

**October 14, 2009**

ATTACHED ARE SLIDES/ HANDOUTS

WHICH WERE PRESENTED AT THE

3/4/09 AREVA NP and UniStar MEETING

# FUNCTIONAL DESIGN, QUALIFICATION, AND INSERVICE TESTING PROGRAM FOR PUMPS, VALVES, AND DYNAMIC RESTRAINTS

## Calvert Cliffs Unit 3 Combined License Application

Component Integrity, Performance, and Testing Branch  
Division of Engineering  
NRC Office of New Reactors

Public Meeting  
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## Functional Design and Qualification of Safety-Related Pumps, Valves and Dynamic Restraints

Calvert Cliffs Unit 3 FSAR Section 3.9.6 incorporates by reference EPR FSAR Tier 2 Section 3.9.6, including Section 3.9.6.1 on the functional design and qualification of pumps, valves, and dynamic restraints.

Calvert Cliffs FSAR includes supplemental information on UHS Makeup System.

Guidance for COL applications is provided in Paragraph C.III.3.9.3.3, “Pump and Valve Operability Assurance,” of Regulatory Guide (RG) 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition),” including:

- (1) identification of all active ASME Code Class 1, 2, and 3 valves;
- (2) criteria to be employed in a test program, or a program consisting of tests and analysis, to ensure operability of valves that are required to open or close to perform a safety function during or after specified plant event;
- (3) features of program, including conditions of test, scale effects (if appropriate), loadings for specified plant event, transient loads (including seismic component, dynamic coupling to other systems, stress limits, and deformation limits), and other information pertinent to assurance of operability;
- (4) design stress limits; and
- (5) program results, summarizing stress and deformation levels and environmental qualification, as well as maximum test envelope conditions for which each component qualifies, including end connections loads and operability results.

Additional guidance for COL applications is provided in Paragraph C.III.3.9.6.1, “Functional Design and Qualification of Pumps, Valves, and Dynamic Restraints,” of RG 1.206, including:

- (1) provisions for testing at maximum flow rates;
- (2) provisions for functional design and qualification of each safety-related valve that demonstrate capability to perform its intended functions for full range of system differential pressures and flows, and ambient temperatures, and available voltage (as applicable) from normal operating to design-basis conditions;
- (3) qualification program for safety-related valves that demonstrates that these valves do not experience leakage from loading;
- (4) provisions for functional design and qualification of dynamic restraints in safety-related systems and access for performing IST program activities; and

- (5) consideration of flow-induced loading in functional design and qualification to incorporate degraded flow conditions.

Discussion topics include

Consideration of RG 1.206 guidance on functional design and qualification for pumps, valves, and dynamic restraints to supplement EPR FSAR description, as necessary

Calvert Cliffs RAI 03.09.06-1 on mechanical equipment qualification program and plans for UniStar response

Functional design and qualification process for plant-specific UHS Makeup Water System

Implementation of functional design and qualification process (for example, design and procurement specifications)

## Inservice Testing of Pumps and Valves

Calvert Cliffs Unit 3 FSAR Section 3.9.6 incorporates by reference EPR FSAR Tier 2 Section 3.9.6 and provides the following supplemental information:

The EPR FSAR includes the following COL Items in Section 3.9.6:

A COL applicant that references the U.S. EPR design certification will submit the Preservice Testing (PST) program and Inservice Testing (IST) program for pumps, valves, and snubbers as required by 10 CFR 50.55a.

A COL applicant that references the U.S. EPR design certification will identify the implementation milestones and applicable ASME OM Code for the preservice and inservice examination and testing programs. These programs will be consistent with the requirements in the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a on the date 12 months before the date for initial fuel load.

Calvert Cliffs FSAR indicates that these COL Items are addressed as follows:

The UHS Makeup Water System is a site-specific safety-related system that is subject to PST and IST program requirements identified in 10 CFR 50.55a. This system's pumps, valves and piping components included in these testing programs are provided in Table 3.9-1 and Table 3.9-2. There are no snubbers in the UHS Makeup Water System.

Constellation Generation Group and UniStar Nuclear Operating Services shall submit the PST and IST programs prior to performing the tests and following the start of construction and prior to the anticipated date of commercial operation, respectively. The implementation milestones for these programs are provided in Table 13.4-1. These programs shall include the implementation milestones and applicable ASME OM Code (ASME, 2004b) and shall be consistent with the requirements in the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a (CFR, 2008) on the date 12 months before the date for initial fuel load.

Based on current NRC review status, EPR FSAR is not sufficient to fully describe IST and Motor-Operated Valve (MOV) Testing operational programs.

Discussion topics include:

Calvert Cliffs RAI 03.09.06-2 on IST and MOV Testing operational programs and plans for UniStar response

Plans to satisfy COL Information Items such as submission of PST and IST programs by COL applicant

Schedules for development of operational programs to support NRC inspection activities

Plans to develop IST Program using the guidance in RG 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," and NUREG-1482 (Revision 1), "Guidelines for Inservice Testing at Nuclear Power Plants," as indicated in EPR FSAR Section 3.9.6.1 (such as use of any ASME OM Code Cases, and development of more detailed IST Program Table that includes valve sizes and P&ID numbers)

## Pump Testing

Calvert Cliffs Unit 3 FSAR Section 3.9.6.2 provides the following supplemental information:

EPR FSAR includes the following COL Item in Section 3.9.6.2:

A COL applicant that references the U.S. EPR design certification will identify any additional site-specific pumps in Table 3.9.6-1 to be included within the scope of the IST program.

This COL Item is addressed as follows:

Table 3.9-1 identifies the additional site-specific pumps that are included within the scope of the IST program.

Paragraph C.III.3.9.6.2, "Inservice Testing Program for Pumps," in RG 1.206 provides the following guidance for COL applications regarding Pump IST programs:

- (1) Provide a list of pumps to be included in the IST program;
- (2) Describe the IST program for pump speed, fluid pressure, flow rate, and vibration at normal, IST, and design-basis operating conditions;
- (3) Describe the methods for establishing and measuring the reference values and IST values for the pump parameters, including instrumentation accuracy and range;
- (4) Describe the pump test plan and schedule, including test duration, and include this information in the technical specifications; and
- (5) Describe the implementation program, including milestones, for the pump IST programs that comply with the requirements in the latest edition and addenda of the ASME OM Code incorporated by reference in 10 CFR 50.55a, on the date 12 months before the date for initial fuel load.

Discussion topics include

Pumps identified in Table 3.9-1 and their IST program description

Consideration of RG 1.206 guidance to fully describe IST operational program for pumps

## Valve Testing

Calvert Cliffs Unit 3 FSAR Section 3.9.6.3 provides the following supplemental information:

The U.S. EPR FSAR includes the following COL Items in Section 3.9.6.3:

A COL applicant that references the U.S. EPR design certification will identify any additional site-specific valves in Table 3.9.6-2 to be included within the scope of the IST program.

This COL Item is addressed as follows:

Table 3.9-2 identifies the additional site-specific valves that are included within the scope of the IST program.

In addition, the following supplement to EPR FSAR Section 3.9.6.3 is provided:

The UHS Makeup Water System Class 3 site-specific valves (motor-operated, manually-operated, check, safety, and relief valves) will be tested in accordance with ASME OM 2004 code, section ISTC (ASME, 2004b).

Paragraph C.III.3.9.6.3, "Inservice Testing Program for Valves," in RG 1.206 provides the following guidance for COL applications:

- (1) IST Program (including test requirements, procedures, and acceptance criteria) for valve preservice tests, valve replacement, valve repair and maintenance, and indication of valve position;
- (2) Proposed methods for measuring the reference values and IST values for power-operated valves (POVs); and
- (3) Valve test procedures and schedules and whether this information will be included in plant technical specifications.

Discussion topics include:

Valves identified in Table 3.9-2 and their IST program description

Consideration of RG 1.206 guidance to fully describe IST operational program for valves

## Motor-Operated Valve IST Program

Calvert Cliffs Unit 3 FSAR does not include supplemental information on MOVs.

Paragraph C.III.3.9.6.3.1, "Inservice Testing Program for Motor-Operated Valves," in RG 1.206 provides the following guidance for COL applications:

- (1) Describe the IST program that periodically verifies the design-basis capability of safety-related MOVs:
  - (a) show how periodic testing (or analysis combined with test results where testing is not conducted at design-basis conditions) objectively demonstrates continued MOV capability to open and/or close under design-basis conditions
  - (b) justify any IST intervals that exceed either 5 years or 3 refueling outages, whichever interval is longer.
- (2) Show how successful completion of the preservice and IST of MOVs demonstrates that the following criteria are met:
  - (a) valve fully opens and/or closes as required by its safety function
  - (b) adequate margin exists and includes consideration of diagnostic equipment inaccuracies, degraded voltage, control switch repeatability, load-sensitive MOV behavior, and margin for degradation
  - (c) maximum torque and/or thrust (as applicable) achieved by the MOV (allowing sufficient margin for diagnostic accuracies and control switch repeatability) does not exceed the allowable structural and undervoltage motor capability limits for the individual parts of the MOV.

Discussion topics include

Consideration of RG 1.206 guidance to fully describe MOV Testing operational program

## Power-Operated Valve IST Program

Calvert Cliffs Unit 3 FSAR states that there are no power-operated valves (POVs) in the UHS Makeup Water System other than MOVs.

Paragraph C.III.3.9.6.3.2, "Inservice Testing Program for Power-Operated Valves Other Than Motor-Operated Valves," in RG 1.206 provides the following guidance for COL applications:

- (1) Describe how the POVs are qualified to perform their design-basis functions either before installation or as part of preoperational testing;
- (2) Describe the POV IST program and show how program incorporates lessons learned from MOV analysis and tests performed in response to GL 89-10; and
- (3) Explain how solenoid-operated valves are verified to meet their Class 1E electrical requirements by performing their safety functions for appropriate electrical power supply amperage and voltage.

Discussion topics include:

Consideration of RG 1.206 guidance to fully describe IST operational program for POVs

## Check Valve Tests

Calvert Cliffs Unit 3 FSAR does not provide supplemental information on IST program for check valves.

Paragraph C.III.3.9.6.3.3, "Inservice Testing Program for Check Valves," in RG 1.206 provides the following guidance for COL applications:

- (1) Describe the preservice and IST program for each check valve (including diagnostic equipment or nonintrusive techniques, testing performed under temperature and flow conditions, how test results identify flow necessary to open the check valve, and how testing includes effects of rapid pump starts and stops and other reverse flow conditions);
- (2) Describe the nonintrusive diagnostic techniques to periodically assess degradation and performance characteristics;
- (3) Describe how successful completion of pre-service testing and IST is assessed (including demonstrating that the disk fully opens or closes, determining disk positions without disassembly, verifying free disk movement, and demonstrating disk is stable in open position);
- (4) Confirm system design features accommodate check valve testing Code requirements; and
- (5) Show how IST program, if applicable, meets the guidelines of Appendix II to ASME OM Code.

Discussion topics include:

Consideration of RG 1.206 guidance to fully describe IST operational program for check valves

## Safety and Relief Valve Testing

Calvert Cliffs Unit 3 FSAR does not provide supplemental information for safety and relief valves.

Paragraph C.III.3.9.6.3.6, "Inservice Testing Program for Safety and Relief Valves," in RG 1.206 states that the COL applicant should provide a list of safety and relief valves that are to be included in the IST program, including their type, valve identification number, code class, valve category, valve functions, test parameters, and test frequency.

Discussion topics include

Consideration of RG 1.206 guidance to fully describe IST operational program for safety and relief valves

## Pressure and Containment Isolation Valve Leak Testing Manually Operated Valves Explosively Activated Valves

Calvert Cliffs Unit 3 FSAR states that there are no Class 3 site-specific containment isolation valves or explosive valves in the UHS Makeup Water System.

RG 1.206, Paragraph C.III.3.9.6.3.4, "Pressure Isolation Valve Leaking Testing," states, for pressure isolation valves (PIVs) not included in the certified design, provide a list of PIVs that includes classification, allowable leak rate, and test interval for each valve.

RG 1.206, Paragraph C.III.3.9.6.3.5, "Containment Isolation Valve Leaking Testing," states no additional information necessary in this technical area for COL application that references certified design.

RG 1.206, Paragraph C.III.3.9.6.3.7, "Inservice Testing Program for Manually Operated Valves," indicates the COL applicant should provide a list of manually operated valves, including their safety function.

RG 1.206, Paragraph C.III.3.9.6.3.8, "Inservice Testing Program for Explosively Actuated Valves," indicates the COL applicant should provide a list of explosively actuated valves.

EPR Section 3.9.6.3.8 states that there are no explosively actuated valves in EPR design.

Discussion topics include

Consideration of RG 1.206 guidance to fully describe IST operational program for applicable valves

## Dynamic Restraints

Calvert Cliffs Unit 3 FSAR provides the following supplemental information on the IST program for dynamic restraints:

The U.S. EPR FSAR includes the following COL Item in Section 3.9.6.4:

A COL applicant that references the U.S. EPR design certification will provide a table identifying the safety-related systems and components that use snubbers in their support systems, including the number of snubbers, type (hydraulic or mechanical), applicable standard, and function (shock, vibration, or dual-purpose snubber). For snubbers identified as either a dual-purpose or vibration arrester type, the COL applicant shall indicate whether the snubber or component was evaluated for fatigue strength. Per ASME Code Section III, Subsection NF, the fatigue evaluation is not required for shock snubbers.

This COL Item is addressed as follows:

Constellation Generation Group and UniStar Nuclear Operating Services shall provide a table identifying the safety-related systems and components that use snubbers in their support systems, including the number of snubbers, type (hydraulic or mechanical), applicable standard, and function (shock, vibration, or dual-purpose snubber). For snubbers identified as either a dual-purpose or vibration arrester type, Constellation Generation Group and UniStar Nuclear Operating Services shall denote whether the snubber or component was evaluated for fatigue strength. Per ASME Section III, Subsection NF (ASME, 2004a), the fatigue evaluation shall not be required for shock snubbers. This information shall be provided prior to installation of any of the snubbers. The UHS Makeup Water System does not incorporate snubbers in the system design.

Paragraph C.III.3.9.6.4, "Inservice Testing Program for Dynamic Restraints," in RG 1.206 provides the following guidance for COL applications:

- (1) Provide a table listing all safety-related components that use snubbers in their support systems and include specific listed information;
- (2) Describe the IST program (including test frequency and duration and examination methods) related to visual inspections and functional testing of dynamic restraints. Describe the basis for dynamic restraint testing.
- (3) Describe the steps to be taken to assure all snubbers are properly installed prior to preoperational piping and plant startup tests.
- (4) Confirm the accessibility provisions for maintenance, IST and testing, and possible repair or replacement of snubbers.
- (5) Describe the implementation program, including milestones, for snubber IST programs that comply with the requirements in the latest edition and addenda of the ASME OM Code incorporated by reference in 10 CFR 50.55a on the date 12 months before the date for initial fuel load.

Discussion topics include

Consideration of RG 1.206 guidance to fully describe IST operational program for dynamic restraints

## Relief Requests and Alternative Authorization

Calvert Cliffs Unit 3 FSAR does not provide supplemental information on relief from or alternatives to the ASME OM Code.

Paragraph C.III.3.9.6.5, "Relief Requests and Alternative Authorization to ASME OM Code," in RG 1.206 provides guidance for COL applications in this area if relief requests or alternatives are planned.

Discussion topics include

Any relief from or alternative to the ASME OM Code planned for Calvert Cliffs Unit 3

## Operational Program Description and Implementation

EPR FSAR Tier 2, Section 3.9.6 states

A COL applicant that references the EPR design certification will submit the PST program and IST program for pumps, valves, and snubbers as required by 10 CFR 50.55a.

A COL applicant that references the EPR design certification will identify the implementation milestones and applicable ASME OM Code for the preservice and inservice examination and testing programs. These programs will be consistent with the requirements in the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a on the date 12 months before the date for initial fuel load.

Calvert Cliffs Unit 3 COL application, Part 10 provides a proposed license condition that states

Calvert Cliffs 3 Nuclear Project and UniStar Nuclear Operating Services shall submit the CCNPP Unit 3 Preservice Testing Programs and Inservice Testing Programs to the NRC prior to performing the tests and following the start of construction and prior to the anticipated date of commercial operation, respectively. The implementation milestones for these programs are provided in CCNPP Unit 3 FSAR Table 13.4-1. These programs shall include the implementation milestones and applicable ASME OM Code and shall be consistent with the requirements in the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a on the date 12 months before the date for initial fuel load.

Discussion topics include:

Completion of COL information items in EPR FSAR as currently specified

Adequacy of proposed license condition to support NRC inspection activities to assess development and implementation of applicable operational programs during plant construction

## Flow-Induced Vibration

Nuclear power plant operating experience has revealed the potential for adverse flow effects from vibration caused by hydrodynamic loads and acoustic resonance within reactor coolant, steam, and feedwater systems.

EPR FSAR Tier 2, Section 3.9.2, “Dynamic Testing and Analysis of Systems, Components, and Equipment,” states that EPR systems, components, and equipment retain their structural and functional integrity when subjected to dynamic loads that can occur during normal operation, plant transients, and external events.

EPR FSAR Tier 2, Section 14.2 includes provisions for the initial plant test program.

Subsection 14.2.12.3.12 addresses Balance of Plant Piping Vibration Measurement.

Subsection 14.2.12.17.1 addresses baseline Nuclear Steam Supply System integrity monitoring.

Discussion topics include:

Planned implementation of EPR FSAR provisions to address flow-induced vibration.