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MFN 07-086
Supplement 2

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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 67 Related to ESBWR Design Certification Application – Design Of Structures, Components, Equipment, and Systems - RAI Numbers 3.9-114 S01, 3.9-117 S01 and 3.9-175 S01**

Enclosure 1 contains GEH's response to the subject NRC RAIs transmitted, respectively, via emails on May 10, 2007, May 15, 2007 and June 13, 2007. GE's original responses were provided in the Reference 1 letter.

If you have any questions or require additional information, please contact me.

Sincerely,

Kathy Sedney for

James C. Kinsey
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. MFN 07-086, Letter from James C. Kinsey, GEH, to U.S. Nuclear Regulatory Commission, *Response to Portion of NRC Request for Additional Information Letter No. 67 Related to ESBWR Design Certification Application – DCD Section 3.9 – RAI Numbers 3.9-24, 3.9-25, 3.9-28, 3.9-31, 3.9-33, 3.9-45, 3.9-111, 3.9-112 through 3.9-119, 3.9-123 through 3.9-126, and 3.9-175*, dated February 16, 2007

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 67 Related to ESBWR Design Certification Application – Design Of Structures, Components, Equipment, and Systems - RAI Numbers 3.9-114 S01, 3.9-117 S01 and 3.9-175 S01

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MFN 07-086, Supplement 2

Enclosure 1

Response to Portion of NRC Request for

Additional Information Letter No. 67

Related to ESBWR Design Certification Application

Design Of Structures, Components, Equipment, and Systems

RAI Numbers 3.9-114 S01, 3.9-117 S01 and 3.9-175 S01

The Original Responses to RAI 3.9-114, RAI 3.9-117 and RAI 3.9-175 that were previously submitted under MFN 07-086 are included to provide historical continuity for review.

NRC RAI 3.9-114

In DCD Tier 2, Section 3.9.3.7.1(3), sufficient information is not provided for potential snubber end fitting clearance and lost motion. Discuss how snubber end fitting clearance and lost motion are managed, and how they affect the calculations of snubber reaction loads and stresses using a linear analysis methodology. In multiple snubber applications where mismatch of end fitting clearance and lost motion exist, discuss their potential impact on the synchronism of activation level or release rate, and, consequently, the assumption of the load sharing of multiple snubber supports.

GE Response

Snubber design detail is added in DCD Tier 2, Section 3.9.3.7.1 (3) c.

DCD Impact

DCD Tier 2, Section 3.9.3.7.1 (3) c will be revised as noted in the attached markup.

NRC RAI 3.9-114 S01

RAI 3.9-114 S01 Comment on response to RAI 3.9 114 (MFN 07 086): (eMail from Chandu Patel 5/10/07)

In RAI 3.9 114, the staff requested the applicant to discuss how snubber end fitting clearance and lost motion are accounted for, and how they would affect the calculations of snubber reaction loads and stresses using a linear analysis methodology. In multiple snubber applications where mismatch of end fitting clearance and lost motion exist, the staff also requested the applicant to 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. By letter dated February 16, 2007, the applicant stated that in multiple snubber applications where mismatch of end fitting clearance and lost motion could possibly exist, the synchronism of activation level or release rate will be evaluated, if deemed necessary, in the piping analysis model when this application could be considered critical to the functionality of the system, such as a multiple snubber application located near rotating equipment. Equal load sharing of multiple snubber supports will not be assumed if a mismatch in end fitting clearances exists and will be evaluated as a part of this assessment. The staff found the applicant's response to be insufficient in explaining how the effects of snubber end fitting clearance and lost motion would be calculated and, as a result, how non equal load sharing of multiple snubber supports will be accounted for in the piping analysis model.

GEH Response

Each end connection consists of a spherical ball bushing with a spacer bar(s) that permits controlled angular rotation in any plane. Snubbers are not permitted to be skewed at severe angles from their connecting points and are not allowed to be binding in the pipe clamp. By design, end connection clearance is not considered a critical element of the support function as long as the manufacturer specifications and installation instructions are strictly adhered too.

Total lost movement, excluding that due to compressibility of fluid and major structural parts, is expected to be less (in the range of 0.05") than the normal gap seen at other types of rigid supports due to construction tolerances and fit-up. This minimal gap is not expected to warrant any "specialty" type of analyses due to this extremely small magnitude in movement.

In the application, the effects of snubber end fitting clearance and lost motion are not considered to be significant and have no bearing on the safety of the piping system to which the snubbers are attached. Typically, snubbers are modeled in a linear analysis as rigid restraints in the dynamic model, which means that their design load is 1.52 times the product of the distributed mass and the seismic acceleration (F=DLFma) at the lowest fundamental frequency in the seismic spectrum. If there is any movement due to end fitting clearance and snubber engagement motion, the net result will be a reduction in dynamic load factor and an increase in system damping, resulting in a reduced dynamic force on the snubber during the earthquake. Therefore it is conservative to ignore end fitting clearances and snubber engagement displacements.

In a snubber pair where one snubber engages before the other, each snubber is typically capable of carrying the entire seismic restraint load by itself without failure. The resulting snubber stress may exceed the design limit, but the other snubber, with its delayed engagement, will pick up load before failure of the snubber that engages first.

DCD Impact

No DCD changes will be made in response to this RAI.

NRC RAI 3.9-117

In DCD Tier 2, Section 3.9.3.7.1(3)c(ii), certain test requirements are provided for snubbers to ensure that they can perform as required under all pertinent loading conditions. In connection with the stated test requirements, (1) discuss the procedure and scope of production test and the qualification test programs, separately, for both the mechanical and hydraulic snubbers, of different sizes and manufacturers; (2) discuss how the criteria of each pertinent snubber functional parameters are met in the testing; and (3) provide the codes and standards used for the programs.

GE Response

Responses included in this DCD satisfy the above question.

DCD Impact

DCD Tier 2, Section 3.9.3.7.1 (3) c will be revised as noted in the attached markup.

NRC RAI 3.9-117 S01

RAI 3.9-117 S01 Comment on response to RAI 3.9-117 S01:

In RAI 3.9-117, the staff requested the applicant to (1) discuss the procedure and scope of production test and qualification test programs, separately, for both mechanical and hydraulic snubbers of different sizes and manufacturers; (2) discuss how the criteria of each pertinent snubber functional parameters are met in the testing; and (3) provide the codes and standards used for the programs. In its response dated February 16, 2007, the applicant stated that DCD Tier 2, Subsection 3.9.3.7.1(3)c will be revised in Rev. 03 to add the following statement:

"Production and qualification test programs for both hydraulic and mechanical snubbers are carried out by the snubber vendors in accordance with the snubber installation instruction manual required to be furnished by the snubber supplier. Acceptance criteria to assure compliance with ASME Section III Subsection NF are cited in this manual, and applicable codes and standards are referenced."

The staff found the above applicant's response to be inadequate in resolving RAI 3.9-117. The staff, therefore, requests that the applicant supplement its response to the previously requested additional information on the snubber production and qualification test programs. For a more specific delineation, the staff requests the applicant to address the following, for mechanical and hydraulic snubbers of all makes and sizes: (1) how are the snubber production and qualification test programs carried out in accordance with the snubber installation instruction manual, as stated in the February 16, 2007, response; (2) confirmation that the production tests consider all snubbers in the population, or justification if not so; (3) how are the samples selected for the qualification tests; (4) what are procedures taken to get the required snubber load ratings demonstrated; (5) what are the acceptance criteria cited in the installation *instruction manual that would ensure compliance with ASME Code Section III, Subsection NF, and what are the referenced Subsection NF requirements; (6) what are the specific functional parameters (activation level, release rate, drag, dead band, etc.) considered for all snubber production and qualification testing, and the bases of their acceptance; (7) what are the acceptable codes and standards (including editions) used for the snubber qualification and production testing; and (8) verify that the production operability tests for the large bore hydraulic snubbers (LBHSs) (greater than 50kips load rating) include (i) a full Service Level D load test to verify sufficient load capacity, (ii) testing at the full load capacity to verify proper bleed with the control valve closed, (iii) testing to verify that the control valve closes within the specified velocity range, and (iv) testing to demonstrate that breakaway and drag forces are within the acceptable design limits.*

GEH Response

In response to the specific questions with regard to snubbers, the DCD Tier 2, *Subsection 3.9.3.7.1(3)c(iii)* is revised and shown in the attached DCD markup.

DCD Impact

DCD Tier 2, *Subsection 3.9.3.7.1(3)c(iii)* will be revised as noted in the attached markup.

NRC RAI 3.9-175

Describe the method for functional design and qualification for snubbers.

GE Response

The functional design and qualification of snubbers is covered in DCD Tier #2 Subsection 3.9.3.7.1(3)c and in ASME Section III, Subsection NF.

DCD Impact

No DCD changes will be made in response to this RAI.

NRC RAI 3.9-175 S01

Comment on response to RAI 3.9-175 (MFN 07-086):

The applicant is requested to specify the appropriate cross reference for functional design and qualification of dynamic restraints in DCD Tier 2, Section 3.9.6.

GEH Response

The functional design and qualification of dynamic restraints should not be included in Section 3.9.6. This section discusses the In-Service Testing of Pumps and Valves only.

The section pertaining to In-Service testing of snubbers can be found in Section 3.9.3.7.1(3) e – Snubber Preservice and Inservice Examination and Testing. To accommodate the appropriate cross reference(s), the last paragraph of this section is revised as noted in the DCD Tier 2 markup.

DCD Impact

DCD Tier 2, Section 3.9.3.7.1(3) e will be revised as noted above.

The resulting loads on the DPV, the main steamline, and the DPV piping are combined with loads due to other effects as specified in Subsection 3.9.3.1. In accordance with Tables 3.9-1 and 3.9-2, the code stress limits for service levels corresponding to load combination classification as normal, upset, emergency, and faulted are applied to the main steam, stub tube, and DPV discharge piping.

3.9.3.7 Component Supports

The establishment of the design/service loadings and limits is in accordance with the ASME Section III, 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, and Regulatory Guides 1.124 and 1.130 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 Section III component supports shall be 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.

The design of bolts for component supports is specified in the Code, Subsection NF. Stress limits for bolts are given in NF-3225. The rules and stress limits which must be satisfied are those given in NF-3324.6 multiplied by the appropriate stress limit factor for the particular service loading level and stress category specified in Table NF-3225.2-1.

Moreover, on equipment which is to be, or may be, mounted on a concrete support, sufficient holes for anchor bolts are provided to limit the anchor bolt stress to less than 68.95 MPa (10,000 psi) on the nominal bolt area in shear or tension.

The design and installation of all anchor bolts is performed in accordance with Appendix B to ACI 349 "Anchoring to Concrete", subject to the conditions and limitations specified in RG 1.199.

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

3.9.3.7.1 Piping Supports

Supports and their attachments for safety-related Code Class 1, 2, and 3 piping are designed in accordance with Subsection NF up to the interface of the building structure, with jurisdictional boundaries as defined by Subsection NF. The building structure component supports (connecting the NF support boundary component to the existing building structure) are designed in accordance with ANSI/AISC N690, Nuclear Facilities-Steel Safety-Related Structures for Design, Fabrication and Erection, or the AISC Specification for the Design, Fabrication, and

Erection of Structural Steel. The applicable loading combinations and allowables used for design of supports are shown on Tables 3.9-10, -11, and -12. The stress limits are per ASME-III, Subsection NF and Appendix F.

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

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

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

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

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

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

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

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

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

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

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

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

a. Required Load Capacity and Snubber Location

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

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

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

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

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

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

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

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

c. Snubber Design and Testing

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

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

- Design requirements include analysis for normal, upset, emergency and faulted loads. Calculated loads are then compared against allowable loads as established by snubber vendor.
- Swing angles, as supplied by the snubber vendor, are incorporated into the design. Pipe movements in the horizontal and vertical direction are taken into account to prevent end bracket/paddle plate binding.
- Snubber stiffness, as supplied by the snubber vendor, is included in the piping analysis. Other support components such as the pipe clamp/extension piece/transition tube and structural auxiliary steel stiffness values are incorporated into the final determination of the stiffness value used in the analysis.

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

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

(iii) The snubbers are tested to ensure that they can perform as required during the seismic and other RBV events, and under anticipated operational transient loads or other mechanical loads associated with the design requirements for the plant. Production and qualification test programs for both hydraulic and mechanical snubbers are carried out by the snubber vendors in accordance with the snubber installation instruction manual required to be furnished by the snubber supplier. Acceptance criteria to assure compliance with ASME Section III Subsection NF ~~are cited in this manual~~, and other applicable codes, ~~and~~ standards and requirements are ~~referenced. The following test requirements are included~~as follows: RAI 3.9-117 S01

- ~~Snubbers are subjected to force or displacement versus time loading at frequencies within the range of significant modes of the piping system.~~Snubber production and qualification test programs are carried out by strict adherence to the manufacturer's snubber installation and instruction manual, which is prepared by the snubber manufacturer and subjected to review by the applicant for compliance with the applicable provisions of the ASME Pressure Vessel and Piping Code of record. The test program is periodically audited during implementation by the applicant for compliance.
- ~~Dynamic cyclic load tests are conducted for hydraulic snubbers to determine the operational characteristics of the snubber control valve.~~All snubbers will be inspected and tested for compliance with the design drawings and functional requirements of the procurement specifications.
- ~~Displacements are measured to determine the performance characteristics specified.~~All snubbers are inspected and tested. No sampling methods may be used in the qualification tests.
- ~~Tests are conducted at various temperatures to ensure operability over the specified range.~~All snubbers are load rated by testing in accordance with the snubber manufacturer's testing program and in compliance with the applicable sections of ASME QME-1, subsection QDR (latest edition) and ASME OM Code, subsection ISTD (latest edition)
- ~~Peak test loads in both tension and compression are required to be equal to or higher than the rated load requirements.~~Design compliance of the snubbers per ASME Section III Subsections NF-3128, NF-3411.3 and NF-3412.4
- The snubbers are tested for various abnormal environmental conditions. Upon completion of the abnormal environmental transient test, the snubber is tested dynamically at a frequency within a specified frequency range. The snubber must operate normally during the dynamic test. The functional parameters cited in Subsection NF-3412.4 are included in the snubber qualification and testing program. Other parameters in accordance with applicable ASME QME-1 and the ASME OM code will be incorporated.
- The codes and standards used for snubber qualification and production testing are as follows:
  - ASME B&PV Code Section III (Code of Record date) and Subsection NF
  - ASME QME-1, subsection QDR and ASME OM Code, subsection ISTD (latest applicable edition)
- All large bore hydraulic snubbers (LBHSs) include full Service Level D load testing, including verifying bleed rates, control valve closure within the specified velocity ranges and drag forces/breakaway forces are acceptable in accordance with ASME, QME-1 and ASME OM Codes.

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

- identification of systems and components
- number of snubbers utilized in each system and on that component
- snubber type (s) – (hydraulic or mechanical) – and name of supplier
- constructed to ASME Code Section III, Subsection NF or other
- snubber use such as shock, vibration, or dual purpose
- those snubbers identified as dual purpose or vibration arrestor type, will include an indication if both snubber and component were evaluated for fatigue strength

d. Snubber Installation Requirements

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

e. Snubber Pre-service and In-service Examination and Testing

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

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

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

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

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

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

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

If the period between the initial pre-service examination and initial system pre-operational tests exceeds 6 months, reexamination of Items i, iv, and v is performed.

Snubbers, which are installed incorrectly or otherwise fail to meet the above requirements, are repaired or replaced and re-examined in accordance with the above criteria.

The in-service examination and testing plan of all snubbers covered by the plant-specific Technical Specifications is prepared in accordance with the requirements of the ASME OM Code, Subsection ISTD and is in conformance with the relevant requirements of 10CFR50 Part B, Appendix A, General Design Criteria 1. Snubber maintenance, repairs, replacements and modifications are performed in accordance with the requirements of the ASME OM Code, Subsection ISTD. Details of the in-service examination and testing program, including test schedules and frequencies, are reported in the in-service inspection and testing plan, which will be provided by the COL applicant. See Subsection 3.9.9. RAI 3.9-175 S01

f. Snubber support data

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

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

(ii) operating environment,

(iii) applicable codes and standards,

(iv) list type of snubber (i.e. hydraulic, mechanical), materials of construction, standards for hydraulic fluids and lubricants, and the corresponding supplier.

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

(vi) production unit functional verification tests and certification,

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

(viii) description of provisions for attachments and installation.

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

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

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

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

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

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

The design loads on frame type pipe supports include those loads caused by thermal expansion, dead weight, and the inertia and anchor motion effects of all dynamic loads. As in the case of other supports, the forces on frame type supports are obtained from an analysis, which are assured not to exceed the design loads for various operating conditions.

Any hot or cold gaps required by the qualifying pipe stress analysis results are incorporated in the design. Where friction between the pipe and frame support occurs as a result of sliding, an appropriate coefficient of friction is used in order to calculate friction loading on the support. Seismic inertia loads as well as static seismic loads are considered in the design of frame supports covered by ASME Section III Subsection NF.

For insulated pipes, special pipe guides with one or two way restraint (two or four trunnions welded to a pipe clamp) may be used in order to minimize the heat loss of piping systems. For small bore pipe guides, it could be acceptable to cut the insulation around the support frame, although this must be indicated in the support specification.

(6) Special Engineered Pipe Supports are not used

3.9.3.7.2 Reactor Pressure Vessel Sliding Supports

The ESBWR RPV sliding supports are sliding supports as defined by Subsection NF-3124 of the Code and are designed as an ASME Code Class 1 component support per the requirements of the Code, Subsection NF. The loading conditions and stress criteria are given in Tables 3.9-1 and 3.9-2, and the calculated stresses meet the Code allowable stresses at all locations for various plant operating conditions. The stress level margins assure the adequacy of the RPV sliding supports.

3.9.3.7.3 Reactor Pressure Vessel Stabilizer

The RPV stabilizer is designed as a safety-related linear type component support in accordance with the requirements of ASME Boiler and Pressure Vessel Code Section III, Subsection NF.