steam generator isolation on natural circulation	
(f) Cooldown capability of the charging and letdown system	
(g) Simulated loss of all onsite and offsite ac power	
5 Power Ascension Program	
5.1 Thermal power measurements	*1. To ascertain level of thermal power for establishment of plateaus for testing activities.*
	2. To provide thermal power information for use in other tests.
5.2 Radiation surveys and shielding effectiveness	*1. To obtain background information to establish access restrictions*
	.
	2. To verify shielding adequacy.
5.3 Operational alignment of nuclear instrumentation	*1. To make necessary adjustments to the NIS as a function of reactor thermal power*

TABLE 14.1-2

	Tests	*Objectives*
	systems (NIS)	
5.4	*Operational alignment of RCS temperature instrumentation at power*	*1. To make necessary adjustments to the T_{avg} and ΔT channels as a function of reactor thermal power*
5.5	*Calibration of steam and feedwater flow instrumentation at power*	*1. To calibrate steam and feedwater flow instrumentation as a function values determined from test instrumentation.*
5.6	*Turbine overspeed trip test*	*1. To test the main turbine electrical and mechanical overspeed trip mechanisms.*
5.7	*Incore power distribution*	*1. To verify that nuclear design predicted power distributions are valid for normal rod patterns and configurations.*
5.8	*Effluents and effluents monitoring*	*1. To verify level of radwaste releases.*
5.9	*Chemical and radiochemical analysis*	*1. To demonstrate ability to control RCS water chemistry.*
5.10	*Control systems checkout*	*1. To demonstrate proper operation of the:* *a. RCS* *b. Steam generator level control system* *c. Steam dump control system* *d. Turbine control system.*
5.11	*Control rod pseudo-ejection and above bank position measurements*	*1. To verify response of the excore detectors to a rod in above bank position.*
		2. To verify the effects of a rod out of position and a pseudo-ejected rod upon neutron flux and hot channel factors.
5.12	*Static rod drop and RCCA below bank position measurements (Unit 1 only)*	*1. To verify the response of excore detectors to a rod in below bank position.*
		2. To verify that a single control rod assembly inserted fully or part way below the control bank results in acceptable hot channel factors.
5.13	*Rod group drop and plant trip*	*1. To verify functioning of negative rate trip circuitry in the excore detector system.*

Tests	*Objectives*
	2. To verify control systems performance as evidenced by plant parameter variations within acceptable limits.
5.14 Plant shutdown from outside the control room	*1. To verify shutdown capability from backup control stations*
5.15 Load swing tests	*1. To verify control systems performance as evidenced by plant parameter variations within acceptable limits.*
	2. To verify plant response to load changes.
5.16 Doppler power reactivity coefficient measurement	*1. To verify nuclear design prediction of the Doppler-only power coefficient.*
5.17 Incore-excore detector calibration	*1. To form a relationship between incore and excore neutron detector signals for generated axial offsets*
5.18 Large load reduction tests	*1. To verify ability of plant to sustain large load reductions as evidenced by parameters remaining within acceptable limits.*
5.19 Steam generator moisture carryover	*1. To verify that actual steam generator moisture carryover is equal to or less than design value.*
5.20 Nuclear steam supply system acceptance test	*1. To operate the plant at or near 100% power for 100 hours to verify plant capability at sustained load.*
5.21 Net load trip tests	*1. To verify plant response to loss of plant load at the 50% and 100% power plateaus for Unit 1 and the 50% power plateau for Unit 2.*
	2. To verify control systems performance as evidenced by plant parameter variations within acceptable limits.
5.22 Plant trip tests	*1. To verify plant response to turbine generator trips at 50% and 100% power plateaus.*
5.22 (Continued)	*2. To verify control systems performance as evidenced by plant parameter variations within acceptable limits.*

Tests	*Objectives*
	3. To verify automatic transfer to offsite standby power.
5.23 Natural circulation boron mixing cooldown test (Unit 1 only)	*1. To verify ability to add and mix 12% boric acid, cooldown to RHR via natural circulation and continue cooldown to cold shutdown conditions*

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PROCEDURE TITLE OR TEST DESCRIPTION	PRE-FUEL LOAD	LOW POWER MODES 6 - 2					POWER OPERATION MODE 1					
		REF	CSD	HSD	HSE	STUP	≤15	30	50	75	90	100
REFER TO TABLE 14.1-2												
1.0 STARTUP PROGRAM												
1.1 Startup Program Master Document	O											O
2.0 FUEL LOADING PROGRAM												
2.1 Fuel Loading Prerequisites and Periodic Checkoffs	O	O										
2.2 Operational Alignment of Nuclear Instrumentation	O											
2.3 Effluents and Effluents Monitoring	O											
2.4 Chemical and Radiochemical Analysis	O											
2.5 Initial Fuel Loading		O										

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FIGURE 14.1-1
CHRONOLOGICAL SEQUENCE OF STARTUP TESTING
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PROCEDURE TITLE OR TEST DESCRIPTION	PRE-FUEL LOAD	LOW POWER MODES 6-2					POWER OPERATION MODE 1					
		REF	CSD	HSD	HSB	STUP	≤15	30	50	75	90	100
3.0 PRECRITICAL TEST PROGRAM												
3.1 Incore Movable Detectors		O	O	O	O							
3.2 Rod Drive Mechanism Timing			O		O							
3.3 Incore Thermocouple - Loop RTD Cross Calibration				O	O							
3.4 Pressurizer Spray and Heater Capacity and Continuous Spray Flow Setting					O							
3.5 RTD Bypass Loop Flow Measurement					O							
3.6 Rod Drop Time Measurement			O		O							
3.7 Rod Position Indication System					O							
3.8 Rod Control System Operational Test					O							
3.9 Reactor Coolant System Flow Measurement					O							
3.10 Reactor Coolant System Flow Coastdown					O							
3.11 Effluents and Effluent Monitoring	O	O			O							
3.12 Chemical and Radiochemical Analysis	O	O			O							
3.13 Operational Alignment of Nuclear Instrumentation	O				O							
3.14 Operational Alignment of Reactor Coolant System Temperature Instrumentation at Power					O							
3.15 Calibration of Steam and Feedwater Flow Instrumentation at Power					O							

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FIGURE 14.1-1
CHRONOLOGICAL SEQUENCE
OF STARTUP TESTING
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PROCEDURE TITLE OR TEST DESCRIPTION	PRE-FUEL LOAD	LOW POWER MODES 6-2					POWER OPERATION MODE 1					
		REF	CSD	HSD	HSB	STUP	15	30	50	75	90	100
4.0 INITIAL CRITICALITY AND LOW POWER PHYSICS PROGRAM												
4.1 Initial Criticality						O						
4.2 Nuclear Design Checks						O						
4.3 Rod and Boron Reactivity Worth Measurements						O						
4.4 Rod Control Cluster Assembly Pseudo-ejection						O						
4.5 Minimum Shutdown Verification						O						
4.6 Operational Alignment of Nuclear Instrumentation	O				O	O						
4.7 Incore Power Distribution						O						
4.8 Effluents and Effluents Monitoring	O					O						
4.9 Chemical and Radiochemical Analysis	O					O						
4.10 Special Test Program (Unit 1 only)					O	O						

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FIGURE 14.1-1
CHRONOLOGICAL SEQUENCE OF STARTUP TESTING
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PROCEDURE TITLE OR TEST DESCRIPTION	PRE-FUEL LOAD	LOW POWER MODES 6 - 2					POWER OPERATION MODE 1					
		REF	CSD	HSD	HSB	STUP	≤15	30	50	75	90	100
5.0 POWER ASCENSION PROGRAM												
5.1 Thermal Power Measurements							O	O	O	O	O	O
5.2 Radiation Surveys and Shielding Effectiveness (Unit 1)							O	O	O	O		O
(Unit 2)							O		O			O
5.3 Operational Alignment of Nuclear Instrumentation	O				O	O	O	O	O	O	O	O
5.4 Operational Alignment of Reactor Coolant System Temperature Instrumentation at Power					O					O		O
5.5 Calibration of Steam and Feedwater Flow Instrumentation at Power					O			O	O	O	O	O
5.6 Turbine Overspeed Trip Test							O					
5.7 Incore Power Distribution						O	O	O	O	O	O	O
5.8 Effluents and Effluents Monitoring	O	- - -	- - -	- - -	- - -	- - -	O	—	—	—	—	O
5.9 Chemical and Radiochemical Analysis	O	- - -	- - -	- - -	- - -	- - -	O	—	—	—	—	O
5.10 Automatic Control Systems Checkout							O	O	O	O		O
5.11 Control Rod Pseudo-ejection and Above Bank Position Measurement								O				
5.12 Static Rod Drop and RCCA Below Bank Position Measurements (Unit 1 Only)									O			
5.13 Rod Group Drop and Plant Trip									O			
5.14 Plant Shutdown from Outside the Control Room									O			
5.15 Load Swing Tests								O	O	O		O
5.16 Doppler Power Reactivity Coefficient Measurement								O	O	O	O	

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FIGURE 14.1-1
CHRONOLOGICAL SEQUENCE OF STARTUP TESTING
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PROCEDURE TITLE OR TEST DESCRIPTION	PRE-FUEL LOAD	LOW POWER MODES 6 - 2					POWER OPERATION MODE 1					
		REF	CSD	HSD	HSB	STUP	≤15	30	50	75	90	100
5.0 POWER ASCENSION PROGRAM (Continued)												
5.17 Incore-Excore Detector Calibration (Test shown at 50% plateau to be performed slightly below 50% power)									O	O		
5.18 Large Load Reduction Tests										O		O
5.19 Steam Generator Moisture Carryover (Tests performed between 90% and 100% power)											O	O
5.20 Nuclear Steam Supply System Acceptance Test												O
5.21 Net Load Trip Tests (Unit 1)									O			O
(Unit 2)									O			
5.22 Plant Trip from 100% Power												O
5.23 Natural Circulation Boron Mixing Cooldown Test (Unit 1 only)			O	O	O							

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FIGURE 14.1-1
CHRONOLOGICAL SEQUENCE
OF STARTUP TESTING
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