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March 04, 2011

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Mr. Jeffrey A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-11058

Subject: Supplemental MHI's Response to US-APWR DCD RAI No. 209-1803 REVISION 1(SRP Section 03.09.03)

Reference: 1) "Request for Additional Information No. 209-1803 Revision 1, SRP Section: 03.09.03 – ASME Code Class 1, 2, and 3 Components, Application Section: DCD, Tier 1 – Section 3.9.3," dated February 25, 2009.

2) "MHI's Response to US-APWR DCD RAI No. 209-1803 Revision 1", UAP-HF-09185, dated April 30, 2009

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Supplemental MHI's Response to Request for Additional Information No. 209-1803 Revision 1."

Enclosed is the response to the RAI contained within Reference 1.

This response will supplemented the previously transmitted responses submitted under MHI's Reference UAP-HF-09185 on April 30, 2009 (Reference 2) based on Conference Call between NRC and MHI on December 23, 2010.

Please contact Dr. C. Keith Paulson, Senior Technical Manager, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of the submittals. His contact information is below.

Sincerely,

Y. Ogata

Yoshiki Ogata
General Manager- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

Enclosures:

1. Supplemental Response to Request for Additional Information No. 209-1803 Revision 1

D081
NRO

CC: J. A. Ciocco
C. K. Paulson

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Docket No. 52-021
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Enclosure 1

UAP-HF-11058
Docket Number 52-021

Supplemental Response to Request for Additional Information
No. 209-1803 REVISION 1

March 2011

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/4/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 209-1803 REVISION 1**
SRP SECTION:	**03.09.03 - ASME Code Class 1, 2, and 3 Components**
APPLICATION SECTION:	**03.09.03**
DATE OF RAI ISSUE:	**02/25/09**

QUESTION NO. RAI 03.09.03-1:

To ensure that ASME components meet the service level stress and functionality requirements, the ASME Code, Section III, NCA-3000 requires that design specifications and corresponding design reports be prepared for ASME Code, Section III, Class 1, 2, and 3 components. In DCD Tier 2 (Rev. 1) Section 3.9.3, MHI states that the design specifications for ASME Code, Section III, Class 1, 2, and 3 components, supports, and appurtenances are prepared under administrative procedures that meet or exceed the ASME Code, Section III rules. The ASME Code also requires a design report for safety-related components, to demonstrate that the component design meets the requirements of the relevant ASME design specification and the applicable ASME Code, Section III requirements. MHI states that the licensee, or the licensee's authorized agent, is responsible for developing design specifications and design reports in accordance with the responsibilities outlined under the ASME Code, Section III rules. In order for the staff to reach a reasonable assurance finding based on the requirements of 10 CFR 52.47, however, certain information is required during the NRC review of the design certification application. The staff requests that MHI commit to provide the certified design specifications of risk-significant mechanical components, as a minimum, for NRC audit. This is to ensure that the components are ready for procurement, and to verify that the DCD design methodologies and criteria are adequately reflected in the associated component design specifications. As for the design reports, the staff requests that MHI discuss in the DCD its plan and schedule of making the design reports of US-APWR major mechanical components available for NRC audit, e.g., through an ITTAC, to ensure that MHI has established a procedure for verifying the completion of the US-APWR component design.

ANSWER:

MHI will prepare the certified design specifications of risk-significant mechanical components during the procurement stage, which is assured through ITAAC as reflected in Table 2.3-2 of DCD Tier 1. Design reports will be prepared in accordance with the design completion plan provided in Table 1 of MHI Letter UAP-HF-08123 (Ref. ML082030589, dated July 14, 2008). Technical Report UAP-HF-09139 was submitted to the Staff in March 2009 (Ref. ML091030073, dated March 31, 2009] which summarized the stress analysis and design specifications of major components and piping. Design completeness will be verified during the reconciliation of the "as-built" plant against pertinent design documents as committed in the system specific ITAAC.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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APPLICATION SECTION:	**03.09.03**
DATE OF RAI ISSUE:	**02/25/09**

SUPPLEMENTAL QUESTION NO. RAI 03.09.03-1:

The staff requests that MHI provide a specific list of the ASME requirements, design specifications and design report for the risk-significant mechanical components and schedule when these specifications and reports would be complete to support an NRC audit.

ANSWER:

MHI have already provided the information on the ASME Section III requirements, design specifications and stress reports for the risk-significant mechanical components by the MHI's letter UAP-HF-10207 "Updated Design Completion Plan for US-APWR Piping Systems and Components" dated on July 21, 2010. This letter descried the specific list of components. MHI will prepare these design specifications and stress reports to be available for an NRC audit on June 2011.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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DATE OF RAI ISSUE:	**02/25/09**

QUESTION NO. RAI 03.09.03-2:

In DCD Tier 2 (Rev. 1) Section 3.9.3.1, MHI states, "This subsection establishes the criteria for the selection and definition of design limits and loading combinations associated with normal operation, postulated accident, and specified seismic and other transient events for the design of other safety-related ASME Code, Section III components." It is not clear what MHI means by stating that this section is applicable to OTHER safety-related components. The staff requests that MHI address the following:

(a) Clarify what other safety-related components are referenced in the above statement.

(b) Clarify if the design of Quality Group D (per RG 1.26: for systems not part of the RCPB, but may contain radioactive materials) components satisfy the ASME B31.1 or any other industry Code/Standard requirements.

ANSWER:

(a) In DCD Subsection 3.9.3.1, first paragraph, first sentence, the word "other" was inadvertently included. The referenced subsection pertains to all safety related components and therefore the word "other" will be deleted.

(b) The industry code and standard requirements for Quality Group D components will be reflected in the design specifications to be developed.

Impact on DCD

See Attachment 1 for a mark-up of DCD Tier 2 Section 3.9, Revision 2 changes to be incorporated.

- Change the first sentence in the first paragraph in Subsection 3.9.3.1 to the following: "This subsection establishes the criteria for the selection and definition of design limits and loading combinations associated with normal operation, postulated accidents, and specified seismic and other transient events for the design of safety-related ASME Code, Section III (Reference 3.9-1) components."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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SUPPLEMENTAL QUESTION NO. RAI 03.09.03-2:

The staff stated that the response to part (b) did not provide enough information, and the staff request MHI to identify Code and Standard requirements for these components, and provide information on how these components will be treated.

ANSWER:

MHI will provid Code and Standard requirements for componets in these design specifications, and prepare these design specifications for an NRC audit on June 2011.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO. RAI 03.09.03-8:

In DCD Tier 2 (Rev. 1) Section 3.9.3.1.5, MHI provides the loading combinations and stress limits criteria for ASME Code, section III, Class 2 and 3 components and supports. DCD Table 3.9-8 summarizes the stress criteria per ASME Code Subarticles applicable to these Class 2 and 3 components and their supports. Clarify the following:

(a) Article NC-3300 provides criteria for vessel design, while NC-3200 provides an alternative design rules for vessels. DCD Table 3.9-8 for vessels/tanks specifies NC- 3217 for the design and service level A condition. The staff noted that there exists no corresponding NC-3317 similar to NC-3217 on design criteria. Discuss the criteria that are used in the design of the US-APWR vessels in accordance with NC-3217 for service level A condition. Also, explain why these criteria are not applicable to other service level conditions for the vessel design.

(b) MHI states that the environmental impact on fatigue of Class 2 and 3 components will follow guidelines established by the NRC at the time of actual analysis. Explain why this should not be a COL information item.

ANSWER:

(a) Reference to NC-3217 in Table 3.9-8 is not appropriate since that subsection provides design criteria not stress criteria. Table 3.9-8 will be changed in Revision 2 to delete reference to NC-3217 for vessels/tanks for the design and service Level A condition.

(b) MHI will be evaluating the environmental impact on fatigue of Class 2 and 3 components and will be submitting the design report as a DC application document. Therefore, this item should not be considered as a COL item. Appropriate changes to the DCD Subsection 3.9.3.1.5 will be considered upon completion of the evaluation.

Impact on DCD

See Attachment 1 for a mark-up of DCD Tier 2 Section 3.9, Revision 2 changes to be incorporated.

- Change the first row (below titles), second column of Table 3.9-8 to the following: "ASME Code, Section III, NC/ND-3310, 3320"

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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SUPPLEMENTAL QUESTION NO. RAI 03.09.03-8:

The staff noted that for Class 1, MHI will be using RG 1.207 for environmental fatigue, but for Class 2 and 3, MHI has not stated if they are using RG 1.207 or not for environmental fatigue. As such, Part (b) of the question is not closed for the Class 2 and 3 components.

The staff stated that should be clarified in the DCD that the Class 2 and 3 components are not required to be evaluated for environmental fatigue per RG 1.207 (need to note that these components do not have such exposure). However, some Class 2 and 3 components are exposed to high radiation or high thermal cycles and therefore their materials are susceptible to environmental fatigue, and there needs to be information provided on how those components will be treated (RG 1.207 or whatever guidance is applied). The DCD needs to be clarified for those Class 2 and 3 components that have such exposure that RG 1.207 or what other guidance will be used to address environmental fatigue.

The staff summarized that they are seeking clarification on how MHI is addressing environmental fatigue on Class 2 and 3 components that are exposed to a harsh environment, specifically per RG 1.207 or some other guidance

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ANSWER:

MHI presented the policy of the environmental impact on fatigue of Class 2 and 3 components by public meeting based on in "Notice of Forthcoming Public and Closed Meetings with Mitsubishi Heavy Industries, Ltd. to Discuss The Design of Piping Systems and Components for The US-APWR Design", (Ref. ML102030536, dated on July 23, 2010). MHI has interpreted that Class 2 and 3 components are out of scope of the environmental fatigue evaluation in accordance with Regulatory Guide 1.207 noted. However, MHI will be performed to be screening evaluation that temperature fluctuation to occur in the junction between cold and hot water, and asses environmental impact on fatigue.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO. RAI 03.09.03-13:

MHI states in DCD Tier 2 (Rev. 1) Section 3.9.3.4 that in accordance with the ASME Code, Section III, non-mandatory Appendix F, the structural integrity of the seismic Category II pipe supports is ensured so that the SSE would not cause unacceptable structural interaction or failure of seismic Category I SSCs. The support design will follow the intent and general requirement specified in ASME Code, Section III, non-mandatory Appendix F. The staff did not find any details about the design criteria for seismic Category II supports for service level A, B, and C load combinations. Explain why the design of these supports is limited to service level D (faulted) loads only (i.e., ASME Appendix F) and provide details about the overall design criteria for seismic Category II component supports.

ANSWER:

The supports referred to in Subsection 3.9.3.4 do not require seismic evaluation to service level A, B, or C load combinations and are not governed by the ASME Code. It is required, however, that these supports be analyzed and designed such that an SSE event does not cause an unacceptable interaction with the seismic category I piping. The analysis performed confirms that these category II piping supports maintain structural integrity when subjected to the SSE earthquake loading. Therefore, the general requirements specified in ASME Code, Section III, non-mandatory Appendix F are used in the support design and a service level D is appropriate and sufficient.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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SUPPLEMENTAL QUESTION NO. RAI 03.09.03-13:

The staff stated that in accordance with SRP Section 3.7.2(ii), the staff noticed that this needs to consider failure of all of the non-Category I structures, supports and components, it is not limited to the piping; and under SSE conditions would not impair the seismic Category I SSCs or cause injuries to the main control room occupants. The staff stated that there needs to be more information provided for Subsections 3.9.3 and 3.7.2 to address this concern, so that the NRC can determine that non-seismic Category I structural failure would not impact the seismic Category I SSCs or cause injury to the main control room occupants. The staff stated that MHI needs to expand upon the DCD to explain how design of non-seismic Category I SSCs prevents failure that would otherwise affect seismic Category I structures or components, relative to application of general requirements of ASME Code, Section III, Appendix F (supports), specifically, Service Level D loads.

ANSWER:

Non-seismin Category I SScs will design in accordance with requirements of ASME Code, Section III, Appendix F for Servicee Level D, as a results, non-seismic Category I SScs do not have an influence to the Category I SScs by securing integrity of the non-seismic Category I SSCs. These information is provided in US-APWR DCD Revision 2, Subsection 3.9.3.4.6.2 for components supports.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO. RAI 03.09.03-14:

The staff noted that DCD Tier 2 (Rev. 1) Section 3.9.3.4.2.4 did not provide sufficient information for potential snubber end fitting clearances, mismatch of activation and release rates, and lost motion.

(a) Discuss how the snubber design will account for snubber end fitting clearances, mismatch of activation and release rates, and lost motion.

(b) How each of these elements would affect the calculations of snubber reaction loads and stresses using a linear analysis methodology?

(c) In multiple snubber applications where mismatch of end fitting clearance and lost motion exists, discuss their potential impact on the synchronism of activation level or release rate and, consequently, on the assumption of the load sharing of multiple snubber supports.

ANSWER:

(a) The end clearances are minimal. The project procurement specifications will require snubber vendors/manufacturers to provide tight fitting pins and spherical bearings that allow for off axis movement while minimizing lost motion at both ends of the connection (i.e., the pipe clamp and the end structural attachment). Any end fitting clearances, as well as release rates and lost motion, will be accounted for in the average dynamic spring rate provided to the designer by the manufacturer.

(b) These elements are accounted for in the spring rate of the snubber. The magnitude of the reaction of the snubber is affected by the spring rate used. Since these elements are accounted in the spring rate, these elements will also effect snubber load resulting from the piping stress analysis.

(c) There are two types of multiple snubber application: in parallel and in series.

1. For parallel applications, like a trapeze type arrangement on a riser, each snubber has independent motion. Therefore, small differences in the synchronism of the two snubbers will not result in any substantial load differential between the two snubbers. For example, when the snubber on the one end of the riser clamp locks, the other end of the riser will start rotating about the pin of the first snubber. This will cause the second snubber to lock almost immediately and take its share of the load. However, as long as the manufacturer supplies the entire assembly (i.e., the same wall brackets, snubbers, and pipe attachments at both ends), the lost motion will be almost identical, as the manufacturing tolerances are very tight at the connection points. Additionally, hydraulic snubbers by their nature will load share more effectively, as they have no internal "dead band", and begin to respond immediately.

2. For snubbers in series (e.g., multiple axial snubbers on the same run of pipe), the issue of non-synchronized locking of the snubbers is possible. The first snubber that locks has the potential to pickup the entire axial load of the pipe without the other snubbers necessarily locking at the same instant since the axial motion of the pipe will be entirely stopped by the first snubber that locks and no motion is left for the pipe to activate the other snubbers. Therefore, multiple snubbers in series in one direction will not be used in the piping design.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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SUPPLEMENTAL QUESTION NO. RAI 03.09.03-14:

(a) The staff would like MHI to explain how any end fitting clearance as well as the release rate allow motion of this type of snubber for dynamic support that is provided by the manufacturer.

(b) How would this affect the snubber calculation reaction load in linear analysis methodology? In the previous response, the procurement specs from the vendor would provide the general requirements for these snubbers during the motion. The NRC would like to know how the clearance, release rate and lost motion of the snubber have been calculated, including reaction loads and stress using linear analysis methodology. Does vendor have any calculation for this per the procurement spec?

(c) How would parallel snubbers be treated for shared loads on the end of a riser, where manufacturer provides entire assembly? How do you ensure manufacturer provides entire assembly with alike parameters for the two snubbers?

ANSWER:

(a) The end attachments are a tight fit, and any end fitting clearance as well as the release rate are accounted for in the equivalent spring rate of the snubber.

(b) The equivalent spring rate of the snubber is used in the piping stress analysis to calculate the load imposed by the dynamic response of the pipe to the snubber. The dynamic response of the piping system and the magnitude of the dynamic loads imposed by the piping on the snubber and adjacent restraints, is dependant, among others, upon the spring rate of the snubber used in the dynamic analysis of the piping system. Therefore, through the equivalent spring rate of the snubber, the impact of any end fitting clearances as well as release rates and lost motion are accounted for in the dynamic analysis of the pipe to determine the dynamic response of the pipe. This dynamic response dictates the piping stresses as well as the pipe support reactions, which in turn are qualified per the applicable code.

The project pipe support specification will require that the vendor provides Load Capacity Data (LCD) or Certified Design Report Summary (CDRS) sheets stamped by a Licensed

Professional Engineer, with all the necessary design data, which also includes the equivalent spring rate of the snubbers. All the data shown on these documents need to be backed up by calculations and/or tests, which can be audited and verified.

(c) It is standard practice for parallel snubbers, which are also parallel to the pipe run, to use identical snubbers (i.e., the same vendor, same part number, same size and same length as well as same distance from the pipe), so that they will behave in the same manner during a dynamic event. This requirement will be stipulated in the project pipe support design specification.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

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QUESTION NO. RAI 03.09.03-23:

In DCD Tier 2 (Rev. 1) Section 3.9.3.4.7, MHI discusses snubbers used as component supports. Snubbers are generally hydraulic; however, there are mechanical snubbers available that lock-up at equivalent hydraulic velocities. Details of snubber design, testing, operation, maintenance, inspection, and other functional characteristics are presented in DCD Tier 2 (Rev. 1) Section 3.9.3.4.2.

(a) It is stated that there are mechanical snubbers available that lock-up at equivalent hydraulic velocities. Clarify what does this mean. Provide criteria or individual cases when mechanical or hydraulic snubbers are used in the component support design.

(b) MHI also states that with the implementation of LBB criteria and the elimination of the analysis of dynamic effects of pipe breaks detailed in Subsection 3.6.3, the use of snubbers is minimized in these LBB qualified piping systems. Discuss how snubbers are minimized based on the satisfaction of the LBB criteria for a piping system.

ANSWER:

(a) For hydraulic and mechanical snubbers, the movement is not equivalent so that the lock-up system is different for arresting a movement. MHI will change Subsection 3.9.3.4.7 as shown below.

(b) Snubbers are used at the SG intermediate shell support and upper shell support in the RCL. The support design is performed using the necessary and sufficient number of snubbers to satisfy the SG seismic design. The results generated by using the calculated MCP piping load to meet the LBB criteria minimize the use of snubbers.

Impact on DCD

See Attachment 1 for a mark-up of DCD Tier 2 Section 3.9, Revision 2 changes to be incorporated.

- Change the first paragraph in Subsection 3.9.3.4.7 to the following: "Snubbers are considered manufactured standard support components. Snubber manufacturers provide various sizes of snubbers and rated loading consistent with ASME Level A, B, C, and D service conditions. Snubbers are generally hydraulic; however, there are mechanical snubbers which have adequate functionality that is resistance to drift velocity change. Details of snubber design, testing, operation, maintenance, inspection, and other functional characteristics are presented in this subsection."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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SUPPLEMENTAL QUESTION NO. RAI 03.09.03-23:

The NRC expressed their concern relative to the need for criteria to be provided that explains the DO's and DON'Ts of applying mechanical and hydraulic snubbers in component support designs. MHI should elaborate on this so the staff understands how this would be addressed.

ANSWER:

The general rule is that for large piping with large loads, hydraulic snubbers will be used, and for small piping with small dynamic loads, mechanical snubbers can be used. However, when using snubbers for a system (analyzed using a single analytical model) there will be no mix and match use of hydraulic and mechanical snubbers. For every system analyzed using a single analytical model in which snubbers are used, the snubbers will be of the same type (i.e., either all hydraulic or all mechanical), so that there will be no issues of interaction between snubbers of different characteristics. These requirements will be included in the project pipe support specification.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

This completes MHI's responses to the NRC's supplemental questions.

3.9.3.1 Loading Combinations, System Operating Transients, and Stress Limits

This subsection establishes the criteria for the selection and definition of design limits and loading combinations associated with normal operation, postulated accidents, and specified seismic and other transient events for the design of ~~other~~ safety-related ASME Code, Section III (Reference 3.9-1) components. These load combinations may include the effects of dead load, internal and external pressure, component and insulation weights, and fluid effects due to various system operational characteristics including testing, predicted thermal expansion, seismic induced dynamic loads and displacements, support reaction loads, and other loads as specified by the requirements of the ASME Code, Section III (Reference 3.9-1), Subsection NB, NC, ND, NF or NG Code depending upon component and Service Level classification.

The basis of the ASME component design acceptance for applicable loading combinations involves comparison of calculated stress and fatigue demand levels to acceptable stress and fatigue capacity allowables specified by ASME Code, Section III (Reference 3.9-1). The ASME Code acceptance standards differ depending on whether a component is classified as ASME Code, Section III, Class 1, 2, or 3. In addition to the ASME classification, plant operational modes and frequency of system operating and/or transient events are used to define which ASME service limit (Level A [Normal], Level B [Upset], Level C [Emergency], Level D [Faulted], and Test) applies. These service limits are defined in Subsection 3.9.1. The system operating and/or transient events are developed from guidance provided in ANS N51.1-1983 (Reference. 3.9-2). The design transients for the US-APWR Class 1 RCS are defined in Subsection 3.9.1. These transients are determined based on a 60-year plant operational life and are classified into the ASME Level A, Level B, Level C, and Level D service limits, and test conditions, depending on the expected frequency of occurrence and severity of the event. The design transients for ASME Level A and B service conditions are required by the ASME Code, Section III, Subsection NB-3200 (Reference 3.9-1), in the evaluation of cyclic fatigue for the Class 1 components and piping. The effects of seismic events are also included in the evaluation of cyclic fatigue by defining a 1/3 SSE seismic event as Level B service condition which will require fatigue evaluation of both thermal and seismic effects. The number of cycles considered are based on equivalent of usage factor where 300 cycles at 1/3 SSE stress range equals the same usage factor as 20 cycles a SSE stress range (see Reference 3.9-~~33~~34).

3.9.3.1.1 Seismic Load Combinations

As indicated in Subsection 3.9.1, mechanical components, classifications are in accordance with ASME Code, Section III, Subsection NCA-2000 (Reference 3.9-1) for Division 1 systems, components, and supports. The required load combinations including seismic events for ASME Code, Section III (Reference 3.9-1), Classes 1, 2, and 3 components and structures is presented in Tables 3.9-3 and 3.9-4, and for piping and pipe supports, in tables within Section 3.12. Table 3.9-5 provides the definition of terms associated with Tables 3.9-3 and 3.9-4.

Two occurrences of an SSE are assumed in the qualification of seismic category I systems and components, including core support structures, using the Level D service condition for pressure boundary integrity. Additionally, fatigue sensitive components are qualified for cyclic motion due to earthquakes smaller than the SSE. Included in the analyses, are the seismic effects of seismic events with amplitude not less than 1/3 SSE amplitude[3]. The number of earthquake motion cycles used is based on IEEE Std 344-2004, Appendix D (Reference 3.9-34) guidance. This guidance requires the equivalent fatigue damage of two full SSE events with 10 high-stress cycles per event, therefore, 20 high-stress cycles. One SSE cycle is equivalent to 15 cycles at 1/3 SSE amplitude in accordance with Reference 3.9-34; therefore, 20 full SSE cycles are equivalent to 300 cycles at 1/3 SSE amplitude.

Tables 3.9-3 and 3.9-4 provide required loads and load combinations associated with ASME Code, Section III (Reference 3.9-1), Class 1, 2, 3 and Class CS systems, components and supports.

~~Due to the low probability of occurrence of a SSE during operational modes occurring less than 10% of the plant's operation time, the SSE is analyzed in combination only with those operating modes that occur greater than 10 percent of the time.~~

The SSE is~~, therefore,~~ considered combined under the following PCs:

- Normal plant full (100%) power conditions and normal plant operating temperatures are considered for material properties and are used in combination with SSE.
- It is assumed that a simultaneous Loss of Offsite Power and a single failure within ~~of~~ a safety-related system occur as a result of an SSE event. In addition, it is assumed that non safety-related systems are unavailable.
- For concurrent events, the timing sequence and initiating conditions that occur between the SSE and occasional transients such as valve discharge are considered combined when the SSE is the initiator of the transient condition. The SSE duration is considered as 22 seconds. Non-seismic structures and components are assumed to be functionally and structurally unavailable at the beginning of the SSE. A single failure assumption is considered for a single active component.
- An evaluation of non safety-related systems is performed to assure that their failure in an earthquake does not impact or jeopardize plant safe shutdown or required post accident monitoring.
- The fire protection lines that could affect safe-shutdown equipment or required post accident equipment through rupture and/or flooding during or following a seismic event are required to be seismically qualified.

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[3] OBE as used in Table 1 of SRP 3.9.3, Appendix A and in ASME Code, Section III for stress evaluation subject to fatigue is 1/3 SSE with SSE damping. The earthquake inertial and anchor movement loads used in the Level B stress intensity range and alternating stress calculation is taken as 1/3 of the peak SSE inertial and anchor movement loads. In this case, the number of cycles to be ~~(continued on next page) (continued from previous page)~~ considered for earthquake loading is 300 as derived in accordance with Appendix D of IEEE Standard 344-2004 (Reference 3.9-34). In certain cases for non-standard SSCs, the 1/3 SSE may be adjusted higher for site-specific design since the site-specific value of OBE is determined by the COL Applicant as discussed in "OBE" of DCD Subsection 3.7.1.1 ~~as permitted by SECY 93-087 (Reference 3.9-17)~~. If used, the COL Applicant is to demonstrate that applicable stress, strain, and deformation limits are satisfied based on the site-specific OBE selected.

the response, and the seismic anchor motion loads represent the static secondary portion.

- Subsection 3.7.3 and Section 3.12 provide the seismic analysis methods used in qualification of piping systems.

Transient loading resulting from a postulated pipe break is analyzed.

- Dynamic flow and pressure loads are analyzed.
- Postulated pipe breaks and the interaction effects on safety-related components and structures are considered based on the requirements of GDC 4 and NUREG-0800, SRP 3.6.1 (Reference 3.9-35) and SRP 3.6.2 (Reference 3.9-36). The pipe rupture event considered for loading is the largest pipe that does not satisfy LBB criteria.
- Asymmetric blowdown load is discussed in Section 3.9.2.5.
- DCD Subsections 3.6.1 and 3.6.2 define postulated pipe break locations and requirements for the evaluation of postulated pipe breaks.

LBB criteria described in Subsection 3.6.3 are used in accordance with GDC 4 and NUREG 1061, Volume 3 (Reference 3.9-37), to determine the following:

- The RCL, the specific ~~RCS~~ RCL ASME Code, Section III, Class 1 branch lines and main steam lines listed in Appendix 3B that can be exempted from required pipe rupture considerations by meeting LBB criteria.
- Piping in these systems that do not meet LBB screening criteria and; therefore, require pipe rupture analysis.

Additional transient loadings are considered as follows:

- Sudden opening and closing of active valves, relief valves and safety valves.
- Components and piping evaluated for the dynamic response to transient loads. ~~The relief valve open system (sustained) is evaluated as a static load subject to a dynamic load factor (DLF).~~

Additional loading events and the effects on safety-related equipment are examined. The loads are evaluated for local and global stress effects on a case-by-case basis and are not combined with any other Level C or D service condition. These additional loads include the following conditions:

- A RCP locked rotor event in the RCL is evaluated for pressure effects and dynamic fluid transient effects on the RCP, SG channel head, and reactor coolant piping. During this event, the RCP is assumed to come to a rapid (but not instantaneous) stop and to transfer the angular momentum through the motor enclosure and pump casing to the SG nozzle and reactor coolant piping. The stresses calculated for this event are evaluated using Level D service limits for the immediately affected components and supports in the affected RCL and using Level B service limits for components in the other RCL. The Level B service stress limits for components outside the affected loop are used for both

Prior to installation, the following tests, as appropriate to the function and mission of the valve, are performed: shell hydrostatic test, backseat and main seat leakage tests, disc hydrostatic tests, and operational tests to verify that the valve opens and closes.

Cold hydro tests, hot functional tests, periodic inservice inspections, and periodic inservice operations are performed in situ to verify the functional capability of the valve.

Section 3.11 describes the operability qualification of motor operators for the environmental conditions.

For active valves with extended structures, an analysis of the extended structure is performed for equivalent static SSE loads applied at the center of gravity of the extended structure.

In addition to these tests and analyses, a representative number of valves of each design type are tested for verification of operability during a simulated Level D service condition SSE condition event by demonstrating operational capabilities within the specified limits.

Valve sizes that cover the range of sizes in service are tested.

When seismic qualification is based on dynamic or equivalent static load testing for structures, systems or subsystems that contain mechanisms that must change position in order to function, operability testing is performed for the SSE preceded by one or more earthquakes. The number of preceding earthquakes is calculated based on IEEE Std 344-2004, Appendix D (Reference 3.9-34) to provide the equivalent fatigue damage of two SSE events.

The seismic qualification testing procedures for valve operability testing are as follows:

The valve is mounted in a manner that will conservatively represent typical valve installations. The valve includes the operator, accessory solenoid valves, and position sensors when attached to the valve in service.

The operability of the valve during a Level D service condition is demonstrated by satisfying the following criteria:

A static load or loads equivalent to those resulting from the accelerations due to Level D service conditions is applied to the extended structure center of gravity so that the resulting deflection is in the nearest direction of the extended structure. The design pressure of the valve is applied to the valve during the static deflection tests.

The valve is cycled while in the deflected position. The valve must function within the specified operating time limits while subject to design pressure.

Electrical motor operators, position sensors, and pilot solenoid valves necessary for operation are qualified in accordance with IEEE seismic qualification standards (Reference 3.9-15). Section 3.10 describes the methods and criteria used to qualify electrical equipment.

3.9.3.4.2.5 Design Specifications

The design specification contains the following and includes the performance, structural, and mechanical properties of the snubbers as provided in the above subsections:

1. General functional requirement
2. Operating environment
3. Applicable codes and standards
4. Materials of construction and standards for hydraulic fluids and lubricants
5. Environmental, structural, and performance design verification tests
6. Production unit functional verification tests and certification
7. Packaging, shipping, handling, and storage requirements
8. Description of provisions for attachments and installation
9. Quality assurance and assembly quality control procedures for review
10. Acceptance by the purchaser

The COL Applicant is to assure snubber functionality in harsh service conditions, including snubber materials (e.g., lubricants, hydraulic fluids, seals).

3.9.3.4.2.6 Considerations for Inspection, Testing, Repair, and/or Replacement of Snubbers

An installation instruction manual contains complete instructions for the testing, maintenance, and repair of the snubber. It contains the required inspection locations and the periods of inspection. The program for inservice examination and testing of snubbers in the completed US-APWR construction is prepared in accordance with the requirements of ASME Code, Section XI (Reference 3.9-43) and ASME OM Code (Reference 3.9-13). Applicable industry and regulatory guidance is used including RG 1.192 (Reference 3.9-44). The intervals for visual examination are the subject of Code Case OMN-13 (Reference 3.9-45), which is accepted under the RG 1.192 (Reference 3.9-44). The examination and test procedures for the snubber is included in the IST program plan, developed per the implementation schedule as described in Chapter 13, Section 13.4. The ~~pipe support~~ applicable design specification requires that hydraulic snubbers be equipped with a fluid level indicator so that the level of fluid in the snubber can be ascertained.

Snubber thermal movement is reviewed, adequate clearance and gaps are verified, including motion measurements, and acceptance criteria assure compliance with ASME Code, Section III (Reference 3.9-1), Subsection NF.

3.9.3.4.2.7 Snubber Design and Testing

Snubbers are designed to meet operational requirements for withstanding sudden dynamic motion due to earthquakes or sudden transient events. Snubbers must be capable of moving freely during thermal cycling under various modes of plant operation. In addition, snubbers are designed to structural capacity limits that are designated by the manufacturer. Design specifications require specific lock-up rates under dynamic inertia loads as well as static seismic loads are considered in the design of frame supports per ASME Code, Section III (Reference 3.9-1), Subsection NF.

For insulated pipes, special pipe guides such as pipe saddles with one or two way restraint may be used in order to minimize the heat loss of piping systems.

Frame type supports have a limited total gap of 1/8th inch to avoid thermal binding due to radial thermal expansion of the pipe. For large pipes with higher temperatures, this gap is evaluated to assure that no thermal bending occurs. The minimum total gap is specified to assure that it is adequate for the thermal radial expansion of the pipe to avoid any thermal binding.

3.9.3.4.5 ~~Special Engineered Pipe Supports~~ Component Support Baseplate and Anchor Bolt

~~Special engineered pipe supports are engineered pipe supports other than manufactured standard supports or supplementary steel supports. Special engineered supports are supports that use non-standard specialized components and can have both mechanical and structural characteristics. These support types are used generally on systems that have high thermal expansion and require seismic or vibration support.~~

~~The design criteria and dynamic testing requirements for the ASME Code, Section III (Reference 3.9-1) piping supports are as follows:~~

- ~~The supports for ASME Code, Section III (Reference 3.9-1), Class 1, 2, and 3 components including pipe supports satisfy the requirements of the ASME Code, Section III (Reference 3.9-1), Subsection NF. The welded connections of tube steel members satisfy the requirements of the Structural Welding Code, ANSI/AWS D1.1 (Reference 3.9-47), Section 10. The boundary between the supports and the building structure is based on the rules found in the ASME Code, Section III, (Reference 3.9-1), Subsection NF. Table 3.9-1 presents the loading conditions. Table 3.9-4 summarizes the load combinations. The stress limits are presented in Tables 3.9-6 and 3.9-8 for the various service levels.~~
- ~~The criteria for Appendix F in ASME Code, Section III (Reference 3.9-1), is used for the evaluation of Level D service conditions. When supports for components not built to ASME Code, Section III (Reference 3.9-1) criteria are evaluated for the effect of Level D service conditions, the allowable stress levels are based on tests or accepted industry standards comparable to those in Appendix F of ASME Code, Section III (Reference 3.9-1).~~
- ~~In order to provide for operability of active equipment, including valves, ASME Code, Section III limits for Level C service loadings are met for the supports of these items.~~
- ~~Dynamic loads for components loaded in the elastic range are calculated using DLFs, time-history analysis, or any other method that accounts for elastic behavior of the component. A component is assumed to be in the elastic range if yielding across a section does not occur. Local yielding due to stress concentration is assumed not to affect the validity of the assumptions of elastic behavior. The stress allowables of Appendix F for elastically analyzed components are used for Code components. Inelastic stress analysis is not used.~~

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~~The use of baseplates with concrete expansion anchors is minimized in the US-APWR. Concrete expansion anchors may be used for pipe supports. For these pipe support baseplate designs, the baseplate flexibility requirements of IE Bulletin 79-02, Revision 2 (Reference 3.9-48), are met by accounting for the baseplate flexibility in the calculation of anchor bolt loads.~~

The use of baseplates with concrete expansion anchors is minimized in the US APWR. Concrete expansion anchors may be used for component supports. Design of component anchorage to concrete follows the requirements of ACI-349 Appendix B (Reference 3.9-50) considering the limitations of RG 1.199 (Reference 3.9-51). All aspects of the anchor bolt design, baseplate flexibility and factors of safety are utilized as identified in IE Bulletin 79-02, Revision 2 (Reference 3.12-24).

3.9.3.4.6 ASME Code, Section III, Class 1, 2, and 3 Component Supports

The establishment of the design/service loadings and limits are in accordance with the ASME Code, Section III (Reference 3.9-1), Division 1, Article NCA-2000 and Subsection NF. These loadings and stress limits apply to the structural integrity of components and supports when subjected to combinations of loadings derived from plant and system operating conditions and postulated plant events. The combination of loadings and stress limits are included in the design specification of each component and support. Where the design and service stress limits specified in the code do not necessarily provide direction for the proper consideration of operability requirements for conditions which warrant consideration, Section II.3 and Appendix A of SRP 3.9.3 (Reference 3.9-27), RG 1.124 (Reference 3.9-41) and RG 1.130 (Reference 3.9-42) are used for guidance. Where these stress limits apply, the treatment of functional capability, including collapse, deformation and deflection limits are evaluated and appropriate information is developed for inclusion into the design specification.

ASME Code, Section III (Reference 3.9-1) component supports are designed, manufactured, installed, and tested in accordance with all applicable codes and standards. Supports include hangers, snubbers, struts, spring hangers, frames, energy absorbers, and limit stops. Pipe whip restraints are not considered as pipe supports.

Section 3.13 provides the requirements for the design of bolts for component supports. Review of programs for ensuring bolting and threaded fastener adequacy and integrity is performed under NUREG-0800, SRP 3.13 (Reference 3.9-49).

The design and installation of all anchor bolts are performed in accordance with Appendix B to "Anchoring to Concrete", American Concrete Institute (ACI) 349 (Reference 3.9-50) subject to the conditions and limitations specified in RG 1.199 (Reference 3.9-51).

It is preferable to attach pipe supports to embedded plates; however, surface-mounted baseplates with undercut anchor bolts can be used in the design and installation of supports for safety-related components.

The load combinations and allowable stresses for ASME Code, Section III (Reference 3.9-1), Class 1 component supports are given in Tables 3.9-4 and 3.9-6.

- Emergency – For emergency conditions, the allowable stresses or load ratings are 33% higher than those specified for normal conditions. This is consistent with subsection NF of ASME Code, Section III (Reference 3.9-1) in which (see NF-3250 and NF-3260 ~~3231~~) limits for emergency conditions are 33% greater than the normal condition limits.
- Faulted – Stress limits are specified in Appendix F which assure that no large plastic deformations will occur (Stress less than 1.2 S_y). If any inelastic behavior is considered in the design, detailed justification is provided for this limit. Otherwise, the supports for active components are designed so that stresses are less than or equal to S_y. Thus, the operability of active components is not endangered by the supports during faulted conditions.

2. Plates and shells supports are designed to the following service level and stress limits:

- Normal – Normal condition limits are those specified in Subsection NF-3320 of ASME Code, Section III (Reference 3.9-1).
- Upset – Limits for upset conditions equal normal condition limits and are consistent with Subsection NF-3320 of ASME Code, Section III (Reference 3.9-1).
- Emergency – For emergency conditions, the allowable stresses or load ratings are 20% higher than those specified for normal conditions.
- Faulted – Same as faulted limits for linear supports.

~~For active ASME Code, Section III, Class 2 or 3 pumps, support adequacy is proven by satisfying the criteria in Tables 3.9-4 and 3.9-8. In addition to these requirements for meeting stress limits, an evaluation of pump/motor support misalignment is required.~~

~~Active valves are, in general, supported only by the pipe attached to the valve. Exterior supports on valves are generally not used.~~

3.9.3.4.7 Use of Energy Absorber and Limit Stops

Energy absorbers and limit stops are not used as ASME Code, Section III, Class 1, 2 and 3 component supports in the US-APWR design.

3.9.3.4.8~~7~~ Snubbers Used as Component Supports

Snubbers are considered manufactured standard support components. Snubber manufacturers provide various sizes of snubbers and rated loading consistent with ASME Level A, B, C, and D service conditions. Snubbers are generally hydraulic; however, there are mechanical snubbers ~~available that lock-up at equivalent hydraulic velocities~~ which have adequate functionality that is resistance ~~toward~~ to drift velocity change. Details of snubber design, testing, operation, maintenance, inspection, and other functional characteristics are presented in this subsection.

Snubber manufacturers are required to construct safety-related snubbers to ASME Code, Section III (Reference 3.9-1), Subsection NF standards. The US-APWR layout

Power Plants. NUREG-0800, SRP 3.9.2, Rev.3, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

3.9-26 Design Response Spectra for Seismic Design of Nuclear Power Plants. Regulatory Guide 1.60, Rev.1, U.S. Nuclear Regulatory Commission, Washington, DC, December 1973.

3.9-27 Stress Limits for ASME Class 1, 2, and 3 Components and Component Supports, and Core Support Structures Under Specified Service Loading Combinations. Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800 SRP Section 3.9.3 and Appendix A to SRP 3.9.3, Rev.2, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

3.9-28 General Design Criteria for Nuclear Power Plants, Domestic Licensing of Production and Utilization Facilities, Energy. Title 10, Code of Federal Regulations, Part 50, Appendix A, U.S. Nuclear Regulatory Commission, Washington, DC.

3.9-29 Codes and Standards, Domestic Licensing of Production and Utilization Facilities, Energy. Title 10, Code of Federal Regulations, Part 50.55a, U.S. Nuclear Regulatory Commission, Washington, DC.

3.9-30 Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants, Energy. Title 10, Code of Federal Regulations, Part 52, U.S. Nuclear Regulatory Commission, Washington, DC.

3.9-31 Contents of Applications, Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants, Energy. Title 10, Code of Federal Regulations, Part 52.47(b)(1), U.S. Nuclear Regulatory Commission, Washington, DC.

3.9-32 Issuance of Combined Licenses, Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants, Energy. Title 10, Code of Federal Regulations, Part 52.80(a), U.S. Nuclear Regulatory Commission, Washington, DC.

3.9-33 Earthquake Engineering Criteria for Nuclear Power Plants, Domestic Licensing of Production and Utilization Facilities, Energy. Title 10, Code of Federal Regulations, Part 50, Appendix S, U.S. Nuclear Regulatory Commission, Washington, DC.

3.9-34 IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations, IEEE Std. 344-2004, Appendix D, Institute of Electrical and Electronics Engineers Power Engineering Society, New York, New York, June 2005. ~~IEEE Std 344-2004.~~

3.9-35 Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 3.6.1, Rev. 3, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

3.9-36 Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 3.6.2, Rev.2, US Nuclear Regulatory Commission, Washington, DC, March 2007.

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3.9-37 Evaluation of Potential Pipe Breaks, NUREG-1061, Vol. 3, U.S. Nuclear Regulatory Commission Piping Review Committee, November 1984.

3.9-38 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. Regulatory Guide 1.207, Rev.1, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

3.9-39 Nuclear Facilities-Steel Safety-Related Structures for Design, Fabrication and Erection. (1994 edition), ANSI/AISC N690, American National Standards Institute/American Nuclear Society.

3.9-40 Manual of Steel Construction. American Institute of Steel Construction, 9th Edition, 1989.

3.9-41 Service Limits and Loading Combinations for Class 1 Linear-Type Component Supports. Regulatory Guide 1.124, Rev.2, US Nuclear Regulatory Commission, Washington, DC, February 2007.

3.9-42 Service Limits and Loading Combinations for Class 1 Plate-and-Shell-Type Component Supports. Regulatory Guide 1.130, Rev.2, U.S. Nuclear Regulatory Commission, Washington, DC, March 2007.

3.9-43 Rules for Inservice Inspection of Nuclear Power Plant Components, ASME Boiler and Pressure Vessel Code. ASME Section XI, 1995 Edition through the 2003 Addenda, American Society of Mechanical Engineers.

3.9-44 Operation and Maintenance Code Case Acceptability, ASME OM Code, Regulatory Guide 1.192, US Nuclear Regulatory Commission, Washington, DC, June 2003.

3.9-45 Requirements for Extending Snubber Inservice Visual Examination Interval at LWR Power Plants, American Society of Mechanical Engineers (ASME) Code Case OMN-13, Rev.0, 2000.

3.9-46 Technical Evaluation of Generic Issue 113: Dynamic Qualification and Testing of Large Bore Hydraulic Snubbers, NUREG/CR-5416, Nitzel, M.E.; Ware, A.G. EG&G Idaho Inc.; Page J.D. NRC; September 1992 (EGG-2571).

3.9-47 Structural Welding Code – Steel. ANSI/AWS D1.1, American National Standards Institute/American Welding Society.

3.9-48 Pipe Support Base Plate Designs using Concrete Expansion Anchor Bolts. IE Bulletin 79-02, Rev.2, U.S. Nuclear Regulatory Commission, Washington, DC, November 1979.

3.9-49 Threaded Fasteners – ASME Code Class 1, 2, and 3, Design of Structures, Components, Equipment, and Systems, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants. NUREG-0800, SRP 3.13, Rev.0, U.S. Nuclear Regulatory Commission, Washington, DC, June 1996.

3.9-50 Anchoring to Concrete. ACI 349, American Concrete Institute.

3.9-51 Anchoring Components and Structural Supports in Concrete. Regulatory Guide 1.199, Rev.0, U.S. Nuclear Regulatory Commission, Washington, DC, November 2003.

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Table 3.9-3 Minimum Design Loading Combinations for ASME Code, Section III, Class 1, 2, 3 and CS Systems and Components

ASME Service Level	Design Loading Combinations(3)(6)(12)
Design	$P + DL + L_{DM} + L_{EM}$
Level A	$P_M^{(1)} + DL + L_{EM}$
	$P_M^{(1)} + DL + L_{DFN}^{(7)} + L_{EM}^{(7)} + TH_{TRN} + TH_{MTL}$
Level B	$P_M^{(1)} + DL + L_{EM}^{(7)} + TH_{TRN} + TH_{MTL} + SRSS^{(2)}((SSEI + SSEA)^{(11)} + L_{DFU}^{(7)})$
Level C	$P_M^{(1)} + DL + L_{DFE}^{(5)(7)} + L_{EM}^{(7)}$
	$P_M^{(1)} + DL + L_{DF} + L_{EM}^{(8)}$
Level D	$P_M^{(1)} + DL + L_{DFF}^{(7)} + L_{EM}^{(7)}$
	$P_M^{(1)} + DL + SRSS^{(2)}((SSEI + SSEA) + DBPB) + L_{EM}^{(4)}$
	$P_M^{(1)} + DL + RV_{OS} + SRSS^{(2)}(SSEI + SSEA) + L_{EM}^{(9)}$
	$P_M^{(1)} + DL + L_{DFS} + SRSS^{(2)}((SSEI + SSEA) + DBPB + L_{DF}) + L_{EM}^{(8)}$
Hydrostatic Test	$H_{DL}^{(10)}$

Notes:

1. P_M is the maximum operational pressure for various ASME service levels of operation and dependent on the type of transient that occurs at a particular service level. During an earthquake P_M is considered normal operational pressure at 100% power levels.
2. SRSS sums the squares of each load and determines the resultant square root.
3. Loadings generated by static displacement of the concrete containment vessel and building settlement are added to the loading combinations for ASME Code, Section III, Class 2 and 3 systems.
4. When determining appropriate load combinations involving L_{EM}, a determination of the timing sequence and initiating conditions that occur between P_M and L_{EM} are considered.
5. Deleted. Pressurizer safety valve discharge and associated load is classified under an emergency service condition.
6. Table 3.9-5 provides a description of loads listed in this table.
7. In determining service level A, B, C, and D load combinations, the timing sequence and initiating conditions that occur between P_M, L_{DFN}, L_{DFU}, L_{DFE}, L_{DFF}, and L_{EM}, are considered respectively.
8. In determining appropriate service level load combination, the timing sequence and initiating conditions that occur between P_M, L_{DF}, and L_{EM}, are considered.
9. In determining appropriate service level load combination, the timing sequence and initiating conditions that occur between P_M, RV_{OS}, and L_{EM}, are considered.
10. If, during operation, the system normally carries a medium other than water (air, gas, steam), sustained loads should be checked for weight loads during hydrostatic testing as well as normal operation weight loads.
11. The earthquake inertial and anchor movement loads used in the Level B Stress Intensity Range and Alternating Stress calculations are taken as 1/3 of the peak SSE inertial and anchor movement loads or as the peak SSE inertial and anchor movement loads. If the earthquake loads are taken as 1/3 of the peak SSE loads then the number of cycles to be considered for earthquake loading are 300 as derived in accordance with Appendix D of Institute of Electrical and Electronic Engineers Standard 344-1987 (Reference. 3.9-15). If the earthquake loads are taken as the peak SSE loads then 20 cycles of earthquake loading are considered.
12. If a loading is considered negligible or is non-existent, it is ignored in the service level combinations.

Table 3.9-4 Minimum Design Loading Combinations for Supports for ASME Code, Section III, Class 1, 2, and 3 Piping and Components(2)

Condition	Design Loading Combinations(3)(10)
Design	$DL + L_{DM}$
Level A Service	$DL + TH_i + L_{EM} + L_{DFN}(4)+ F$
Level B Service	$DL + TH_i + L_{EM} + L_{DFU}$(4))
Level C Service	$DL + TH_i + L_{EM} + L_{DFE}$(5)(4)
	~~$DL + TH_i + L_{EM} + L_{DF}$~~
Level D Service	$DL + TH_i + L_{EM} + RV_{OS} + SSEI + SSEA + SE$(6)(8)
	$DL + TH_i + L_{EM} + L_{DFF}$(4)
	$DL + TH_i + L_{EM}$ + SRSS (DBPB + (SSEI + SSEA + SE))(6)
	$DL + TH_i + L_{EM}$(7) $+ L_{DFS}$ + SRSS (DBPB + (SSEI + SSEA + SE))(6) $+L_{DFF}$)(7)
Hydrostatic Test	H_{DL}(9)

Notes:

1. SRSS sums the squares of each load and determines the resultant square root.
2. Loadings generated by static displacement of the concrete containment vessel and building settlement are added to the loading combinations for ASME Code, Section III, Class 2 and 3 systems.
3. Table 3.9-5 provides a description of loads listed in this table.
4. In determining service level A, B, C, and D load combinations, the timing sequence and initiating conditions that occur between TH_i, L_{DFN}, L_{DFU}, L_{DFE}, L_{DFF}, and L_{EM}, are considered respectively.
5. Deleted. ~~Pressurizer safety valve discharge and associated load is classified under an emergency service condition.~~
6. SE is support self weight excitation of the support, caused by seismic building inertial loads. SSEI, SSEA, and SE are combined using absolute summation.
7. In determining appropriate service level load combination, the timing sequence and initiating conditions that occur among TH_i and L_{DFE} are considered.
8. In determining appropriate service level load combination, the timing sequence and initiating conditions that occur between TH_i and RV_{OS} are considered.
9. If, during operation, the system normally carries a medium other than water (air, gas, steam), sustained loads should be checked for weight loads during hydrostatic testing as well as normal operation weight loads.

~~10. If a loading is considered negligible or is non-existent, it is ignored in the service level combinations.~~

Table 3.9-8 Stress Criteria for ASME Code, Section III Class 2 and 3 Components and Supports

Design/ Service Level	Vessels/Tanks	Piping (6)	Pumps	Valves, Disks, Seats	Component Supports (1)(2)
Design and Service Level A	ASME Code, Section III, ~~NC-3217~~ NC/ND-3310, 3320	See Section 3.12	ASME Code, Section III, NC/ND-3400	ASME Code, Section III, NC/ND-3510	ASME Code, Section III, (3)
Service Level B (Upset)	ASME Code, Section III, NC/ND-3310, 3320	See Section 3.12	ASME Code, Section III, NC/ND-3400	ASME Code, Section III, NC/ND-3520	ASME Code, Section III, (3)
Service Level C (Emergency)	ASME Code, Section III, NC/ND-3310, 3320	See Section 3.12	ASME Code, Section III, NC/ND-3400	ASME Code, Section III, NC/ND-3520	ASME Code, Section III, (3)
Service Level D (Faulted)	ASME Code, Section III, NC/ND-3310, 3320	See Section 3.12	ASME Code, Section III, NC/ND-3400	ASME Code, Section III, NC/ND-3520 (5)	ASME Code, Section III, (3)(4)

Notes:

1. Component supports include equipment and piping supports. For pipe support criteria explanation refer to Section 3.12 of the DCD. For component supports refer to Section 3.9.3 of the DCD.
2. RG 1.124, Rev. 1 provides additional methods that can be used for evaluating component supports in addition to ASME Code, Section III, Subsection NF requirements.
3. ASME Code, Section III, Subsection NF, Table 3131(a)-1 provides reference paragraphs for Subsection NF procedural sections used for design of component supports, piping supports, and standard supports.
4. Subsection 3.9.3.4 provides criteria for component supports used for active equipment, valves, and piping with active valves.
5. Active valve operability is demonstrated by testing or analysis. Pressure integrity verification of active valves is based on using the ASME Code allowables one level less than the service loading condition. Subsection 3.9.3.2 provides additional information on test requirements.
6. Table 3.12-3 provides additional stress limit information for piping.