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Subject: Draft ITP Program Description for May 22 Meeting
Attachments: Draft ITP program description 051908.pdf

Hi Tom,

Attached is a draft ESBWR DCWG Initial Test Program description (or startup manual program description) for the NRC staff to consider in preparation for our meeting on May 22.

We plan to provide this document as a handout at Thursday's meeting.

Please let me know if you have any questions.

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NRC – ESBWR DCWG Meeting
May 22, 2008
Draft Initial Test Program Description

Appendix 14AA Initial Test Program Description

NAPS COL 14.2-1-A

14AA.1 Summary of Test Program and Objectives

14AA.1.1 Applicability

Appendix 14AA provides the requirements to be included in the administrative procedures contained in the Startup Administrative Manual (SAM) as discussed in Design Control Document (DCD) Subsection 14.2.2.1 and 14.2.2.3. The information contained in and referenced in Appendix 14AA meets the criteria of the NUREG 0800 Acceptance Criteria for the Initial Test Program (ITP) and is formatted to follow Regulatory Guide 1.206 Section C.I.14.2.

The Initial Test Program is applied to those structures, systems and components that meet one of the following criteria (per RG 1.68 Revision 3):

- Will be used for shutdown and cool down of the reactor under normal plant conditions and for maintaining the reactor in a safe condition for an extended shutdown period
- Will be used for shutdown and cool down of the reactor under transient (infrequent or moderately frequent events) conditions and postulated accident conditions and for maintaining the reactor in a safe condition for an extended shutdown period following such conditions
- Will be used to establish conformance with safety limits or limiting conditions for operation that will be included in the facility's technical specifications
- Are classified as engineered safety features or will be relied on to support or ensure the operation of engineered safety features within design limits
- Are assumed to function or for which credit is taken in the accident analysis of the facility, as described in the FSAR
- Will be used to process, store, control, or limit the release of radioactive materials

The Initial Test Program is applied to applicable structures, systems and components that perform functions described in RG RG 1.68 Revision 3, Appendix A, item a through o. The Initial Test Program is also applied to additional systems that meet any of the criteria of above and are not included in Appendix A of RG 1.68 Revision 3.

A listing of the specific ESBWR systems that are subject to the Initial Test program is included in the administrative procedures in the Startup Administrative Manual.

14AA.1.2 **Phases of the Initial Test Program**

The Initial Test Program (per RG 1.68 Revision 3) has the following five phases:

(1) Preoperational Testing

(2) Initial Fuel Loading and Pre-Criticality Tests

(3) Initial Criticality

(4) Low-Power Tests

(5) Power Ascension Tests

These phases are described in DCD Section 14.2 and FSAR 14.2 in further detail and are referred to collectively as Startup Tests.

14AA.1.3 **Objectives of Preoperational and Startup Testing**

Objectives of Preoperational Testing are in DCD 14.2.1.2.
Objectives of Startup Testing are in DCD 14.2.1.3.

14AA.1.4 **Testing of First of a Kind Design Features**

First of a Kind Testing (FOAK) testing may occur in any of the phases depending on the nature of the testing and required sequencing of the tests. When testing FOAK design features, applicable operating experience from previous test performance on other ESBWR plants is reviewed where available and the ITP modified as needed based on those lessons learned.

14AA.1.5 **Credit for Previously Performed Testing of First of a Kind Design Features**

In some cases, FOAK testing is only required for the first of a new design or for the first few plants of a standard design. In such cases, credit may be taken for the previously performed tests. A discussion is included in the startup test reports of the results of those tests that are credited.

14AA.2 Organization and Staffing

The administration of the Initial Test Program is governed by administrative procedures in the Startup Administrative Manual.

14AA.2.1 **Organizational Description**

Plant Staff organization is described in FSAR 13.1. General preoperational responsibilities and description of preoperational and startup testing are in FSAR 13AA.2. DCD 14.2.1.4 contains the description of the startup group organization.

The Startup Group has two internal groups: the Preoperational Test Group, which is responsible for conducting and documenting preoperational tests; and the Startup Test Group, which is responsible for conducting and documenting initial startup testing. Both groups consist of personnel drawn from various organizations

such as plant staff, construction personnel, GE-H, and other contractors, vendors and consultants.

The functional manager in charge of the Startup Group reports to the Plant Manager and has the qualifications of Preop Testing Supervisor as defined in FSAR Table 13.1-201.

The Preoperational Test Group consists of Preop Testing Supervisors (i.e. NSSS, BOP, Electrical and others as required) each of who reports to the Startup Group Manager. Preop Testing Engineers are assigned to this group and report to one of the Preop Testing Supervisors. Qualifications of Startup Testing Supervisors, Startup Testing Engineers and Preop Testing Engineers are in FSAR Table 13.1-201.

The Startup Test Group consists of Startup Testing Supervisors who report to the Startup Group Manager. Startup Engineers are assigned to this group and report directly to one of the Startup Testing Supervisors. Qualifications of Startup Testing Supervisors and Startup Testing Engineers are in FSAR Table 13.1-201.

Figure 1 illustrates the organizational structure of the Startup Group.

14AA.2.2 **Responsibilities:**

The functional manager in charge of operations coordinates with the functional manager in charge of the Startup Group during the initial test program providing operations personnel to coordinate, support and participate in preoperational testing. The Functional manager in charge of operations is a voting member of JTG and the Facility Safety Review Committee (FSRC). The functional manager in charge of operations is responsible for safe operation of the plant and equipment and ensuring tests are performed efficiently and effectively.

14AA.2.2.1 **Startup Group Manager**

The functional manager in charge of the Startup Group is responsible for:

- Staffing within the Startup Group.
- Developing procedures associated with ITP.
- Acting as Chairman of the Joint Test Group (JTG).
- Acting as an advisor to the FSRC for all matters associated with startup testing.
- Responsible for all contracts associated with the ITP.
- Coordinating with station and construction department heads for assignment of staff personnel to accomplish the test program objectives.

- Acting as an advisor to the FSRC
- Coordinating with station department heads for assignment of staff personnel to accomplish the test program objectives.

14AA.2.2.2 **GE-H Resident Site Manager**

The GE-H resident site manager is responsible for technical direction during the initial test program. Qualifications of the GE-H resident site manager is equivalent to the qualifications described in ANSI/ANS-3.1-1993 for a Preop Tesing Supervisor. Specific responsibilities are:

- Acting as liaison with GE-H on testing matters involving GE-H supplied equipment
- Reviewing preoperational and startup test procedures with emphasis on GE-H NSSS
- Assisting in data reduction, analysis, and evaluation for completed tests
- Acting as voting member of JTG
- Providing administrative support and supervision to GE-H onsite personnel involved in the test program.

14AA.2.2.3 **Vendor Site Representative**

A vendor site representative is responsible for technical direction during the preoperational phase of the test program. Qualification of the vendor site representative is equivalent to the qualifications described in ANSI/ANS-3.1-1993 for a Preop Testing Supervisor. These positions will be filled as needed based on the scope of non-GEH supplied equipment that requires preoperational or startup testing to be performed. Specific responsibilities are:

- Acting as liaison with vendor on testing matters involving vendor supplied equipment
- Reviewing preoperational tests with emphasis on vendor supplied equipment
- Assisting in data reduction, analysis, and evaluation for preoperational tests
- Acting as voting member of JTG
- Providing administrative support and supervision to vendor onsite personnel involved in the test program.

14AA.2.2.4 **Preop Testing Supervisor**

The preop testing supervisors are responsible for:

- Supervising the preop testing engineers assigned to them.
- Coordinating and scheduling test preparation and test activities.

- Acting as voting member of JTG
- Preparation, review, and performance of the preoperational test procedures.
- Reviewing and making recommendations of the preoperational test results.
- Responsible for the resolution of deficiencies identified during pre-op inspection and test activities.
- Ensuring test engineers conducting the test are not the same personnel who designed or are responsible for satisfactory performance of the system(s) or design features(s) being tested.

14AA.2.2.5 **Startup Testing Supervisor**

The startup testing supervisors are responsible for:

- Supervising the startup testing engineers assigned to them.
- Coordinating and scheduling test preparation and test activities.
- Coordinating and directing testing via the operations shift supervisor for the conduct of all initial startup testing for their shift.
- Assisting in the preparation, review, and performance of the startup test procedures.
- Reviewing, analyzing, and evaluating the test results and data.
- Assisting in the resolution of deficiencies identified during startup testing activities.
- Coordinating with planning and scheduling for initial startup activities.
- Expediting testing progress as necessary to support project schedule.
- Ensuring test engineers conducting the test are not the same personnel who designed or are responsible for satisfactory performance of the system(s) or design features(s) being tested.

14AA.2.2.6 **Preop Test Engineer**

The preop testing engineers are responsible for:

- Determining the nature and degree of testing required for assigned systems.
- Developing test activity milestones, target dates and manpower requirements.
- Following construction progress to support the test program requirements.

- Ensuring that the required detailed preoperational test procedures are available for review and approval.
- Identifying special or temporary equipment or services needed to support testing.
- Assuring test identification tagging and station tagging are implemented as necessary to support testing and turnover.
- Directing all participating groups during preparation for the execution of assigned tasks.
- Identifying and assisting in the resolution of deficiencies and problems found during the construction and testing of assigned systems and areas.
- Reviewing and evaluating test results and preparing test summaries

14AA.2.2.7 **Startup Test Engineer**

The startup testing engineers are responsible for:

- Preparing the required detailed startup test procedures making them available for review and approval.
- Identifying special or temporary equipment or services need to support testing.
- Directing all participating groups during preparation for the execution of assigned tasks.
- Identifying and assisting in the resolution of deficiencies found during the construction and testing of assigned systems.
- Reviewing and evaluating the test results and data.
- Coordinating with operations during the execution of assigned Tasks.
- Assisting in the supervision and inspection of BOP work, reviewing installation and performance tests, and provide general advice on startup tests.
- Providing engineering support activities and services during startup testing of the turbine generator and testing of main turbine EHC system.

14AA.2.2.8 **Joint Test Group**

The Joint Test Group (JTG) is the primary review and approval organization during the preoperational test phase of the test program. The required JTG quorum will be described in an administrative procedure contained in the Startup Administrative Manual. The Startup Controlling Group (SCG) in DCD 14.2.14 is

also known as the Joint Test Group (JTG). The functions and responsibilities of the JTG are:

- Performs duties delineated in the Startup Administrative Manual
- Reviews and approves all preoperational test procedures prior to testing
- Reviews and approves all major changes or revisions to JTG approved test procedures
- Reviews and approves the overall preoperational test schedule and sequence
- Reviews and approves the results of preoperational tests
- Recommends the disposition of test deficiencies
- Recommends retests or supplemental tests as required.
- Determines system readiness for turnover to operations.

14AA.2.2.9 **Document Control Coordinator**

A document control coordinator reports to the Functional Manager in charge of the Startup Group and has the qualifications described in ANSI/ANS-3.1-1993 for a Startup Testing Engineer. The document control coordinator is responsible for:

- Tracking test procedure changes
- Reviewing, approving and tracking document changes (including drawings, vendor tech manuals, procedures, design changes, etc)
- Verifying that the test schedules are up to date with regard to latest testing results
- Processing final test packages through final review and approval by the FSRC

14AA.2.2.10 **Facility Safety Review Committee (FSRC)**

Commencing with initial fuel load, the FSRC supplants the JTG as the primary review and approval organization of the test program. The FSRC is responsible for review of all procedures that require a regulatory evaluation under 10 CFR 50.59 and 10 CFR 72.48 as well as all tests and modifications that affect nuclear safety. The organizational structure, functions, and responsibilities of FSRC are described in ANSI3.2-1994. During the startup test phase, the FSRC is advised by the Startup Group Manager and the GE-H resident site manager. The FSRC is responsible for review and approval of all startup test procedures. This committee may also be addressed by different titles such as PORC, Plant Operations

Review Committee, On-site Safety Review Committee, or PSRC, Plant Safety Review Committee.

14AA.2.3 **Operating and Technical Staff Participation**

Experience and qualification requirements

- Plant Staff experience and qualification requirements are in FSAR Chapter 13 and in Appendix 14AA.
- Contractor qualification and experience requirements are in Appendix 14AA and in approved contractor procedures.
- Vendor staff qualification and experience requirements are in Appendix 14AA and in approved vendor procedures.
- Architect Engineer Staff qualification and experience requirements are in Appendix 14AA and in approved Architect Engineer procedures.

Plant staff will participate in all phases of the Initial Test program. Plant Staff groups that will participate include but are not limited to: Quality Assurance staff, Quality Control Staff, Operations staff, Maintenance staff, Engineering Staff, Planning, Scheduling and Outage planning staff, and Work Management staff including work planners and schedulers. Operations staff will participate in preoperational testing as part of gaining experience as described in Appendix 13BB of the FSAR. Refer to figure 1 for identification of organizations that have one or more participants in the ITP.

14AA.2.4 **Conflict of Interest**

Members of the Startup Group responsible for formulating and conducting preoperational and startup tests are not the same individuals who designed or are responsible for satisfactory performance of the systems or design features being tested. This does not preclude members of the design organizations from participating in test activities.

14AA.2.5 **Training Requirements**

Training on the overall test program is conducted prior to scheduled preoperational and initial startup testing and as new employees are added to the test groups. A training program for each fundamental group in the organization is developed, with regard to the scheduled preoperational and startup testing, to ensure that the necessary plant staff is ready for commencement of the Initial Test Program. Additional discussion on staff training is found in FSAR 13AA, 13BB and Figure 13AA-202. The training program includes:

- Systems to be tested

- Training by selected major equipment vendors, e.g., turbine; plant control
- A review of test program administration
- Content of test procedures including acceptance criteria review
- Test sequence
- Test conduct and closure

Specific just in time training (JIT) is conducted for operating crews and other personnel conducting certain startup tests. This just in time training may involve simulator training. Criteria to be considered when determining if JIT is used for a test include: complexity of the test and plant response, such as test that result in plant trips or other transients or where they may occur. Accredited training program procedures describe the process for determining training topics to be conducted. The intention is to be as well prepared as possible to operate the plant safely.

14AA.3 Test Procedures

14AA.3.1 Procedure Development

A general discussion concerning Test Procedure development and review is in DCD 14.2.2.2 and 14.2.2.4. General requirements for administrative procedures are described in FSAR Section 13.5.1. Details of procedure development, review and schedule for other than Pre-op and Startup procedures is found in FSAR Chapter 13.5.

Test Procedures are written in accordance with a technical procedure writer's guide. This writer's guide provides for procedure validation. This validation may, in some cases, be through the use of an available plant reference simulator. The suitability of using the simulator to validate a test procedure is evaluated on a case by case basis. It may not be suitable, for example, to use the simulator to validate a procedure whose results are required to validate the simulator modeling.

Because procedures may be approved for implementation weeks or months in advance of the scheduled test date, a review of the approved test procedure is required before commencement of testing. The Test Engineer is responsible for ensuring:

- Drawing and document revision numbers listed in the reference section of the test procedure agree with the latest revisions.
- The procedure text reflects any design change(s) made since the procedure was originally approved for implementation in the areas of acceptance criteria, FSAR, Technical Specifications, piping changes, etc.

- Any new Operating Experience lessons learned (since preparation of the procedure) are incorporated into individual test procedures.

Test Procedures maximize the use of plant operating and maintenance procedures for the performance of test tasks. This can take the form of referencing a plant procedure to perform a task, or extracting the steps from the plant procedure for use in the Preoperational and Startup test procedures. This includes the use of emergency procedures for verifying appropriate emergency actions as described in DCD 14.2.5. Step-by-step instructions on how to conduct the applicable test are described and are coordinated with plant procedures wherever applicable in the Test Procedure. Test Procedures contain CAUTIONs, WARNINGs, and NOTES using criteria established in the technical procedure writer's guide.

14AA.3.2 **Procedure Format and Content Requirements**

DCD 14.2.8.1 discusses technical information to be provided by GEH and others that form the technical basis for test procedure objectives and acceptance criteria.

Each Preoperational and Startup Test Procedure will include the following:

- Cover page

The cover page provides approval signatures and effective dates (signatures may be maintained on file and may not appear on the cover page). The Title and the unit designator water mark appear on the cover page. If the test is considered an infrequently performed test this would appear on the cover page. Since all of the ITP tests are infrequently performed, it is not intended that each preop and startup test be treated like an infrequently performed test. The intention is that such measures be considered for the test on estimated probability and severity of potential equipment damage during the performance of the test.

- Table of Contents

The second page is the table of contents.

- Purpose and Test Objectives Section

This section identifies the goal of the specific preoperational/startup test. This is established by stating those systems, subsystems, or components that are included in the test and a series of summarized specific functions to be demonstrated during the test. Objectives of the test are stated. Many systems tests are intended to demonstrate that each of several initiation events will produce one or more expected responses. These initiating events and the corresponding responses are identified.

- Description Section

This section will describe the power plateau, specific testing activities, operability impacts, systems affected, RPS trips, containment isolation, etc.

- Reference Section

This section identifies the references that were used in the preparation or revision of the pre-op or startup test procedure and any documents used or referenced in the performance of the procedure.

- Special Tools and Equipment (Temporary Equipment Installations) Section

This section lists test equipment and special tools not routinely carried, plus any unusual expendable items recommended to perform the procedure. This section also identifies temporary test equipment installations and test equipment instructions.

- Precautions and Limitations Section

The test procedure highlights and clearly describes any and all precautions needed to ensure a reliable test or the safety of personnel or equipment including termination criteria for the test. Included are any special actions to be taken if the test is terminated at critical points in the test.

- Initial Conditions Section

This section lists the plant conditions required to perform the test. Example: verify that the plant is operating at the 75% (+0, -5%) rod line. Each test of the operation of a system requires that certain other activities be performed first (e.g., completion of construction, construction and/or preliminary tests, inspections, and certain other preoperational tests or operations). Where appropriate, instructions are given pertaining to the system configuration, components that should or should not be operating, and other pertinent conditions that might affect the operation of the given system. The preoperational testing procedures include, as appropriate, these specific prerequisites, as illustrated by the following examples:

- Confirm that construction activities associated with the system have been completed and documented.
- Field inspections have been conducted to ensure that the equipment is ready for operation, including inspection for proper fabrication and cleanness, checkout of wiring continuity and electrical protective devices, adjustment of settings on torque-limiting devices and calibration of instruments, verification that all instrument loops are operable and respond within required response times, and adjustment and settings of temperature controllers and limit switches.

- Confirm that test equipment is operable and properly calibrated.
- Confirm communications systems are functional for conducting the test
- Access control is in place for personal safety
- Requirements for support or interface systems to be functional
- Confirm that prerequisite tests are conducted of individual components or subsystems to demonstrate that they meet their functional requirements. Regulatory Guide 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants" is used as guidance.

Special environmental condition will be included in this section. Test procedures include provisions to test the equipment under environmental conditions as close as practical to those the equipment will experience in both normal and accident situations, however, many tests are conducted at ambient conditions due to impracticality of achieving normal and accident conditions during preoperational testing.

- System Testing Section

This section provides detailed step-by-step instructions for each test. To the extent practical, the test procedures use approved normal plant operating procedures. Expected plant result is explicitly or implicitly stated in the instructions through verification or measurement steps. Each procedure requires necessary nonstandard arrangements to be restored to their normal status after the test is completed. Control measures such as jumper logs and check off lists are specified. Nonstandard bypasses, valve configurations, and instrument settings are identified and highlighted for return to normal. Nonstandard arrangements are carefully examined to ensure that temporary arrangements do not invalidate the test by interfering with proper testing of the as-built system.

- Data Collection Section

The test procedures prescribe the data to be collected and the form in which the data are to be recorded. All entries are permanent. The administrative controls include an acceptable method for correcting an entry.

- Acceptance Criteria Section

The test procedures clearly identify the criteria against which the success or failure of the test will be judged, and accounts for measurement errors and uncertainties. In some cases, these will be

qualitative criteria. Where applicable, quantitative values with appropriate tolerances are designated as acceptance criteria. This section includes acceptance criteria for judgment of plant and system performance (as described in the applicable test specification). Those test criteria that show compliance with the Combined License Inspections Tests, Analyses, and Acceptance Criteria (ITAAC), will be identified in this section. When test criterion for a Preoperational Test is not met, the Test Engineer documents the failure through the corrective action process and contacts the applicable preoperational test supervisor to determine actions to take (may require submitting a work request).

For the Startup Test program, criteria are divided into three categories depending on significance of the parameter or function. The following paragraphs describe the degree of each kind of test criterion, and the actions to be taken by the Test Engineer after an individual test criterion is not satisfied.

- Level 1 Criteria: Level 1 criterion relate to the values of process variables assigned in the design or analysis of the plant and component systems or associated equipment. Violation of these Level 1 criteria may have plant operational or plant safety implications. If a Level 1 test criterion is not satisfied, the plant must be placed in a suitable hold condition that is judged to be satisfactory to safety based on the results of prior testing. The Test Engineer will notify the on shift SRO, (who may declare the equipment inoperable), notify Startup Manager/test group supervisor, initiate Condition Report and issue Work requests as needed. Plant operating or test procedures or the Technical Specifications will guide the decision on the direction to be taken. Startup tests compatible with this hold condition may be continued. Resolution of the problem must be documented and pursued by appropriate equipment adjustments or through engineering support personnel. Following resolution, the applicable test portion must be repeated to verify that the Level 1 requirement is ultimately satisfied. A description of the problem resolution shall be included in the report documenting the successful test.
- Level 2 Criteria: Level 2 criteria are specified as key plant performance requirements that are equipment design specification values or requirements for the measured response. The expected plant response is predicted by best estimate computer code and the desired trip avoidance margins. Level 2 failures that occur during tuning and system adjustment must be documented in the test report and following resolution, the applicable test portion must be repeated (retesting could occur at a higher power level with FSRC approval) to verify that the Level 2 criterion requirement is satisfied. If a Level 2 criterion

requirement is not satisfied after a reasonable effort, then the cognizant design and engineering organization shall document the results in the Corrective Action Program with a full explanation of their recommendations. In order for the system as a whole to be acceptable, all Level 2 requirements have to be satisfied or documentation provided that either modifies Level 2 requirements or changes specific design criteria.

- Level 3 Criteria: Level 3 criteria are associated with specifications on the expected or desired performance of individual control loop components. Meeting Level 3 criteria helps assure that overall system and plant response requirements are satisfied. Therefore, Level 3 criteria are to be viewed as highly desirable rather than required to be satisfied. Good engineering judgment is appropriate in the application of these rules. Since overall system performance is a mathematical function of its individual components, one component whose performance is slightly worse than specified can be accepted provided that a system adjustment elsewhere will positively overcome this small deficiency. Large deviations from Level 3 performance requirements are not allowable. If a Level 3 criterion requirement is not satisfied, the subject component or inner loop shall be analyzed closely. However, if all Level 1 and Level 2 criteria are satisfied, then it is not required to repeat the transient test to satisfy the Level 3 performance requirements. The occurrence of this Level 3 criterion failure shall be documented in the test report and with a Condition Report

- Follow-on Task Section

This subsection includes activities that must be performed to complete the test procedure.

- Completion Notification

  This subsection is included to identify persons to be notified that the procedure has been satisfactorily or unsatisfactorily completed.

- Procedure Reviews

  This subsection is included to specify required reviews and comments by various personnel.

- Records Disposition

  Records disposition guidance is described in site specific procedures for procedure adherence and usage.

- Attachments

  Supporting information is contained in test procedure attachments and will contain equations and evaluation

methods to be used in the analysis of the obtained data. This attachment lists the signals to be recorded by the data collection equipment. Analysis and Evaluation attachments outline the calculations to be performed and provides for an evaluation of the test.

Upon completion of a given test, a preliminary evaluation is performed which confirms acceptability for continued testing. Smaller transient changes are performed initially, gradually increasing to larger transient changes. Test results at lower powers are extrapolated to higher power levels to determine acceptability of performing the test at higher powers.

- Documentation of Test Results

  Records identify each observer and/or data recorder participating in the test, as well as the type of observation, identifying numbers of test or measuring equipment, results, acceptability, and action taken to correct any deficiencies. Administrative procedures specify the retention period of test result summaries, and require permanent retention of documented summaries and evaluations.

14AA.3.3 **Other Startup Test Procedures**

The need for special startup tests may arise due to unplanned conditions. The format and content requirements for preoperational tests apply to these procedures.

14AA.3.4 **Test Procedure Changes**

If it is determined that procedure corrections (including changes in test sequence) are required before or during the conduct of the test, the Test Engineer suspends testing and notifies operations and test personnel of the required change. For all such corrections, the Test Engineer prepares and processes a procedure change request as delineated in a site specific procedure for processing procedure changes. Revisions are classified into two categories based on the intent of the change. The intent of a procedure is the specific task or goal that is to be accomplished by the procedure.

Intent changes are changes to:

- Purpose
- Initial conditions (or prerequisites)
- Acceptance criteria or tolerances
- Scaling or setpoints

- The method for meeting a commitment identified in the procedure
- Step verification (independent or simultaneously verified)
- System/component as left condition(s)
- Reactivity Management (changes that impact the operator's ability to monitor, control, or manipulate the reactor)
- Changes that add or delete a subsection
- Changes that decrease personnel safety or Fire Protection effectiveness
- Change that deletes, relocates, or adds a Hold Point
- Change to CAUTION or WARNING statements.
- Change start-up test procedure testing sequence

Non intent changes and revisions do not change the intent of the procedure such as correcting typographical errors. Procedure changes that change the intent of the procedure receive the same level of review and approval as the original procedure. Review and approval requirements for procedure changes that do not change the intent are established in administrative procedures in the SAM. Timely notification of the NRC is made when procedures are changed that have been sent to the NRC.

14AA.4 Conduct of the Initial Test Program

14AA.4.1 Administrative Controls

The conduct of the ITP is described in DCD 14.2.2.3. The Startup Administrative Manual governs the ITP and will be issued 60 days prior to the beginning of the pre-operational phase. Testing during all phases of the test program is conducted using approved test procedures to control the conduct of each test.

14AA.4.2 Procedure Verification

Because procedures may be approved for implementation weeks or months in advance of the scheduled test date, a review of the approved test procedure is required before commencement of testing. The Test Engineer is responsible for ensuring:

- Drawing and document revision numbers listed in the reference section of the test procedure agree with the latest revisions.
- The procedure text reflects any design change(s) made since the procedure was originally approved for implementation in the areas of acceptance criteria, FSAR, Technical Specifications, piping changes, etc.

- Any new Operating Experience lessons learned (since preparation of the procedure) are incorporated into individual test procedures.

Procedures require signoff of verification for prerequisites and instruction steps. This signoff includes identification of the person doing the signoff and the date and time of completion.

Test Engineers maintain chronological logs of test status to facilitate turnover and aid in maintaining operational configuration control. These logs become part of the test documentation.

There is a documented turnover process to ensure that test status and equipment configuration are known when personnel transfer responsibilities, such as shift change.

Test briefings are conducted for each test in accordance with administrative procedures. When shift change occurs before test completion, another briefing occurs before resumption or continuation of the test.

Data collected will be marked or identified with test, date, person collecting data. This data becomes part of the test documentation.

The plant corrective action program is used to document all deficiencies, discrepancies, exceptions, nonconformance and failures (collectively known as test exceptions) identified in the ITP. The corrective action documentation becomes part of the test documentation. GEH and/or other design organizations participate in resolution of test exceptions.

The plant manager approves proceeding from one test phase to the next during the initial test program. This approval is documented in an overall initial test program governance document.

Administrative procedures detail the test documentation review and approval. Review and approval of test documentation includes the Testing Engineer, Testing Supervisor, Startup Group Manager, GEH site representative or appropriate vendor, and JTG or FSRC. Final approval is by the Plant Manager.

Plant readiness reviews are conducted to assure that the plant staff and equipment are ready to proceed to the next test phase or plateau.

14AA.4.3 **Work Control**

The Startup Group is responsible for preparing Work Requests when Construction assistance is required. Work Requests are issued in accordance with a site specific procedure governing the Work Management process. The Plant Staff, upon identifying a need for Construction assistance, coordinates their requirements through the appropriate Startup Testing Engineer. Activities requiring Construction work efforts are performed under the plant

tagging procedures. Tagging requests will be governed by a site specific procedure for equipment clearance. Tagging procedures shall be used for protection of personnel and equipment and for jurisdictional or custodial conditions that have been turned over in accordance with the turnover procedure. The Startup Group is responsible for supervising minor repairs and modifications, changing equipment settings, and disconnecting and reconnecting electrical terminations as stipulated in a specific test procedure. Test Engineer's may perform independent verification of changes made in accordance with approved test procedures.

14AA.4.4 **Measuring and Test Equipment (M&TE)**

During the pre-op test program, as well as the startup test program, most activities that lead to plant commercial operation involve design value verifications. Measuring and Test Equipment (M&TE) used during these activities will be properly controlled, calibrated, and adjusted at specified intervals to maintain accuracy within necessary limits. Measuring and Test Equipment will be governed by a site specific procedure for control of Measuring and Test Equipment. M&TE includes portable tools, gauges, instruments, and other measuring and testing devices not permanently installed, e.g., startup test instruments prepared by the pre-op Test Group as well as those provided by Construction or provided by vendors.

A calibration program is implemented. For standard M&TE equipment, calibration procedures will be prepared for each type of M&TE calibrated onsite. Calibration intervals will be established for each item of M&TE. However, if the calibration requirement of a particular piece of M&TE is beyond the capabilities or resources of the plant staff, this M&TE will be sent to an offsite certified calibration or testing agency. If special test equipment, used only for the initial test program, is necessary, the responsible vendor will provide this equipment with the appropriate calibration documentation.

14AA.4.5 **System Turnover**

During the Construction Phase, systems, subsystems, and equipment are completed and turned over in an orderly and well-coordinated manner. Guidelines are established to define the boundary and interface between related system/subsystem and are used to generate boundary scope documents, for example, marked up Piping and Instrument Diagrams (P&IDs), Electrical Schematic Diagrams, etc. for scheduling and subsequent development of component and system turnover packages. The system turnover process includes requirements for the following:

- Documenting inspections performed by the construction organization (e.g. highlighted drawings showing areas inspected).
- Documenting results of construction testing
- Determining the construction-related inspections and tests that need to be completed before preoperational testing begins. Any open items will be evaluated for acceptability of commencing preoperational testing.
- Plans will be developed and implemented for correction of adverse conditions and open items, and means exist for tracking such conditions and items.
- Verify completeness of construction and documentation of incomplete items

14AA.4.6 **Preoperational Testing**

During performance of preoperational testing it may be necessary to return system control to construction to repair or modify the system or to correct new problems. Administrative procedures include direction for:

- Means of releasing control of systems and or components to construction.
- Methods used for documenting actual work performed and determining impact on testing.
- Identification of required testing to restore the system to operability/functionality/availability status, and to identify tests to be re-performed based on the impact of the work performed.
- Determinations of operability and unavailability are properly tracked and authorized.
- Verifying retests stay in compliance with ITAAC.

14AA.4.7 **Startup Testing**

- The program is planned to increase power in discrete steps.
- Major testing is performed at discrete power levels as described in DCD 14.2.7
- The first tests during power ascension testing that verify that movements and expansion of equipment are in accordance with design are conducted at a power level as low as practical (approximately 5%).
- The governing power ascension test plan requires the following operations to be performed at appropriate steps in the power-ascension test phase:

- Conduct any tests that are scheduled at the test condition or power plateau.
- Confirm core performance parameters (core power distribution) are within expectations.
- Determine reactor power by heat balance, calibrate nuclear instruments accordingly, and determine the existence of adequate instrumentation overlap between the startup range and power range detectors.
- Reset high-flux trips, just prior to ascending to the next level, to a value no greater than 20% beyond the power of the next level unless technical specification limits are more restrictive.
- Perform general surveys of plant systems and equipment to determine that they are operating within expected values.
- Check for unexpected radioactivity in process systems and effluents.
- Perform reactor coolant leak checks.
- Review the completed testing program at each plateau; perform preliminary evaluations, including extrapolation core performance parameters for the next power level; and obtain the required management approvals before ascending to the next power level or test condition.

Upon completion of a given test, a preliminary evaluation is performed which confirms acceptability for continued testing. Smaller transient changes are performed initially, gradually increasing to larger transient changes. Test results at lower powers are extrapolated to higher power levels to determine acceptability of performing the test at higher powers. This extrapolation is included in the analysis section of the lower power procedure.

Surveillance test procedures may be used to document portions of tests and ITP tests or portions of tests may be used to satisfy Technical Specification surveillance requirements in accordance with administrative procedures. At the completion of the Startup Test Program, a plant capacity warranty test is performed to satisfy the contract warranty and to confirm safe and stable plant operation.

14AA.4.8 Conduct of Modifications during the Initial Test Program

Temporary modifications may be required to conduct certain tests. These modifications are documented in the test procedure. The test procedures contain restoration steps and retesting required to confirm satisfactory restoration to required configuration. Modifications may be performed by the construction organization

or the plant staff processes prior to NRC issuance of the 10CFR52.103g finding. If the modification invalidates a previously completed ITAAC, then that ITAAC is re-performed. Each modification is reviewed to determine the scope of post-modification testing that is performed. Testing is conducted and documented to ensure that preoperational testing and ITAAC remains valid. Modifications made following NRC issuance of the 10CFR52.103g finding are in accordance with plant staff processes and meet license conditions. Modifications that require change of ITAAC require NRC approval of the ITAAC change.

14AA.4.9 Conduct of Maintenance during the Initial Test Program

All corrective or preventative maintenance activities are reviewed to determine the scope of post-maintenance testing to be performed. Prior to NRC issuance of the 10CFR52.103g finding, post-maintenance testing is conducted and documented to ensure that associated preoperational testing and ITAAC remain valid. Maintenance performed following NRC issuance of the 10CFR52.103g finding is in accordance with plant staff processes and meets license conditions.

14AA.4.10 Audits

A comprehensive system of planned and periodic audits is carried out to verify compliance with the ITP in accordance with the Quality Assurance Program Description. Follow-up actions, including re-audit of deficient areas, are taken where indicated.

14AA.5 Review, Evaluation and Approval of Test Results

14AA.5.1 Review and Approval Responsibilities

Reactor Vendor- reviews and approves the results of all tests of supplied equipment. Architect Engineer representatives review and approve the results of all tests of supplied equipment. Other Vendors representatives review and approve the results of all tests of supplied equipment. Plant Staff review and approval responsibilities are in Appendix 14AA.2. Final approval of individual test completion is by the Plant Manager after approval by the JTG or FSRC.

14AA.5.2 Technical Evaluation

Each completed test package is reviewed by technically qualified personnel to confirm satisfactory demonstration of plant, system or component performance and compliance with design and license criteria.

14AA.6 Test Records

Records retention requirements are in DCD 14.2.2.5 and in the Quality Assurance Program Description.

14AA.6.1 Startup Test Reports

Startup test reports are generated describing and summarizing the completion of tests performed during the Initial Test Program. A startup report is required per Regulatory Guide 1.16 at the earliest of 1) 9 months following initial criticality, 2) 90 days after completion of the Initial Test program, or 3) 90 Days after start of commercial operations. If one report does not cover all three events, then supplemental reports are submitted every three months until all three events are completed. These reports:

- Address each Initial Test program test described in the FSAR
- General description of measured values of operating conditions or characteristics obtained from the initial test program as compared to design or specification values.
- Describe any corrective actions that were required to achieve satisfactory operation.
- Include any other information required to be reported by license conditions due to regulatory guide commitments.

14AA.7 Test Program's Conformance with Regulatory Guides

Commitment is made to comply with guidance in RG 1.68 Revision 3.

In addition to the Regulatory Guides in DCD 14.2.3, the following Regulatory guides are complied with in the conduct of the Initial Test program:

- Regulatory Guide 1.30, "Quality Assurance Requirements for Installation, Inspection and Testing of Instrumentation and Electrical Equipment (Safety Guide 30)
- Regulatory Guide 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants
- Regulatory Guide 1.78, "Evaluating the Habitability of a Nuclear Power Plant Control Room during a Postulated Hazardous Chemical Release"
- Regulatory Guide 1.116, "Quality Assurance Requirements for Installation, Inspection, and Testing of Mechanical Equipment and Systems,

- Regulatory Guide 1.139, "Guidance for Residual Heat Removal"
- Regulatory Guide 1.152, "Criteria for Digital Computers in Safety Systems of Nuclear Power Plants"
- Regulatory Guide 1.168, "Verification, Validation, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants"

These regulatory guides contain guidance that is included in the content of test procedures.

14AA.8 Utilization of Operating Experience

Administrative procedures provide methodologies for evaluating and initiating action for operating experience information (OE). DCD 14.2.4 describes the general use of operating experience by GE-H in the development of the Initial Test program.

14AA.8.1 Sources and Types of Information Reviewed for ITP Development

Multiple sources of operating experience were reviewed. These included:

- INPO Operating Experience Reports
- INPO 06-001 Addendum
- INPO 06-001, "Operating Experience"
- INPO 07-003 Addendum
- INPO 07-003, "INPO/ Utility Benchmarking for New Plant Deployment"
- INPO 86-023, "Guidelines for Nuclear Power Construction Projects"
- INPO 94-005, "Standard Operation Support of Nuclear Plants"
- INPO 94-03, "Review of Commercial Nuclear Power Industry Standardization Experience"
- INPO Document AP-909, "Construction of Standard Nuclear Plants"
- INPO NX-1067, "Browns Ferry Nuclear Plant Unit 1 Restart Operational Readiness Lessons Learned
- NRC Regulatory Guide 1.68, "Initial Test Programs For Water-Cooled Nuclear Power Plants"
- SER 24-85, "Xenon Tilt Oscillation Following Control Rod Insertion Test (05-24-1985)"
- SER 29-86, "Inadvertent Rapid Cooldown and Depressurization During a Remote Shutdown Test (08-12-1986)"
- SOER 87-01, "Core Damaging Accident Following an Improperly Conducted Test (03-06-1987)"

- SOER 91-01, "Conduct of Infrequently Performed Tests or Evolutions"

14AA.8.2 Conclusions from Review

The test procedures should provide guidance as to the expected plant response and instructions concerning what conditions warrant aborting the test. Errors and problems with the procedures should be anticipated. A means for prompt but controlled approval of changes to test procedures is needed. Critical test procedures should provide specific criteria for test termination and specific steps to ensure termination is conducted in a safe and orderly manner. Providing procedural guidance for aborting the test could prevent delays in plant restoration. Conservative guidance for actions to be taken should be included in the procedures.

Plant simulators may prove useful in preparing for special tests and verifying procedures.

Appropriate component/system operability should be verified prior to critical tests.

The need to perform physics tests that can produce severe power tilts should be evaluated, particularly if tests at other similar reactors have provided sufficient data to verify the adequacy of the nuclear physics analysis

Implement compensatory measures in accordance with guidance for infrequently performed tests or evolutions where appropriate.

14AA.8.3 Summary of Test Program Features Influenced by the Review

Guidance from the preceding section was developed and included in Appendix 14AA 3.1 and 3.2. The guidance included test termination criteria, use of plant simulator, and implementing guidance for infrequently performed tests and evolutions. Other lessons learned were already in the guidance for ITP.

14AA.8.4 Use of OE during Test Procedure Preparation

Administrative procedures require review of recent internal and external operating experience when preparing test procedures.

14AA.8.5 Use of OE during Conduct of ITP

Administrative procedures require discussion of operating experience when performing prejob briefs immediately prior to the conduct of a test.

14AA.9 Trial Use of Plant Operating Procedures and Emergency Procedures

14AA.9.1 Use of Plant Procedures during Initial Test Program

Whenever practical, plant procedures will be used to perform system and component operation during the conduct of a test.

14AA.9.2 Operator Training and Participation during Certain Initial Tests (TMI Action Plan Item I.G.1, NUREG-0737)

The objectives of operator participation were to increase the capability of shift crews to operate facilities in a safe and competent manner by assuring that training for plant changes and off-normal events was conducted.

The major thrust of TMI Action Plan Task I.G was to use the preoperational and startup test programs as a training exercise for operating crews. NUREG 0933 contains a discussion of the proposed actions and the conclusions made. NUREG 0800 section 14 was revised to address the original issue of this action item. NUREG 0933 discusses three anticipated operational occurrences applicable to the ESBWR. These are pressure controller failed high, pressure controller failed low and stuck open safety/relief valve. These events are addressed in the abnormal operating procedures. Operators will receive training on them as part of their initial training. Operators will participate in preoperational and startup testing.

Operators will be trained on the specifics of the Initial Test Program schedule, administrative requirements and tests. Specific just in time training will be conducted for selected startup tests.

The ITP may result in discovery of acceptable plant or system response differing from expected response. Test results are reviewed to identify these differences and the training for operators is changed to reflect them. Training is conducted as soon as is practicable in accordance with training procedures.

14AA.10 Initial Fuel Loading and Initial Criticality

14AA.10.1 Prerequisites for Fuel Loading

- Preoperational Tests are completed or justification is documented and approved for test exceptions and tests not performed.
- All ITAAC are complete and the NRC has issued 10CFR 52.103 g declaration.
- Technical Specifications required for fuel load are met.

- License Conditions are met to allow fuel load.
- Licensed operators are stationed in the control room and for supervision of core alterations.
- Composition, duties, and emergency procedure responsibilities of the fuel handling crew are specified.
- Persons are technically qualified in accordance with plant procedures.
- Radiation monitors, nuclear instrumentation, manual initiation, and other devices are tested and verified to be operable to actuate the building evacuation alarm and ventilation control.
- Status of all systems required for fuel loading are specified.
- Inspections of fuel and control rods are complete and all identified issues with installed fuel and control rods are resolved.
- Nuclear instruments are calibrated, operable and properly located (source-fuel-detector geometry). One operating channel has audible indication or annunciation in the control room.
- A response check of nuclear instruments to a neutron source consistent with the Technical Specification surveillance frequency for source range nuclear instruments in the refueling mode is complete.
- Required status of containment is specified.
- Required status of the reactor vessel is specified. Components are either in place or out of the vessel, as specified, to make it ready to receive fuel.
- Vessel water level is established, and the minimum level for fuel loading and unloading is specified.
- The standby liquid control system is operable.
- Fuel handling equipment is confirmed functional and operable through surveillance and other tests including dry runs.
- The status of protection systems, interlocks, mode switch, alarms, and radiation protection equipment is prescribed and verified.
- Water quality is established within identified limits.

14AA.10.2 **Fuel Loading Procedure Details**

The Fuel Loading procedure includes instructions or information for the following areas:

- loading sequence and pattern for fuel, control rods, and other components, with guidance regarding fuel addition increments so that the reactivity worth of added individual fuel assemblies becomes less as the core is assembled
- maintenance of a display for indicating the status of the core and fuel pool, as well as appropriate records of core loading
- proper seating and orientation of fuel and components (the procedure specifies a visual check of each assembly in each core position)
- functional testing of each control rod immediately following fuel loading
- nuclear instrumentation and neutron source requirements for monitoring subcritical multiplication, including source or detector relocation and normalization of count rate after relocation
- flux monitoring, including counting times and frequencies and rules for plotting inverse multiplication and interpreting plots (the counting period for count rates is specified, and an inverse multiplication plot is maintained)
- the expected subcritical multiplication behavior
- The minimum shutdown margin is proved periodically during loading and at the completion of loading. Shutdown margin verifications do not involve planned approach to criticality using nonstandard rod patterns or with operational interlocks bypassed.
- actions (especially those pertaining to flux monitoring) for periods when fuel loading is interrupted
- maintenance of continuous voice communication between the control room and loading station
- minimum crew required to load fuel (the procedure requires the presence of at least two persons at any location where fuel handling is taking place, and a senior reactor operator with no other concurrent duties is in charge)
- crew work time limits per 10CFR 26 Fitness For Duty are in effect
- approvals required for changing the procedure

14AA.10.3 **Fuel Loading Procedure Limitations and Actions**

- Established criteria for stopping fuel loading. Some circumstances that might warrant this are unexpected subcritical multiplication behavior, loss of communications between the control room and fuel loading station, inoperable

source-range detector, and inoperability of the emergency boration system.

- Established criteria for emergency boron injection.
- Established criteria for containment evacuation.
- Actions to be performed in the event of fuel damage.
- Actions to be performed and/or approvals to be obtained before routine loading may resume after one of the above limitations has been reached or invoked.

14AA.10.4 Initial Criticality Procedure Requirements

- The format and content requirements for preoperational tests apply to the initial criticality procedure. Plant operations will be in accordance with plant operating procedures to the maximum extent possible.
- This procedure includes steps to ensure that the startup will proceed in a deliberate and orderly manner, changes in reactivity will be continuously monitored, and inverse multiplication plots will be maintained and interpreted.
- A critical rod position is predicted so that any anomalies may be noted and evaluated.
- All systems needed for startup are aligned and in proper operation.
- The standby liquid control system is operable and in readiness.
- Procedural, license and technical specification requirements are met for initial criticality.
- Nuclear instruments are calibrated. A neutron count rate (of at least ½ count per second) should register on neutron monitoring channels before the startup begins, and the signal-to-noise ratio should be known to be greater than two. A conservative startup rate limit (no shorter than approximately a 30-second period) is established.

14AA.11 Plant Procedure Development Schedule

The milestone schedule for the development of plant operating procedures is in FSAR Table 13.5-202 and a discussion is in FSAR 13.5.2.1. The operating and emergency procedures must be available prior to start of licensed operator training and therefore will be available for use during the ITP.

Required or desired procedure changes may be identified during their use. Administrative procedures describe the process for revising plant operating procedures.

14AA.12 Individual Test Descriptions

Individual test descriptions can be found in DCD Section 14.2.8, Individual Test Descriptions.

FIGURE 1
Preoperational and Startup Test Organization (Typical)