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Subject: Handouts from 5/22 NRC - ESBWR DCWG Meeting
Attachments: DRAFT ESBWR IST Program Description 051608.pdf; Draft ITP admin program description 052008.pdf; GG COLA_Stack-ST Changes_05-21.pdf; IST Program Description_ 05-22-08.pdf; P- T Curves NRC presentation for 5-22-08 Rev2.pdf

Attached are pdf files of the handouts from our NRC - ESBWR DCWG meeting on May 22.

Please let me know if you have any questions.

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Hearing Identifier: NorthAnna3_Public_EX
Email Number: 68

Mail Envelope Properties (OF3B4F7D43.BB1858D6-ON85257457.0052DBE7-85257457.005375AC)

Subject: Handouts from 5/22 NRC - ESBWR DCWG Meeting
Sent Date: 5/28/2008 11:11:34 AM
Received Date: 5/28/2008 11:11:51 AM
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Files	**Size**	**Date & Time**
MESSAGE	1012	5/28/2008 11:11:51 AM
DRAFT ESBWR IST Program Description 051608.pdf	186970	
Draft ITP admin program description 052008.pdf	140130	
GG COLA_Stack-ST Changes_05-21.pdf	15965	
IST Program Description_05-22-08.pdf	20283	
P- T Curves NRC presentation for 5-22-08 Rev2.pdf	35205	

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Priority: Standard
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Red Text – currently shown in DCD Draft Revision 5, which incorporates GEH RAI responses (3.9-159 S01, 3.9-168 S01, 3.9-178, 3.9-180 through 3.9-196, 3.9-199, 3.9-178 S01, 3.9-188 S01, and 3.9-189 S01) and other changes. (Underline from DCD draft R5 markups is removed.)

Blue Text – suggested additional text to be added to or to replace DCD R4 or draft R5 text (from the RAI responses), or deletion (with strikethrough) of DCD or RAI response text.

Green Text – recommended text to be added to or deleted from the COLA IST Program description, or text that is currently included in COLA R0.

Black text – DCD Revision 4 text.

3.9.3.5 Valve Operability Assurance

~~Active mechanical (with or without electrical operation) equipment designed to perform a mechanical motion for its safety-related function is Seismic Category I. Equipment with faulted condition functional requirements includes active pumps and valves in fluid systems such as the Residual Heat Removal (RHR) System, Emergency Core Cooling System (ECCS), and MS system.~~

This subsection discusses operability assurance of active Code valves, including ~~the~~ actuators ~~that is a part of the valve~~ (Subsection 3.9.2.2).

[*Valves that perform an active safety-related function are functionally qualified to perform their required functions. For valve designs developed for the ESBWR that were not previously qualified, the qualification programs meet the requirements of QME-1-2007. For valve designs previously qualified to standards other than ASME QME-1-2007, the following approach is used:*

- *The ESBWR general valve requirements specification includes requirements related to design and functional qualification of safety-related valves that incorporate lessons learned from nuclear power plant operations and research programs.*
- *Qualification specifications (e.g., design specifications) consistent with Appendices QV-I and QV-A of QME-1-2007 will be prepared to ensure the operating conditions and safety functions for which the valves are to be qualified are communicated to the manufacturer or qualification facility.*
- *Suppliers are required to submit, for GEH review and approval, application reports, as described in QME-1-2007, that describe the basis for the application of specific predictive methods and/or qualification test data to a valve application.*
- *GEH reviews the application reports provided by the suppliers for adherence to specification requirements to ensure the methods used are applicable and justified and to verify any extrapolation techniques used are justified. A gap analysis is performed to identify any deviations from QME-1-2007 in the valve qualification. Each deviation is evaluated for impact on the overall valve qualification. If the conclusion of the gap analysis is that the valve qualification is inadequate, then the valve may be qualified using a test-based methodology, as allowed by QME-1-2007.*
- *GEH performs independent sizing calculations, using bounding design parameters (such as sliding friction coefficients), to verify supplier actuator sizing.*

Functional qualification addresses key lessons learned from industry efforts, particularly on air- and motor-operated valves, many of which are discussed in Section QV-G of QME-1-2007.]* For example:

- Evaluation of valve performance is based on a combination of testing and analysis, using design similarity to apply test results to specific valve designs.
- Testing to verify proper valve setup and acceptable operating margin is performed using diagnostic equipment to measure stem thrust and/or torque.
- Sliding friction coefficients used to evaluate valve performance (e.g. disk-to-seat friction coefficients for gate valves and bearing coefficients for butterfly valves) account for the effects of temperature, cycle history, load and internal parts geometry.
- Actuator sizing allows margin for aging/degradation, test equipment accuracy and other uncertainties, as appropriate.
- Material combinations that may be susceptible to galling or other damage mechanisms under certain conditions are not used.

Subsection 3.9.2.2 and Section 3.10 provide details on the seismic qualification of valves. Section 3.11 provides details on the environmental qualification of valves.~~Safety-related valves are qualified by testing and analysis and by satisfying the stress and deformation criteria at the critical locations within the valves. Operability is assured by meeting the requirements of the programs defined in Subsection 3.9.2.2, Section 3.10, Section 3.11 and the following subsections.~~

Section 4.4 of GE's Environmental Qualification Program (Reference 3.9-3) applies to this subsection, and the seismic qualification methodology presented therein is applicable to mechanical as well as electrical equipment.

3.9.3.5.1 Major Active Valves

Some of the major safety-related active valves (Tables 6.2-21, 6.2-42 and 3.2-1) discussed in this subsection for illustration are the main steamline isolation valves and safety relief valves, and standby liquid control valves and depressurization valves. These valves are designed to meet the Code requirements and perform their mechanical motion in conjunction with a dynamic (SSE and other RBV) load event. These valves are supported entirely by the piping (i.e., the valve operators are not used as attachment points for piping supports) (Subsection 3.9.3.7). The dynamic qualification for operability is unique for each valve type; therefore, each method of qualification is detailed individually below.

Main Steamline Isolation Valves (MSIVs)

The typical Y-pattern MSIVs described in Subsection 5.4.5.2 are evaluated by analysis and test for capability to operate under the design loads that envelop the predicted loads during a design basis accident and safe shutdown earthquake.

The valve body is designed, analyzed and tested in accordance with the Code, Class 1 requirements. The MSIVs are modeled mathematically in the main steamline system analysis. The loads, amplified accelerations and resonance frequencies of the valves are determined from the overall steamline analysis. The piping supports (snubbers, rigid restraints, etc.) are located and designed to limit amplified accelerations of and piping loads in the valves to the design limits.

As described in Subsection 5.4.5.3, the MSIV and associated electrical equipment (wiring, solenoid valves, and position switches) are dynamically qualified to operate during an accident condition.

Main Steam Safety Relief Valves

The typical SRV design described in Subsection 5.2.2.2 is qualified by type test to IEEE 344 for operability during a dynamic event. Structural integrity of the configuration during a dynamic event is demonstrated by both the Code Class 1 analysis and test.

- The valve is designed for maximum moments on inlet and outlet, which may be imposed when installed in service. These moments are resultants due to dead weight plus dynamic loading of both valve and connecting pipe, thermal expansion of the connecting pipe, and reaction forces from valve discharge.
- A production SRV is demonstrated for operability during a dynamic qualification (shake table) type test with moment and "g" loads applied greater than the required equipment's design limit loads and conditions.

A mathematical model of this valve is included in the main steamline system analysis, as with the MSIVs. This analysis ensures the equipment design limits are not exceeded.

Standby Liquid Control Valve (Injection Valve)

The typical SLC injection valve design is qualified by type test to IEEE 344. The valve body is designed, analyzed and tested per the Code, Class 1. The qualification test demonstrates the ability to remain operable after the application of the horizontal and vertical dynamic loading exceeding the predicted dynamic loading.

Depressurization Valves (DPV)

The DPV design described in Subsection 6.3.2.8 is qualified by test to IEEE 344 for operability during a dynamic event. Structural integrity of the configuration during dynamic events is demonstrated by both the Code Class 1 analysis and test.

- The valve is designed for maximum moments on the inlet that may be imposed when installed in service. These moments are resultants due to dead weight plus dynamic loading of both valve and connecting pipe, thermal expansion of the connecting pipe, and reaction forces from valve discharge.
- A production DPV is demonstrated for operability after the performance of a dynamic qualification (shake table) type test with moment and "g" loads applied greater than the required equipment's design limit loads and conditions.

A mathematical model of this valve is included in the main steamline system analysis and in the analysis of stub lines attached directly to the reactor vessel. These analyses assure that the equipment design limits are not exceeded.

3.9.3.5.2 Other Active Valves

Other safety-related active valves are ASME Class 1, 2 or 3 and are designed to perform their mechanical motion during dynamic loading conditions. The operability assurance program ensures that these valves operate during a dynamic seismic and other RBV event.

Procedures

Qualification tests accompanied by analyses are conducted for all active valves. Procedures for qualifying electrical and instrumentation components, which are depended upon to cause the valve to accomplish its intended function, are described in Section 3.10.

Tests

Prior to installation of the safety-related valves, the following tests are performed: (1) shell hydrostatic test to the Code requirements; (2) back seat and main seat leakage tests; (3) disk hydrostatic test; (4) functional tests to verify that the valve opens and closes within the specified

time limits when subject to the design differential pressure; and (5) operability qualification of valve actuators for the environmental conditions over the installed life. Environmental qualification procedures for operation follow those specified in Section 3.11. The results of all required tests are properly documented and included as a part of the operability acceptance documentation package.

Dynamic Load Qualification

The functionality of an active valve during and after a seismic and other RBV event may be demonstrated by an analysis or by a combination of analysis and test. The qualification of electrical and instrumentation components controlling valve actuation is discussed in Section 3.10. The valves are designed using either stress analyses or the pressure temperature rating requirements based upon design conditions. An analysis of the extended structure is performed for static equivalent dynamic loads applied at the center of gravity of the extended structure. Refer to Subsection 3.9.2.2 for further details.

The maximum stress limits allowed in these analyses confirm structural integrity and are the limits developed and accepted by the ASME for the particular ASME Class of valve analyzed. When qualification of mechanisms that must change position to complete their safety-related function is based on dynamic testing or equivalent static load testing, operability testing is performed for the loads defined by the applicable events and conditions per Subsection 3.9.1.1 and Table 3.9-1.

The dynamic qualification testing procedure for valve operability is outlined below. A subject valve assembly is mounted in a test stand or fixture in a manner that conservatively represent typical valve installation(s). Each test valve assembly includes the actuator and accessories that are attached to an in-service valve. Additional discussion of test criteria and method is provided in Subsection 3.9.2.2, and also in the portions of Subsections 3.10.1 and 3.10.2 applicable to active valve assemblies.

Dynamic load qualification is accomplished in the following way:

(1) The active valves are designed to have a fundamental frequency that is greater than the high frequency asymptote of the dynamic event. This is shown by suitable test or analysis.

(2) The actuator and yoke of the valve system is statically loaded to an amount greater than that due to a dynamic event. The load is applied at the center of gravity to the actuator alone in the direction of the weakest axis of the yoke. The simulated operational differential pressure is simultaneously applied to the valve during the static deflection tests.

(3) The valve is then operated while in the deflected position (i.e., from the normal operating position to the safe position). The valve is verified to perform its safety-related function within the specified operating time limits.

(4) Powered valve actuators and other accessory components directly attached onto the valve or actuator that are necessary for operation are qualified as operable during a dynamic event by appropriate qualification tests prior to installation on the valve. The powered actuator assemblies then have individual Seismic Category I supports attached to decouple the dynamic loads between the actuators and valves themselves.

The piping, stress analysis, and pipe support designs maintain the actuator assembly accelerations below the qualification levels with adequate margin of safety.

If the fundamental frequency of the valve, by test or analysis, is less than that for the ZPA, a dynamic analysis of the valve is performed to determine the equivalent acceleration to be applied during the static test. The analysis provides the amplification of the input acceleration considering the natural frequency of the valve and the frequency content of the applicable plant floor response

spectra. The adjusted accelerations have been determined using the same conservatism contained in the horizontal and vertical accelerations used for rigid valves. The adjusted acceleration is then used in the static analysis and the valve operability is assured by the methods outlined in Steps (2) through (4), using the modified acceleration input. Alternatively, the valve, including the actuator and other accessories, is qualified by shake table test.

Valves that are safety-related but can be classified as not having an overhanging structure, such as check valves and pressure-relief valves, are considered as follows:

Check Valves

Due to the particular simple characteristics of the check valves, the active check valves are qualified by a combination of the following tests and analysis:

- Stress analysis including the dynamic loads where applicable;
- In-shop hydrostatic tests;
- In-shop seat leakage test; and
- Periodic in-situ valve exercising and inspection to assure the functional capability of the valve.

Pressure-Relief Valves

The active pressure relief valves (RVs) are qualified by the following procedures. These valves are subjected to test and analysis similar to check valves, stress analyses including the dynamic loads, in-shop hydrostatic seat leakage, and performance tests. In addition to these tests, periodic in-situ valve inspection, as applicable, and periodic valve removal, refurbishment, performance testing, and reinstallation are performed to assure the functional capability of the valve. Tests of the RV under dynamic loading conditions demonstrate that valve actuation can occur during application of the loads. The tests include pressurizing the valve inlet with nitrogen and subjecting the valve to accelerations equal to or greater than the dynamic event (SSE plus other RBV) loads.

Qualification of Electrical and Instrumentation Components Controlling Valve Actuation

A practical problem arises in attempting to describe tests for devices (relays, motors, sensors, etc.) as well as for complex assemblies such as control panels. It is reasonable to assume that a device, as an integral part of an assembly, can be subjected to dynamic loads tests while in an operating condition and its performance monitored during the test. However, in the case of complex panels, such a test is not always practical. In such a situation, the following alternate approach may be followed.

The individual devices are tested separately in an operating condition and the test levels recorded as the qualification levels of the devices. The panel, with similar devices installed but inoperative, is vibration tested to determine if the panel response accelerations, as measured by accelerometers installed at the device attachment locations, are less than the levels at which the devices were qualified. Installing the non-operating devices assures that the test panel has representative structural characteristics. If the acceleration levels at the device locations are found to be less than the levels to which the device is qualified, then the total assembly is considered qualified. Otherwise, either the panel is redesigned to reduce the acceleration level to the device locations and retested, or the devices are requalified to the higher levels.

Documentation

All of the preceding requirements are satisfied to demonstrate that functionality is assured for active valves. The documentation is prepared in a format that clearly shows that each

consideration has been properly evaluated, and a designated quality assurance representative has validated the tests. The analysis is included as a part of the certified stress report for the assembly.

3.9.3.7.1 Piping Supports

Supports and their attachments for safety-related Code Class 1, 2, and 3 piping are designed in accordance with Subsection NF up to the interface of the building structure, with jurisdictional boundaries as defined by Subsection NF. The design of the nuclear power plant structures, systems, and components will provide access for the performance of inservice testing (IST) and inservice inspection (ISI) as required by the applicable ASME Code. The building structure component supports (connecting the NF support boundary component to the existing building structure) are designed in accordance with ANSI/AISC N690, Nuclear Facilities-Steel Safety-Related Structures for Design, Fabrication and Erection, or the AISC Specification for the Design, Fabrication, and Erection of Structural Steel. The applicable loading combinations and allowables used for design of supports are shown on Tables 3.9-10, -11, and -12. The stress limits are per ASME-III, Subsection NF and Appendix F.

Maximum calculated static and dynamic deflections of the piping at support locations do not exceed the allowable limits specified in the piping design specification.

Seismic Category II pipe supports are designed so that the SSE would not cause unacceptable structural interaction or failure. Support design follows the intent and general requirement specified in ASME-III, Nonmandatory Appendix F. This is used to evaluate the total design load condition with respect to the requirements of the safe shutdown earthquake (SSE) condition to ensure the structural integrity of the pipe supports are maintained.

The design of supports for the non-nuclear piping satisfies the requirements of ASME B31.1 Power Piping Code, Paragraphs 120 and 121.

For the major active valves identified in Subsection 3.9.3.5, the valve operators are not used as attachment points for piping supports.

The friction loads caused by unrestricted motion of the piping due to thermal displacements are considered to act on the support with a friction coefficient of 0.3, in the case of steel-to-steel friction. For stainless steel, Teflon, and other materials, the friction coefficient could be less. The friction loads are not considered during seismic or dynamic loading evaluation of pipe support structures.

For the design of piping supports, a deflection limit of 1.6 mm (1/16 in.) for erection and operation loadings is used, based on WRC-353 paragraph 2.3.2. For the consideration of loads due to SSE and in the cases involving springs, the deflection limit is increased to 3.2 mm (1/8 in.).

For frame type supports, the total gap is limited to 3.2 mm (1/8 inch). In general, this gap is adequate to avoid thermal binding due to radial thermal expansion of the pipe. For large pipes with higher temperatures, this gap is evaluated to assure that no thermal binding occurs. The minimum total gap is specified to ensure that it is adequate for the thermal radial expansion of the pipe to avoid any thermal binding.

The small bore lines (e.g. small branch and instrumentation lines) are supported taking into account the flexibility, and thermal and dynamic motion requirements of the pipe to which they connect. Subsection 3.7.3.16 provides details for the support design and criteria for instrumentation lines 50 mm (1.97 in.) and less where it is acceptable practice by the regulatory agency to use piping handbook methodology.

The design criteria and dynamic testing requirements for the ASME-III piping supports are as follows:

(1) Piping Supports—All piping supports are designed, fabricated, and assembled so that they cannot become disengaged by the movement of the supported pipe or equipment after they have been installed. All piping supports are designed in accordance with the rules of Subsection NF of the Code up to the building structure interface as defined by the jurisdictional boundaries in Subsection NF.

(2) Spring Hangers—The operating load on spring hangers is the load caused by dead weight. The hangers are calibrated to ensure that they support the operating load at both their hot and cold load settings. Spring hangers provide a specified down travel and up travel in excess of the specified thermal movement.

(3) Snubbers—The operating loads on snubbers are the loads caused by dynamic events (e.g., seismic, RBV due to LOCA, SRV and DPV discharge, discharge through a relief valve line or valve closure) during various operating conditions. Snubbers restrain piping against response to the dynamic excitation and to the associated differential movement of the piping system support anchor points. The criteria for locating snubbers and ensuring adequate load capacity, the structural and mechanical performance parameters used for snubbers and the installation and inspection considerations for the snubbers are as follows:

a. Required Load Capacity and Snubber Location

The loads calculated in the piping dynamic analysis, described in Subsection 3.7.3.8, cannot exceed the snubber load capacity for design, normal, upset, emergency and faulted conditions.

Snubbers are generally used in situations where dynamic support is required because thermal growth of the piping prohibits the use of rigid supports. The snubber locations and support directions are first decided by estimation so that the stresses in the piping system have acceptable values. The snubber locations and support directions are refined by performing the dynamic analysis of the piping and support system as described above in order that the piping stresses and support loads meet the Code requirements.

The pipe support design specification requires that snubbers be provided with position indicators to identify the rod position. This indicator facilitates the checking of hot and cold settings of the snubber, as specified in the installation manual, during plant preoperational and startup testing.

b. Inspection, Testing, Repair and/or Replacement of Snubbers

The pipe support design specification requires that the snubber supplier prepare an installation instruction manual. This manual is required to contain complete instructions for the testing, maintenance, and repair of the snubber. It also contains inspection points and the period of inspection. The program for inservice examination and testing of snubbers in the completed ESBWR construction is prepared in accordance with the requirements of ASME Section XI Code and ASME OM Code, ISTD, and the applicable industry and regulatory guidance including RG 1.192. The intervals for visual examination are the subject of Code Case OMN-13, which is accepted under the RG 1.192. The preparation and submittal of a program for the inservice testing and examination of snubbers is addressed in Subsection 3.9.9.

The pipe support design specification requires that hydraulic snubbers be equipped with a fluid level indicator so that the level of fluid in the snubber can be ascertained easily.

The spring constant achieved by the snubber supplier for a given load capacity snubber is compared against the spring constant used in the piping system model. If the spring constants are the same, then the snubber location and support direction become confirmed. If the spring constants are not in agreement, they are brought in agreement, and the system analysis is redone to confirm the snubber loads. This iteration is continued until all snubber load capacities and spring constants are reconciled.

A thermal motion monitoring program is established for verification of snubber movement, adequate clearance and gaps, including motion measurements and acceptance criteria to assure compliance with ASME Section III Subsection NF.

c. Snubber Design and Testing

To assure that the required structural and mechanical performance characteristics and product quality are achieved, the following requirements for design and testing are imposed by the design specification:

(i) The snubbers are required by the pipe support design specification to be designed in accordance with the rules and regulations of the ASME Section III Code, Subsection NF and consider the following:

- Design requirements include analysis for normal, upset, emergency and faulted loads. Calculated loads are then compared against allowable loads as established by snubber vendor.

- Swing angles, as supplied by the snubber vendor, are incorporated into the design. Pipe movements in the horizontal and vertical direction are taken into account to prevent end bracket/paddle plate binding.

- Snubber stiffness, as supplied by the snubber vendor, is included in the piping analysis. Other support components such as the pipe clamp/extension piece/transition tube and structural auxiliary steel stiffness values are

incorporated into the final determination of the stiffness value used in the analysis.

In multiple snubber applications where mismatch of end fitting clearance and lost motion could possibly exist, the synchronism of activation level or release rate is evaluated, if deemed necessary, in the piping analysis model when this application could be considered critical to the functionality of the system, such as a multiple snubber application located near rotating equipment. Equal load sharing of multiple snubber supports is not assumed if a mismatch in end fitting clearances exists and is evaluated as a part of this assessment.

(ii) A list of snubbers on systems which experience sufficient thermal movement to measure cold to hot position is provided as part of the testing program after the piping analysis has been completed.

(iii) The snubbers are tested to ensure that they can perform as required during the seismic and other RBV events, and under anticipated operational transient loads or other mechanical loads associated with the design requirements for the plant. Production and qualification test programs for both hydraulic and mechanical snubbers are carried out by the snubber vendors in accordance with the snubber installation instruction manual required to be furnished by the snubber supplier. Acceptance criteria to assure compliance with ASME Section III Subsection NF ~~are cited in this manual~~, and other applicable codes~~, and~~ standards and requirements are as follows:~~referenced. The following test requirements are included:~~

- ~~Snubbers are subjected to force or displacement versus time loading at frequencies within the range of significant modes of the piping system.~~Snubber production and qualification test programs are carried out by strict adherence to the manufacturer's snubber installation and instruction manual, which is prepared by the snubber manufacturer and subjected to review by the applicant for compliance with the applicable provisions of the ASME Pressure Vessel and Piping Code of record. The test program is periodically audited during implementation by the applicant for compliance.

- ~~Dynamic cyclic load tests are conducted for hydraulic snubbers to determine the operational characteristics of the snubber control valve.~~All snubbers will be inspected and tested for compliance with the design drawings and functional requirements of the procurement specifications.

- ~~Displacements are measured to determine the performance characteristics specified.~~All snubbers are inspected and tested. No sampling methods may be used in the qualification tests.

- ~~Tests are conducted at various temperatures to ensure operability over the specified range.~~All snubbers are load rated by testing in accordance with the

snubber manufacturer's testing program and in compliance with the applicable sections of ASME QME-1-2007, Subsection QDR and ASME OM Code, Subsection ISTD.

- ~~Peak test loads in both tension and compression are required to be equal to or higher than the rated load requirements.~~Design compliance of the snubbers per ASME Section III Subsections NF-3128, NF-3411.3 and NF-3412.4.

- The snubbers are tested for various abnormal environmental conditions. Upon completion of the abnormal environmental transient test, the snubber is tested dynamically at a frequency within a specified frequency range. The snubber must operate normally during the dynamic test. The functional parameters cited in Subsection NF-3412.4 are included in the snubber qualification and testing program. Other parameters in accordance with applicable ASME QME-1-2007 and the ASME OM Code will be incorporated.

- The codes and standards used for snubber qualification and production testing are as follows:

  - ASME B&PV Code Section III (Code of Record date) and Subsection NF.

  - ASME QME-1-2007, Subsection QDR and ASME OM Code, Subsection ISTD.

- All large bore hydraulic snubbers include full Service Level D load testing, including verifying bleed rates, control valve closure within the specified velocity ranges and drag forces/breakaway forces are acceptable in accordance with ASME, QME-1-2007 and ASME OM Codes.

(iv) All safety-related components which utilize snubbers in their support systems will be identified and inserted into the Final Safety Analysis Report ~~(FSAR)~~ in table format and will include the following:

- identification of systems and components

- number of snubbers utilized in each system and on that component

- snubber type (s) – (hydraulic or mechanical) – and name of supplier

- constructed to ASME Code Section III, Subsection NF or other

- snubber use such as shock, vibration, or dual purpose

- those snubbers identified as dual purpose or vibration arrestor type, will include an indication if both snubber and component were evaluated for

fatigue strength

d. Snubber Installation Requirements

An installation instruction manual is required by the pipe support design specification. This manual is required to contain instructions for storage, handling, erection, and adjustments (if necessary) of snubbers. Each snubber has an installation location drawing that contains the installation location of the snubber on the pipe and structure, the hot and cold settings, and additional information needed to install the particular snubber.

e. Snubber Preservice and Inservice Examination and Testing

Preservice Examination and Testing

The preservice examination plan for ~~of all~~ snubbers is prepared in accordance with the requirements of the ASME Code for Operation and Maintenance of Nuclear Power Plants (OM Code), Subsection ISTD, and the additional requirements of this section. The~~is~~ preservice examinations are~~is~~ made after snubber installation but not more than 6 months prior to initial system pre-operational testing. The preservice examination verifies the following:

(i) There are no visible signs of damage or impaired operability as a result of storage, handling, or installation.

(ii) The snubber load rating, location, orientation, position setting, and configuration (attachments, extensions, etc.) are according to design drawings and specifications.

(iii) Snubbers are not seized, frozen or jammed.

(iv) Adequate swing clearance is provided to allow snubber movements.

(v) If applicable, fluid is to the recommended level and is not to be leaking from the snubber system.

(vi) Structural connections such as pins, fasteners and other connecting hardware such as lock nuts, tabs, wire, cotter pins are installed correctly.

If the period between the initial preservice examination and initial system preoperational tests exceeds 6 months, reexamination of Items i, iv, and v is performed. Snubbers, which are installed incorrectly or otherwise fail to meet the above requirements, are repaired or replaced and re-examined in accordance with the above criteria.

A preservice thermal movement examination, as required by ISTD-4130, is also performed - during initial system heatup and cooldown, for systems whose design operating temperature exceeds 250ºF (121ºC), snubber thermal movement is verified in accordance with ISTD-4131 through ISTD-4133.

Additionally, preservice operational readiness testing is performed on all snubbers in

accordance with ISTD-5100. The operational readiness test is performed to verify the parameters of ISTD-5120 as required by ISTD-3210. Snubbers that fail the Preservice Operational Readiness Test shall be evaluated and retested in accordance with ISTD-5130.

Snubbers that are installed incorrectly or otherwise fail preservice testing requirements are re-installed correctly, adjusted, modified, repaired or replaced, as required. Preservice examination and testing is re-performed on installation-corrected, adjusted, modified, repaired or replaced snubbers as required by ISTD-4140 and ISTD-5134.

Inservice Examination and Testing

Inservice examination of all safety-related snubbers is conducted in accordance with the requirements of ISTD-4200 and inservice testing requirements of ISTD-5200. Inservice examination is initially performed not less than two months after attaining 5% reactor power operation and will be completed within 12 calendar months after attaining 5% reactor power (ISTD-4251). Subsequent examinations are performed at intervals defined by ISTD-4252 and Table ISTD-4252-1. Examination intervals are adjusted as allowed by Table ISTD-4252-1, based on the number of unacceptable snubbers identified in the current interval.

An inservice visual examination is performed on all snubbers in accordance with ISTD-4200 to identify physical damage, leakage, corrosion, degradation, indication of binding, misalignment or deformation and potential defects generic to a particular design (ISTD-4231 through ISTD-4233). Snubbers that do not meet examination requirements of ISTD-4230 are evaluated to determine the root cause of the unacceptability, and corrective actions (snubber adjusted, repaired, modified, or replaced) are taken in accordance with ISTD-4280. Snubbers evaluated as unacceptable during visual examination may be accepted for continued service by successful completion of an operational readiness test of ISTD-5210 (ISTD-4233).

Snubbers are tested inservice to determine operational readiness, in accordance with ISTD-5200 during each fuel cycle, beginning no sooner than 60 days before the start of the refueling outage. Snubbers tests are conducted with the snubber in the as-found condition, to the extent practical, either in place or on a test bench, to verify the test parameters of ISTD-5210 (ISTD-5220). When an in-place test or bench test can not be performed, snubber subcomponents that control the parameters to be verified are examined and tested in accordance with ISTD-5225. Preservice examinations of ISTD-5224 are performed on snubbers after reinstallation, when bench testing is used, or on snubbers where individual subcomponents are reinstalled after examination.

Defined test plan groups (DTPG) are established and the snubbers of each DTPG tested according to an established sampling plan each fuel cycle (ISTD-5250, and ISTD-5260). Sample plan size and composition is determined as required by ISTD-5310/ISTD-5410, and additional sampling as may be required by ISTD-5320 or ISTD-5420. Snubbers that do not meet test requirements are evaluated to determine root cause of the failure, and are

assigned to failure mode groups based on the evaluation unless the failure is considered unexplained or isolated. For unacceptable snubbers, additional testing is conducted for the DTPG or FMG until the requirements of ISTD-5330 or ISTD-5430 are satisfied.

Unacceptable snubbers are adjusted, repaired, modified, or replaced. Replacement snubbers meet the requirements of ISTD-1600. Post-maintenance testing and testing of repaired snubbers is in accordance with ISTD-1500.

Service life for snubbers is established, monitored and adjusted as required by ISTD-6000 and the guidance of ASME OM Code Nonmandatory Appendix F .

The inservice examination and testing plan for ~~of all~~ snubbers ~~covered by the plant-specific Technical Specifications~~ is prepared in accordance with the requirements of the ASME OM Code, Subsection ISTD and is in conformance with the relevant requirements of 10 CFR 50 Part B, Appendix A, GDC 1. ~~Snubber maintenance, repairs, replacements and modifications are performed in accordance with the requirements of the ASME OM Code, Subsection ISTD.~~ The COL Applicant will provide a full description of the snubber preservice and inservice inspection and test programs, and a milestone for program implementation.~~Details of the in-service examination and testing program, including test schedules and frequencies and an, are reported in the inservice inspection and testing plan., which will be provided by the COL applicant.~~ See Subsection 3.9.9.

[The above COL Applicant item text (last sentence) would be replaced with the following in the COLA]
The inservice testing program for snubbers will be completed in accordance with milestones described in Section 13.4.

f. Snubber support data

~~The COL Holder will prepare a plant-specific table to be included as part of the inspection and test program for snubbers (see Subsection 3.9.9) that will include the following information:~~

A plant specific table will be prepared in conjunction with closure of ITAAC Table 3.1-1 and include the following specific snubber information:

(i) the general functional requirement (i.e. shock, vibration, dual purpose) for each system and component using snubbers including the number and location of each snubber. If either dual-purpose or arrestor type indicate whether the snubber or component was evaluated for fatigue strength.

(ii) operating environment,

(iii) applicable codes and standards,

(iv) list type of snubber (i.e. hydraulic, mechanical), materials of construction,

standards for hydraulic fluids and lubricants, and the corresponding supplier,~~.~~

(v) environmental, structural, and performance design verification tests,

(vi) production unit functional verification tests and certification,

(vii) packaging, shipping, handling, and storage requirements, ~~and~~

(viii) description of provisions for attachments and installation,~~.~~ and

(ix) quality assurance and assembly quality control procedures for review and acceptance by the purchaser.

This information will be included in the FSAR as part of a subsequent FSAR update.

(4) Struts — Struts are defined as ASME Section III, Subsection NF, Component Standard Supports. They consist of rigid rods pinned to a pipe clamp or lug at the pipe and pinned to a clevis attached to the building structure or supplemental steel at the other end. Struts, including the rod, clamps, clevises, and pins, are designed in accordance with the Code, Subsection NF-3000.

Struts are passive supports, requiring little maintenance and inservice inspection, and are normally used instead of snubbers where dynamic supports are required and the movement of the pipe due to thermal expansion and/or anchor motions is small. Struts are not used at locations where restraint of pipe movement to thermal expansion significantly increases the secondary piping stress ranges or equipment nozzle loads.

Because of the pinned connections at the pipe and structure, struts carry axial loads only. The design loads on struts may include those loads caused by thermal expansion, dead weight, and the inertia and anchor motion effects of all dynamic loads. As in the case of other supports, the forces on struts are obtained from an analysis, and are confirmed not to exceed the design loads for various operating conditions.

(5) Frame Type (Linear) Pipe Supports — Frame type pipe supports are linear supports as defined as ASME Section III, Subsection NF, Component Standard Supports. They consist of frames constructed of structural steel elements that are not attached to the pipe. They act as guides to allow axial and rotational movement of the pipe but act as rigid restraints to lateral movement in either one or two directions. Frame type pipe supports are designed in accordance with the Code, Subsection NF-3000.

Frame type pipe supports are passive supports, requiring little maintenance and inservice inspection, and are normally used instead of struts when they are more economical or where environmental conditions are not suitable for the ball bushings at the pinned connections of struts. Similar to struts, frame type supports are not used at locations where restraint of pipe movement to thermal expansion significantly increases the secondary piping stress ranges or equipment nozzle loads.

The design loads on frame type pipe supports include those loads caused by thermal expansion, dead weight, and the inertia and anchor motion effects of all dynamic loads. As ….

3.9.6 Inservice Testing

Inservice testing of certain ASME Code, Section III, Class 1, 2, and 3 pumps and valves is performed in accordance with the ASME Operations and Maintenance (OM) Code as required by 10 CFR 50.55a(f), including limitations and modifications set forth in 10 CFR 50.55a. ~~Operability testing as required by 10 CFR 50.55a(b)(3)(ii) is performed on motor -operated valves (MOVs) that are included in the ASME OM Code inservice testing program to demonstrate that the MOVs are capable of performing their design basis safety function(s).~~ The Inservice Testing Program does not include any non-Code Class valves. The design of the nuclear power plant structures, systems, and components will provide access for the performance of inservice testing (IST) and inservice inspection (ISI) as required by the applicable ASME Code.

Inservice testing of pumps and valves is in conformance with the relevant requirements of 10 CFR Part 50, Appendix A, ~~General Design Criteria~~GDC 1, 37, 40, 43, 46, 54, and 10 CFR 50.55a(f). The relevant requirements are as follows:

(1) GDC 1, as it relates to testing safety-related components to quality standards commensurate with the importance of the safety functions to be performed.

(2) GDC 37, as it relates to periodic functional testing of the emergency core cooling system to ensure the leak tight integrity and performance of its active components.

(3) GDC 40, as it relates to periodic functional testing of the containment heat removal system to ensure the leak tight integrity and performance of its active components.

(4) GDC 43, as it relates to periodic functional testing of the containment atmospheric cleanup systems to ensure the leak tight integrity and the performance of the active components, such as pumps and valves.

(5) GDC 46, as it relates to periodic functional testing of the cooling water system to ensure the leak tight integrity and performance of the active components.

(6) GDC 54, as it relates to piping systems penetrating containment being designed with the capability to test periodically the operability of the isolation and determine valve leakage acceptability.

(7) Subsection 50.55a(f) of 10 CFR, as it relates to including pumps and valves whose function is required for safe operation in the in-service testing program to verify operational readiness by periodic testing.

The Inservice Testing Program includes periodic tests and inspections that demonstrate the operational readiness of safety-related components and their capability to perform their safety-related functions. The inservice testing program is based on the requirements of the ASME OM Code, Subsections ISTA, ISTB, ISTC and (mandatory) Appendix I. The specific ASME OM Code requirements for functional testing of pumps are found in the ASME OM Code, Subsection ISTB, requirements for inservice testing of valves are found in the ASME OM Code, Subsection ISTC, and requirements for inservice testing of pressure relief devices are found in ASME OM Code, (mandatory) Appendix I. General requirements for inservice testing are found in ASME OM Code, Subsection ISTA.

The requirements for system pressure testing are defined in ASME Code Section XI, Subsection IWA-5000; this testing, which verifies pressure boundary integrity, is included within the scope of the inservice inspection program described in Subsection 5.2.4 and Section 6.6.

The requirements for preservice and inservice examination and testing of dynamic restraints are defined in the ASME OM Code Subsection ISTD. This program is described in ~~DCD~~Subsection 3.9.3.7.1.

Refer to Subsection 3.9.9 for COL information requirements. ~~The COL applicant will provide milestones for implementation of the preservice and inservice testing programs and motor-operated valve programs.~~

Milestones for implementation of the ASME OM Code preservice and inservice testing programs~~, and the Motor-Operated Valve Testing Program,~~ are defined in Section 13.4.

3.9.6.1 Inservice Testing of Valves

Certain ASME Code Class 1, 2, and 3 valves and pressure relief devices are subject to inservice testing in accordance with the ASME OM Code Subsection ISTC and/or Appendix I, including the general requirements in ISTA. Inservice testing of valves assesses operational readiness including actuating and position-indicating systems. The valves that are subject to inservice testing include those valves that perform a specific function in shutting down the reactor to a safe shutdown condition, in maintaining a safe shutdown condition, or in mitigating the consequences of an accident. In addition, pressure relief devices used for protecting systems or portions of systems that perform a function in shutting down the reactor to a safe shutdown condition, in maintaining a safe shutdown condition, or in mitigating the consequences of an accident, are subject to inservice testing.

The inservice testing program does not require testing of non-safety related valves. Any non-safety related valves included in the Inservice Testing Program as part of regulatory treatment of non-safety systems (RTNSS, see Appendix 19A) are considered augmented components and tested commensurate with their functions.

Valves subject to inservice testing in accordance with the ASME OM Code are indicated in ~~DCD~~ Table 3.9-8.

Active valve dynamic qualification and pre-installation testing requirements to assure valve operability are addressed in Section 3.9.3.5. Periodic operability (non-ASME Code) testing for power-operated valves ~~(other than motor-operated valves)~~is described in Subsection 3.9.6.8.

3.9.6.1.1 Valve Exemptions

ASME OM Code ISTC-1200 provides exemptions from the inservice testing program for certain Code Class 1, 2, and 3 valves provided that they are not required to perform a specific function in shutting down the reactor to a safe shutdown condition, in maintaining a safe shutdown condition, or in mitigating the consequences of an accident. The following valves are exempt from Subsection ISTC:

(1) valves used only for operating convenience such as vent, test, drain and instrument valves

(2) valves used only for system control, such as pressure regulating valves

(3) valves used only for system or component maintenance

(4) skid-mounted valves provided they are justified and adequately tested

(5) valves used for external control and protection systems responsible for sensing plant conditions and providing signals for valve operation (e.g. solenoid valves on air operated valves).

3.9.6.1.2 Valve Categories

Non-exempt ASME Class 1, 2 and 3 valves are categorized in accordance with the ASME OM Code Subsection ISTC-1300 as follows:

(1) Category A – valves for which seat leakage is limited to a specific maximum amount in the closed position for fulfillment of their required function(s).

(2) Category B – valves for which seat leakage in the closed position is inconsequential for fulfillment of the required function(s).

(3) Category C – valves that are self-actuating in response to some system characteristic, such as pressure (relief valve) or flow direction (check valve) for fulfillment of the required function(s).

(4) Category D – valves that are actuated by an energy source capable of only one operation, such as rupture disks and explosively actuated valves.

When more than one distinguishing category characteristic is applicable, all requirements of each of the individual categories are applicable, although duplication or repetition of common testing requirements is not necessary.

3.9.6.1.3 Valve Functions

Valves in the IST program are classified as either active or passive in accordance with the ASME OM Code ISTA-2000 as follows:

(1) Active Valve – valves that are required to change obturator position to accomplish a specific function in shutting down a reactor to the safe shutdown condition, maintaining the safe shutdown condition, or mitigating the consequences of an accident.

(2) Passive Valve – valves that maintain obturator position and are not required to change obturator position to accomplish the required function(s) in shutting down a reactor to the safe shutdown condition, maintaining the safe shutdown condition, or mitigating the consequences of an accident.

The Inservice Testing Program identifies the safety-related functions for safety-related valves. The following are typical safety-related functions that are identified in the Inservice Testing Program.

- Maintain closed (passive function)
- Maintain open (passive function)
- Transfer closed (active function)
- Transfer open (active function)

3.9.6.1.4 Valve Testing

Based on the valve category, active/passive function(s), and safety-related function(s) identified for each valve, the inservice tests to confirm the capability of the valve to perform these functions are identified in Table 3.9-8. ASME OM Code Table ISTC-3500-1, Inservice Test Requirements, specifies the required tests.

Table ISTC-3500-1 requires four basic valve tests which includes the following:

- exercise tests
- seat leakage tests
- remote position indicator tests
- special tests (i.e., fail-safe tests, explosive valve tests, rupture disc tests)

(1) Valve Exercise Tests

Active Category A valves, Category B valves, and Category C check valves are exercised periodically, except for self-actuated safety and relief valves. The ASME OM Code specifies a quarterly valve exercise frequency for all valves except power-operated safety and relief valves, which are required to be tested once per fuel cycle, and manual valves, as discussed in Subsection 3.9.6.1.5(2). Where it is not practicable to exercise a valve during normal power operation, the valve exercise test is deferred to either cold shutdown or refueling outages. Valve exercise tests and frequencies are identified in Table 3.9-8. In some cases, quarterly stroke testing is deferred to refueling outages or cold shutdown, as indicated in Table 3.9-8 Note g. The bases for deferral are consistent with NUREG 1482, Revision 1.

During valve exercise tests, the necessary valve obturator movement is determined while observing an appropriate direct indicator, such as indicating lights that signal the required changes of obturator position, or by observing other evidence or positive means, such as changes in system pressure, flow, level, or temperature that reflects change of obturator position.

Check ~~V~~valve exercise tests use direct observation or other positive means (ISTC-5221(a)) for verification of valve obturator position.

(2) Valve Leakage Tests

Active and passive Category A containment isolation valves are tested to verify their seat leakage limits in accordance with 10 CFR 50 Appendix J. Frequency of containment isolation valve seat leakage tests are in accordance with the Appendix J requirements. All containment isolation valves and seat leakage tests are identified in Table 3.9-8.

Other Category A valves are required to be seat leakage tested at least once every two years as specified by the ASME OM Code ISTC-3630. ~~The ESBWR design does not include any Category A valves except for containment isolation valves.~~

(3) Remote Position Indicator Tests

Active and passive valves that are included in the IST program and that are equipped with remote position indication require periodic verification of the remote position indication function in accordance with ISTC-3700. Valves that require remote position indication testing are observed locally during valve exercising to verify proper operation of the position indication. The frequency for this position indication test is once every two years. Where local observation is not practicable, other methods are used for verification of valve position indicator operation.

Valves with remote position indicators are identified in Table 3.9-8.

(4) Special Tests

- Valves with fail-safe actuators are tested by observing the operation of the actuator upon loss of valve actuating power (electrical power and/or pneumatic supply) in accordance with ISTC-3560. These tests are performed in conjunction with the valve exercise test. Fail-safe test requirements are identified in Table 3.9-8.
- Category D explosively actuated valves are subject to periodic test firing of the explosive actuator charges. In accordance with ASME OM Code ISTC-5260, at least 20 percent of the charges installed in the plant in explosively actuated valves are fired and replaced at least once every 2 years. If a charge fails to fire, all charges within the same batch number are removed, discarded, and replaced with charges from a different batch. The firing of the explosive charge may be performed inside the valve or outside of the valve in a test fixture.

  The maintenance and review of the service life for charges for explosively actuated valves follows the requirements in the ASME OM Code ISTC-5260. Replacement charges are from batches from which a sample charge has been tested satisfactorily, and with a service life such that the requirements of ISTC-5260(b) are met.

  Category D explosively actuated valves are identified in Table 3.9-8.
- Category D rupture disks are replaced on a 5 year frequency unless historical data indicates a requirement for more frequent replacement, in accordance with Mandatory Appendix I of the ASME OM Code.

  Category D rupture disks are identified in ~~DCD~~ Table 3.9-8.

3.9.6.1.5 Specific Valve Test Requirements

~~(1) Power Operated Valve Exercise Tests~~

~~a. Active Motor Operated Valve Tests~~

~~The inservice operability testing of active motor operated valves relies on nonintrusive diagnostic techniques to permit periodic assessment of the valve's ability to perform its safety related function during design basis conditions. MOVs upon which inservice testing is performed are identified in Table 3.9-8. Test frequencies are developed in~~

~~accordance with Generic Letter 96-05 and ASME Code Case OMN-1, Rev. 1 and will not exceed 10 years.~~

~~Inservice testing of active MOVs consists of both static and dynamic testing. The specific testing frequencies are based on the individual valve's risk ranking and functional margin. These factors are described below.~~

- ~~Risk Ranking~~

  ~~The MOV's risk ranking is determined by review of the valve's individual Probabilistic Safety Assessment (PSA) which is documented on the individual component's ranking worksheet and reviewed and approved by an expert panel. Guidance for this process is outlined in the Joint Owners' Group (JOG) Motor Operated Valve Periodic Verification Program Summary [MPR-2524-A].~~

- ~~Functional Margin~~

  ~~Functional margin is that increment by which the MOV's available capability exceeds the capability required to operate the MOV under design basis conditions. The required capability of the MOV is a known, calculated quantity, which is then compared to the valve's actual capability, a measured quantity.~~

  ~~Diagnostic equipment inaccuracies, degraded voltage, control switch repeatability, load-sensitive MOV behavior and margin for degradation are considered in the calculations used to determine the valve's capacity from the valves measured test values~~

  ~~The MOV Program utilizes guidance from Generic Letter 96-05 and the Joint Owners Group (JOG) MOV Periodic Verification (PV) study, MPR 2524-A (November 2006).~~

  ~~**Design Basis Verification Test** – Prior to power operation a design basis verification test is performed upon each active motor-operated valve to verify the capability of each valve to meet its safety-related design basis requirements. The test is performed at conditions that are as close to design basis conditions as practicable. Results from this test are used along with the valves preservice test to develop the valve's initial (periodic verification) testing frequency.~~

  ~~**Active MOV Test Frequency Determination** – The ability of a valve to meet its design basis functional requirements (i.e. required capability) is verified during the valve's design basis verification test. The preservice test measures the valve's actual actuator output capability. The difference between the two capabilities is termed "functional margin." With the valves functional margin and risk ranking, a periodic verification test interval/frequency is determined. This determined test frequency is first compared to the valve's historical data to verify that any potential valve degradation during the test period would not reduce the functional margin to less than zero prior to the next scheduled periodic verification test. If the data shows that the functional margin may be reduced to less than zero, the frequency is reduced to ensure that the next periodic verification test is performed prior to a loss of functional margin. If there is not sufficient data to determine whether there will be a loss of functional margin prior to the next periodic verification test, the test frequency is limited to not exceed two (2) refueling cycles or three (3) years, whichever is longer, for high risk safety significant components, and is limited to not exceed three (3) refueling cycles or five (5) years, whichever is longer, for low risk safety significant components.~~

~~A motor-operated valve with an adequate functional margin is assured of being able to open and/or close under design basis conditions.~~

~~b. Other Power-Operated Valve Tests~~

~~Power-operated valves other than active MOVs are exercised either quarterly in accordance with ASME OM ISTC. Active passive power-operated valves upon which operability testing is performed are identified in Table 3.9-8.~~

~~**Design Basis Verification Test** – Prior to power operation a design basis verification test is performed upon each power-operated valve to verify the capability of each valve to meet it's safety-related design requirements. The test is performed at conditions that are as close to design basis conditions as practicable.~~

(1) Power-Operated Valve Tests

Power-operated valves (POV) are tested in accordance with the ASME OM Code, Subsection ISTC. Specific testing activities for each valve are listed in Table 3.9-8. Active power-operated valves will have their stroke times measured during the exercise tests. Any abnormalities or erratic actions will be documented and evaluated. Test failures (e.g., failure to fully stroke or high stroke time measurements) are~~will be~~ addressed per the OM Code by repair, replacement or analysis.

The IST program for power-operated valves will consider the guidance in the NRC Regulatory Issue Summary 2000-03, which incorporates lessons learned from motor-operated valve (MOV) analyses and tests in response to Generic Letter 89-10. The COL Applicant is responsible for describing, in the IST program description (see COL Item 3.9.9-3-A), how the IST program addresses these lessons learned.

(2) Manual Valve Exercise Tests

Active Category A and B manual valves are exercised once every two years in accordance with 10 CFR 50.55a(b)(3)(vi).

(3) Check Valve Exercise Tests

Category C check valves are exercised to both the open and closed positions regardless of safety function position in accordance with ASME OM Code ISTC-3522(a) using the methods of ISTC-5221. Check valves that have seat leakage requirements are leak tested in accordance with ISTC-3600.

During the exercise test, valve obturator position is verified by direct observation (position indicating lights) or by other positive means (i.e., changes in system pressure, temperature, flow rate, level, seat leakage or nonintrusive testing results). Nonintrusive test techniques used are dependent on system and valve configuration, design and materials, and include methods such as radiography, ultrasonic (acoustics) and use of accelerometers, to verify obturator position and/or full stroke, presence or absence of cavitation or back-tapping and valve degradation.

Check valves are exercised open with flow to either the full open position or to the position required to perform its intended open safety function. Check valve closure tests are performed by verifying that the obturator travels to the seat upon cessation of flow or reverse flow. Check valves with only an open safety function may be verified closed by other direct observations such as pressure, level, temperature, or seat leakage. This methodology meets the exercise requirements of ISTC-5221.

Check valve exercise tests and frequencies are included in Table 3.9-8.

Data acquired during check valve testing and inspections, and the maintenance history of a valve or group of valves is collected and maintained in order to establish the basis for specifying inservice testing, examination, and preventive maintenance activities that will identify and/or mitigate the failure of the check valves or groups of check valves tested. This data is also used to determine if certain check valve condition monitoring tests, such as nonintrusive tests, are feasible and effective in monitoring for these identified failure mechanisms, whether periodic disassembly and examination activities would be effective in monitoring for these failure mechanisms, as well as to determine possible valve groupings to implement in a future check valve condition monitoring program as allowed by ISTC-5222, the requirements of which are described in ASME OM Code, Appendix II.

(4) Vacuum Breaker Tests

Vacuum breakers must meet the test requirements for both a Category C check valve (ISTC-5220) and for a pressure relief device (Appendix I). Vacuum breaker tests and frequencies are included in Table 3.9-8.

(5) Pressure Relief Valve Tests

Pressure relief devices that protect systems or portions of system that are required to perform a function in shutting down the reactor to the safe shutdown condition, in maintaining the safe shutdown condition, or in mitigating the consequences of an accident, are subject to periodic inservice testing. The inservice tests for these valves are identified in ASME OM Code (mandatory) Appendix I.

The periodic inservice testing includes visual inspection, seat tightness determination, set pressure determination, and operational determination of balancing devices, alarms, and position indication as appropriate. The frequency for this inservice test is every 5 years for ASME Class 1, and every 10 years for ASME Classes 2 and 3 devices. Pressure relief valves that require inservice testing are identified in Table 3.9-8.

3.9.6.2 Inservice Testing of Pumps

The ESBWR design does not require the use of pumps to mitigate the consequences of any ~~design basis accident~~DBA, or to achieve or maintain the safe shutdown condition. Therefore, there are no pumps required to be included in the Inservice Testing Program. Table 3.9-8 does not list any pumps in the Inservice Testing Program.

3.9.6.3 Preservice Testing of Valves

Category A, B, C (check valves), and D valves that are subject to periodic inservice testing are preservice tested in accordance with ASME OM Code Subsection ISTC-3100.

Category C pressure relief valves are preservice tested in accordance with ASME OM Code, Mandatory Appendix I.

3.9.6.4 Deferred Testing Justifications

In cases where it is not practicable to exercise category A, B or C (check) valves during normal power operations (quarterly), the valve is exercised during cold shutdown or refueling as permitted by ASME OM Code Subsections ISTC-3521 and ISTC-3522.

Valve exercise tests and associated frequencies are identified in Table 3.9-8. Justifications for deferred testing are detailed in Table 3.9-8~~the Inservice Testing Program~~.

3.9.6.5 Valve Replacement, Repair and Maintenance

Testing in accordance with ASME OM, ISTC-3310 and ISTC-5000 is performed after a valve is replaced, repaired, or has undergone maintenance that could affect the valve's performance.

3.9.6.6 10CFR50.55a Relief Requests and Code Cases

Inservice testing of ASME Code Class 1, 2, and 3 pumps and valves is performed in accordance with the ASME Operations and Maintenance (OM) Code except where specific relief has been granted by the NRC in accordance with 10 CFR 50.55a(f). Relief from the testing requirements of ASME OM Code is requested when compliance with requirements of the ASME OM Code is not practical. In such cases, specific information is provided which identifies the impractical code requirement, justification for the relief request, and the testing method to be used as an alternative. Demonstration of the impracticality of the testing required by the Code, and justification for alternative testing proposed is provided. No relief from or alternatives to the ASME OM Code is being requested ~~beyond what is identified in the DCD~~.

~~The IST program described herein utilizes Code Case OMN-1, Revision 1, "Alternative Rules for the Preservice and Inservice Testing of Certain Electric Motor-Operated Valve Assemblies in Light-Water Reactor Power Plants." Code Case OMN-1 establishes alternate rules and requirements for preservice and inservice testing to assess the operational readiness of certain motor operated valves in lieu of the requirements set forth in ASME OM Code Subsection ISTC. Implementation of the program described will require request for relief, unless Code Case OMN-1, Revision 1 is approved by NRC in Regulatory Guide 1.147, or the case has been incorporated into the OM Code on which the IST program is based, and that code is approved in 10 CFR 50.55a(b).~~

The IST program does not invoke the use of any ~~other~~ ASME Code Cases for inservice testing of pumps and valves.

3.9.6.7 Inservice Testing Program Implementation

ASME OM Code inservice test intervals are as required by ISTA-3120; the initial 120-month test interval beginning following the start of commercial service. The duration of each 120-month test interval may be modified by as much as one year as allowed by the Code, provided these adjustments do not cause successive intervals to be altered by more than one year from the original pattern of intervals.

The COL Applicant will provide milestones for implementation of the preservice and inservice testing programs and other valve-related programs.

3.9.6.8 Non-Code ~~Power~~ Testing of ~~Other~~ Power-Operated Valves ~~Testing~~

Although the design basis capability of power-operated valves is verified as part of the design and qualification process, power-operated valves that perform an active safety function are tested again after installation in the plant, as required, to ensure valve setup is acceptable to perform their required functions, consistent with valve qualification. These tests, which are typically performed under static (no flow or pressure) conditions, also document the "baseline" performance of the valves to support future maintenance and trending programs performed by the COL Holder. During the testing, critical parameters needed to ensure proper valve setup are measured. Depending on the valve and actuator type, these parameters may include seat load, running torque or thrust, valve travel, actuator spring rate, bench set~~benchset~~ and regulator supply pressure. Uncertainties associated with performance of these tests and use of the test results (including those associated with measurement equipment and potential degradation mechanisms) are considered appropriately. Uncertainties may be considered in the specification of acceptable valve setup parameters or in the interpretation of the test results (or a combination of both). Uncertainties affecting both valve function and structural limits are considered.

~~Additional valve testing may be performed by the COL Holder, for example, as part of the plant's air operated valve Program in response to Regulatory Issue Summary 2000-003 or as part of the plant's preventive maintenance program.~~ [THIS PARA OF DCD TEXT IS TO BE DELETED IN THE COLA AND REPLACED WITH THE TEXT BELOW TO SATISFY RG 1.206]

Additional testing is performed as part of the air-operated valve (AOV) program, which includes the key elements for an AOV Program as indentified in the JOG AOV program document, Joint Owners Group Air Operated Valve Program Document, Revision 1, December 13, 2000 (Reference 3.9-xxx and 3.9-2xy). The AOV program incorporates the attributes for a successful power-operated valve long-term periodic verification program, as discussed in Regulatory Issue Summary 2000-03, Resolution of Generic Safety Issue 158: Performance of Safety-related Power-Operated Valves Under Design Basis Conditions, (Reference 3.9-2xz) by incorporating lessons learned from previous from nuclear power plant operations and research programs as they apply to the periodic testing of air- and other power-operated valves included in the IST program. For example:

- Valves are categorized according to their safety significance and risk ranking
- Sufficient diagnostics are used, at a minimum on high risk, high safety significance valves, to collect relevant data (e.g., valve stem thrust and torque, fluid pressure and temperature, stroke time, operating and/or control air pressure, etc.) to verify the valve meets the functional requirements of the qualification specification
- Test frequency is specified, and is evaluated each refueling outage based on data trends as a result of testing
- Post-maintenance procedures include appropriate instructions and criteria to ensure baseline testing is re-performed as necessary when maintenance on the valve has the potential to affect valve functional performance
- Guidance is included to address lessons learned from other valve programs in procedures and training specific to the AOV program, and
- Documentation from AOV testing, including maintenance records and records from the corrective action program are retained and periodically evaluated as a part of the AOV program.

~~Active safety-related power-operated valve assemblies are tested to verify that the valve opens and closes under static and design conditions. Where design conditions cannot be achieved, testing is performed at the maximum achievable dynamic conditions. During the testing, critical parameters needed to determine the required closing and opening loads are measured. These parameters include seat load, torque or thrust, travel, spring rate, differential pressure, system pressure, fluid flow, temperature, power supply, operating time and minimum supply pressure. The data collected during the testing on the parameters is used to determine the required operating loads for the design operating conditions in conjunction with the diagnostic equipment inaccuracies and other parameters that could result in an increase in operating loads or decrease in operating output capability. The resulting operating loads including uncertainties are then compared to the structural capabilities of the power-operated valve.~~

~~During pre-operational testing the following are verified to demonstrate the acceptability of the functional performance.~~

- ~~Valves are verified to open and close as applicable at a range of conditions up to the design conditions to perform its safety function.~~
- ~~For air-operated valves and hydraulically-operated valves the operator capability at minimum supply pressure, power supply or loss of motive force exceed the required operating loads including diagnostic equipment inaccuracies and other parameters that could result in an increase in operating loads or decrease in operator output capability.~~

- ~~Solenoid-operated valves must be capable of opening or closing at the minimum power supply voltage.~~
- ~~Air-operated valves and hydraulically-operated valves maximum operating loads including diagnostic equipment inaccuracies and other parameters that could result in an increase in operating loads are verified not to exceed the allowable structural capability limits of the power-operated valve components.~~
- ~~Stroke time measurements during opening and closing must be within the design requirements for safety-related functions.~~
- ~~Remote position indication is verified against the local position indication.~~
- ~~Valve seat leakage when fully closed is within established limits, as applicable.~~

~~During the operational inservice testing period the following are verified to demonstrate the acceptability of the functional performance of air-operated and hydraulic-operated valves.~~

- ~~Periodically assess the diagnostic methods used in the verification of valve function.~~
- ~~Evaluation of lessons learned through other related programs such as the MOV Generic Letter (GL) 89-10 and (GL) 96-05 Programs~~

3.9.7 Risk-Informed Inservice Testing

Risk-informed inservice testing initiatives, if any, are included in the implementation plans for the inservice testing program, which is an operational program addressed in Section 13.4.

3.9.8 Risk-Informed Inservice Inspection of Piping

Risk-informed inservice inspection of piping initiatives, if any, are included in the implementation plans for the inservice inspection of piping program, which is an operational program addressed in Section 13.4.

3.9.9 COL Information

3.9.9-1-H Reactor Internals Vibration Analysis, Measurement and Inspection Program

The COL Holder shall provide the information identified in Subsection 3.9.2.4 related to position C.3 of Regulatory Guide 1.20.

3.9.9-2-H ASME Class *2 or 3 or Quality Group D Components with 60 Year Design Life*

For the piping segments identified in Subsection 3.9.3.1 that are subject to loadings that could result in thermal or dynamic fatigue, the COL Holder shall provide the analyses as required by the ASME Code, Subsection NB.

3.9.9-3-A Inservice Testing Programs

COL Applicant shall provide a full description of the inservice testing program and a milestone

for full ~~valve in-service testing~~ program implementation as identified in Subsection 3.9.6.1.

3.9.9-4-A ***A* Snubber *Inspection and Test Program***

The Applicant shall provide a full description ~~milestone for implementation~~ of the snubber preservice and inservice inspection and testing programs, and a milestone for program implementation~~as identified in Subsection 3.9.3.7.1(3)e~~, including development of a data table identified in Subsection 3.9.3.7.1(3)f.

3.9.10 References

3.9-1 General Electric Company, "BWR Fuel Channel Mechanical Design and Deflection," NEDE-21354-P, September 1976 (GE proprietary) and NEDO-21354, September 1976 (Non-proprietary).

3.9-2 GE Nuclear Energy, "BWR Fuel Assembly Evaluation of Combined Safe Shutdown Earthquakes (SSE) and Loss-of-Coolant Accident (LOCA) Loadings (Amendment 3)," NEDE-21175-3-P-A, October 1984 (GE proprietary) and NEDO-21175-3-A, October 1984 (Non-proprietary).

3.9-3 GE Nuclear Energy, "General Electric Environmental Qualification Program," NEDE-24326-1-P, Proprietary Document, January 1983.

3.9-4 M.A. Miner, "Cumulative Damage in Fatigue," Journal of Applied Mechanics, Vol. 12, ASME, Vol. 67, pages A159-A164, September 1945.

3.9-5 American Society of Mechanical Engineers Code for Operation and Maintenance of Nuclear Power Plants, 2001 Edition with 2003 Addenda.

3.9-6 General Electric Company, "ESBWR Reactor Internals Flow Induced Vibration Program", NEDE-33259P, Class III (Proprietary), Rev. 1~~0~~, ~~January 2006~~December 2007, and NEDO-33259, Class I (Non-proprietary), Rev. 1~~0~~, ~~January 2006~~December 2007.

Add these AS COLA references:

3.9-2xx Joint Owners Group Air Operated Valve Program Document, Revision 1, December 13, 2000

3.9-2xy USNRC, Eugene V. Imbro, letter to Mr. David J. Modeen, Nuclear Energy Institute, Comments On Joint Owners' Group Air Operated Valve Program Document, dated October 8, 1999

3.9-2xz Regulatory Issue Summary 2000-03, Resolution of Generic Safety Issue 158: Performance of Safety-related Power-Operated Valves Under Design Basis Conditions, March 15, 2000

NRC – ESBWR DCWG Meeting
May 22, 2008
Draft Working Material
Description of Initial Test Program Administration

Draft Appendix 14AA

Description of Initial Test Program Administration

STD 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) Subsections 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):

- 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, Appendix A, items 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.

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.

Description of Initial Test Program Administration

14AA.1.2 Phases of the Initial Test Program

The Initial Test Program (per RG 1.68) 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

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Description of Initial Test Program Administration

- 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

Description of Initial Test Program Administration

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.

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.

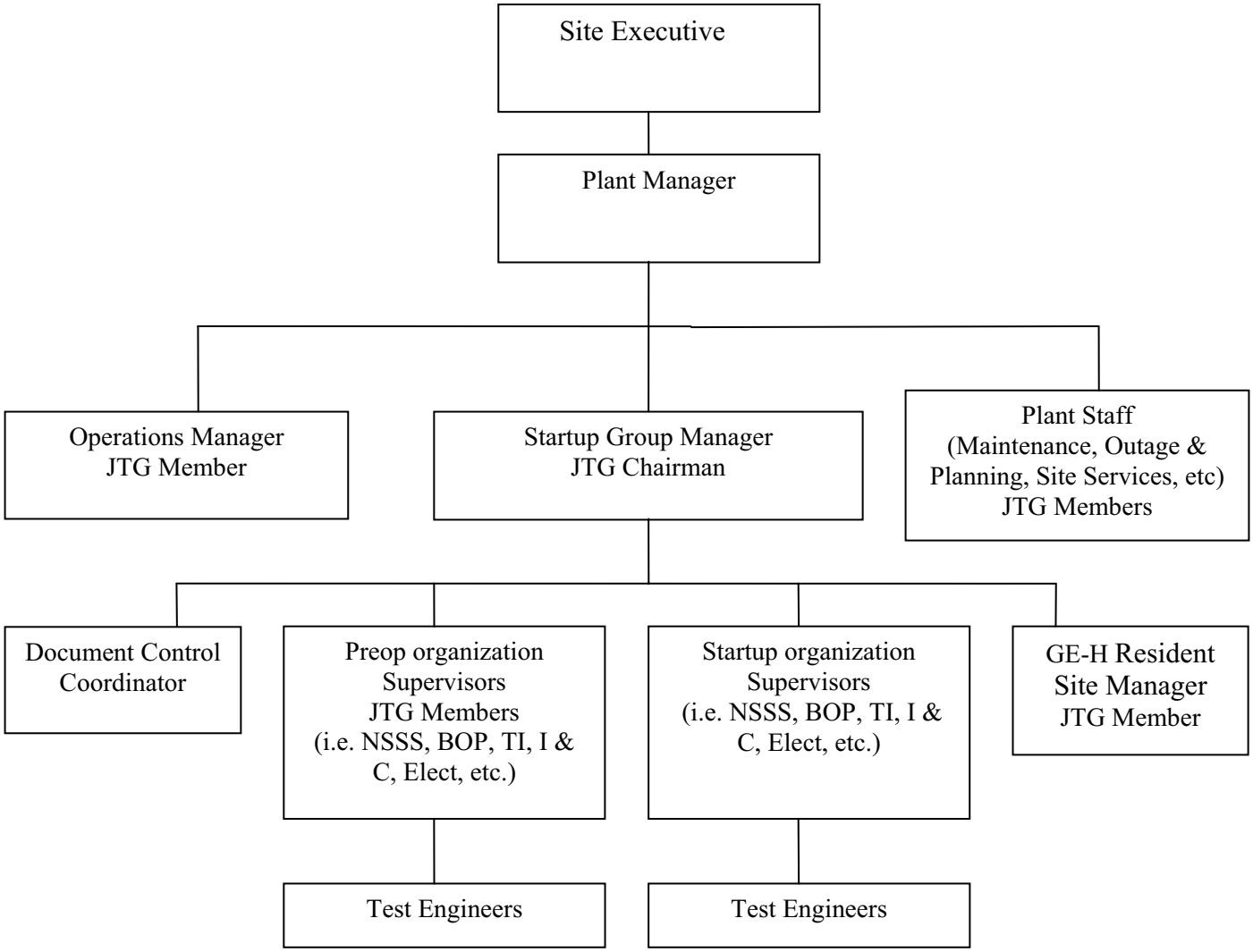
14AA.12 Individual Test Descriptions

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

Draft Appendix 14AA

Description of Initial Test Program Administration

FIGURE 1
Preoperational and Startup Test Organization (Typical)



NRC – ESBWR DCWG Meeting
May 22, 2008

Expected Grand Gulf COLA Impacts, Related to DCD Changes to Stack Design and "Normal" Gaseous Release Source Term

May 22, 2008

5/22/07

Background – Grand Gulf Unit 3 COLA Rev 0 (2/27/08)

- Normal Gaseous Release Source Term
  - Established at ESP (“Composite” Source Term)
  - At COLA, ESP Source Term bounded DCD Rev 4 values
- Long-Term Dispersion (X/Q, D/Q)
  - No change from ESP values (ground level release); receptors confirmed at COLA
  - Not all X/Q, D/Q values were bounded by DCD. Analysis in COLA demonstrated compliance with Part 20 and 10 CFR 50 Appendix I; justified no departure (using DCD provision)
  - Dose results from ESP demonstrate compliance with guidelines of 10 CFR 50 Appendix I (using bounding ESP source and site characteristic X/Q, D/Q values)
- Control Room (Accident) X/Q
  - DCD values shown to be bounding relative to calculated, site-specific X/Q values using ESBWR design

Expected GG Unit 3 COLA Impact

- Normal Gaseous Release Source Term
  - ESP Source term remains bounding except for 1 isotope
  - DCD Rev 5 source term to be adopted for COLA (Variance)
- Long-Term Dispersion (X/Q, D/Q)
  - Use of 3 specific stack locations: Results in small changes in distances to receptors; X/Q and D/Q to be recalculated
  - Demonstrate compliance with Part 20, Table 2, Column 2 concentrations (using revised site boundary X/Q); no significant change expected regarding margin
  - Recalculation of doses, to demonstrate compliance with 10 CFR 50 Appendix I; no significant change expected regarding margin
- Control Room (Accident) X/Q
  - To be recalculated to support demonstration comparison with DCD Table 2.0-1 (Rev 5)

Expected Impact: GG Unit 3 COLA Changes

- Part 2
  - FSAR 1.8 (Variances)
  - FSAR 2.0 (Table 2.0-201; Control Room X/Q and long term X/Q, D/Q comparison with DCD)
  - FSAR Chapters 1 and 2 (Site plan drawings)
  - FSAR 2.3.2, 2.3.4, 2.3.5 (Control Room X/Q; long term X/Q, D/Q)
  - FSAR 11.3 (Gaseous effluent doses; cost/benefit analysis)
  - FSAR 12.2 (Gaseous release concentrations, resulting doses)
- Part 3
  - ER 2.1 (site plan drawings); ER 2.7 (Long term X/Q, D/Q); ER 3.0 (Table 3.0-201); ER 5.4 (gaseous pathway dose)
- Part 7
  - New variance: Adopting DCD normal gaseous source term
- Incorporate into next COLA Submission to these Parts

ESBWR DCWG Meeting
May 22, 2008

Inservice Testing Program Description

IST Program Description

- Objectives of Meeting
  - Brief review of NRC & DCWG interactions and discussions
  - History of ESBWR DCD and COLA content for IST program description
  - Present and discuss current plans for DCD and COLA changes
  - Discuss any further actions to complete the IST program description

History - IST Program Description

- DCWG Meeting August 8, 2007
  - Examples of AP1000 and ESBWR IST Program description
  - NRC provided comments on example program descriptions
  - Several phone calls as followup to discuss NRC comments
- WEC TR-138 provided changes to AP1000 DCD
- March 26 & 27 public meeting to review AP1000 composite IST program description and NRC talking points
  - Composite AP1000 DCD/TR/COLA IST document provided to NRC in March 2008
  - NRC Staff provided “talking points” for review
- Issues requiring further clarification in the DCD or COLA assigned to WEC or BLN, as applicable
  - RAIs issued by NRC Staff to WEC on DCD and TVA on COLA

ESBWR IST Program Description - DCD R4, COLA R0

- Significant changes to DCD in Rev. 4 to address IST program requirements, with the intent to
  - Minimize COLA supplemental information while meeting RG 1.206 and SECY-05-0197 via DCD standard content
  - Address NRC comments from August 8 meeting
  - Minimize need for departures from DCD
- Attempt to maintain some consistency with AP1000 program description content

ESBWR IST Program Description – DCD Revision 5

- Requirements for ESBWR IST program scope changed due to changes in design
  - For example, no safety-related MOVs in the ESBWR design
- DCD Revision 5 reflects changes in design, valve qualification requirements, and scope of the IST program
  - Requirements for MOVs deleted from Section 3.9.6
  - Other minor changes in Section 3.9.6 to address IST requirements
  - Changes to discuss use of QME-1-2007 for valve qualification in Section 3.9.3

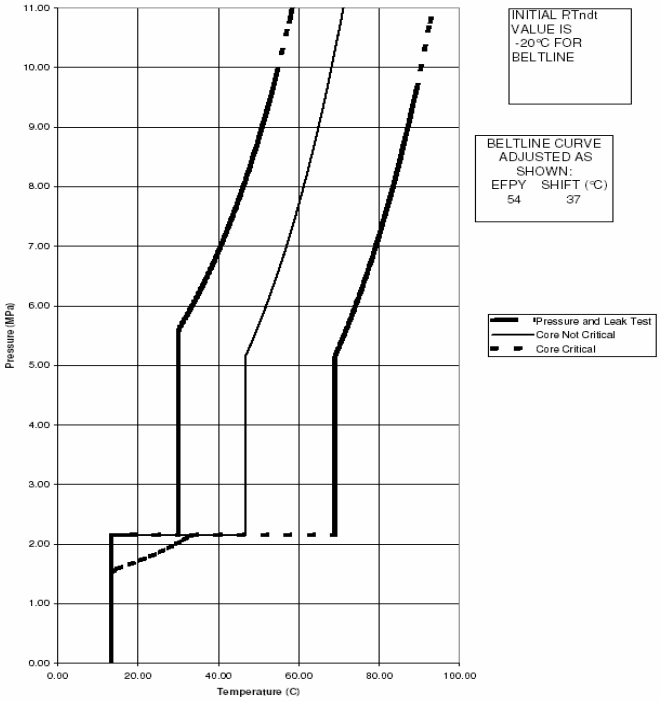
ESBWR IST Program Description – FSAR Rev. 1

- Results of March 26 & 27 meeting with AP1000 DCWG incorporated into the ESBWR COLA IST Program description, as applicable
  - Snubber inservice testing per ISTD is described
    - DCD currently addresses only preservice exams/testing
  - Power-operated valve testing program (other than MOVs), beyond OM Code IST program requirements, is described – lessons learned from MOV programs
- Reflects design change to eliminate MOVs
- Discussion added to address data collection for CV condition monitoring in the future

ESBWR IST Program Description

- Composite DCD/COLA developed for review with NRC Staff
  - BLACK font – DCD Revision 4 content, unchanged
  - RED font – DCD Revision 5 changes planned by GEH
  - BLUE font – additional DCD changes suggested by COL Applicants for Rev. 5 – GEH concurs
  - GREEN font – COLA FSAR material, Rev. 0 and Rev. 1 changes/additions.

Pressure–Temperature Limits



ESBWR DCWG Meeting

May 22, 2008

Mark Loeffler (GEH)

Objectives

- Respond to NRC's presentation on April 10, 2008
- Describe DCWG plan to provide pressure-temperature limit information
- Request NRC feedback on proposed scope and schedule

Pressure-Temperature (PT) Limits

- Must meet 10CFR50.60 and Appendix G (fracture toughness requirements)
- Must meet SRP 5.3.2 (Section XI ASME)
  - Allows limits in DCD or COLA
- PT Limit Curves in T.S. or Pressure-Temperature Limits Report (PTLR)
- PTLR Guidance in GL 96-03
  - States the need for NRC approved methodology

Pressure-Temperature (PT) Limits

- DCD has Representative Curves / COL Item
  - ***5.3-1-A: The COL applicant shall submit a full description of the methodology for preparing the plant specific pressure and temperature limits for NRC review and approval.***

- To address COL Item, COL Applicant will:
  - Submit P-T limits methodology in an LTR in August 2008
  - Submit revised LTR to add bounding numerical evaluation in December 2008

COL Holder Action

- Plant-Specific P-T Curves
  - Develop plant-specific curves based on this previously approved methodology with actual vessel data
  - Place P-T curves in plant-specific PTLR
  - LTR will have PTLR template for license holder to use

LTR Content – ESBWR P-T Curve Assumptions

Curves are bounding as long as the following items remain valid:

1. 10 CFR 50 Appendix G remains unchanged.
2. Regulatory Guide 1.99, Rev. 2 is still applicable.
3. Adjusted Reference Temperatures (ART) at the 1/4T locations remain bounding.
   a. The limiting Cu and Ni material composition remain bounding.
   b. The fluence used to develop the ART remains bounding.
4. There are no significant design changes.
5. There are no significant changes to the operating conditions.

Questions?