GE Nuclear Energy

General Electric Company
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April 30, 1993

Docket No. STN 52-001

Chet Poslusny, Senior Project Manager
Standardization Project Directorate
Associate Directorate for Advanced Reactors
and License Renewal
Office of the Nuclear Reactor Regulation

Subject: Submittal Supporting Accelerated ABWR Review Schedule - **OBE Elimination and Limit Stops**

Dear Chet:

Enclosed are SSAR markups for some minor revisions to my January 28, 1993 OBE Elimination submittal (DFSER Open Items 3.1-1 and 14.1.3.3.5.15-1. In addition, a SSAR markup is provided to expand the definition of pipe supports identified as "Limit Stops." These changes are delineated below:

OBE Elimination

Pages 3.6-7 and 9, have been revised to require that SSE loads be included in the calculation of the Class 1 piping cumulative usage factor.

- o Page 3.6-7, paragraph 3.6.2.1.4.2(1), in second sentence deleted item (b).
- o Page 3.6-9, paragraph 3.6.2.1.4.3, last sentence of first paragraph, deleted "and (c)".

Added the following clarification to Note 12 of Table 3.9.2:

- o For ASME Class 1 piping added the equation number:
  Eq. (12a)
- o For ASME Class 2 & 3 piping added the equation number:
  Eq. (10b), added an additional stress limit: ($\ngtr$ 2.0 Sy). Added "Service Levels A & B," to clarify that SSE inertia and anchor displacement loads are not included in the Service Level A & B Equation 9 calculations.

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All of the above revisions to the OBE elimination requirements were discussed between Maryann Herzog and Dave Terao in a phone call on April 16, 1993.

Limit Stops

Page 3.9-34, added a sentence to expand the "Limit Stop" description to cover the special component standard supports that have a configuration, size and end-to-end dimensions similar to snubbers.

Please provide a copy of this transmittal to Dave Terao.

Sincerely,

Jack Fox

Jack Fox
Advanced Reactor Programs

cc: Norman Fletcher (DOE)
Maryann Herzog (GE)

not result in whipping of the cracked pipe. High-energy fluid systems are also postulated to have cracks for conservative environmental conditions in a confined area where high- and moderate-energy fluid systems are located.

The following high-energy piping systems (or portions of systems) are considered as potential candidates for a postulated pipe break during normal plant conditions and are analyzed for potential damage resulting from dynamic effects:

(1) All piping which is part of the reactor coolant pressure boundary and subject to reactor pressure continuously during station operation;

(2) All piping which is beyond the second isolation valve but subject to reactor pressure continuously during station operation; and

(3) All other piping systems or portions of piping systems considered high-energy systems.

Portions of piping systems that are isolated from the source of the high-energy fluid during normal plant conditions are exempted from consideration of postulated pipe breaks. This includes portions of piping systems beyond a normally closed valve. Pump and valve bodies are also exempted from consideration of pipe break because of their greater wall thickness.

3.6.2.1.4 Locations of Postulated Pipe Breaks

Postulated pipe break locations are selected as follows:

3.6.2.1.4.1 Piping Meeting Separation Requirements

Based on the HELSA evaluation described in Subsection 3.6.1.3.2.2, the high-energy lines which meet the spatial separation requirements are generally not identified with particular break points. Breaks are postulated at all possible points in such high-energy piping systems. However, in some systems break points are particularly specified per the following subsections if special protection devices such as barriers or restraints are provided.

3.6.2.1.4.2 Piping in Containment Penetration Areas

No pipe breaks or cracks are postulated in those portions of piping from containment wall to and including the inboard or outboard isolation valves which meet the following requirement in addition to the requirement of the ASME Code, Section III, Subarticle NE-1120:

(1) The design stress and fatigue limits of (a) through (e) are not exceeded. When meeting the limits of (a), (b) and (d), earthquake loads are excluded. (See Subsection 3.6.1.1.1) Deleted

For ASME Code, Section III, Class 1 Piping

(a) The maximum stress range between any two loads sets (including the zero load set) does not exceed 2.4 S_m, and is calculated* by Eq. (10) in NB-3653, ASME Code, Section III.

If the calculated maximum stress range of Eq. (10) exceeds 2.4 S_m, the stress ranges calculated by both Eq. (12) and Eq. (13) in Paragraph NB-3653 meet the limit of 2.4 S_m.

(b) The cumulative usage factor is less than 0.1

(c) The maximum stress, as calculated by Eq. (9) in NB-3652 under the loadings resulting from a postulated piping failure beyond these portions of piping does not exceed the lesser of 2.25 S_m and 1.8 S_y except that following a failure outside containment, the pipe between the outboard isolation valve and

* *For those loads and conditions in which Level A and Level B stress limits have been specified in the Design Specification.*

(c) The assemblies are subjected to a single pressure test at a pressure not less than its design pressure.

(d) The assemblies do not prevent the access required to conduct the inservice examination specified in item (7).

(7) A 100% volumetric inservice examination of all pipe welds would be conducted during each inspection interval as defined in IWA-2400, ASME Code, Section XI.

3.6.2.1.4.3 ASME Code Section Class 1 Piping In Areas Other Than Containment Penetration

With the exception of those portions of piping identified in Subsection 3.6.2.1.4.2, breaks in ASME Code, Section III, Class 1 piping are postulated at the ~~following~~ locations identified in (a), (b) and (c) in each piping and branch run: Earthquake loads are excluded from (b) and (c). Deleted

(a) At terminal ends*

(b) At intermediate locations where the maximum stress range as calculated by Eq. (10) exceeds 2.4 Sm, and

~~If the calculated maximum stress range of Eq.(10) exceeds 2.4 Sm,~~ the stress range calculated by either ~~both~~ Eq.(12) or ~~and~~ Eq.(13) in Paragraph NB-3653 exceed ~~should meet the limit of~~ 2.4 Sm.

(c) At intermediate locations where the cumulative usage factor exceeds 0.1.

* *Extremities of piping runs that connect to structures, components (e.g., vessels, pumps, valves), or pipe anchors that act as rigid constraints to piping motion and thermal expansion. A branch connection to a main piping run is a terminal end of the branch run, except where the branch run is classified as part of a main run in the stress analysis and is shown to have a significant effect on the main run behavior. In piping runs which are maintained pressurized during normal plant conditions for only a portion of the run (i.e., up to the first normally closed valve) a terminal end of such runs is the piping connection to this closed valve.*

As a result of piping re-analysis due to differences between the design configuration and the as-built configuration, the highest stress or cumulative usage factor locations may be shifted; however, the initially determined intermediate break locations need not be changed unless one of the following conditions exists:

(i) The dynamic effects from the new (as-built) intermediate break locations are not mitigated by the original pipe whip restraints and jet shields.

(ii) A change is required in pipe parameters such as major differences in pipe size, wall thickness, and routing.

3.6.2.1.4.4 ASME Code Section III Class 2 and 3 Piping in Areas Other Than Containment Penetration

With the exception of those portions of piping indentified in Subsection 3.6.2.1.4.2, breaks in ASME Codes, Section III, Class 2 and 3 piping are postulated at the following locations in those portions of each piping and branch run:

(a) At terminal ends (see Subsection 3.6.2.1.4.3, Paragraph (a))

(b) At intermediate locations selected by one of the ~~following~~ criteria below. Earthquake loads are excluded from criteria (ii).

(i) At each pipe fitting (e.g., elbow, tee, cross, flange, and nonstandard fitting), welded attachment, and valve. Where the piping contains no fittings, welded attachments, or valves, at one location at each extreme of the piping run adjacent to the protective structure.

(ii) At each location where stresses calculated (see Subsection 3.6.2.1.4.2, Paragraph (1)(d)) by the sum of Eqs. (9) and (10) in NC/ND-3653, ASME Code, Section III, exceed 0.8 times the sum of the stress limits given in NC/ND-3653.

As a result of piping re-analysis due to differences between the design configuration and the as-built configuration, the highest stress

NOTES 6 & 12 FOR TABLE 3.9.2

(6) All ASME Code Class 1,2 and 3 Piping systems which are essential for safe shutdown under the postulated events are designed to meet the requirements of NUREG-1367 (Reference 7). Piping system dynamic moments can be calculated using an elastic response spectrum or time history analysis.

(12) For ASME Code 1,2 and 3 piping the following changes and additions to ASME Code Section III Subsections NB-3600, NC-3600 and ND-3600 are necessary and shall be evaluated to meet the following stress limits:

(a) ASME Code Class 1 Piping:

$$S_{SAM} = C_2 \frac{D_o}{2I} M_c \le 6.0 S_m \qquad \text{Eq. (12a)}$$

added

where: S_{SAM} is the nominal value of seismic anchor motion stress

M_c is the combined moment range equal to the greater of (1) the resultant range of thermal and thermal anchor movements plus one-half the range of the SSE anchor motion, or (2) the resultant range of moment due to the full range of the SSE anchor motions alone.

C_2, D_o and I are defined in ASME Code Subsection NB-3600

SSE inertia and seismic anchor motion loads shall be included in the calculation of ASME Code Subsection NB-3600 equations (10) and (11).

(b) ASME Code Class 2 and 3 Piping:

$$S_{SAM} = i \frac{M_c}{Z} \le 3.0 S_h \; (\ngtr 2.0 S_y) \qquad \text{Eq. (10b)}$$

added

where S_{SAM} and M_c are as defined in (a) above, and

i and Z are defined in ASME Code Subsections NC/ND-3600

SSE inertia and seimic anchor motion loads shall not be included in the calculation of ASME Code Subsections NC/ND-3600 Equations (9), ~~and~~ (10) and (11).

Service Levels A and B

added

(5) **Frame Type (Linear) Pipe Supports**: Frame type 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 pipes. 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 ASME Code Section III, Subsection NF-3000.

Frame type pipe supports are passive supports, requiring little maintenance and in-service inspection, and will normally be 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 will not be used at locations where restraint of pipe movement to thermal expansion will significantly increase the secondary piping stress ranges or equipment nozzle loads. Increases of thermal expansion loads in the pipe and nozzles will normally be restricted to less than 20%.

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.

(6) **Special Engineered Pipe Supports**: In an effort to minimize the use and application of snubbers there may be instances where special engineered pipe supports can be used where either struts or frame-type supports cannot be applied. Examples of special engineered supports are Energy Absorbers, and Limit Stops.

Energy Absorbers: are linear energy absorbing support parts designed to dissipate energy associated with dynamic pipe movements by yielding. When energy absorbers are used they will be designed to meet the requirements of ASME Section III, Code ~~Class~~ Case N-420, Linear Energy Supports for Subsection NF, Classes 1, 2, and 3 Construction, Section III, Division 1. The restrictions on location and application of struts and frame-type supports, discussed in (4) and (5) above, are also applicable to energy absorbers since energy absorbers allow thermal movement of the pipe only in its design directions.

Limit Stops: are passive seismic pipe support devices consisting of limit stops with gaps sized to allow for thermal expansion while preventing large seismic displacements. Limit stops are linear supports as defined as ASME Section III, Subsection NF, and are designed in accordance with ASME Code Section III, Subsection NF-3000. They consist of either special component standard supports with a configuration, size and end to end dimensions similar to snubbers, or box frames constructed of structural steel elements that are not attached to the pipe. The box frames allow free movement in the axial direction but limit large displacement in the lateral direction.

3.9.3.4.2 Reactor Pressure Vessel Support Skirt

The ABWR RPV support skirt is designed as an ASME Code Class 1 component per the requirements of ASME Code Section III, 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 in the critical support areas for various plant operating conditions. The stress level margins assure the adequacy of the RPV support skirt. An analysis for buckling shows that the support skirt complies with Subparagraph F-1332.5 of ASME III, Appendix F, and the loads do not exceed two thirds of the critical buckling strength of the skirt. The permissible skirt

*Augmented by the following: (1) application of Code Case N-476, Supplement 89.1 which governs the design of single angle members of ASME Class 1,2,3 and MC linear component supports; and (2) when eccentric loads or other torsional loads are not accommodated by designing the load to act through the shear center or meet "Standard for Steel Support Design", analyses will be performed in accordance with torsional analysis methods such as: "Torsional Analysis of Steel Members, USS Steel Manual", Publication T114-2/83.