INSPECTION PROCEDURE 72304

STARTUP TESTING FOR AP 1000: TEST PROCEDURE REVIEW, TEST WITNESSING, AND TEST RESULTS EVALUATION

PROGRAM APPLICABILITY: 2504

72303-01 INSPECTION OBJECTIVES

01.01 Determine if the startup test procedures are consistent with the licensee's technical and administrative criteria, COL commitments, DCD, FSAR, regulatory requirements, and TS (See Section 05 in this IP for a list of acronyms).

01.02 Witness some AP 1000 startup tests, and determine if they are being performed in accordance with the COL, DCD, FSAR, and test procedures.

01.03 Assess whether test records are in accordance with licensee procedural controls, and accurately depict the startup test procedures as modified during their implementation.

01.04 Determine if the startup test results are being evaluated in a consistent manner so as to ensure that test acceptance criteria are met.

72303-02 INSPECTION REQUIREMENTS AND GUIDANCE

02.01 Review of Startup Test Procedures. Verify that a test procedure exists for each Class I and Class II startup test shown in Attachment 24. Select either Group A or Group B startup tests in Class I from Attachment 24. Then for the tests in the group selected, review the startup test procedures for the following and the additional requirements in the respective Attachments 1-23:

a. Management approval is indicated. All test procedures shall include licensee operations management review, regardless of who prepares the procedures.

b. Safety review committee approval is indicated. The FSAR and TS will identify those tests which require special committee review, and will define the committee composition.

c. Format is consistent with ANSI N18.7 and RG 1.68, Appendix C.

d. Test objectives are clearly stated along with all DCD and FSAR commitments.

e. Pertinent prerequisites are identified, for example

   1. Required plant systems are specified.
   2. Proper facility procedures are specified.
   3. Completion of calibration checks, limit switch setting protective device setting, included where applicable.
   4. Special supplies and test equipment are specified.

f. Special environmental conditions are identified.

g. Acceptance criteria are clearly identified. The test shall require a comparison of the test results with the acceptance criteria.

h. The sources of the acceptance criteria and critical steps in the test procedure are identified, for example, the DCD, FSAR, TS. Sources of acceptance criteria are only necessary for critical variables.

i. Initial test conditions are specified, for example:

1. Valve lineups.
2. Electrical power and control requirements.
3. Temporary installations (instrumentation, electrical, and piping).
4. Temperatures, pressures, flows.
5. Water chemistry.
6. Other.

j All references are listed, that is, FSAR, drawings, codes, and other requirements.

k. Step-by-step instructions are provided to ensure that test objectives are met. Use of plant operating procedures by reference is permissible provided the operating procedures have been approved for use as stated in the FSAR and TS.

l. All items, including prerequisites, can be initialed to indicate their completion. Sign-offs of individual steps should include the date and time, if the actual time is pertinent to the test. Initials and check marks or stamps may be used if they are traceable to an individual.

m. Provisions and instructions are provided for recording details of test performance, that is, deficiencies, their resolution, and retest.

n. Steps are provided to restore temporary connections, disconnections, or jumpers to their normal state or to control them.

o. Test personnel, conducting the testing and evaluating the test data, are identified in the test records.

p. Quality assurance verification is provided for critical steps or parameters. Modifications of the tests from how described in the FSAR, in any manner, shall require special review, evaluation, and approval pursuant to Appendix D, Section VIII of the AP 1000 Design Certification Rule, 10 CFR 52.63(b)(2), and 10 CFR 52.97(a)(2).

q. Each test procedure is consistent with the respective test description in the FSAR.

r. Special precautions for personnel and equipment safety are specified. Guidance is provided in RG 1.68, Appendix C, Section 1.c.

s. Instructions for testing a system or component over the full operating range/load change are provided. Guidance is provided in RG 1.68, Appendix A, Section 1.

t. Provisions are provided for the data taker to indicate the acceptability of the data. Guidance is provided in RG 1.68, Appendix C, Section 1.i.

u. Expected performance of automatic controls, for example, automatic actuation of process components and safety systems, is specified. Guidance is provided in RG 1.68, Appendix A, Section 1.

v. Provisions are made for using the plant simulator as a training means for startup testing and for updating simulator with data taken during the startup testing.

w. The tests shall meet the intent and operability requirements of the TS and their bases.

02.02 Witnessing Startup Tests. The inspector shall witness the Class I tests for the group selected in Section 02.01. Before witnessing a test, the inspector shall have completed a review of the test procedure per Section 02.01 of this IP. The inspector must be familiar with the test procedure in order to adequately witness the testing described in this IP. Communication must be maintained between the inspector and the licensee so that the licensee's test dates are known far enough in advance for the inspector to be ready to witness the selected tests. Licensees are not expected, nor are they to be asked, to delay conduct of a test pending the inspector's arrival.

a. Overall Crew Performance.

1. Current test procedure must be available and in use by all crew members. The inspector should determine the proper procedure revision by examining the licensee's master index or the "up-to-date" procedure file. Assure by examination and discussions that crew members are using the test procedure with the proper revision number and are familiar with the procedural requirements, especially the limitations and precautions.

2. Minimum crew requirements are met for both licensed and non-licensed operators.

3. Any test prerequisites and any initial conditions waived should be reviewed and approved in accordance with the test procedure or TS. Verify that procedural prerequisites and initial conditions have been met by reviewing the required records, for example, valve lineup list, instrumentation calibration procedure, system checklist, or signoff item in the listed test procedure or by direct observation, for example, monitoring instrumentation indications, valve positions, equipment start position switches, or personnel actions. Additionally, if the test involves the use of a TS Special Test Exception LCO, ensure that the LCO is adhered to and the applicable surveillance requirements are performed.

4. Test equipment must be calibrated and ready for use. Test equipment is normally required for measuring important parameters that determine the functionality of components and systems. Verify that the equipment is not outside its calibration period.

5. Crew actions are correct, timely, and coordinated. Crew coordination is an important part of any test since many of the steps involve coordinated activities between two or more crew members. The individual directing the test activities must have knowledge of the activities of each crew member and of the time sequence of activities when necessary. The test sequence may need to be interrupted or modified. These interruptions or changes must be communicated to crew members and any changes must be handled in accordance with existing procedures. On a sampling basis, verify adherence to the procedural limitations and precautions, and the individual test steps.

6. Summary analysis is made to assure proper plant response to the test.The acceptance criteria should be stated in the test procedure. Crew members should be knowledgeable of the expected events at their stations, that is, control rod position, boron concentration, thermal power level, core axial and radial power distribution, DNBR, peak linear heat rates, system flow rates,

pressures and temperatures. This type of information should be available to the person in charge in a timely manner so that an evaluation may be made soon after performing the test. Events or data individually within expectations may be collectively indicating unexpected results.

7. All data are collected for final analysis by the proper personnel. All necessary raw data must be gathered in a timely manner following the test. The person in charge must ensure that these data are collected, assembled, and transferred to person(s) performing the final analysis.

b. Test Results. The inspector should also, independent from the licensee evaluation, observe and evaluate certain events or data gathering during and following the tests. These events or data gathering activities should be selected during the inspector's review of the test procedure. The inspector should be knowledgeable of the expected measurements for important test parameters, for example, (1) the flow rate drops to 1/10 of the initial value for x seconds and returns to some other value within 2 minutes, (2) a specific reactivity change occurs during a specified time interval, or (3) computer printout values are read to be within the acceptance criteria. At least two of the most important events or data gathering activities shall be observed or evaluated by the inspector and the inspector shall verify the following:

1. That all test acceptance criteria have been met.
2. That licensee's preliminary test evaluation is consistent with inspector observation.
3. Adherence to the requirements of any TS LCOs affected during the test.

02.03 Startup Test Program Review and Evaluation. Performance of these activities will ensure the inspector is cognizant of test activities, test results, and test discrepancies or other plant problems affecting testing, including their disposition. These inspection requirements will normally be accomplished by the Resident Inspector. The inspector is concerned with potential problems that affect the implementation of the licensee's Startup Test Program, most especially the Class I tests in Attachment 24.

a. Review the test sequencing document (or test procedure) including changes (daily).

b. Review the Startup Test Engineers Log (or equivalent), the Control Room Log, and the Shift Supervisor's Log, as applicable (daily).

c. Review Plant Information Reports or equivalent (daily).

d. Attend meetings of the Test Data Evaluation Group and the Plant Operations Review Committee or their equivalents (at least once every 2 weeks or at the frequency the meetings are held if less frequently than every 2 weeks).

02.04 Evaluation of Test Results . This IP provides a standard review practice to be applied to startup test results and applies to the Class I and II tests in Attachment 24. Following the licensee's evaluation and acceptance of the test results, inspect the licensee's completed test data by doing the following:

For the group of Class I tests, selected in Section 02.01, and for 50% of the Class II tests for this design, complete all steps of this section below. For the remaining Class I tests and for the remaining 50% of the Class II tests, complete only steps e. and f. of this section. For Class I tests that are in both Group A and Group B, do not duplicate steps e. and f. for them.

a. Review All Test Changes, Including Deletions. All changes, including deletions, to the test program should be reviewed for conformance to the requirements

established in the FSAR and RG 1.68. If a change results in failure to satisfy FSAR commitments, or eliminates testing identified in RG 1.68, the change should have been reviewed and approved pursuant to 10 CFR 50.59.

1. Verify that each change was approved in accordance with the pertinent administrative procedures and that the basis for the change is documented.

2. Verify that the test procedure is annotated to identify test changes.

3. Verify that the test change has been completed if it entails specific actions.

4. Verify that nothing changed the basic objectives of the test.

b. Review All Test Deficiencies. In some cases, the test data will not be within the written predicted acceptance criteria. If this occurs, determine if further licensee actions will or have been taken. These actions may require (1) plant design changes, (2) evaluation by a manufacturer of the error between the design and predicted plant performance, or (3) restriction of plant operations because of the difference in plant performance and predicted acceptance criteria. The inspector must determine that for each of the above type actions, licensee followup corrective actions have been correctly performed, that is, 10 CFR 50.59 review, licensing approval if required, and subsequent testing for each design change, and do the following:

1. Verify that each test deficiency has been resolved, that the resolution has been accepted by appropriate management, and that retest requirements have been completed.

2. Verify that any system or process changes necessitated by a test deficiency have been properly documented and reviewed.

3. Verify that deficiencies which constitute a reportable occurrence as defined by the TS have been properly reported (followup on reportable deficiencies is done by the inspectors).

c. Review ‘test exceptions’ which are inconsequential errors, for example, typo-like errors, in the test procedure which the licensee believes will not invalidate the test or create a test deficiency by doing the following:

1. Verify that they were documented during the test.

2. Verify that they were subsequently approved after the test is completed.

3. Confirm that licensee has administrative and procedural controls in place to address such errors.

d. Review "As-run" Copy of Test Procedure. Make an independent technical analysis and use technical judgment to assure that the licensee's analysis has been performed correctly. Confirm that all test results have been compared with acceptance criteria and do the following:

1. Verify that data sheets have been completed (25% sample).

2. Verify that all data are recorded where required and are within acceptance tolerances (25% sample).

3. Verify that all test changes, deficiencies, and exceptions are noted.

4. Verify that individual test steps and data sheets have been properly initialed and dated.

e. Review the Test Summary and Evaluation. Review the test data packages assembled by licensees to ensure that the package is complete (as defined in licensee procedures). Ascertain that the licensee has verified that the acceptance criteria of the test procedure have been met. The inspector should use the appropriate means, for example, computer software, available for ensuring that test data supports the conclusion that test acceptance criteria have been met. The inspector should also do the following:

1. Verify that the cognizant engineering function has evaluated the test results, and has signified that the testing demonstrated that the system or component met design requirements.

2. Verify that the licensee specifically compared test results with established acceptance criteria.

3. Verify that those personnel responsible for review and acceptance of test results have documented their review and acceptance of the data package and the evaluation.

4. If the offsite review committee or equivalent has audited the test package, verify that the records reflect this audit and that their comments are included and corrective action has been taken.

5. Verify the Quality Assurance/Safety Group or another independent organization's review of test results as prescribed in FSAR or other commitments.

f. Verify That the Test Results Have Been Approved. Verify that those personnel charged with responsibility for review and acceptance of test results have documented their review and acceptance of the data package and the evaluation.

Normally, the test results are reviewed through the startup organization, culminating in review by a committee comprised of the Plant Superintendent, the NSSS Site Manager, the A/E Site Manager, or their designees. FSAR or other commitments frequently require review by Quality Assurance, Safety Review, or other independent organization.

Frequently, test review committees will also have examined the results in accordance with TS requirements.

02.05 Test Specific Inspection Requirements and Guidance. Refer to the attachments for test specific inspection requirements and guidance that are based on the startup test program in Chapter 14 of the AP 1000 DCD. Some of these attachments have general guidance which is so labeled and located at the end of each of those attachments. Refer to Attachment 24 for the specific section in the AP 1000 DCD and for the appropriate reference to RG 1.68 for the respective test. The inspector should be fully aware that the test requirements in Chapter 14 of the DCD for a particular test are subject to change. The primary purpose of the inspection requirements and guidance in the attachments is to focus the attention of the inspectors and to provide insight into the specific aspects of each startup test. The inspection requirements are not binding requirements on any aspects of the licensee's startup tests for the AP 1000 advanced reactor design. The attachments are to be used for test procedure review, witnessing, and results evaluation.

72303-03 RESOURCE ESTIMATE

This IP supports review of the startup testing for this design. The resource estimate for this IP is approximately 430 hours of direct inspection effort.

72303-04 REFERENCES

AP -1000 Design Control Document, Chapter 14, “Initial Test Program”

RG 1.68, “Initial Test Programs for Water-Cooled Nuclear Power Plants”

72303-05 LIST OF ACRONYMS

A/E	Architect Engineering
AP 1000	Westinghouse Advanced Pressurized Water Reactor
BOL	Beginning of Life
COL	Combined Operating License
DC	Direct Current
DCD	Design Control Document
DNBR	Departure from Nucleate Boiling Ratio
EDGs	Emergency Diesel Generators
EOL	End of Life
FSAR	Final Safety Analysis Report
FW	Feedwater
IIS	Incore Instrumentation System
IP	Inspection Procedure
IR	Intermediate Range
IRWST	In-containment Refueling Water Storage Tank
ITAAC	Inspection, Tests, Analyses, and Acceptance Criteria
LCO	Limiting Conditions for Operation
MCR	Main Control Room
NOP	Normal Operating Pressure
NOT	Normal Operating Temperature
NSIR	Nuclear Security and Incident Response
NSSS	Nuclear Steam System Supplier
PRHRHE	Passive Residual Heat Removal Heat Exchanger
PXS	Passive Core Cooling System
PZR	Pressurizer
RCP	Reactor Coolant Pump
RCS	Reactor Control System
RG	Regulatory Guide
RHR	Residual Heat Removal System
RPCS	Reactor Power Control System
RPIS	Rod Position Indication System
RPRS	Rapid Power Reduction System
RPS	Reactor Protection System
RTD	Resistance Temperature Detector
RWS	Remote Shutdown Work Station
Rx	Reactor
SRO	Senior Reactor Operator
SR	Source Range
SRM	Source Range Meter
S/G	Steam Generator
S/U	Startup
Tave	Average Temperature of RCS Coolant.

T/C	Thermocouple
T/G	Turbine Generator
TS	Technical Specifications
3D	Three Dimensional

Attachments:

01. Axial Flux Difference Instrumentation (Flux Asymmetry)
02. Bank Worth Measurement (Rod Worth)
03. Boron Endpoint Determination (Boron Reactivity Worth Measurements)
04. Determination of Physics Testing Range
05. Fuel Loading Prerequisites and Periodic Checks
06. IIS (Core Performance)
07. Initial Criticality
08. Initial Fuel Loading
09. Isothermal Temperature Coefficient Measurement (Moderator Temperature Coefficient)
10. Load Follow Demonstration
11. Loss of Offsite Power
12. Natural Circulation
13. PRHRHE
14. Plant Trip from 100% Power (Generator Trip)
15. RPRS (Reactor Protective Trip Circuit and Manual Scram)
16. RCS Flow Measurement
17. RPCS
18. RWS
19. RTDs - Incore T/C Cross Calibration
20. Rod Cluster Control Assembly Out of Bank Measurement (Pseudo Rod Ejection)
21. Rod Drop Measurements
22. RPIS
23. 100 Percent Load Rejection
24. AP 1000 Startup Tests
25. Revision History for IP 72304

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Axial flux difference signals from the nuclear instrumentation power range (excore) detectors is within the specified limits in the plant-specific DCD. The primary function of the IIS is to generate a 3D flux map so as to calibrate the excore power range detectors. The operator can check the peaking factor. The axial flux difference is displayed in the MCR and the operators can get hard copies of the 3D flux maps.
2. The signals from the excore detectors indicate the actual incore power distribution.
3. Axial flux difference signals are displayed on the MCR panel.

b. Assure these precautions are identified and met during the test: The control room operators can check the 3D Flux maps of the IIS to determine if the outputs of the excore system appear correct and can monitor the Rx overpower and overtemperature trips. The Rx thermal power calculated by a heat balance calculation can also be used in this verification.

1. Critical peaking factors, DNBR, and peak linear heatup rate shall not be exceeded.
2. Safe shutdown margin.
3. Reactivity changes only with specified approval.
4. RCS temperature and pressure maintained.
5. Control rod drive control system meets TS and Administrative requirements.
6. Rx protection circuits are functional.
7. Overtemperature and overpower trips should not initiate.
8. Excore instrumentation power range high neutron trip (high setpoint) and high positive flux rate do not initiate.

c. Confirm these initial conditions are identified and met during the test:

1. Rx power level in the range of power ascension testing.
2. IIS is available.
3. Axial flux difference instrumentation is available.
4. Overtemperature and overpower trips are functional.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Sufficient data points are selected to ensure accurate calibration of the nuclear instrumentation power range channels
2. Data points are for Rx thermal power, and outputs of incore and nuclear (power range) instrumentation.
3. Axial power distribution is varied to obtain sufficient data points.
4. Agreement between Rx thermal power and output of IIS in regard to Rx power level before proceeding.
5. Calibration of excore instrumentation is based on data for Rx thermal power and output of IIS for various axial power distributions.
6. Allowed tolerance for flux difference signals is stated.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A test procedures are selected, perform the following:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Measured value of bank worth is consistent with the DCD.
2. Sum of all bank worths meet shutdown margin requirements.

The bank worths have been stated in the DCD but this is a check to determine if actual values are within the tolerance range of the expected values. This test is important in verifying the required shutdown margin can be maintained for various Rx power levels.

b. Assure these precautions are identified and are met during the test:

1. The requirements of shutdown margin shall not be violated.
2. Critical peaking factor and DNBR shall not be exceeded.
3. No more than two banks should be simultaneously withdrawn. Permissives only allow two banks to be withdrawn but requirement exists even if they are bypassed.
4. Boron sampling rates. Boron sampling and dilution to maintain boron concentration.
5. Required ranges of nuclear instrumentation are operable including their trip points.
6. Startup rate limits if required.

c. Confirm these initial conditions are identified and met during the test:
1. Plant power level and the basis.
2. RCS temperature and pressure. These variables should be constant to better determine the change in reactivity due to insertion of the rods.
3. Neutron flux level and RCS boron concentrations status. These variables should be constant to better determine change in reactivity due to insertion of rods.
4. Instrumentation and equipment to measure/compute reactivity installed and operational.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. All rod control banks are withdrawn.
2. A rod control bank is inserted and its reactivity is measured.
3. The worth of remaining rod control banks are measured as in d.2. or determined by using the worth of a reference bank at various points.

General Guidance:

There will be indication of banks being withdrawn and being inserted in a prescribed manner, and it is possible to check the licensee’s method and accuracy of records. There should not be any alarms as a result of this test and, if there are, the licensee should investigate the cause. This test should plainly indicate the reactivity worth of each rod control bank and whether that agrees with expected values and how any deviations are to be handled and their impact on the performance of the plant. The inspector should verify that for each rod bank that only its reactivity is measured and recorded.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of ensuring that the boron endpoint is consistent with design values in TS and that they are met.

b. Assure these precautions are identified and are met during the test:

1. Startup rate limits.
2. Boron dilution rate limits.
3. Boron sampling frequency.
4. Nuclear instrumentation trip limits.
5. Power level limits and startup rates prior to attaining measurable thermal power.
6. Incore instrumentation to be used as backup to nuclear instrumentation.
7. Controls for reactor operation in event of significant delay or interruption during testing.
8. Temperature limits for criticality.

c. Confirm these initial conditions are identified and met during the test:

1. Precritical tests after fueling loading complete and evaluated.
2. Manual scram tested. Verify the capability for operator intervention as ensured by manual scram capability.
3. Rx critical and neutron flux level within range for low-power physics testing. These variables should be stable so that there is an easier computation of change in reactivity due to boron concentration.
4. RCS temperature, pressure, and boron concentration stable. RCS temperature will change slightly during test.
5. Test equipment for measuring reactivity installed and operational.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Rod banks' positions in Rx and supporting basis.
2. Data and measurements to be taken: boron concentration, change in reactivity due to rod repositioning.
3. State any conversions of data to obtain equivalent change in boron concentration.
4. Any uncertainties are stated and justified.
5. A reference for supporting method for determining the boron endpoint determination.

General Guidance:

The licensee should address the test methodology that will be used and the appropriate uncertainties that will be incorporated into the data analysis. The test procedure should provide the justification to support the test as conducted. The rods are being adjusted with no boron adjustment thus the change in reactivity induced by the movement of the rods and the change in coolant temperature is computed and added to just critical boron concentration to determine boron concentration at EOL. There will be changes in rod positions per expected values at EOL and changes in RCS temperatures which can be observed. The inspector can determine if the computations involved are in agreement with the basis for calculating boron at EOL in this manner.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of ensuring that the zero power testing range and corresponding neutron flux are determined and that they are met.

b. Assure these precautions are identified and are met during the test:

1. Source range and intermediate range trips.
2. Shutdown margin.

c. Confirm these initial conditions are identified and met during the test:

1. RCS temperature, pressure, boron concentration and neutron flux level ranges.
2. Means to measure neutron flux level.
3. Rod banks' positions in Rx.
4. Rx power level.
5. Power level and the basis.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Ascertain how point of nuclear heating is determined.
2. Determination of neutron flux level at point of nuclear heating.
3. Required calculations to obtain maximum flux level for zero power testing range.
4. Reference to support test method.

General Guidance:

Licensee's method should be supported by an acceptable standard. For this test the inspector should focus on the following:
- The licensee's expected changes in the Rx as the result of the test.
- The factors that determine the minimum and maximum values of the physics testing range.
- The purpose of knowing the boundaries of the physics testing range.
- The factors that determine when nuclear heating occurs.
- The purpose of knowing the point of nuclear heating and how that is used in the future operation of the Rx.

The inspector should determine the safety concerns associated with the physics testing range and point of nuclear heating and whether those safety concerns are being properly addressed.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A or B test procedures are selected, perform the following review:

a. Verify that conditions for fuel loading are met and those conditions are documented. The test acceptance criteria should specifically delineate the requirements for loading fuel and how the licensee assures that the actual loading of fuel will be in accordance with FSAR and TS. Verify that the test procedure indicates the required checks to determine that the required operational programs dictated by the license or regulations are established.

b. Assure these precautions are identified and are met during the test:

1. Security measures. The licensee should provide the required security resources to ensure that fuel loading is not compromised in any way. NSIR and regional personnel should identify prior to this inspection the measures that should be in place before fuel loading is initiated.
2. Source and intermediate range trips.
3. Radiation monitoring.

c. Confirm these initial conditions are identified and met during the test:

1. Pre-operational testing is complete with open items addressed.

The FSAR requires that pre-operational testing be complete before fuel loading which can be accomplished by the following:

-confirming that the Commission has found all ITAAC have been met per 10 CFR 52.103(g).

-for important systems and components with no ITAAC but risk significance, reviewing the licensee's lists of systems and components for which pre-operational testing has been completed, and confirming that the systems and components in question are on that list.

2. Plant conditions for fuel loading per TS.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Method for determining that conditions for loading fuel are met.
2. Means to verify if those conditions are maintained during fuel loading.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A or B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Incore T/C and flux maps. The requirements, basis, and purpose for recording incore T/C and flux data should be stated along with an indication that the flux maps are in agreement with TS Section 3.2.
2. Core power distributions and peaking factors are consistent with design basis. Determine how these factors are measured and identify the criteria used to state that they have been met.
3. Criteria for fuel loading errors. Determine how fuel loading errors are determined and justified.

b. Assure these precautions are identified and are met during the test:

1. DNBR
2. Linear heat rates and heatup rates.
3. Axial flux difference.
4. Status of plant conditions.

c. Confirm these initial conditions are identified and met during the test:

1. IIS available and calibrated.
2. Intermediate and power range trips are available.
3. Power range instrumentation preliminarily calibrated.
4. Rx and plant are safe to operate up to full power level.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Steady state operations.
2. Method of increasing power level. As discussed in RG 1.68, Revision 2, Paragraph C.8, power hold points (power test conditions) are approximate. The licensee may choose to select its power hold points at 5% to 10% from the 10%, 25%, 50%, 75%, and 100% power levels. The IIS's two purposes are generating a 3D flux map of the core and of determining the core exit temperatures. These variables will be available in the MCR and hard copies of the flux maps can be obtained. The expected values of these variables and others covered by this test should agree with design predictions. The inspector should observe the indications in the MCR or elsewhere of the 3D flux and core exit temperatures and also for the core peaking factors. The test should indicate the process for determining fuel loading errors, and the inspector should understand how the licensee justifies the present loading of the Rx core and evaluate whether that is correct or not.
3. Data recorded at various power levels to produce incore thermocouple and flux maps.
4. Compare data obtained for core power distribution with design predictions.
5. Determination of any fuel loading errors.

General Guidance:
IP 61702, "Surveillance of Core Power Distribution Limits," may be used concurrently with test procedure or as reference for the inspector during performance of this test.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A or B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Rx achieved criticality.
2. Prediction of boron concentration at criticality. Parametric treatment is required to account for variations in temperature from the point of calculation.

b. Assure these precautions are identified and are met during the test: Signoffs for control. Nuclear instrumentation is calibrated per the TS. If more than 3 months after fuel loading, the SRMs should be checked prior to initial criticality for any indication of neutron activity.

1. Nuclear instrumentation calibration meets surveillance requirements.
2. A manual scram test is conducted not more than 24 hours prior to initiation of boron dilution.
3. Acceptable signal-to-noise ratios and the minimum acceptable count rate are specified for special startup and SR channels.
4. Reactor coolant system temperature and pressure are within TS limits for reactor startup.
5. A listing of RPS trips required to be in service, including reduced trip points if applicable.

c. Confirm these initial conditions are identified and met during the test:

1. RCS temperature and pressure requirements.
2. Rod banks' positions in Rx.
3. RCS boron concentration level requirements.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Identification of control rod pattern prior to and during boron dilution. Rod positions should be specified for all rods, even part length rods. Controls should be identified.
2. Requirements for maintaining inverse multiplication plots during dilution until criticality is achieved. Inverse multiplication plots are required if the licensee has committed to Regulatory Guide 1.68.
3. Establishing an acceptable startup rate limit for increasing power following criticality. Startup rate limits are typically defined as a 60 second period but rates of 1 decade/minute are acceptable.
4. Frequency of boron concentration determination and limits on boron dilution rates. Samples analyzed at least once/hour and drawn at about 15 minute intervals. Use of continuous monitors would justify reduced sampling once response and accuracy have been confirmed.
5. Verification of overlap of SR and IR nuclear instrumentation. One decade of overlap will be adequate to prove operability of the IR instrumentation.
6. The manner and order in which control rods are to be withdrawn.
7. The means for monitoring the approach to criticality and the plant operating procedures to be followed.
8. As criticality is approached, the required dilution of boron concentration should be stated.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A or B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Fuel assemblies installed consistent with designated configuration of Rx core. Fuel loading should be a slow, orderly process with sufficient licensee oversight. The licensee should have a detailed record of the fuel loading steps, in case, any changes in the positions of the fuel assemblies are required.

b. Assure these precautions are identified and are met during the test:

1. Containment integrity established and maintained.
2. Controls for fuel loading established and maintained.
3. Initial fuel loading supervised by a SRO. Oversight by an SRO is required so that fuel loading proceeds in a controlled manner and so that any incidents are properly addressed.
4. Security measures and capability to monitor radiation levels addressed. NRC considers security of utmost importance and the licensee should take the necessary precautions.

c. Confirm these initial conditions are identified and met during the test:

1. ITAAC are met based on Commission's finding for 10 CFR 52.103(g).
2. Boron concentration meet TS requirements.
3. Status of RCS water sources.
4. Conditions for loading fuel are met, and are being monitored and maintained.
5. Source range channels operable for monitoring core reactivity.
6. Pre-operational testing completed with open items addressed. The startup test for "Fuel Loading Prerequisites and Periodic Checks" should have been completed.
7. Required Rx water level per TS.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Loading of fuel assemblies one at a time per prescribed loading sequence. Loading must be conducted exactly per established/approved sequence.
2. Changes in source range indication are to be verified as expected or not. The goal is to maintain reactor subcritical during loading sequence.
3. Multiple checks of fuel assemblies of serial numbers and types. Attention to detail is needed to ensure fuel assemblies are in the correct location.
4. Criteria to be met to stop loading operations for a loading step in regard to count rate on SRMs and decrease in boron concentration in accordance with NRC guidelines. Guidelines must be established to ensure unwanted criticality does not occur.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of ensuring that the measured value of moderator temperature coefficient conservatively exceeds the TS limit and that they are met.

b. Assure these precautions are identified and are met during the test:

1. Source and intermediate range instrumentation should be calibrated and operable.
2. Boron sampling to verify no variation in RCS boron concentration.
3. Limits on startup rate and power level prior to obtaining test initial conditions.
4. The Rx should not go sub-critical.

c. Confirm these initial conditions are identified and met during the test:

1. Rx power and neutron flux levels.
2. RCS temperature, pressure, and boron concentration.
3. Required instrumentation installed and operable.
4. Status of rod banks.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Varying RCS temperature using reactor coolant pumps or a similar means. Guidance is provided in RG 1.68, Revision 2, Appendix A, Paragraph 4.a. Due to a soluble absorber in the RCS coolant, the temperature coefficient may be positive at low temperatures so an alternative method is required to heatup the RCS. Typically that is achieved by operation of the RCPs until the RCS is at NOT. The inspector should verify that an alternative means is also used to obtain NOP.
2. Plot of a curve indicating increase/decrease of reactivity versus RCS temperature. As RCS temperature is varied, then the change in reactivity will vary directly but negatively with increasing temperature. In order to obtain a good graph of a line, at least three data points are needed. More data points would provide more affirmation that the true slope of the line is obtained. Be aware of how changes in RCS temperature cause resulting changes in reactivity. Pressure in RCS should not change once a bubble is drawn in the pressurizer. The temperature coefficient with boron in the RCS is not as negative at high temperatures as it would be without boron.
3. Determination that isothermal temperature coefficient is the slope of curve plotted. The licensee should have a basis that supports computing isothermal temperature coefficient in accordance with the test procedure. The licensee should state the tolerance of the calculation and whether the effects of induced errors have been considered.
4. Determination that moderator temperature coefficient at BOL is the isothermal temperature coefficient minus the Doppler temperature coefficient. This equation should be supported by some industry standard or contractor manual. The inspector should review the data for determining the Doppler temperature coefficient at each data point.

General Guidance:
Refer to IP 61708, "Isothermal Temperature Coefficient of Reactivity Measurement (PWR)," for additional guidance.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A or B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. The Rx can load follow for slow or fast changes in turbine loading without changes to reactor boron concentration. The Rx is in load follow which means the Rx will respond to main generator loading which is normally how the plant will operate. As turbine load increases, Tave will decrease. The RPCS sensing a change in Tave tries to maintain it by withdrawing control rod banks. This test simulates both slow and fast changes in turbine loading.

2. Core power limits should not be exceeded.

b. Assure these precautions are identified and are met during the test:

1. Load decreases should not be so rapid as to initiate a turbine trip. A turbine trip should be avoided since this test only verifies the operation of plant for normal occurrences, not for tripping of the turbine and then possibly the Rx.
2. Cooldown and heatup rates should not be exceeded.

c. Confirm these initial conditions are identified and met during the test:

1. Rx power level and xenon status.
2. Incore and nuclear (power range) instrumentation is calibrated and available.
3. Rx and turbine protection circuits are operational based on prior testing.
4. Setup of calibrated test equipment to record data.
5. MCR operator and roving operator following this test.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Determination of references for thermal power and incore power distribution maps. In order to determine that core power limits are not exceeded, the licensee should develop power and flux distributions for full rated power.
2. Slow reduction in turbine load to achieve a significantly lower reactor thermal power. The turbine will experience small load fluctuations to simulate daily load changes and whether the Rx output will follow turbine load. Again, this is under the control of the RPCS.
3. Slow increase in turbine load to achieve a significantly higher reactor thermal power. This simulates loading of turbine during normal operations.
4. Monitoring of outputs of incore and excore instrumentation to track plant performance during the reduction and increase in power level. This is further verification that Rx is responding to turbine load changes. These records can be permanent records used as a baseline during future plant operations. Licensee should state the purpose of the records and whether regulatory and license commitments are being met.
5. Fast changes in turbine loading to simulate abrupt grid frequency perturbations. The licensee is determining whether the Rx and turbine respond properly to fast load changes that simulate frequency changes in the offsite power grid.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A or B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Verification that Rx trips.
2. EDGs start and supply the safety buses
3. Battery continues to supply DC loads.
4. RCS temperature and pressure remain within prescribed limits.
5. Turbine bypass system operates to maintain secondary system pressure.
6. S/G level remains within prescribed limits. The plant should align itself for operation using the EDGs. Rx protection circuits should activate to initiate a Rx trip when RCS variables or Rx power exceeds prescribed limits due to a turbine trip. In this case, because the RCPs would trip on loss of offsite power, the Rx would probably trip due to low RCS flow. Primary and secondary plants should initially stabilize at or near normal operating temperatures and pressure. The Plant Trip Steam Dump Controller should activate to open the steam dump valves to remove decay heat.
7. PZR and S/G safety valves should not lift. The pressure in the primary and secondary systems should not rise to the thresholds where the safety valves in the primary and secondary systems activate.

b. Assure this precaution is identified and is met during the test:

1. DNBR is not exceeded.

c. Confirm these initial conditions are identified and met during the test:

1. Turbine is only supplying in-house loads.
2. Rx protection circuits and permissives are operable.

d. Assess if the test procedure has steps for tripping the T/G resulting in the opening of the generator output breaker. The generator should have been disconnected from the grid so that a large load rejection is avoided. The test procedure should reference a licensee procedure that states the events that will occur following a loss of offsite power with the Rx and T/G tripping.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A or B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of ensuring that the average vessel temperature drop for natural circulation is equal to or less than limiting design predictions and that they are met. The Rx should not trip and no permissive or protection circuits should activate. The temperature variation across the Rx vessel, the low primary-side hydraulic resistance of the S/Gs, and the large surface area of S/Gs are the factors that allow natural circulation to be achieved without using the RCPs.

b. Assure that a precaution is identified so that the DNBR does not decrease below design base limit at any time and that it is met. The licensee should monitor temperatures in the Rx to determine, by some means, whether the temperatures of the fuel bundles are exceeding their design limitations due to no or low coolant flow around them.

c. Confirm these initial conditions are identified and met during the test:

1. Status of Rx power level and neutron flux level.
2. RCS boron concentration and temperature.
3. Plant equipment operating.
4. Instrumentation available to measure neutron flux and Rx temperature drop.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Obtaining a prescribed low power level.
2. Recording neutron flux level and RCS loop temperatures during forced flow condition.
3. Tripping of RCPs.
4. Means to verify natural circulation established.
5. Recording neutron flux level and RCS temperatures for natural circulation.
6. Determining flow rate achieved during natural circulation. The licensee should have a calculation or analysis stating the required minimum flow rate under natural circulation for the Rx core to be sufficiently cooled.

General Guidance:

For this test, a low power level is achieved by pulling the rods. The RCPs are initially running with the RCS flow through the Rx being verified along with neutron flux levels and RCS temperatures. The RCPs are subsequently tripped with the plant still operating at the same power level. The RCS low flow Rx trip should not be operable at this low power level. There will be a comparison of critical plant parameters with forced and natural circulation. A determination should be made when natural circulation is achieved and whether the flow rate agrees with expected value. The plant should be able to remove decay heat from the RCS using the S/Gs to the main condenser. The PRHRHE should not activate because the S/Gs are still available and the plant is operating at a low power level. The PRHRHE typically operates when there is either a increase or decrease in the heat removal capability of the secondary system or when required with the activation of the PXS.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A or B test procedures are selected, perform the following review:

a. Verify that the procedure contains acceptance criteria with the intent of ensuring that the heat removal rate of PRHRHE is equal or greater than predicted in the safety analysis and that they are met. The heat removal capability of the PRHRHE will be higher than what was measured during the pre-operational test because more heat is being put into the RCS system, with the core operating at a low power level, than during the pre-operational test when plant was heated up using the RCPs.

b. Assure these precautions are identified and are met during the test:

1. DNBR does not decrease below design base limit at any time. During any increases in core power, the possibility exists that hot spots could impair the integrity of some fuel bundles.
2. The average water temperature of the IRWST should not reach 150 degrees F. The PRHRHE is located inside the IRWST and it heats up the water inside the IRWST. The temperature limit is to prevent boiling of the water in the IRWST so that its vents do not open up and disperse hot steam into containment.
3. Pressurizer safety valves do not actuate. The PRHRHE should be able to cool the primary systems without operation of the pressurizer safety valves.

c. Confirm these initial conditions are identified and met during the test:

1. Rx power in physics testing range.
2. RCS boron concentration and temperature.
3. Equipment operating and their purpose.
4. Instrumentation available to measure neutron flux and RCS temperatures.
5. The startup test “Natural Circulation” was just completed.
6. PRHRHE’s inlet and outlet temperature instrumentation available.
7. Status of PRHRHE’s inlet and outlet isolation valves.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Obtaining a certain Rx power and neutron flux levels.
2. Manually establishing flow through the PRHRHE.
3. S/G steam dump should reduce heat removal by S/Gs.
4. Record PRHRHE’s flow and inlet/outlet temperatures.
5. Calculation of PRHRHE’s heat removal rate.
6. Recording RCS temperatures and pressure.
7. On termination of flow through PRHRHE, the S/Gs’ heat removal should increase to maintain Tave.
8. Restart the RCPs once the Rx has been shutdown by inserting control rods.

General Guidance:

The calculated heat removal rate of the PRHRHE should be compared to the safety analysis to confirm that it is sufficient to allow the PRHRHE to meet its assignments for Chapter 15 accidents and events. The inspector should also determine if the S/G steam dump changes the heat removal rate of the S/Gs based on the participation of the PRHRHE in removing heat from the Rx.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Primary and secondary systems stabilize. The turbine will trip on overspeed due to no load on it and that should be evident by alarms for turbine overspeed, the plant operating on EDGs, and no steam being drawn by the turbine. The RPRS will activate to reduce Rx power by inserting rods unless the Rx trips. The turbine bypass (steam dump) system will activate to dump excess steam.

2. PZR and S/G safety valves do not open. The activation of these safety valves should not be necessary since the systems stated in a.1. above should stabilize the primary and secondary systems.

3. Hot leg temperature responses are less than or equal to those in safety analysis. The hot leg temperatures are contained in Section 15.2 of the DCD.

b. Assure that a precaution is identified that DNBR is not exceeded and that it is met.

c. Confirm these initial conditions are identified and met during the test:

1. Rx power level.
2. Primary and secondary safety valves operable.
3. Startup FW is available.
4. Steam dump control system available.
5. PRHRHE is available.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Open main generator output breaker
2. Monitor and record - RCS temperatures and pressure, PZR and S/G levels, plant power level, etc.
3. Adjust primary and secondary controls if necessary.
4. Determination of RTD time responses for RCS.

General Guidance:

Opening the generator output breaker will trip the turbine on overspeed since it will be unloaded. There is not a direct link between a turbine trip and a Rx trip in accordance with the Chapter 15 analysis but the Rx may trip due to the following: high pressurizer pressure or level, overtemperture delta T, low RCP speed, and low steam generator water level. Following a turbine trip, offsite power is assumed to be lost shortly thereafter which causes a coastdown of the RCPs. The Chapter 15 analysis of a turbine trip does not consider the operation of either the RPRS or the steam dump system. However, with the operation of those two systems, the severity of a turbine trip will be mitigated, and the protective functions that could cause a Rx trip may not reach their necessary thresholds. The inspector should observe the responses of the primary and secondary systems to a turbine trip to see if they compare favorably to the Chapter 15 analysis. The licensee will be collecting this data to be used in their operating procedures so that operators can respond predicably to this event in the future.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Performance of rapid power reduction system per design requirements.
2. For simulated loss of load, power to preselected control rods is interrupted.

The test is with Rx shutdown so only the verification of RPRS is verified along with the opening of the prescribed Rx trip breakers for the preselected control rods.

b. Assure these precautions are identified and are met during the test:

1. Shutdown margin is not reduced below required value.
2. Rx not allowed to go critical.

c. Confirm these initial conditions are identified and met during the test:

1. Rx is shutdown.
2. Designated rod position and boron concentration allows shutdown margin to be maintained.
3. Rod positions are specified along with basis.
4. Rod control and indication systems are available.
5. RPS and related Rx trips are functional.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Simulated Rx power signals input to Rx control and protections system.
2. Closing of the Rx trip breakers.
3. Simulated input signal for rapid loss in power input to the RPRS.
4. The verification of the RPRS response.

General Guidance:

There should be indication of closing of the Rx trip breakers and inputs to the RPRS followed by an output signal that will trip the Rx trip breakers just closed. The purpose of the RPRS is to quickly reduce Rx power to a level capable of being handled by the steam dump system for a large load rejection. When activated, the RPRS causes the release of a specified number of control rods. This causes Rx power to drop to approximately 50 percent of rated power if the Rx was operating at a higher power level initially. The inspector can verify that only the preselected control rods drop into the Rx.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of ensuring that RCS flow equals or exceeds 90% of the minimum value in TS and that they are met.

b. Assure that a precaution is identified that DNBR is not exceeded and that it is met.

c. Confirm these initial conditions are identified and met during the test:

1. Status of RCS temperature and pressure.
2. Instrumentation to measure Rx flow installed.
3. Rx at a specific high power levels.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Determination of RCS flow rates by measuring core thermal power and hot and cold leg temperatures at various power levels. Calculation of the flow rates using a prescribed equation. The indications of core thermal power, the hot and cold leg temperatures, and RCS flow should be readily available in the MCR. The calculation should be supported by a widely accepted industry standard. The inspector could check the licensee's results by using the data and doing his own hand calculation.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of ensuring the RPCS returns RCS Tave to a temperature reference setpoint within specified limits and that they are met without manual intervention. The RPCS is comprised of two subsystems: Power Control and Axial Offset Control. It is the Power Control subsystem that actually controls Tave which is described in Section 7.7.1.1.1 of the DCD. The Power Control System receives temperature signals from protection channels and also an additional input comprised of the difference of Rx power and turbine load. The latter input modifies determination of Tave by enhancing response time and reducing transient peaks.

b. Assure these precautions are identified and are met during the test:

1. DNBR does not decrease below design base limit at any time.
2. Shutdown margin is maintained.

c. Confirm these initial conditions are identified and met during the test:

1. Rx status and power level.
2. Equipment required for the test are operable.
3. The required control room and auxiliary operators are on duty.
4. The required systems per TS are operable.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Tave varied by some method, i.e., loading T/G.
2. Determination of the performance of the RPCS.

General Guidance:

Tave is displayed on the MCR and the response of it to various changes in Rx power level can be readily witnessed. The control of Tave is by regulating certain control bank positions. The rod-position displays for those control rod banks will indicate movement and in a specific direction. Temperature in cold leg should vary first with the temperature in hot leg changing as rods are moved. If temperature in cold leg drops with increased turbine load then the specified rods will move out to increase temperature in hot leg in order to maintain Tave.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A or B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of ensuring that the operators can shutdown the Rx, maintain hot standby, and transition to a point approaching cold shutdown conditions and that they are met. These types of operations are available to the operators from the RWS outside of the MCR.

b. Assure these precautions are identified and are met during the test:

1. Sufficient operators are available in case of an emergency.
2. Prescribed cooldown limits are not exceeded.

c. Confirm these initial conditions are identified and met during the test:

1. Operators using required normal and emergency operating procedures.
2. Communication requirements.
3. Rx power level and status and basis.
4. Shutdown margin is maintained.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Evacuation of the MCR. Transfer control of plant from MCR to means outside of MCR.
2. After transferring control, operators will trip and isolate the Rx per plant procedures. There should be defined method of transferring control from MCR to means outside MCR.
3. Operators take the plant to hot standby.
4. The plant is brought to hot standby and then will approach, but not obtain, cold shutdown. The operators will cool the plant sufficiently to initiate the shutdown cooling mode of RHR.

General Guidance:

Systems controlled for this test should be readily available on the RWS. The operator's actions can be observed and there should be indication of what systems are operating and how Rx power and other plant parameters are responding to the operator's actions. The operators should be following the test procedure and also applicable plant procedures for this test which the inspectors can determine by observing the operators and questioning them on particular steps.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Determining that the temperature values derived by using the calibration data with each RTD's resistance compares within reasonable tolerance to the different temperature values at which data was recorded during the test.
2. Determining that the temperature values derived by using the calibration data with each T/C's output compares within reasonable tolerance to the different temperature values at which data was recorded during the test.

b. Assure these precautions are identified and are met during the test:

1. Factors that could induce significant errors in this test and subsequent calculations. Licensee should identify the factors that could cause appreciable errors and the basis.
2. Rx is not taken critical.

c. Confirm these initial conditions are identified and met during the test:

1. Status of reactor and power level.
2. RCS RTDs are all operational with initial alignment completed.
3. Incore instrumentation system is operational and calibrated.
4. Availability of calibration data obtained during pre-operational testing for the RTDs and the T/Cs.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Measurement and recording of the resistence of each RTD and output of each incore T/C at different temperatures as RCS temperature is increased to NOT.
2. Determination of best temperature value for each data point.
3. Sufficient iterations to validate the correct temperature values.
4. Determination of calibration data for RTDs and T/Cs.
   Licensee should identify the basis for performing the test in this manner with supporting evidence of vendor and industry standards.

General Guidance:

The calibration data determined in this test of the RTDs in the RCS and the T/Cs for the incore instrumentation system is being verified against the calibration data obtained for those same components during pre-operational testing. The final calibration data is based on the results of both pre-operational and startup testing and is very important because the data for the RTDs is used in the overtemperature trip for the Rx and the data for the T/Cs is used in determining core exit temperatures for the Rx core. The final calibration data is also verified by using it in calculations employing the RTDs' resistance and the T/Cs outputs independently to determine if the temperature values obtained in that manner compare favorably with the temperatures at which data was recorded during this test. The inspector can check the values obtain from pre-operational testing with those obtained during this startup test and also in the appropriate equations using the licensee's data.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A or B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Power distributions and power peaking factors are within TS.
2. Verification of the sensitivity of incore and excore instrumentation.

b. Assure these precautions are identified and are met during the test:

1. Do not exceed minimum DNBR.
2. Critical peaking factors should not be exceeded.

c. Confirm these initial conditions are identified and met during the test:

1. Rx power level.
2. RCS boron concentration and temperature status.
3. Positioning of rod assemblies.
4. Control room operators are reviewing required operating procedures.
5. Systems required by TS are operable.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Insertion and withdrawal to limits of misalignment specified in Chapter 15 of FSAR. Compensation for reactivity changes.
2. Recording incore and excore instrumentation signals at the various misalignments of the rod control assemblies.
3. Comparison of the outputs of incore and excore instrumentation to determine if power distributions and peaking factors meet TS.
4. Determination of the sensitivity of incore and excore instrumentation to control rod assembly misalignment.
5. Capturing this data for future use by the licensee.

General Guidance:

The incore and excore instrumentation systems are being used to determine whether they are sensitive to control rod assembly misalignments. The licensee should state the expected sensitivities so a comparison can be made with the actual values. The test is also looking at the affect of the misalignments on power distributions and peaking factors. The inspector should ask if this information will some how be maintained for future use under similar plant conditions.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Rod drop times are consistent with design basis and TS.
2. Rod decelerating devices properly operate.

b. Assure these precautions are identified and are met during the test:

1. Shutdown margin should be maintained.
2. Control rods should not incur any damage.

c. Confirm these initial conditions are identified and met during the test:

1. Rx status and power level.
2. RCS temperature and pressure.
3. Source range instrumentation available.
4. Status of control rods.
5. Equipment required to be operating.
6. Rod position indication system available.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Withdraw each rod cluster control assembly one at a time.
2. Drop control assembly into the core.
3. Measure and record rod drop times for the following conditions:
   -no flow cold
   -full flow cold
   -no flow, hot zero power
   -full flow, hot zero power
4. Compare results with the expected rod drop times for the assemblies.
5. Perform additional drops for those assemblies that do not meet design requirements.

General Guidance:

The inspector should verify the rod drop times against TS and verify that the rod drop times under all test conditions are satisfactory. The test procedure should state the additional number of times that a rod should be dropped if it fails to meet the design requirements, and the allowed tolerances for rod drop times. For any rod that does not meet the expected drop time requirements, after repeated tests, then the licensee should have defined remedial steps that must be taken.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A or B test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. RPIS performs as intended for indication and alarm functions.
2. Rods can freely travel over entire operating range.

b. Assure these precautions are identified and are met during the test:

1. The reactor should not go critical.

c. Confirm these initial conditions are identified and met during the test:

1. Rx status and power level.
2. RCS temperature and pressure.
3. Source range instrumentation available.
4. Status of control rods.
5. Equipment required to be operating.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:
1. Withdraw each rod bank one at a time.
2. Reinsert the rod bank.
3. Record rod position on readouts and step counters in MCR.
4. Determine if each rod is able to be tracked over entire range and appropriate alarms activate.

General Guidance:

The RPIS must have the capability to track each rod bank from fully inserted to fully withdrawn with any errors in the RPIS displays taken into account. Being able to know the accurate position of each rod bank enables the licensee to be able to determine the following: when criticality will be obtained, the positions of the rod banks for a designated plant power, when all rods are fully inserted, and when a rod bank is misaligned. The licensee will keep track of rod positions during power ascension testing and record those rod positions so that the Rx operator can know approximately which rod positions elicit a specific plant response.

INSPECTION REQUIREMENTS AND GUIDANCE

02.05 If Group A test procedures are selected, perform the following review:

a. Verify the test procedure has acceptance criteria with the intent of the following and that they are met:

1. Plant can accept 100% load rejection without Rx trip or operations of pressurizer safety valves or steam generator relief and safety valves.
2. Turbine remains operable and supplies in-house loads.

b. Assure these precautions are identified and are met during the test:

1. The turbine overspeed does not affect voltage and frequency sensors.
2. Minimum DNBR is not exceeded.

c. Confirm these initial conditions are identified and met during the test:

1. Rx stable at 100% load.
2. Rx and turbine control and protection circuits are available.
3. Incore instrumentation available.
4. Turbine bypass system is functional.
5. Pressurizer and S/G safety valves are functional.

d. Assess if the test procedure has similar steps to the following and that the test is conducted in accordance with them:

1. Trip the main step-up transformer.
2. Record key plant parameters, i.e., temperature, pressure, flow rates in primary and secondary systems.

General Guidance:

The AP 1000 plant is designed to accept a 100 percent load rejection from full power to in-house loads without a Rx trip or operation of the pressurizer or steam generator safety valves. The RPRS rapidly reduces power to about 50% by sending a signal that causes preselected control rods to be inserted. The large power reduction also activates the steam dump system which prevents a large increase in RCS temperatures. Insertion of the rods continues until power is reduced to about 15 percent rated with the steam dump system operating to remove excess steam. The turbine continues to operate stable and eventually supplies only in-house loads which require only 5 percent power.

AP 1000 STARTUP TESTS

CLASS I: MANDATORY AP 1000 S/U TESTS FOR INSPECTION References are to sections in Regulatory Guide 1.68, Revision 2, Appendix A.			
Group A	Group B	Test Title	Ref.
X		Axial Flux Difference Instrumentation Calibration (Flux Asymmetry) - (14.2.10.4.7)	5.x.
X		Bank Worth Measurement (Rod Worth) (14.2.10.3.5)	4.b.
	X	Boron Endpoint Determination (Boron Reactivity Worth Measurements) - (14.2.10.3.3)	4.a.
	X	Determination of Physics Testing Range (Power Reactivity Coefficient) - (14.2.10.3.2)	4.
X	X	Fuel Loading Prerequisites and Periodic Checks (14.2.10.1.1)	2.
X	X	Incore Instrumentation System (Core Performance) - (14.2.10.4.2)	5.i.
X	X	Initial Criticality (14.2.10.2.2)	3.
X	X	Initial Fuel Loading (14.2.10.1.5)	2.
	X	Isothermal Temperature Coefficient Measurement (Moderator Temperature Coefficient) - (14.2.10.3.4)	4.a.
X	X	Load Follow Demonstration Test (14.2.10.4.22) - prototype only	5.h.h.
X	X	Loss of Offsite Power (14.2.10.4.26)	5.j.j.
X	X	Natural Circulation -prototype only (14.2.10.3.6)	4.t.
X	X	Passive Residual Heat Removal Heat Exchanger - prototype only (14.2.10.3.7)	4.q.
X		Plant Trip from 100% Power (Generator Trip) (14.2.10.4.24)	5.l.l.
	X	Rapid Power Reduction System (Protective Trip Circuit and Manual Scram) (14.2.10.1.15)	2.c.
X		Reactor Coolant System Flow Measurement (14.2.10.1.17)	5.m.
	X	Reactor Power Control System (14.2.10.4.19)	5.s.
X	X	Remote Shutdown Work Station (14.2.10.4.28)	5.d.d.
X		Resistance Temperature Detector-Incore Thermocouple Cross Calibration (14.2.10.1.8)	2.

CLASS I: MANDATORY AP 1000 S/U TESTS FOR INSPECTION References are to sections in Regulatory Guide 1.68, Revision 2, Appendix A.			
Group A	Group B	Test Title	Ref.
X	X	Rod Cluster Control Assembly Out-of-Bank Measurements (Pseudo Rod Ejection-prototype only) (14.2.10.4.6)	5.y.
X		Rod Drop Measurements (14.2.10.1.14)	2.b.
X	X	Rod Position Indication System (14.2.10.1.12)	2.b.
	X	100 Percent Load Rejection (14.2.10.4.20)	5.n.n.

CLASS II: RECOMMENDED S/U TESTS FOR AP 1000	
DCD Test No	**Test Title**
14.2.10.1.3	Fuel Loading Instrumentation and Neutron Source Requirements
14.2.10.2.1	Initial Criticality Test Sequence
14.2.10.1.7	Incore Instrumentation System Precritical Verification
14.2.10.1.4	Inverse Count Rate Ratio Monitoring for Fuel Loading
14.2.10.4.3	Nuclear Instrumentation System
14.2.10.1.9	Nuclear Instrumentation System Precritical Verifications
14.2.10.2.3	Nuclear Instrumentation System Verification During Initial Criticality
14.2.10.4.20	Load Swing Test
14.2.10.3.1	Low-Power Test Sequence
14.2.10.1.6	Post-Fuel Loading Precritical Sequence
14.2.10.1.19	Pressurizer Spray Capability and Continuous Spray Flow Verification (Pressurizer Effectiveness)
14.2.10.1.16	Process Instrumentation Alignment
14.2.10.4.10	Process Instrumentation Alignment at Power Conditions
14.2.10.4.9	Process Measurement Accuracy Verification
14.2.10.4.8	Primary and Secondary Chemistry
14.2.10.4.11	Reactor Calibration Coolant System Flow Measurement at Power Conditions
14.2.10.1.18	Reactor Coolant System Flow Coastdown

14.2.10.1.10	Setpoint Precritical Verification
14.2.10.4.12	Steam Dump Control System (Turbine Trip)
14.2.10.4.5	Startup Adjustments of Reactor Coolant System
14.2.10.4.13	Steam Generator Level Control System
14.2.10.4.17	Thermal Power Measurement and Statepoint Data Collection

Attachment 25

Revision History For IP 72304

Commitment Tracking Number	Issue Date	Description of Change	Training Needed	Training Completion Date	Comment Resolution Accession Number
N/A	09/05/06 CN 06-021	IP 72304 has been issued for Construction Inspection Program	None	N/A	ML061100395