to the piping system design. In addition, ASME Section III requires that design reports for all ASME Class 1, 2, and 3 piping systems demonstrating and documenting that as-built piping system and pipe support configurations adhere to the requirements of the design specification (Reference 6). ~~The COL applicant is to prepare design reports for ASME Class 1, 2, and 3 piping systems in accordance with ASME Section III (COL 3.12(1)).~~

Delete

3.12.3 Piping Analysis Methods

Seismic analysis methods used for all seismic Category I, seismic Category II, and non-seismic piping systems, as described below, include the response spectrum method, time-history method, or where applicable, the equivalent static load method in accordance with Subsection 3.7.3.1.1.

This subsection covers the procedure used for analytical modeling, selection of frequencies, damping criteria, combination of modal responses, the analysis for small-bore piping, and interaction of seismic Category I piping systems with other piping systems.

3.12.3.1 Experimental Stress Analysis Method

For the APR1400, experimental stress analysis methods are not used for the design of the piping system and its supports.

3.12.3.2 Modal Response Spectrum Method

3.12.3.2.1 General

The modal response spectrum method is a measure of how the piping system with certain natural frequencies responds to an earthquake applied at its pipe supports. To determine the piping system natural frequencies, each piping system is idealized as a mathematical model consisting of lumped masses connected by elastic members.

The response spectra are applied to the piping system at locations of structural attachment, such as pipe supports or equipment for each of the three orthogonal spatial components. The response spectra analysis is performed using either uniform support motion (USM) or independent support motion (ISM) method.

3.12.5.4 Damping Values

Damping values in Table 3 of NRC RG 1.61 (Reference 7) are used for dynamic response spectra and time-history analyses.

Frequency-dependent damping values identified in Figure 1 of NRC RG 1.61 may also be used for USM response spectra analysis provided the five restrictions identified in C.2 of NRC RG 1.61 (Reference 7) are maintained.

3.12.5.5 Combination of Modal Responses

Seismic responses to each mode are calculated in accordance with the method described in NRC RG 1.92 (Reference 9) and combined with other responses. Seismic responses to periodic modal response with sufficiently separated frequencies are combined by SRSS. Closely spaced frequencies are combined by the 10 percent method.

3.12.5.6 High-Frequency Modes

PIPESTRESS and ADLPIPE computer programs use left-out-force (LOF) and missing mass correction (MMC) methods to calculate the effect of high-frequency rigid modes (References 11 and 18). The result obtained from this method is multiplied by scalar amplitude that is equivalent to the highest spectral acceleration for frequencies, which is greater than the last natural frequency being calculated by LOF and MMC methods regarding the corresponding directional spectrum.

3.12.5.7 Fatigue Evaluation of ASME Code Class 1 Piping

Fatigue evaluation of ASME Class 1 piping systems is performed for loadings caused by thermal and pressure transients, thermal stratification, and other cyclic events including earthquakes. Fatigue evaluation of ASME Class 1 piping greater than DN 25 (NPS 1) is performed per ASME Section III, Subsection NB-3653. ~~The COL applicant is to perform fatigue evaluation of ASME Class 1 piping (COL 3.12(3)).~~

Delete

The fatigue evaluation considering the effects of the reactor coolant environment in ASME Class 1 piping follows the guidance in NRC RG 1.207 (Reference 19).

3.12.5.8 Fatigue Evaluation of ASME Code Class 2 and 3 Piping

The calculation for the cumulative usage factors of ASME Class 2 and 3 piping is not required. Fatigue evaluation of ASME Class 2 and 3 piping is not performed in accordance with the requirements in NC/ND-3653.2(a). Acceptable cyclic stress is reduced by applying stress range reduction factor, f, to thermal expansion stress ranges in accordance with Table NC/ND-3611.2(e)-1. The stress intensification factors that are applicable to piping components and joints are based on fatigue testing. ~~The COL applicant is to perform stress evaluations for ASME Class 2 and 3 piping (COL 3.12(4)).~~

Delete

3.12.5.9 Thermal Oscillations in Piping Connected to the Reactor Coolant System

Unisolable sections of piping connected to the reactor coolant system (RCS) that could be subjected to stresses from thermal stratification caused by valve leakages or turbulent penetrations are reviewed to provide reasonable assurance of the structural integrity of the lines.

APR1400 conforms with the requirements in U.S. NRC Bulletin 88-08 (Reference 20) for all piping connected to the reactor coolant system. Data available from the reference plant have been evaluated and incorporated into the design of the APR1400.

Based on the temperature distributions in the piping between the direct vessel injection (DVI) nozzle and the first isolation valve, and the piping between shutdown cooling system (SCS) nozzle and the first isolation valve, which were evaluated using a commercial thermal-hydraulic analysis code, it is expected that the temperature difference in stratified flow is relatively small and the thermal stratification effects would be negligible for the SCS suction line. ~~However, the COL applicant that references the APR1400 design certification will perform the piping stress analysis including thermal stratification effects on the SCS suction line (COL 3.12(6)).~~

Delete

The effect of thermal stratification on the piping system is analyzed in two parts:

a. Global stratification, which causes bending

3.12.5.16 Modal Damping for Composite Structures

The composite modal damping for coupled building and piping systems is used for piping systems that are coupled to concrete building structures, if applicable. The procedure used to determine the composite modal damping value for the piping system is described in Subsection 3.7.2.15.

3.12.5.17 Minimum Temperature for Thermal Analyses

The stress-free state temperature for a piping system is typically defined as 21 °C (70 °F). The analysis for a piping system with an operational temperature of greater than 65 °C (150 °F) or less than 4 °C (40 °F) is performed for the effect of thermal expansion/contraction.

3.12.5.18 Intersystem Loss-of-Coolant Accident

The design feature of low-pressure piping systems that interface with reactor coolant pressure boundary (RCPB) is described in Appendix 5A.

3.12.5.19 Effects of Environment on Fatigue Design

The fatigue evaluation considering the effects of the reactor coolant environment in ASME Class 1 piping follows the guidance in NRC RG 1.207 (Reference 19). ~~The COL applicant is to perform a fatigue evaluation of environmental impact on ASME Class 1 piping, using methods acceptable to the NRC at the time of evaluation (COL 3.12(5)).~~

Delete

3.12.6 Piping Support Design Criteria

This section provides piping support design methods, procedures and criteria, and piping support design criteria provided in Subsection 3.9.3 are used as references.

3.12.6.1 Applicable Codes

Seismic Category I pipe supports are designed in accordance with ASME Section III, NF for Service Levels A, B, C, and D, and the acceptance limits of Appendix F of ASME Section III for Service Level D.

3.12.6.11 Pipe Support Gaps and Clearances

For guide type pipe supports modeled as rigid restraints in the piping analysis, the typical industry design practice is to provide small gaps between the pipe and its surrounding structural members. These small gaps allow radial thermal expansion of the pipe as well as allow rotation of the pipe at the support. The normal design practice for the APR1400 is to use a nominal cold condition gap of 1.6 mm (1/16 in) on each side of the pipe in the restrained direction. ~~The COL applicant is to determine maximum radial thermal expansion at its design temperature (COL 3. 12(7)).~~

Delete

3.12.6.12 Instrumentation Line Support Criteria

The design and analysis loadings, load combinations, and acceptance criteria to be used for instrumentation line supports are similar to those used for pipe supports. The applicable design loads include deadweight, thermal expansion, and seismic loadings where appropriate. The applicable loading combinations similarly follow those used for the ASME Section III Levels in Table 3.9-10 using the design loadings mentioned above. The acceptance criteria are in accordance with ASME Section III, Subsection NF for seismic Category I instrumentation lines, AISC 360-05 (Reference 14) for non-seismic instrumentation lines.

3.12.6.13 Pipe Deflection Limits

For standard component pipe supports using standard manufactured hardware components, the manufacturer's recommendations for limitations in its hardware are followed. The limitations are travel limits for spring hangers; stroke limits for snubbers; swing angles for rods, struts, and snubbers; alignment angles between clamps or end brackets with their associated struts and snubbers; and the variability check for variable spring supports. In addition to the manufacturer's recommended limits, allowances are made in the initial designs for tolerances on such limits. This is especially important for snubber and spring design in which the function of the support may be changed by an exceeded limit.

3.12.7 Combined License Information

Deleted

COL 3.12(1) ~~The COL applicant is to prepare design reports for ASME Class 1, 2, and 3 piping system in accordance with ASME Section III.~~

COL 3.12(2) The COL applicant is to design the piping exposed to wind and/or tornado, if any, to the plant design basis loads.

According to the MEB AI 3-2, COL 3.12(2) item will be changed

COL 3.12(3) ~~The COL applicant is to perform fatigue evaluations of ASME Class 1 piping.~~

Deleted

COL 3.12(4) ~~The COL applicant is to perform stress evaluations for ASME Class 2 and 3 piping.~~

Deleted

COL 3.12(5) ~~The COL applicant is to perform fatigue evaluations of environmental impact on ASME Class 1 piping, using methods acceptable to the NRC at the time of evaluation.~~

Deleted

COL 3.12(6) ~~The COL applicant is to perform the piping stress analysis including the thermal stratification effect on the SCS suction line.~~

Deleted

COL 3.12(7) ~~The COL applicant is to determine maximum radial thermal expansion at its design temperature.~~

Deleted

3.12.8 References

1. ASME Boiler and Pressure Vessel Code, Section III, "Rules for Construction of Nuclear Facility Components," The American Society of Mechanical Engineers, the 2007 Edition with the 2008 Addenda.

2. ASME B31.1, "Code for Pressure Piping, Power Piping," The American Society of Mechanical Engineers, the 2010 Edition.

3. ASME B31.3, "Code for Pressure Piping, Process Piping," American Society of Mechanical Engineers, the 2010 Edition.

Table 1.8-2 (6 of 29)

Item No.	Description
COL 3.10(1)	The COL applicant is to provide documentation that the designs of seismic Category I SSCs are analyzed for OBE, if OBE is higher than 1/3 SSE.
COL 3.10(2)	The COL applicant is to investigate if site-specific spectra generated for the COLA exceed the APR1400 design spectra in the high-frequency range. Accordingly, the COL applicant is to provide reasonable assurance of the functional performance of vibration-sensitive components in the high-frequency range.
COL 3.10(3)	The COL applicant is to develop the equipment seismic qualification files that summarize the component's qualification, including a list of equipment classified as seismic Category I in Table 3.2-1 and seismic qualification summary data sheets (SQSDS) for each piece of safety-related seismic Category I equipment.
COL 3.10(4)	The COL applicant is to perform equipment seismic qualification for seismic Category I equipment and provide milestones and completion dates of equipment seismic qualification program.
COL 3.11(1)	The COL applicant is to identify and qualify the site-specific mechanical, electrical, I&C, and accident monitoring equipment specified in RG 1.97.
COL 3.11(2)	The COL applicant is to document the qualification test results and qualification status in an auditable file for each type of equipment in accordance with the requirements 10 CFR 50.49(j).
COL 3.11(3)	The COL applicant is to describe the EQP implementation milestones based on the APR1400 EQP.
COL 3.11(4)	The COL applicant is to identify the nonmetallic parts of mechanical equipment in procurement process.
COL 3.12(1)	~~The COL applicant is to prepare design reports for ASME Class 1, 2, and 3 piping system in accordance with ASME Section III.~~ Deleted
COL 3.12(2)	The COL applicant is to design the piping exposed to wind and/or tornado, if any, to the plant design basis loads.
COL 3.12(3)	~~The COL applicant is to perform fatigue evaluations of ASME Class 1 piping.~~ Deleted
COL 3.12(4)	~~The COL applicant is to perform stress evaluations for ASME Class 2 and 3 piping.~~ Deleted
COL 3.12(5)	~~The COL applicant is to perform fatigue evaluations of environmental impact on ASME Class 1 piping, except for the RCS primary loop, using methods acceptable to the NRC at the time of evaluation.~~ Deleted

According to MEB AI 3−2, the COL 3.12(2) item will be changed.

Table 1.8-2 (7 of 29)

Item No.	Description
COL 3.12(6)	~~The COL applicant is to perform the piping stress analysis including thermal stratification effects on SCS suction line.~~ Deleted
COL 3.12(7)	~~The COL applicant is to determine maximum radial thermal expansion at its design temperature.~~ Deleted
COL 3.13(1)	The COL applicant is to maintain quality assurance records including CMTRs on ASME Section III Class 1, 2, and 3 component threaded fasteners in accordance with the requirements of 10 CFR 50.71.
COL 3.13(2)	The COL applicant is to submit the preservice and inservice inspection programs for ASME Section III Class 1, 2, and 3 component threaded fasteners to the NRC prior to performing the inspections.
COL 5.2(1)	The COL applicant is to address the addition of ASME Code cases that are approved in NRC RG 1.84.
COL 5.2(2)	The COL applicant is to address the ASME Code cases, which are invoked for the ISI program of specific plant.
COL 5.2(3)	The COL applicant is to address the Code cases invoked for operation and maintenance activities.
COL 5.2(4)	The COL applicant is to address the material specifications, which are not shown in Table 5.2-2, as necessary.
COL 5.2(5)	The COL applicant is to specify the version of EPRI's, "Primary Water Chemistry Guidelines," that will be implemented.
COL 5.2(6)	The COL applicant is to address the actual, as-procured, fracture toughness data of the RCPB materials to the staff at a predetermined time by an appropriate method.
COL 5.2(7)	The COL applicant is to submit the actual, as-procured yield strength of the austenitic stainless steel materials used in RCPB to the staff at a predetermined time agreed-upon by the regulatory body.

the OBE load case does not require explicit design analysis. In the event of an earthquake that meets or exceeds the OBE ground motion, plant shutdown is required and seismic Category I piping and supports are inspected to provide reasonable assurance that no functional damage has occurred. The design of the APR1400 seismic Category I piping and supports includes analysis of the inertial and anchor movement (greater than 1.59 mm (1/16 inch)) effects of the SSE event. These loads are Service Level D loads.

Fatigue effects due to earthquake loads are addressed in Table 3.12-1. Tables 3.12-1 and 3.12-2 identify SSE inertial and displacement loads in various load combinations for ASME Class 1, 2, and 3 piping and piping supports.

3.12.5.3.5 Fluid Transient Loads

The relief/safety valve thrust loads for open or closed systems are functions of valve opening, flow rate, flow area, and fluid properties. The analysis of these loads is usually accomplished using static loads as input to the piping analysis with appropriate dynamic load factors. Dynamic analysis of relief valve thrusts is used when static analysis produces undesirably conservative results. These loads are considered in Service Level B or D load combinations.

The water hammer phenomenon involves the rapid change in fluid flow creating a "shock wave" effect in the piping system. They are usually set in motion by rapid actuation of control valves, relief valves, and check valves. Rapid start or trip of a pump or turbine can also initiate such a phenomenon. The water hammer phenomenon is analyzed using dynamic analysis methods. The water hammer loads are considered in Level B, or D service load combinations.

The fluid transient loads are identified as dynamic fluid loads in Tables 3.12-1 and 3.12-2.

3.12.5.3.6 Wind/Tornado Loads

~~ASME Class 1, 2, and 3 piping for the APR1400 within the DC scope is not exposed to wind or tornado loads. The COL applicant is to design those piping exposed to wind and/or tornado, if any, to the plant design basis loads (COL 3.12(2)).~~

Safety related piping systems of ASME Class 1,2, and 3 are designed within the wind/ tornado protected structure. If COL applicant finds it necessary to route the piping systems outside the structure, the wind and/or tornado load must be included in the plant design basis loads considering the site-specific loads(COL 3.12(2)).

3.12.7 Combined License Information

COL 3.12(1) ~~The COL applicant is to prepare design reports for ASME Class 1, 2, and 3 piping system in accordance with ASME Section III.~~

COL 3.12(2) ~~The COL applicant is to design the piping exposed to wind and/or tornado, if any, to the plant design basis loads.~~ If COL applicant finds it necessary to route ASME Class 1, 2 or 3 piping systems outside the structure, the wind and/or tornado load must be included in the plant design basis loads considering the site–specific loads.

COL 3.12(3) ~~The COL applicant is to perform fatigue evaluations of ASME Class 1 piping.~~

COL 3.12(4) ~~The COL applicant is to perform stress evaluations for ASME Class 2 and 3 piping.~~

COL 3.12(5) ~~The COL applicant is to perform fatigue evaluations of environmental impact on ASME Class 1 piping, using methods acceptable to the NRC at the time of evaluation.~~

COL 3.12(6) ~~The COL applicant is to perform the piping stress analysis including the thermal stratification effect on the SCS suction line.~~

COL 3.12(7) ~~The COL applicant is to determine maximum radial thermal expansion at its design temperature.~~

3.12.8 References

1. ASME Boiler a[nd Pressure Vessel Code, Section III, "Rules for Construction of] Nuclear Facility Components," The American Society of Mechanical Engineers, the 2007 Edition with the 2008 Addenda.

2. ASME B31.1, "Code for Pressure Piping, Power Piping," The American Society of Mechanical Engineers, the 2010 Edition.

3. ASME B31.3, "Code for Pressure Piping, Process Piping," American Society of Mechanical Engineers, the 2010 Edition.

Table 1.8-2 (6 of 29)

Item No.	Description
COL 3.10(1)	The COL applicant is to provide documentation that the designs of seismic Category I SSCs are analyzed for OBE, if OBE is higher than 1/3 SSE.
COL 3.10(2)	The COL applicant is to investigate if site-specific spectra generated for the COLA exceed the APR1400 design spectra in the high-frequency range. Accordingly, the COL applicant is to provide reasonable assurance of the functional performance of vibration-sensitive components in the high-frequency range.
COL 3.10(3)	The COL applicant is to develop the equipment seismic qualification files that summarize the component's qualification, including a list of equipment classified as seismic Category I in Table 3.2-1 and seismic qualification summary data sheets (SQSDS) for each piece of safety-related seismic Category I equipment.
COL 3.10(4)	The COL applicant is to perform equipment seismic qualification for seismic Category I equipment and provide milestones and completion dates of equipment seismic qualification program.
COL 3.11(1)	The COL applicant is to identify and qualify the site-specific mechanical, electrical, I&C, and accident monitoring equipment specified in RG 1.97.
COL 3.11(2)	The COL applicant is to document the qualification test results and qualification status in an auditable file for each type of equipment in accordance with the requirements 10 CFR 50.49(j).
COL 3.11(3)	The COL applicant is to describe the EQP implementation milestones based on the APR1400 EQP.
COL 3.11(4)	The COL applicant is to identify the nonmetallic parts of mechanical equipment in procurement process.
COL 3.12(1)	~~The COL applicant is to prepare design reports for ASME Class 1, 2, and 3 piping system in accordance with ASME Section III.~~
COL 3.12(2)	~~The COL applicant is to design the piping exposed to wind and/or tornado, if any, to the plant design basis loads.~~
COL 3.12(3)	~~The COL applicant is to perform fatigue evaluations of ASME Class 1 piping.~~
COL 3.12(4)	~~The COL applicant is to perform stress evaluations for ASME Class 2 and 3 piping.~~
COL 3.12(5)	~~The COL applicant is to perform fatigue evaluations of environmental impact on ASME Class 1 piping, except for the RCS primary loop, using methods acceptable to the NRC at the time of evaluation.~~

If COL applicant finds it necessary to route ASME Class 1, 2 or 3 piping systems outside the structure, the wind and/or tornado load must be included in the plant design basis loads considering the site-specific loads.

Delete

14.3.5 Design ITAAC Closure Process

APR1400 standard design uses "design ITAAC" to specify the limits, parameters, procedures, and attributes associated with ~~final design and analysis of piping systems and components, and~~ HFE(V&V). These design ITAAC are identified in DCD Tier 1 and provided with an as-built ITAAC to verify their completion prior to initial fuel load. Delete

Design ITAAC will be closed using the process described in this subsection. Following closure of the design ITAAC, ITAAC for related as-built SSCs will be closed to verify that their respective principal performance characteristics and safety functions conform to the certified design. RG 1.206 (Reference 1), "Combined License Applications for Nuclear Power Plants (LWR Edition)," Section C.III.5 provides design ITAAC closure guidance.

14.3.5.1 Design ITAAC Closure Options

There are three options available to close a design ITAAC. Design information used to close design ITAAC represents a level of detail similar to that which would have been provided during design certification review if a design ITAAC had not been used. The three options for design ITAAC closure are:

a. Closure through an amendment of the design certification rule

   A design certification rule amendment request is submitted to the NRC to provide the design and analysis information needed to close the design ITAAC and the design ITAAC are deleted from the DCD. ITAAC for as-built SSCs will remain or be modified, as appropriate, to demonstrate that the as-built facility conforms to the final design and analysis information.

b. Closure through the COLA review process

   A COL application contains the required design and analysis information needed to close the design ITAAC. ITAAC for as-built SSCs will remain or be modified, as appropriate, to demonstrate that the as-built facility conforms to the final design and analysis information.

c. Closure after COL issuance

The NRC issues a COL with design ITAAC still open and inspects design ITAAC closure as part of the construction inspection process. Design ITAAC closure is accomplished using the normal ITAAC closure process.

Regarding the first option, this method resolves design with finality for all COL applicants that subsequently reference the amended standard design.

The second or third option may be applied only by the first licensee following completion of the required design and analysis information needed to close design ITAAC. Subsequent licensees may use the standard plant design and analysis information approved for closure of design ITAAC by the first licensee. This does not include design ITAAC that are dependent upon site-specific parameters. As discussed by RG 1.206 Section C.III.5(Reference 1), the licensee and NRC may use the design centered review approach to close design ITAAC for subsequent licensees.

Topical reports may be submitted to the NRC to support design ITAAC closure using any of the three options. The NRC may issue a safety evaluation in conjunction with a closure letter or inspection report conclusion that design ITAAC acceptance criteria have been satisfied. This allows subsequent COL applicants or licensees to reference NRC closure documents to close design ITAAC.

14.3.5.2 ~~Piping Systems and Components Design ITAAC~~

Delete

~~Piping systems and components design includes stress analyses, environmental fatigue analyses, pipe break hazards analyses, and leak-before-break analyses. Design ITAAC is used for environmental fatigue analyses of ASME code Class 1 piping systems and components for APR1400. The environmental fatigue analyses will be performed in accordance with RG 1.207 (Reference 34), and provided in the design report for reconciliation of the as-designed information with the as-built design. The design ITAAC for the environmental fatigue analysis is listed in Table 2.3-2 of Tier 1 DCD.~~

25. NUREG-0800, Standard Review Plan, Section 7, "Instrumentation and Controls – Overview of Review Process," Rev. 6, U.S. Nuclear Regulatory Commission, May 2010.

26. Regulatory Guide 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," Rev. 4, U.S. Nuclear Regulatory Commission, June 2006.

27. 10 CFR 52.80, "Contents of Applications; Additional Technical Information," U.S. Nuclear Regulatory Commission.

28. NUREG-0800, Standard Review Plan, Section 17.4, "Reliability Assurance Program (RAP)," U.S. Nuclear Regulatory Commission, March 2007.

29. Regulatory Guide 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants," Rev. 4, U.S. Nuclear Regulatory Commission, June 2013.

30. NUREG-0800, Standard Review Plan, Section 14.2, "Initial Plant Test Program – Design Certification and New License Applicants, U.S. Nuclear Regulatory Commission, March 2007.

31. Regulatory Guide 1.215, "Guidance for ITAAC Closure under 10 CFR PART 52," Rev. 1, U.S. Nuclear Regulatory Commission, May 2012.

32. NEI 08-01, "Industry Guideline for the ITAAC Closure Process under 10 CFR Part 52," Rev. 4, Nuclear Energy Institute, 2010.

33. 10 CFR Part 20, "Standards for Protection against Radiation," U.S. Nuclear Regulatory Commission.

~~34. Regulatory Guide 1.207, "Guidelines for Evaluating Fatigue Analyses incorporating the Life Reduction of Metal Components Due to the Effects of the Light Water Reactor Environment for New Reactors," Rev. 0, U.S. Nuclear Regulatory Commission, March 2007.~~

Delete

TABLE OF CONTENTS

LIST OF TABLES

Delete

functional capability under internal design and operating pressures and design basis loads.

2. The ASME Section III Class 1 piping systems and components for systems identified in Table 2.3-1 are evaluated for fatigue usage factor in both air and reactor coolant environments.

3. The ASME Section III Class 2 and 3 piping systems and components for systems identified in Table 2.3-1 are designed to retain their pressure integrity and functional capability under internal design and operating pressures and design-basis loads.

4. For each piping system qualified for LBB identified in Table 2.3-1, the as-built piping and materials are reconciled with the basis used for LBB acceptance criteria.

5. SSCs required for safe shutdown are protected from the dynamic and environmental effects of postulated high and moderate energy piping failures inside and outside the containment where consideration of these dynamic effects is not eliminated by LBB.

2.3.2 ~~Inspections, Tests, Analyses, and Acceptance Criteria~~

Delete

~~The ITAAC for piping systems and components is specified in Table 2.3-2.~~

Table 2.3-2

Delete

Piping Systems and Components ITAAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The ASME Section III Class 1 piping systems and components for systems identified in Table 2.3-1 are evaluated for fatigue usage factor in reactor coolant environments.	1. Environmental Fatigue analysis of the ASME Section III Class 1 piping systems and components identified in Table 2.3-1 will be performed. [Design ITAAC]	1. Report(s) exist and conclude that the fatigue usage factors for ASME Section III Class 1 piping systems and components for systems identified in Table 2.3-1 are evaluated for reactor coolant environments.

3.12.6.11 Pipe Support Gaps and Clearances

For guide type pipe supports modeled as rigid restraints in the piping analysis, the typical industry design practice is to provide small gaps between the pipe and its surrounding structural members. These small gaps allow radial thermal expansion of the pipe as well as allow rotation of the pipe at the support. The normal design practice for the APR1400 is to use a nominal cold condition gap of 1.6 mm (1/16 in) on each side of the pipe in the restrained direction. The COL applicant is to determine maximum radial thermal expansion at its design temperature (COL 3. 12(7)).

3.12.6.12 Instrumentation Line Support Criteria

The design and analysis loadings, load combinations, and acceptance criteria to be used for instrumentation line supports are similar to those used for pipe supports. The applicable design loads include deadweight, thermal expansion, and seismic loadings where appropriate. The applicable loading combinations similarly follow those used for the ASME Section III Levels in Table 3.9-10 using the design loadings mentioned above. The acceptance criteria are in accordance with ASME Section III, Subsection NF for seismic Category I instrumentation lines, AISC 360-05 (Reference 14) for non-seismic instrumentation lines.

3.12.6.13 Pipe Deflection Limits

For standard component pipe supports using standard manufactured hardware components, the manufacturer's recommendations for limitations in its hardware are followed. The limitations are travel limits for spring hangers; stroke limits for snubbers; swing angles for rods, struts, and snubbers; alignment angles between clamps or end brackets with their associated struts and snubbers; and the variability check for variable spring supports. In addition to the manufacturer's recommended limits, allowances are made in the initial designs for tolerances on such limits. This is especially important for snubber and spring design in which the function of the support may be changed by an exceeded limit.

3.12.6.14 Clamp-induced Local Pipe Stress Evaluation

Stiff pipe clamps of the type identified in Information Notice (IN) 83-80 and Generic safety Issue (GSI) 89 are not used for the piping supports.

MEB AI 3-11,12,13 (1/26)

As indicated in the preceding sections, the stress and fatigue limits for reactor internals are obtained from ASME Code. Allowable deformation limits are established as 80 percent of the loss-of-function deflection limits. These limits provide adequate safety factors providing reasonable assurance that as long as calculated stresses, cumulative usage factors, or deformations do not exceed these limits, the design is conservative.

The APR1400 utilizes an IST program for ASME Code, Section III, Class 1, 2 and 3 safety-related pumps, valves, and dynamic restraints. The IST program is developed in accordance with the requirements of ASME OM Code (Reference 34), as required by 10 CFR 50.55a(f) and the acceptable ASME Code Cases listed in RG 1.192 (Reference 66) that are incorporated by 10 CFR 50.55a(b).

3.9.6 Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints

inservice testing (IST)

This section describes the functional design and qualification provisions and ~~IST~~ programs for safety-related pumps, valves, and dynamic restraints. The qualification provisions and IST programs are described to verify that these components are in a state of operational readiness to perform their safety functions throughout the life of the plant.

to

~~The APR1400 utilizes an IST program for ASME Code, Section III, Class 1, 2 and 3 safety-related pumps, valves, and dynamic restraints that is developed in accordance with the requirements of ASME OM Code. IST of safety-related pumps, valves, and dynamic restraints is performed in accordance with ASME OM Code as required by 10 CFR 50.55a(f).~~ ASME OM Code Subsection ISTB applies the inservice testing requirements for pumps, Subsection ISTC applies the inservice testing requirements for valves, and Subsection ISTD applies the inservice testing requirements for dynamic restraints.

Insert A(next page)

3.9.6.1 Functional Design and Qualification of Pumps, Valves, and Dynamic Restraints

Additionally, APR1400 IST program incorporates the guidance and information on the format and content for IST program, and relief requests of NUREG-1482 Rev. 02 (Reference 60).

~~The IST program includes the design and qu[alification ...] for ASME OM Code and applicable addenda. The functional design and qualification of safety-related pumps, valves, and dynamic restraints are performed in accordance with ASME QME-1 as endorsed by NRC RG 1.100.~~

Insert B(next page)

Insert A

The sections of 10 CFR 50, General Design Criteria (GDC), that apply to this section are:

a. GDC 1 as it relates to structures, systems, and components (SSCs), which include pumps, valves, and dynamic restraints being designed, fabricated, erected, and tested to quality standards commensurate with the safety-related functions to be performed. These requirements provide reasonable assurance that safety-related components and structures meet service loading conditions, stress limits, and quality requirements of ASME Code permitted in 10 CFR 50.55a.

b. GDC 2 as it relates to components important to safety being designed to withstand the effects of earthquakes without loss of capability to perform their safety functions. The effects of expected natural phenomena on normal and accident conditions are considered in the loading combinations for components important to safety. Additional design information is provided in the sections that describe the individual safety-related SSCs.

c. GDC 4 as it relates to components important to safety being designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents. The safety-related SSCs are designed to accommodate the effects of, and to be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents (LOCA). Additionally, the APR1400 design is based on the leak-before-break (LBB) concept, as described in Section 3.6.3, to eliminate the dynamic effects of postulated pipe rupture.

d. GDC 14 as it relates to the reactor coolant pressure boundary (RCPB) being designed, fabricated, erected, and tested to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture. The RCPB is designed to accommodate the system pressures and temperatures attained under all expected modes of plant operation, including anticipated transients, with stresses within applicable limits.

e. GDC 15 as it relates to the reactor coolant system (RCS) being designed with sufficient margin to provide reasonable assurance that the design conditions of the RCPB are not exceeded during any condition of normal operation, including anticipated operational occurrences (AOO). Steady-state and transient analyses are performed to ensure that the design conditions of the RCS are not exceeded during normal operation. Additionally, RCPB components have sufficient margin of safety based on the use of proven materials and design codes, the use of proven fabrication techniques, nondestructive shop examination, and integrated hydrostatic testing of assembled components.

f. GDC 37 as it relates to the emergency core cooling system (ECCS) being designed to permit appropriate periodic pressure and functional testing to confirm the structural and leak-tight integrity of its components, and the operability and performance of the active components of the system. The ECCS is provided with testing capability to demonstrate system and component leak-tight integrity, operability and performance.

g. GDC 40 as it relates to the containment heat removal system being designed to permit appropriate periodic pressure and functional testing to confirm the structural and leak-tight integrity of its components, and the operability and performance of the active components of the system. System piping, valves, pumps, and other components of the containment heat removal system are arranged so that each component can be tested periodically for leak-tight integrity and operability.

h. GDC 43 as it relates to the containment atmospheric cleanup system being designed to permit appropriate periodic pressure and functional testing to ensure the structural and leak-tight integrity of its components, and the operability and performance of the active components of the system, including pumps and valves. Testing of the CSS is conducted to ensure structural and leak-tight integrity, and operability and performance in accordance with GDC 40. In addition, performance testing is conducted on active components of the CSS.

i. GDC 46 as it relates to the cooling water system being designed to permit appropriate periodic pressure and functional testing to confirm the structural and leak-tight integrity of its components, and the operability and performance of the active components of the system. The design provides measures for periodic testing of active components of the cooling water systems for operability and functional performance.

j. GDC 54 as it relates to piping systems penetrating the primary reactor containment being provided with leak detection and isolation capabilities to test periodically the operability of the isolation valves and determine valve leakage acceptability. Piping systems that penetrate the containment are designed to provide the required isolation and testing capabilities.

Other DCD sections that interface with this section are:

a. Section 3.2.2 addresses the classification system and quality group for pumps and valves.

b. Section 3.9.2 addresses dynamic testing and analysis of safety-related pumps, valves, and snubbers.

c. Section 3.9.3 addresses the structural design of safety-related pumps, valves, and snubbers.

d. Section 3.10 addresses the seismic and dynamic qualification of safety-related pumps and valves.

e. Section 3.11 addresses the environmental qualification of safety-related pumps and valves.

f. Section 3.12 addresses the design and leak testing provisions of pressure retaining systems and components that interface with the reactor coolant system as part of the primary review responsibility for intersystem LOCAs.

g. Section 3.13 addresses programs for ensuring the adequacy and integrity of bolting and threaded fastener.

h. Section 5.2.2 addresses the valves specified for overpressure protection of the reactor coolant pressure boundary.

i. Sections 5.4.7 and 6.3 address residual heat removal and emergency core cooling systems piping, each of which is connected to the reactor coolant system and is subject to thermally stratified flow, thermal striping, and/or thermal cyclic effects.

j. Section 6.2.1.2 addresses the analyses of subcompartment differential pressures resulting from postulated pipe breaks.

k. Sections 6.2.4 and 6.2.6 address the containment isolation system and the overall containment leakage testing program, respectively.

l. Section 9.2.1 addresses surveillance, testing, inspection, and maintenance programs of essential service water systems.

m. Section 10.3 addresses the safety-related portion of the main steam system.

n. Section 14.2 addresses preoperational and initial startup testing for systems that contain safety-related pumps, valves, and dynamic restraints.

o. Section 17.6 describes the program for implementation of the Maintenance Rule for systems that contain safety-related pumps, valves, and dynamic restraints.

ASME OM Code describes the IST scope and establishes the requirements for preservice and inservice testing and examination of certain components to assess their operational readiness. ASME OM Code identifies the components subject to test or examination, responsibilities, methods, intervals, parameters to be measured and evaluated, criteria for evaluating the results, corrective action, personnel qualification, and record keeping.

These requirements apply to:

a. Pumps and valves that are required to perform a specific function in shutting down the reactor to a safe shutdown condition, in maintaining the safe shutdown condition, or in mitigating the consequences of an accident.

b. Pressure relief devices that protect systems or portions of systems that perform one or more of the three functions identified above.

c. Dynamic restraints used in systems that perform one or more of the three functions identified above, or that ensure the integrity of the RCPB.

The COL applicant will provide a full description of the IST program including preservice testing (PST) for pumps, valves and dynamic restraints as required by 10 CFR 50.55a and will be administratively controlled that the applicable requirements of the ASME OM Code edition and addenda are incorporated in the IST program (COL 3.9(4)).

ASME Code, Section III Class 1, 2, 3 and non-ASME Code safety-related pumps, valves, and dynamic restraints are incorporated into a 10 year interval IST program.

Insert B

The functional qualification of safety-related pumps, valves, and dynamic restraints (snubbers) are performed in accordance with ASME QME-1-2007 (Reference 53), as endorsed in RG 1.100, Rev. 3 (Reference 35).

The functional design and qualification of safety-related pumps, valves, and snubbers includes:

a. Safety-related pump, valve, and piping designs include provisions that allow testing of pumps and valves at the maximum flow specified in the plant accident analyses.

b. The functional design and qualification of each safety-related pump and valve is performed such that each pump and valve are capable of performing its intended function for a full range of system differential pressure and flow, ambient temperatures, and available voltage (as applicable) under conditions ranging from normal operating to design-basis accidents.

c. The APR1400 design provides ready access to SSC to facilitate comprehensive testing using currently available equipment and techniques. Accessibility incorporated into the design complies with the requirements of ASME OM Code and 10 CFR 50.55a(f). System design incorporates provisions, including alternate flow paths and required instrumentation, to allow full flow testing of pumps under the IST program. The design also incorporates provisions to permit ready IST of valves.

d. The provisions for the functional design and qualification of snubbers are provided in Sections 3.9.3 and 3.9.6.4. Snubbers in safety-related systems include provisions to allow access for IST program activities.

e. The design and installation of safety and relief valves are described in Section 3.9.3.

f. The seismic and dynamic qualification of mechanical and electrical equipment is described in Section 3.10.

g. The environmental qualification of safety-related pumps and valves is described in Section 3.11.

h. Safety-related valves that are part of the RCPB are designed and tested such that these valves will not experience any abnormal leakage, or increase in leakage, from their loading, as addressed in Section 3.10.

i. Pumps, valves, and snubbers are designed with sufficient margin to demonstrate that the design conditions are not exceeded.

j. Pump motors are designed to tolerate anticipated frequency and voltage variations due to degraded electrical power supply line conditions.

MEB AI 3-11,12,13 (8/26)

qualification

of them

Pumps and valves are tested within the IST program requirements to confirm that the required components are capable of performing their intended safety function. The safety analysis includes information concerning the design limitations and functional requirements for the performance of pumps and valves, including operation at the maximum flow rate. The IST pump functional design and pump qualification include an assessment for degraded flow conditions. The IST program requires pump and valve testing over the full range of system differential pressures, flow rates, temperatures, and available voltages (as applicable), from normal operating to design basis conditions, and considers degraded flow that may occur during post-accident conditions. IST testing is also performed on RCPB valves to demonstrate that they will not have leakage, or increased leakage, from their loading.

For each safety-related pump, the design basis and required operating conditions, including tests, under which the pump is required to function, will be established. These design conditions include flow rate and corresponding pump head for each system mode of pump operation and the required operating time for each mode, acceptable shaft vibration levels, seismic/dynamic loads, fluid temperature, ambient temperature, and pump motor minimum voltage.

For the safety-related valves, the IST program includes the following design and qualification requirements and acceptance criteria for these requirements. By testing each size, type, and model, the force requirements to operate the power-operated valves (POVs) is determined to provide reasonable assurance of the adequacy of the force that the operator can deliver under design conditions. For the safety-related power-operated valves, each size, type, and model are tested under a range of differential pressure and flow conditions up to the design conditions. These design conditions include fluid flow, differential pressure including pipe break, system pressure, fluid temperature, ambient temperature, minimum air supply system pressure, spring force, minimum voltage, and minimum and maximum stroke time requirements. This testing of each size, type, and model includes test data from the manufacturer, field test data for plant-specific dedication, empirical data supported by test, or tests of similar valves that support the qualification of the required valve where similarity is justified by technical data. This preoperational testing demonstrates that the results of the testing under in-situ or installed conditions can be used to provide reasonable assurance of the capability of the valves to operate under design conditions. Test data are used to provide reasonable assurance that the structural capability limits of the individual parts of the valves are not exceeded under design conditions.

Test data are used to provide reasonable assurance of the proper check valve application, including selection of the valve size and type based on the system flow conditions, installed location of the valve with respect to sources of turbulence, and correct orientation of the valve in the piping (vertical versus horizontal) as recommended by the manufacturer. Valve design features, material, and surface finish provide reasonable assurance that the non-intrusive diagnostic testing methods available in the industry or as specified can be accommodated. Flow through the valve is determinable from installed instrumentation, and valve disk positions are determinable without disassembly, such as by the use of non-intrusive diagnostic methods. Valve internal parts are designed with self-aligning features for correct installation.

3.9.6.2 Inservice Testing Program for Pumps

IST program

Inservice testing (IST) for safety-related pumps is developed in accordance with the requirements of ASME OM Code, ISTA and ISTB. Pumps subject to IST in accordance with the ASME Code are listed in Table 3.9-13. This table includes the safety class, test parameters, and the frequency at which the testing is performed.

Preservice testing is performed on pumps prior to initial plant operation.

This program includes baseline pre-service testing to support the periodic in-service testing of the safety-related pumps. Depending on the test results, the plan will provide commitment to disassemble and inspect the safety-related pumps.

reference value of pump speed,

For each size, type, and model of pump, testing that encompasses design conditions is performed to demonstrate acceptable flow rate and corresponding pump head, bearing vibration levels, and pump internals wear rates for the operating time specified for each system mode of pump operation. From these tests, baseline hydraulic and vibration data for evaluating the acceptability of the pump after installation are also developed. Test data are used to provide reasonable assurance that the pump specified for each application is not susceptible to inadequate minimum flow rate and inadequate thrust bearing capacity. With respect to minimum pump flow operation, the sizing of each minimum recirculation flow path is evaluated to provide reasonable assurance that its use under all analyzed conditions does not result in degradation of the pump. The flow rate through minimum recirculation

performance

The methods, range and accuracy of measurements used to measure pressure, flowrate, speed, and vibration meet the requirements of ASME OM Code, subsection ISTB-5000. The range, accuracy, instrument locations, fluctuations, and frequency response range meet the requirements of subsection ISTB-3510, ASME OM Code.

MEB AI 3-11,12,13 (10/26)

flow paths can be measured periodically to verify that flow is in accordance with the design specification.

The safety-related pumps and piping configurations accommodate ~~in-service testing~~ the IST at a flow rate at least as large as the maximum design flow for the pump application. The safety-related pumps are provided with instrumentation to verify that net positive suction head available (NPSHA) is greater than or equal to the net positive suction head required (NPSHR) during all modes of pump operation. These pumps can be disassembled for evaluation when ASME OM Code, ISTB testing results in a deviation that falls within the required action range. The code provides criteria limits for the test parameters identified in Table 3.9-13. The detailed IST program establishes the frequency and the extent of disassembly and inspection based on suspected degradation of all safety-related pumps, including the basis for the frequency and the extent of each disassembly. Factors to be considered in the frequency and extent of disassembly include, but are not limited to the following:

a. ~~Historical performance~~ Performance history of the pump to identify pumps that are prone to degradation/wear.

b. Analysis of trends of pump test parameters and service conditions.

c. Analysis of pump components that are subject to aging and require ~~a maintenance replacement approach~~ an approach to maintenance and replacement (e.g., O-rings).

d. Results of non-intrusive pump testing. The non-intrusive technologies used may obviate the need for inspection/disassembly of safety-related pumps, provided the technologies demonstrate an equivalent ability to detect pump degradation as inspection/disassembly would.

The testing requirements and acceptance criteria are identified in ISTB-5000.

The program may be revised throughout the plant life to minimize disassembly based on disassembly experience.

The COL applicant is to provide an IST program including type of testing and frequency of site-specific pumps subject to IST in accordance with the ~~ASME Code~~ ASME OM Code and Table 3.9-13 (COL 3.9~~(4)~~(5)).

3.9.6.3 Inservice Testing Program for Valves

The IST of safety-related valves is addressed in the IST program.

The valves IST program categories are classified based on the safety-related valve functions. The following categories are used in classifying the valve IST categories in accordance with the ASME OM Code.

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

b. Category B – valves for which seat leakage in the closed position is inconsequential for fulfillment of the required functions.

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

d. Category D – valves that are actuated by an energy source capable of only one operation, such as rupture disks or explosively actuated valves.

Category A and Category B valves are tested as follows:

a. ~~The full~~ Full-stroke exercising of valves during operation at power to the positions is required to fulfill their functions. If full-stroke exercising during operation at power is not practical, the testing may be limited to part-stroke exercising during operation at power and full-stroke exercising during cold shutdowns.

b. If valve exercising is not practical during operation at power, the testing may be limited to full-stroke exercising of the valves during cold shutdowns. Valve exercising may be limited to part-stroke during cold shutdowns and full-stroke during refueling outages.

MEB AI 3-11,12,13 (12/26)

c. Valve exercising is not required if the time period since the previous full-stroke exercise is less than 3 months. During extended shutdowns, valves that are required to perform their intended safety function are exercised every 3 months.

d. Valve exercising during cold shutdown commences within 48 hours of achieving cold shutdown and continues until testing is complete or the plant is ready to return to operation at power.

e. For extended outages, testing need not be commenced in 48 hours, provided all valves required to be tested during cold shutdown will be tested before or as part of plant startup. However, it is not the intent of this subsection to keep the plant in cold shutdown to complete cold shutdown testing.

f. All valve testing required to be performed during a refueling outage is completed before returning the plant to operation at power.

~~Detail information on Category A and Category B valves testing are addressed in Subsections 3.9.6.3.1 and 3.9.6.3.2.~~ Category C valves testing are addressed in Subsections 3.9.6.3.3 (check ~~vales~~ valves) and 3.9.6.3.6 (safety and relief valves).

IST for safety-related valves is developed in accordance with the requirements of ASME OM Code ISTA and ISTC. Table 3.9-13 lists the valves to be included in the IST program as well as the valve type, valve identification number, code class, valve category, valve functions, required tests, and test frequencies. Safety-related valves include the valves that are necessary to provide reasonable assurance of the following:

a. Integrity of the RCPB

b. Capability to achieve safe shutdown of the reactor and keep it in a safe shutdown condition

c. Capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures in excess of the guidelines of 10 CFR 100.11 ~~guidelines~~

Preservice testing is performed on valves prior to initial plant operation.

Table 3.9-13 also provides explanatory notes/justifications for any code defined testing exceptions. The IST program includes safety-related valve IST details, ~~including~~ and test schedules and frequencies, in the inspection and testing program. This program includes baseline preservice testing to support the periodic inservice testing of the safety-related valves. Depending on the test results, the plan will provide commitment to disassemble and inspect the safety-related valves. The primary elements of this plan, including the requirements of ~~GL 89-10~~ Generic Letter (GL) 96-05 (Reference 62) for motor-operated valves (MOVs), are ~~promulgated~~ presented in Subsection 3.9.6.3.1.

~~Inservice inspection (ISI) is described in Subsection 5.2.5 and Section 6.6.~~

The specific testing requirements and acceptance criteria are identified in ISTC-5000.

The COL applicant is to provide an IST program including the type of testing and frequency of any site-specific valves subject to IST in accordance with the ~~ASME Code~~ ASME OM Code and Table 3.9-13 (COL 3.9~~(5)~~(6)).

3.9.6.3.1 Inservice Testing Program for Motor-Operated Valves

~~IST of ASME Section III Classes 1, 2, and 3, and safety-related MOVs is performed in accordance with ASME OM Code with applicable addenda and GL 89-10, as required by 10 CFR 50.55a(f).~~

Insert C(next page)

The IST of MOVs relies on diagnostic techniques that are consistent with the state-of-the-art and that permit an assessment of the performance of the valve under actual loading. Periodic testing per ~~GL 89-10 Paragraphs D and J~~ GL 96-05 (Reference 62) is conducted under adequate differential pressure and flow conditions that allow a justifiable demonstration of continuing MOV capability for design basis conditions. The detailed IST program includes the optimal frequency of this periodic verification. The frequency and test conditions are sufficient to demonstrate continuing design basis and required operating capability. The IST interval between testing to demonstrate continued design basis capability does not exceed 5 years or three refueling outages, whichever is longer. The code provides criteria limits for the test parameters identified in Table 3.9-13 ~~for the~~ in accordance with ASME Code IST.

Insert C

In addition to the IST program requirements in the ASME OM Code incorporated by reference in 10 CFR 50.55a(f), 10 CFR 50.55a(b)(3)(ii) requires establishment of a program periodically to ensure that the safety-related MOVs continue to be capable of performing their design basis safety functions. GL 96-05 (Reference 62) provides additional guidance for the periodic verification of the design basis capability of MOVs.

Therefore, the IST program for all safety-related MOVs incorporates requirements of ISTC of ASME OM, and applicable addenda, as required by 10 CFR 50.55a(f).
The IST program incorporates ASME Code Case OMN-1, "Alternative Rules for Preservice and Inservice Testing of Active Electric Motor-Operated Valve Assemblies in Light-Water Reactor Power Plants," and OMN-11, as accepted by the NRC with conditions in RG 1.192 (Reference 66). The Code Cases listed in Table 2 of RG 1.192 (Reference 66) are conditionally accepted Code Cases, which may be used without request to the NRC provided it is used with any identified limitations or modifications.

The provision listed in Table 2 of RG 1.192 (Reference 66) includes:

a. The adequacy of the diagnostic test interval for each MOV must be evaluated and adjusted as necessary, but not later than 5 years or three refueling outages (whichever is longer) from initial implementation of OMN-1.

b. When extending exercise test intervals for high risk MOVs beyond a quarterly frequency, ensure that the potential increase in Core Damage Frequency (CDF) and risk associated with the extension is small and consistent with the intent of the Commission's Safety Goal Policy Statement.

c. When applying risk insights as part of the implementation of OMN-1, MOVs must be categorized according to their safety significance using the methodology described in Code Case OMN-3, with the conditions discussed in this regulatory guide or use other MOV risk ranking methodologies accepted by the NRC on a plant specific or industry-wide basis with the conditions in the applicable safety evaluations.

The IST program for MOVs also incorporates the guidance of NUREG-1482, Revision 2 (Reference 60). The periodic verification program for all safety-related MOVs incorporates the guidance of GL 96-05 (Reference 62) which supersedes GL 89-10 (Reference 61) and its supplements with regards to MOV periodic performance verification. The MOV periodic verification program also implements the recommendations from the Joint Owners Group (JOG) MOV Periodic Verification Program (MPR-2524-A, November 2006, Reference 67).

to verify correct MOV actuator sizing and control settings.

Each MOV is tested in the open and closed states under static and maximum achievable preoperational conditions using diagnostic equipment that measures torque and thrust, and motor parameters. The MOV is tested under various differential pressure and flow conditions up to maximum achievable conditions to determine torque and thrust requirements at design conditions. The parameters and acceptance criteria, which demonstrate fulfillment of the functional performance requirements, are as follows:

a. As required by the safety function, the valve is fully open or fully closed with diagnostic indication of hard-seat contact.

b. The control switch settings provide adequate margin to achieve design requirements including consideration of diagnostic equipment inaccuracies, control switch repeatability, load-sensitive behavior, and margin for degradation.

c. The motor output capability at degraded voltage is equal to or exceeds the control switch setting including consideration of diagnostic equipment inaccuracies, control switch repeatability, load-sensitive behavior, and margin for degradation.

d. The maximum torque and thrust achieved by the MOV, including diagnostic equipment inaccuracies and control switch repeatability, do not exceed the allowable structural capability limits for the individual parts of the MOV.

e. The remote position indication testing verifies that proper disk position is indicated in the control room.

f. Stroke time measurements taken during valve opening and closing meet minimum and maximum stroke time requirements.

The detailed IST program establishes the frequency and the extent of disassembly and inspection based on suspected degradation of all safety-related MOVs, including the basis for the frequency and extent of each disassembly. Factors to be considered in the frequency and extent of disassembly include, but are not limited to the following:

Performance history

a. ~~Historical performance~~ of the safety-related valves to identify valves that are prone to degradation/wear

MEB AI 3-11,12,13 (16/26)

b. Analysis of trends of valve test parameters and service condition

c. Analysis of valve components that are subject to aging and require ~~a maintenance replacement approach~~ (e.g., O-rings)

an approach to maintenance and replacement

d. Results of non-intrusive valve testing. Use of non-intrusive technologies may obviate the need for inspection/disassembly of safety-related valves altogether, provided the technologies demonstrate an equivalent ability to detect valve degradation as inspection/disassembly would.

The program may be revised throughout plant life to minimize disassembly based on past disassembly experience.

the

3.9.6.3.2 Inservice Testing Program for Power-Operated Valves Other than Motor-Operated Valves

Each power-operated valve (POV) is tested in the open and closed directions under static and maximum achievable preoperational conditions using diagnostic equipment that measures or provides information to determine total friction, stroke time, seat load, spring rate, travel under normal pneumatic or hydraulic pressure (as applicable to the type of POV), and minimum pneumatic or hydraulic pressure. The POV is tested under differential pressure and flow conditions up to maximum achievable conditions and perform tests to determine the force requirements at design conditions.

The force requirements to close the valve to the position at which there is diagnostic indication of full valve closure (as required for the safety function of the applicable valves) will be determined. The determination of design force requirements will be made for such parameters as differential pressure, fluid flow, minimum pneumatic or hydraulic pressure, power supply, temperature, and seismic/dynamic effects for POVs which must operate during these transients. The design force requirements will be adjusted for diagnostic equipment inaccuracies.

The total

~~Total~~ force delivered by the POV under static and dynamic conditions (including diagnostic equipment inaccuracies) will be measured to compare to the allowable structural capability

IST program of safety-related power-operated valves (air-operated, hydraulic-operated, solenoid-operated) is performed in accordance with the requirements of ASME OM Code by reference in 10 CFR 50.55a(f).

limits for the assembly and individual parts of the POV. Tests will be conducted for proper MCR position indication of the POV.

All safety-related piping systems incorporate provisions for testing to demonstrate the operability of the POVs under design conditions. Periodic testing is conducted under adequate differential pressure and flow conditions per the guidance of Regulatory Issue Summary 2000-03, which incorporates the lessons learned from MOV analyses and tests in response to GL 89-10 and the Joint Owners Group (JOG) air-operated valve program (Reference 63). Periodic testing allows a justifiable demonstration of continuing POV capability for design basis conditions. The detailed IST program includes the optimal frequency of this periodic verification. The frequency and test conditions are sufficient to demonstrate continuing design basis and required operating capability. The in-service testing of POVs incorporates the use of advanced non-intrusive techniques to periodically assess degradation and the performance characteristics of the POVs. Solenoid-operated valves (SOVs) are tested using Class 1E electrical power supply voltage and current to verify SOVs are capable of performing their safety functions at design basis accident conditions. SOV tests include confirmation of the energized position and fail position when de-energized. The ASME Insert D(next page) ISTC tests are performed, and valves that fail to exhibit the required performance can be disassembled for evaluation.

The ASME OM Code, Subsection ISTC, provides criteria limits for the test parameters identified in Table 3.9-13.

The detailed IST program establishes the frequency and the extent of disassembly and inspection based on suspected degradation of all safety-related POVs, including the basis for the frequency and the extent of each disassembly. Factors to be considered in the frequency and extent of disassembly include but are not limited to the following:

a. ~~Historical performance~~ Performance history of the safety-related valves to identify valves that are prone to degradation/wear

b. Analysis of trends of valve test parameters and service conditions

c. Analysis of valve components that are subject to aging and require ~~a maintenance replacement approach~~ an approach to maintenance and replacement (e.g., O-rings)

Insert D

Solenoid-operated valves (SOVs) are tested using Class 1E electrical power supply voltage and current to verify SOVs are capable of performing their safety functions at design basis accident conditions. SOV tests include confirmation of the energized position and fail position when de-energized.

All safety-related piping systems incorporate provisions for testing to demonstrate the operability of the POVs under design conditions. The inservice testing of POVs incorporates the use of advanced non-intrusive techniques to periodically assess degradation and performance characteristics of the POVs. The ASME OM Code, Subsection ISTC tests are performed, and valves that fail to exhibit the required performance can be disassembled for evaluation.

Periodic verification testing is conducted under adequate differential pressure and flow conditions per the guidance of Regulatory Issue Summary (RIS) 2000-03 (Reference 59), which incorporates the lessons learned from MOV analyses and tests in response to GL 96-05 (Reference 62). Periodic testing allows a justifiable demonstration of continuing POV capability for design basis conditions.

Additional testing is performed as part of the air-operated valve (AOV) periodic verification program, which includes the elements for an AOV periodic verification program as identified in the JOG air-operated valve program. The AOV periodic verification program incorporates the attributes for a successful POV design capability and long-term periodic verification program, as discussed in RIS 2000-03 (Reference 59) by incorporating lessons learned from previous nuclear power plant operations and research programs as they apply to the periodic testing of AOVs and other POVs included in the IST program. The lessons learned addressed in the AOV program include:

a. Setpoints for AOV are defined based on current vendor information or valve qualification diagnostic testing, such that the valve is capable of performing its design-basis function(s).

b. Periodic static testing is performed to identify potential degradation, unless those valves are periodically cycled during normal plant operation, under conditions that meet or exceed the worst case operating conditions within the licensing basis of the plant for the valve, which would provide adequate periodic demonstration of AOV capability. If required, based on valve qualification or operating experience, periodic dynamic testing is performed to re-verify the capability of the valve to perform its required functions.

c. Sufficient diagnostics are used 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.

d. Test frequency is specified, and is evaluated each refueling outage based on data trends as a result of testing. Frequency for periodic testing is in accordance with References JOG air-operated valve program (Reference 63) and Comments on JOG air-operated valve program (Reference 68), with a minimum of 5 years (or 3 refueling cycles) of data collected and evaluated before extending test intervals.

e. Post-maintenance procedures include appropriate instructions and criteria to demonstrate baseline testing is re-performed as necessary when maintenance on the valve, valve repair, or replacement has the potential to affect valve functional performance.

f. Guidance is included to address lessons learned from other valve programs in procedures and training specific to the AOV program.

g. Documentation from AOV testing, including maintenance records and records from the corrective action program are retained and periodically evaluated as part of the AOV program.

h. The attributes of the AOV testing program described above, to the extent that they apply to and can be implemented on other safety-related POVs, such as electro-hydraulic valves, are applied to those other POVs.

i. Safety-related valves are categorized according to their safety significance and risk ranking.

d. Results of non-intrusive valve testing. Use of non-intrusive technologies may obviate the need for inspection/disassembly of safety-related valves altogether, provided the technologies demonstrate an equivalent ability to detect valve degradation as inspection/ disassembly would.

The program may be revised throughout plant life to minimize disassembly based on past disassembly experience. the

3.9.6.3.3 Inservice Testing Program for Check Valves

All safety-related piping systems incorporate provisions for testing to demonstrate the operability of check valves under design conditions. The IST of check valves incorporates the use of advanced non-intrusive techniques to periodically assess degradation and the performance characteristics of the check valves. The effects of rapid pump starts and stops, as expected for system operating conditions, are considered in the testing. Conditions of ~~any~~ reverse flow that may occur during expected system operation are also considered in the testing. Non-intrusive technique includes acoustic, ultrasonic, magnetic, and x-ray technologies, which are used to measure valve operating parameters (e.g., fluid flow, disk position, disk movement, disk impact forces). The technique is also used for monitoring an upstream pressure or tank level, and for performing a leak test, a system hydrostatic or pressure test, or radiography. and

The parameters and acceptance criteria for demonstrating that the above functional performance requirements have been fulfilled are as follows:

a. During all tests modes that simulate expected system operating conditions, the valve disk fully opens or fully closes as expected based on the direction of the differential pressure across the valve.

b. Leak-tightness of valve when fully closed is within established limits, as applicable.

c. Valve disk positions are determinable without disassembly.

MEB AI 3-11,12,13 (21/26)

d. Valve testing must verify free disk movement whenever moving to and from the seat.

e. The disk is stable in the open position under normal and other required system operating fluid flow conditions.

f. The valve is correctly sized for the flow conditions specified, i.e., the disk is in full-open position at normal full-flow operating condition.

g. Valve design features, material, and surfaces accommodate non-intrusive diagnostic testing methods available in the industry or as specified.

h. Piping system design features accommodate all the applicable check valve testing requirements as described in Table 3.9-13.

The ASME OM Code, ISTC tests are performed, and check valves that fail to exhibit the required performance can be disassembled for evaluation. The ASME OM Code, ISTC, provides criteria limits for the test parameters as identified in Table 3.9-13.

The detailed IST program includes the frequency and extent of disassembly and inspection based on suspected degradation of all safety-related check valves, including the basis for the frequency and the extent of each disassembly. Factors to be considered in the disassembly frequency and extent of disassembly include but are not limited to the following:

Performance history

a. ~~Historical performance~~ of the safety-related check valves to identify valves that are prone to degradation/wear

b. Analysis of trends of valve test parameters and service conditions

c. Analysis of valve components that are subject to aging and require ~~a maintenance replacement approach~~

an approach to maintenance and replacement

d. Results of non-intrusive valve testing. Use of non-intrusive technologies may obviate the need for inspection/disassembly of safety-related check valves

3.9.6.4 Inservice Testing Program for Dynamic Restraints

Safety-related systems inside and outside of containment may experience dynamic effects under various accident conditions, including seismic events and DBAs. Snubbers are attached to these systems to reduce these dynamic effects in areas where rigid supports are unacceptable. The snubber is selected to satisfy the system design requirements. The snubber design and operating information form the basis for snubber examination and testing requirements.

As described in Subsection 3.12.6.6, dynamic restraints within piping systems is to be minimized as-much-as-possible due to the maintenance and testing requirements for these components. However, dynamic restraints in the form of snubber supports are used where free thermal movements are required and restraining movements caused by dynamic loadings are also required. Snubber operability inspections and tests including scope and frequency requirements are specified and controlled in the components support inspection and testing program plan. The ASME OM Code, provides ISI methods and requirements for examinations and tests of snubbers at nuclear power plants.

Preservice and in-service examinations are performed using the VT-3 visual examination method described in IWA-2213 of the ASME Section XI, 2007 edition with 2008 addenda. Snubbers are visually examined to identify impaired function caused by physical damage, leakage, corrosion, or degradation from environmental exposure or operating conditions. External features that may affect operability are also examined.

Insert E(next page)

Preservice functional testing is performed on snubbers prior to initial plant operation. This testing may be performed at the manufacturer's facility. Inservice functional testing is performed over the test plan intervals specified in ASME OM Code Subsection ISTD. Snubbers are tested in their installed location or removed and bench tested. Snubbers are tested in their as-found condition and the test parameters are selected so that the snubbers are tested to the fullest extent practicable.

Insert F(next page)

The APR1400 snubber design incorporates accessibility provisions for maintenance, inspection, and testing of components. The correct installation and operation of snubbers is confirmed as part of the ITP described in Section 14.2. This program includes visual inspections, hot and cold position measurements, and documenting thermally induced component movement that occurs during plant startup.

Insert G(next page)

Insert E

Intervals with the low rate of problem are in accordance with ASME Code Case OMN-13 (Reference 69) as accepted in NRC RG 1.192 (Reference 66).

Insert F

The functional test for snubbers is performed to verify activation level of velocity or acceleration, release rate, and drag force.

Generic Letter 90-09 (Reference 70) addresses that a snubber is considered unacceptable if it fails the acceptance criteria of the visual inspection. An engineering evaluation will be conducted to determine the cause of unacceptability for an unacceptable snubber. The unacceptable snubbers will be adjusted, repaired, modified, or replaced.

Insert G

The methods addressed in Nonmandatory Appendix F of the ASME OM code (Reference 34) will be applied for service life monitoring of dynamic restraints.

MEB AI 3-11,12,13 (24/26)

The COL applicant is to provide a table of all safety-related components that use snubbers in support systems and that includes the following information (COL 3.9~~(6)~~(7)).

a. Identification of the systems and components that use snubbers

b. The number of snubbers used in each system and on the components in that system

c. Identification of the type(s) of snubber (hydraulic or mechanical)

d. Specification whether the snubber was constructed in accordance with the ASME Section III, Subsection NF

e. A statement of whether the snubber is used as a shock, vibration, or dual-purpose snubber

f. If a snubber is identified as a dual-purpose or vibration arrester type, indication of whether the snubber and/or component was evaluated for fatigue strength

3.9.6.5 Relief Requests and Alternative Authorizations to ASME OM Code

In case implementing the requirements of ASME OM Code is impractical, the relief request will be made on a case-by-case basis. Information provided will describe the specific area of relief requested, explain why conformance with ASME OM Code is impractical, and describe any alternative test pursuant to 10 CFR 50.55a.

3.9.7 [Reserved]

3.9.8 [Reserved]

3.9.9 Combined License Information

COL 3.9(1) The COL applicant is to provide the inspection results for the APR1400 reactor internals classified as non-prototype Category I in accordance with NRC RG 1.20.

COL 3.9(2) The COL applicant is to provide a summary of the maximum total stress, deformation, and cumulative usage factor values for each of the component operating conditions for ASME Code Class 1 components except for ASME Code Class 1 nine major components. For those values that differ from the allowable limits by less than 10 percent, the contribution of each loading category (e.g., seismic, deadweight, pressure, and thermal) to the total stress is provided for each maximum stress value identified in this range.

The COL applicant is to also provide a summary of the maximum total stress and deformation values for each of the component operating conditions for Class 2 and 3 components required to shut down the reactor or mitigate consequences of a postulated piping failure without offsite power (with identification of those values that differ from the allowable limits by less than 10 percent).

COL 3.9(3) The COL applicant is to identify the site-specific active pumps.

COL 3.9~~(4)~~ (5) The COL applicant is to provide an IST program including the type of testing and frequency of site-specific pumps subject to IST in accordance with the ASME Code.

COL 3.9~~(5)~~ (6) The COL applicant is to provide an IST program including the type of testing and frequency of site-specific valves subject to IST in accordance with the ASME Code.

COL 3.9~~(6)~~ (7) The COL applicant is to provide a table listing all safety-related components that use snubbers in their support systems.

COL 3.9(4) The COL applicant is to provide a full description of the IST program including PST for pumps, valves and dynamic restraints and will be administratively controlled that the applicable requirements of the ASME OM Code edition and addenda are incorporated in the IST program.

Electric Power Research Institute, January 1982.

2. NUREG/CR-3862, "Development of Transient Initiating Event Frequencies for Use in Probabilistic Risk Assessment," U.S. Nuclear Regulatory Commission, May 1985.

63. Joint Owners Group Air Operated Valve Program, Rev. 1, December 13, 2000.

64. Regulatory Guide 1.124, “Service Limits and Loading Combinations for Class 1 Linear-Type Supports,” Rev. 3, U.S. Nuclear Regulatory Commission, July 2013.

65. Regulatory Guide 1.130, “Service Limits and Loading Combinations for Class 1 Plate-and-Shell-Type Supports,” Rev. 3, U.S. Nuclear Regulatory Commission, July 2013.

66. Regulatory Guide 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code", Rev.1, U.S. Nuclear Regulatory Commission, June 2014.

67. MPR-2524-A, "Joint Owners Group (JOG) Motor Operated Valve Periodic Verification Program Summary," MPR Associates, November 2006.

68. Comments on Joint Owners Group Air Operated Valve Program Document, Nuclear Energy Institute. October 8, 1999.

69. ASME OM Code Cases OMN-13, " Requirements for Extending Snubber Inservice Visual Examination Interval at LWR Power Plants," American Society of Mechanical Engineers, the 2004 Edition.

70. Generic Letter 90-09,"Alternative Requirements for Snubber Visual Inspection Intervals and Corrective Actions," U.S. Nuclear Regulatory Commission, December 11, 1990.

Table 1.8-2 (5 of 29)

Item No.	Description
COL 3.8(7)	The COL applicant is to confirm that uneven settlement due to construction sequence of the NI basemat falls within the values specified in Table 2.0-1.
COL 3.8(8)	The COL applicant is to provide the necessary measures for foundation settlement monitoring considering site-specific conditions.
COL 3.8(9)	The COL applicant is to provide testing and inservice inspection program to examine inaccessible areas of the concrete structure for degradation and to monitor groundwater chemistry.
COL 3.8(10)	The COL application is to provide the following soil information for APR1400 site: 1) Elastic shear modulus and Poisson's ratio of the subsurface soil layers, 2) Consolidation properties including data from one-dimensional consolidation tests (initial void ratio, Cc, Ccr, OCR, and complete e-log p curves) and time-versus-consolidation plots, 3) Moisture content, Atterberg limits, grain size analyses, and soil classification, 4) Construction sequence and loading history, and 5) Excavation and dewatering programs.
COL 3.9(1)	The COL applicant is to provide the inspection results for the APR1400 reactor internals classified as non-prototype Category I in accordance with RG 1.20.
COL 3.9(2)	The COL applicant is to provide a summary of the maximum total stress, deformation, and cumulative usage factor values for each of the component operating conditions for ASME Code Class 1 components except for ASME Code Class 1 nine major components. For those values that differ from the allowable limits by less than 10 percent, the contribution of each loading category (e.g., seismic, deadweight, pressure, and thermal) to the total stress is provided for each maximum stress value identified in this range. The COL applicant is to also provide a summary of the maximum total stress and deformation values for each of the component operating conditions for Class 2 and 3 components required to shut down the reactor or mitigate consequences of a postulated piping failure without offsite power (with identification of those values that differ from the allowable limits by less than 10 percent).
COL 3.9(3)	The COL applicant is to identify the site-specific active pumps.
COL 3.9~~(4)~~ (5)	The COL applicant is to confirm the type of testing and frequency of site-specific pumps subject to IST in accordance with the ASME Code.
COL 3.9~~(5)~~ (6)	The COL applicant is to confirm the type of testing and frequency of site-specific valves subject to IST in accordance with the ASME Code.
COL 3.9~~(6)~~ (7)	The COL applicant is to provide a table listing all safety-related components that use snubbers in their support systems.

COL 3.9(4)	The COL applicant is to provide a full description of the IST program including PST for pumps, valves and dynamic restraints and will be administratively controlled that the applicable requirements of the ASME OM Code edition and addenda are incorporated in the IST program.

form an interface between seismic Category I and seismic Category II/III (or NS) features are designed to seismic Category I requirements in accordance with Regulatory Position C.3 of NRC RG 1.29 (Reference 5). Seismic Category I design requirements extend to the first seismic anchor (restraint) beyond the defined boundaries.

Portions of some non-safety-related systems (e.g., fire protection system) are classified as seismic Category I to conform with NRC RG 1.189.

Seismic Category I SSCs are designed to remain functional and within the applicable stress and deformation limits (elastic range of material properties) when subjected to the effects of the vibratory motion of the operating basis earthquake (OBE) in combination with normal operation loads. This design is based on the design for SSE loads where an OBE is defined as one third of the SSE, as described in Subsection ~~3.7.1.1~~ 3.7.1. Seismic Category I structures are protected from interaction with adjacent non-seismic structures, as described in Subsection ~~3.7.2.8~~ 3.7.2.7.1. The seismic classifications of platforms and miscellaneous steel located in seismic Category I application are described in Subsection 3.8.3. MEB AI 3-19 MEB AI 3-19

Seismic Category I SSCs meet the pertinent QA requirements of 10 CFR Part 50, Appendix B (Reference 10). The criteria used for the design of seismic Category I SSCs are described in Section 3.7. MEB AI 3-20

b. Seismic Category II

SSCs that do not perform a nuclear safety-related function and whose continued function is not required are classified as non-nuclear safety (NNS) (see Subsection 3.2.3).

NNS SSCs that are not seismic Category I but whose failure by virtue of physical proximity to safety-related equipment or structures could prevent a component or structure from fulfilling its required function are classified as seismic Category II.

NNS SSCs are designed to preclude a gross structural failure resulting from an SSE that could degrade the ability of an adjacent safety-related SSC to function to

Table 1.8-2 (5 of 29)

Item No.	Description
COL 3.8(7)	The COL applicant is to confirm that uneven settlement due to construction sequence of the NI basemat falls within the values specified in Table 2.0-1.
COL 3.8(8)	The COL applicant is to provide the necessary measures for foundation settlement monitoring considering site-specific conditions.
COL 3.8(9)	The COL applicant is to provide testing and inservice inspection program to examine inaccessible areas of the concrete structure for degradation and to monitor groundwater chemistry.
COL 3.8(10)	The COL application is to provide the following soil information for APR1400 site: 1) Elastic shear modulus and Poisson's ratio of the subsurface soil layers, 2) Consolidation properties including data from one-dimensional consolidation tests (initial void ratio, Cc, Ccr, OCR, and complete e-log p curves) and time-versus-consolidation plots, 3) Moisture content, Atterberg limits, grain size analyses, and soil classification, 4) Construction sequence and loading history, and 5) Excavation and dewatering programs.
COL 3.9(1)	The COL applicant is to provide the inspection results for the APR1400 reactor internals classified as non-prototype Category I in accordance with RG 1.20.
COL 3.9(2)	The COL applicant is to provide a summary of the maximum total stress, deformation, and cumulative usage factor values for each of the component operating conditions for ASME Code Class 1 components except for ASME Code Class 1 nine major components. For those values that differ from the allowable limits by less than 10 percent, the contribution of each loading category (e.g., seismic, deadweight, pressure, and thermal) to the total stress is provided for each maximum stress value identified in this range. The COL applicant is to also provide a summary of the maximum total stress and deformation values for each of the component operating conditions for Class 2 and 3 components required to shut down the reactor or mitigate consequences of a postulated piping failure without offsite power (with identification of those values that differ from the allowable limits by less than 10 percent).
COL 3.9(3)	The COL applicant is to identify the site-specific active pumps.
COL 3.9(4)	The COL applicant is to confirm the type of testing and frequency of site-specific pumps subject to IST in accordance with the ASME Code.
COL 3.9(5)	The COL applicant is to confirm the type of testing and frequency of site-specific valves subject to IST in accordance with the ASME Code.
COL 3.9(6)	The COL applicant is to provide a table listing all safety-related components that use snubbers in their support systems.

Delete

The other loading conditions mean the loading conditions specified for the design of ASME Section III Class 1, 2, and 3 components, supports, and piping, Control Element Drive Mechanism (CEDM), and Reactor Pressure Vessel Internals except for design pressure and temperature. These items are defined in Subsections 3.9.3.1, 3.9.4, and 3.9.5.

... n Subsection 3.9.1.1. The ... , as defined in the ASME ... mponent in performing its

... systems are designed and constructed in accordance with ASME Section III. Hydrostatic testing is performed per ASME Section III.

Design pressure, temperature, and other loading conditions that provide the bases for design of fluid systems are presented in the sections that describe the systems.

Stress analysis and fatigue evaluations are performed to determine structural adequacy of pressure components under the operating conditions of normal, upset, emergency, or faulted, as applicable.

Significant structural discontinuities in parts such as nozzles and flanges are considered. In addition to the design calculation required by ASME Section III, stress analysis is also performed by methods outlined in the code appendices ~~or by other methods by reference to analogous codes or other published literature~~.

Delete

Thermal stratification and striping are described not to create adverse effect on the associated piping in Subsection 3.12.5.10.

The loading combinations for the design of ASME Code Class 2 and 3 components and supports, CEDM, and reactor internals are described in Subsections 3.9.3.1.3, 3.9.4, and 3.9.5, respectively.

~~The applicant is to provid a summary of the maximum total stress, deformation, and cumulative usage factor values for each of the component operating conditions for ASME Code Class 1 nine major components. For those values that differ from the allowable limits by less than 10 percent, the contribution of each loading category (e.g., seismic, deadweight, pressure, and thermal) to the total stress is provided for each maximum stress value identified in this range.~~

Delete

For ASME Code Class 1 components other than the nine major components, the COL applicant is to also provide the same summary of the analysis results (COL 3.9(2)).

The COL applicant is to also provide a summary of the maximum total stress and deformation values for each of the component operating conditions for Class 2 and 3 components required to shut down the reactor or mitigate consequences of a postulated piping failure without offsite power (with identification of those values that differ from the allowable limits by less than 10 percent) (COL 3.9(2)).

Delete

3.9.3.1.1 ASME Code Class 1 Components and Supports

Design transients for ASME Code Class 1 components and component supports are described in Subsection 3.9.1.1. Loading combinations for ASME Code Class 1 components are described in Table 3.9-2. Stress limits for ASME Code Class 1 components, supports, and piping are described in Table 3.9-3. The operating pressures of Code Class 1 active valves are limited to the pressures taken from the pressure-temperature rating of the ASME Section III for the maximum temperature of the given condition.

3.9.3.1.2 Reactor Internals

Design transients for reactor internals are described in Subsection 3.9.1.1. Loading combinations and stress limits are presented in Subsection 3.9.5.

3.9.3.1.3 ASME Code Class 2 and 3 Components and Supports

ASME Section III, Subsections NC and ND, provide design requirements for ASME Class 2 and 3 components. Loading combinations applicable to these Class 2 and 3 components and supports are described in Table 3.9-2. The stress criteria for the components are presented in Tables 3.9-5 through 3.9-9.

The Class 2 and 3 components that are subject to thermal or dynamic cyclic loads are evaluated for their fatigue sustainability using the ASME Section III NC-3219.2 per SRP 3.9.3. A fatigue analysis is also performed in accordance with NC-3200 for the components that do not meet the NC-3219.2 criteria.

COL 3.9(2) The COL applicant is to provide a summary of the maximum total stress, deformation, and cumulative usage factor values for each of the component operating conditions for ASME Code Class 1 components except for ASME Code Class 1 nine major components. For those values that differ from the allowable limits by less than 10 percent, the contribution of each loading category (e.g., seismic, deadweight, pressure, and thermal) to the total stress is provided for each maximum stress value identified in this range.

The COL applicant is to also provide a summary of the maximum total stress and deformation values for each of the component operating conditions for Class 2 and 3 components required to shut down the reactor or mitigate consequences of a postulated piping failure without offsite power (with identification of those values that differ from the allowable limits by less than 10 percent).

Delete

COL 3.9(3) The COL applicant is to identify the site-specific active pumps.

COL 3.9(4) The COL applicant is to provide an IST program including the type of testing and frequency of site-specific pumps subject to IST in accordance with the ASME Code.

COL 3.9(5) The COL applicant is to provide an IST program including the type of testing and frequency of site-specific valves subject to IST in accordance with the ASME Code.

COL 3.9(6) The COL applicant is to provide a table listing all safety-related components that use snubbers in their support systems.

3.9.10 <u>References</u>

1. EPRI-NP-2230, “ATWS: A Reappraisal, Part 3: Frequency of Anticipated Transients,” Electric Power Research Institute, January 1982.

2. NUREG/CR-3862, “Development of Transient Initiating Event Frequencies for Use in Probabilistic Risk Assessment,” U.S. Nuclear Regulatory Commission, May 1985.

performed with a simulator capable of independent motions in all three orthogonal directions. The input motions should be statistically independent.

d. The test response spectra (TRS) should envelop the RRS over the frequency range of interest. The TRS should be computed with a damping value equal to or greater than that of the RRS. The shake table maximum peak acceleration should equal or exceed the ZPA of the RRS. The total test duration and number of equivalent maximum peak cycles should be per IEEE Std. 344-2004.

Testing is performed to provide reasonable assurance that equipment can withstand the effects of seismic events and accidents and still be capable of performing its safety-related functions.

6.3.1.6

Seismic ground motion occurs simultaneously in all directions in a random fashion. Currently, single-axis, biaxial, and triaxial testing are allowed. A 10 percent margin is added on RRS during testing in accordance with Subsection ~~6.3.2.5~~ of IEEE-323. The TRS must envelop the RRS in order for an item of equipment to be qualified (or justified). Sometimes, in a low-frequency area (below 3 Hz), TRS does not envelop RRS because of machine limitations. This requires justification based on the dynamic characteristics of the equipment. The TRS and RRS should be compared at the same damping value. A conservative TRS is greater than the RRS. Justification must be made when the TRS is less than the RRS.

Vibration aging testing may be performed preceding the OBE and SSE tests to show that the lower levels of normal and transient vibration associated with the plant operation will not adversely affect the equipment's performance of its safety function.

Seismic qualification tests include five OBE test preceding the SSE for specified seismic events.

t. Loss of seal injection with loss of cooling water

A loss of seal injection with a loss of cooling water event is set as a DBE for the design of the RCP bleed-off line.

This event is assumed to occur five times during the 60-year plant design life.

3.9.1.1.3 Service Level C Conditions

There are no events classified as a Service Level C condition.

3.9.1.1.4 Service Level D Conditions

The events traditionally known as Service Level C conditions are classified as other Service Level conditions based on the recent nuclear power plant industry data (for example, a loss of offsite power with natural circulation event is classified as a Service Level B condition and one steam generator tube failure event as a Service Level D condition). The frequencies of events traditionally categorized as a Service Level C condition are conservatively modified to be classified as a Service Level B condition for design purpose.

Service Level D conditions con
conditions are categorized sir
accidents are considered as S
descriptions for specific events

a. Steam system piping fa

A main steam line break (MSLB) results in an increase in heat removal by the secondary system. A rupture in the main steam line is postulated to cause an uncontrolled blowdown of the steam generators until the main steam isolation valves (MSIVs) close upon the receipt of a main steam isolation signal (MSIS). If the steam line break occurs downstream of the MSIV, the closure of the MSIVs will terminate the primary system cooldown. If the steam line break occurs upstream of the MSIVs, the ruptured steam generator continues to blow down after MSIS, causing a greater cooldown of the primary system.

This event is assumed to occur one time during the 60-year plant design life.

b. Feedwater system line break (FWLB)

The feedwater system pipe break or feedwater line break (FWLB) is an accident that results in a decrease in heat removal from the secondary system. A break in