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SCHWENCER,A. Licensing Branch 2

SUBJECT: Forwards final results of assessment for NRC review & closure of NUREG-0892,SER Confirmatory Issue 7 re component supports.SufficientSufficient design margin exists.

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December 30, 1982
G02-82-1021

Docket No. 50-397

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Schwencer:

Subject: NUCLEAR PROJECT NO. 2
SAFETY EVALUATION REPORT (NUREG-0892)
CONFIRMATORY ISSUE NO. 7 - COMPONENT SUPPORTS

The Supply System committed to assess component support design with respect to the NRC position presented during the Mechanical Engineering Branch review in September of 1981. The status of this assessment was further discussed with the NRC staff on November 12, 1982.

The attached report provides the final results of our assessment in the detail necessary for staff review and closure of this confirmatory issue.

Our conclusion is that although no applicable code or standard requires inclusion of the specific load combinations presented in the NRC staff position, our design either explicitly did include these loads or sufficient design margin exists to demonstrate compliance with the NRC position.

Very truly yours,

G. D. Bouchey, Manager
Nuclear Safety and Licensing

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PWH:cph

Enclosure: Status Report (60 copies)

cc: R. Auluck - NRC - w/att
WS Chin - BPA - w/att
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WNP-2

Component Support Assessment

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WNP-2

Component Support Assessment

I. Background

In September 1981, prior to issuance of the Safety Evaluation Report (SER)/NUREG-0892 for WNP-2, a review meeting was held with the USNRC's Mechanical Engineering Branch (MEB). During this meeting the NRC staff posed the following discussion:

> "Does the design criteria for component supports in WNP-2 systems categorize the stresses produced by seismic anchor point motion of piping and the thermal expansion of piping as primary or secondary?
>
> NRC position - For the design of supports, these stresses should be considered primary. Expansion stresses in the support themselves may be categorized as secondary."

The Supply System response was that:

> "When a component is covered by the ASME Boiler and Pressure Vessel Code, the stresses due to relative displacement (thermal and seismic anchor point) are treated as primary or secondary stresses, per ASME Section III, for piping. For loads due to relative displacement, supports are analyzed as per ASME Code Section NF."

Additionally the Supply System committed to assess component support design with respect to the NRC position. The SER (NUREG-0892) summarizes the above discussion in Section 3.9.3.3 and identifies this issue as Confirmatory Issue No. 7 as follows:

> "3.9.3.3 Component Supports
>
> The staff reviewed Section 3.9.3.4 of the FSAR relative to the criteria used by the applicant in the design of ASME Class 1, 2, and 3 component supports. All component supports have been designed in accordance with Subsection NF of the ASME Code, Section III. It is the staff's position that for the design of component supports, the stresses produced by seismic anchor point motion of piping and the thermal expansion of piping should be categorized as primary stresses. Expansion stresses in the supports themselves may be categorized as secondary stresses. The applicant is committed to assess the design with respect to the staff position. He will identify supports not meeting the staff position and identify how they will be revised to comply. The staff will review the applicant's assessment and report its evaluation in a supplement to this SER."

Results of the Supply System design assessment were presented to and discussed with the NRC staff on November 12, 1982; this report includes clarifications and specific additional material requested by the staff.

II. Introduction and Summary

Design of ASME piping and associated supports for WNP-2 has been the contractual responsibility of several parties. The following describes those design responsibilities:

Contract	Designer	General Scope	Effective ASME Code Edition
C-220	Johnson Controls	Small Bore[1]* - Instrumentation Piping and Tubing	1974 thru Winter 1975
C-002	General Electric	Recirculation Piping Main Steam Piping	1971 thru Summer 1971 1971 thru Summer 1972
C-240	General Electric (I&SE)	Control Rod Drive Piping	1971 thru Winter 1973
C-208	Gilbert/ Commonwealth	All remaining small bore	1971 thru Winter 1973
C-2808	Burns and Roe	All large bore and ASME III Class 1 small bore greater than 1" diameter	1971 thru Winter 1973

With respect to Confirmatory Issue No. 7, the effective ASME code editions listed above are similar. The ASME code in NF-3231.1(b) and (c) states:

> Constrained free end displacement and differential support motion effects and bearing types stresses need not be considered for the Emergency or Faulted Condition, respectively.

This position has been maintained through the current ASME code (1980 Edition through Summer 1982 Addenda).

*All footnotes are contained in Section VI of this report.

The assessment committed to by the Supply System was conducted to evaluate the plant design in view of the NRC staff concern.

As discussed later in Section III, actual WNP-2 piping design did include (either explicitly or implicitly) the thermal and faulted end motion loads as referenced by the NRC staff position. Where these loads were not explicitly included, they can be demonstrated to be enveloped by conservatisms in load definitions and design practices. Where emergency or upset load combinations are used, thermal loads are included. As discussed with the NRC staff, supports at WNP-2 are designed to meet a specific maximum load combination rather than for a load carrying capacity in excess of the design load. Component standard supports were designed to not exceed maximum load ratings for each of the load combinations as certified by the manufacturer.

III. Discussion

The component support assessment addressed each design contract individually. The results of that assessment are as follows:

A. C-220 Johnson Controls - Small Bore Instrumentation Piping

C-220 is responsible for the design and installation of small bore piping, tubing and supports used primarily for instrumentation and sampling.

1. Piping Unaffected by Hydrodynamic Loads[2]

For the normal/upset condition, C-220 designed for deadweight, thermal, and OBE loads; the calculated maximum stresses are limited to specified normal/upset (N/U) allowables:

$$DW + T + OBE^{(3)} \leq \text{N/U allowable}$$

For the faulted condition C-220 designed supports for deadweight and SSE loads; calculated maximum stresses were limited to specified faulted allowables. For expediency this was implemented by the following equation in which the faulted allowable is greater than twice the N/U allowable:

$$2(DW + T + OBE) \leq 2(\text{N/U Allowable}) \leq \text{Faulted Allowable}^{(4)}$$

Based on the above, it is concluded that C-220 piping unaffected by hydrodynamic loads complies with the NRC position regarding the effects due to seismic anchor point motion and thermal expansion of piping[5].

2. Piping Affected by Hydrodynamic Loads

These piping systems were designed using a load combination of deadweight and conservative dynamic spectra enveloping thermal and seismic end displacements.

To confirm that this envelope and conservatism encompass the NRC staff concerns, a study of five representative instrumentation lines, chosen from among those determined to be most highly stressed, were selected for assessment. The five selected lines: (a) cover the contract pipe size range (3/4" and 1" diameter), (b) contain natural frequencies from 4.3 Hz to over 60 Hz, (c) are subject to the maximum design temperature of 545°F, (d) are supported by various structures in the drywell (i.e., containment, platforms, sac wall, RPV pedestal, and process lines) and (e) include highly stressed lines based on original seismic loads. Three of these lines are supported or penetrate the primary containment near elevation 541 ft. These lines are subjected to the maximum response in the drywell from the upset load condition which usually governs. Lines that penetrate containment elsewhere experience a load reduction of up to 70 percent. The assessment concluded that Contract 220 piping is adequately designed and evaluated for seismic as well as thermal end movement loads.

Based on the above, it is concluded that C-220 piping affected by hydrodynamic loads complies with the NRC position regarding the effects due to seismic anchor point motion and thermal expansion of piping.

B. C-002 General Electric - Main Steam and Reactor Recirculation Piping

C-002 has design responsibility for only two piping systems: that portion of the main steam system inside containment out to the outboard isolation valve and the reactor recirculation system which is entirely inside containment. The faulted load combination used in design includes both thermal and seismic end movement.

C-002 piping complies with the NRC position regarding the effects due to seismic anchor point motion and thermal expansion of piping.

C. C-240 General Electric (I&SE) - Control Rod Drive Piping

C-240 is responsible for the design and installation of the control rod drive piping and supports. For all CRD piping, the faulted load combination, as well as normal, upset and emergency combinations, include thermal, seismic and seismic end movements. Additionally, the emergency allowable [6] is used for the faulted load combination.

C-240 piping complies with the NRC position regarding the effects due to seismic anchor point motion and thermal expansion of piping.

D. C-208 Gilbert Commonwealth - Small Bore Piping

C-208 has design responsibility for small bore piping and supports except that discussed under Subsection IIIA, IIIC and IIIE.

1. Piping Unaffected by Hydrodynamic Loads

For the normal/upset condition, C-208 designed supports for deadweight, thermal and OBE loads with calculated maximum stresses which were equal to or less than specified normal/upset allowables:

$$DW + T + OBE^{(3)} \leq N/U \text{ allowable}$$

For the faulted (SSE) condition the specified faulted stress allowable is twice the normal/upset allowable and the design equation may be conservatively written as:

$$2(DW + T + OBE) \leq 2(N/U \text{ Allowable}) = \text{Faulted Allowable}^{(7)}$$

In design practice, reviewing the faulted condition need not be actually performed when the normal/upset case is limiting as indicated by the above equations.

Based on the above, it has been demonstrated that C-208 piping unaffected by hydrodynamic loads complies with the NRC position regarding the effects due to seismic anchor point motion and thermal expansion of piping.

2. Piping Affected by Hydrodynamic Loads

Support design for this piping was controlled by the emergency load combination.

The "emergency" load combination includes deadweight, thermal and a conservatively defined dynamic loads resultant. These dynamic loads include concurrent "faulted condition" dynamic loads (hydrodynamic and SSE) and associated anchor point movements.

These actual "faulted condition" loads are combined to meet an emergency allowable:

$$DW + \bar{T} + \text{Faulted Dynamic Loads} \leq \text{Emergency Allowable}$$

C-208 piping affected by hydrodynamic loads complies with the NRC position regarding the effects due to seismic anchor point motion and thermal expansion of piping.

E. C-2808 Burns and Roe - Large Bore Piping

C-2808 is the architect engineering contract for WNP-2. In addition to design responsibility for all remaining large bore piping and supports, C-2808 also retains design responsibility for ASME III Class 1 piping and supports greater than 1" diameter.

1. Piping Affected by Seismic Anchor Point Motion

The Confirmatory Issue No. 7 question identifies two concerns, the first of which is seismic anchor point motion. C-2808 incorporates seismic anchor point motion into all piping analysis with the exception of one case. That one exception is the main steam and feedwater piping outside of the primary containment. This piping is not required to perform a safety function after any faulted condition or LOCA event; containment isolation must however be insured. Containment isolation capability has been evaluated and found to be maintained under faulted conditions.

C-2808 piping complies with the NRC position regarding effects of seismic anchor point motion, as discussed above.

2. The second point of Confirmatory Issue No. 7 addressed inclusion of thermal loads in the faulted load combination. C-2808 does include thermal loads in the normal/upset and emergency load combinations.

C-2808 contains a number of conservatisms in the design of large bore pipe supports.

One such conservatism in the C-2808 design is the seismic margin in the defined response spectra. Refinements of this load definition have not been applied to most of the piping analysis. The piping design, fabrication and installation have been completed using prior conservative data. Secondly, structural calculations and assumptions regarding the rigidity of supports have not been refined.

WNP-2 contains approximately 10,000 large bore hangers of which approximately 4000 are on ASME III systems. Of these 4000 ASME supports, about 2200 are on thermally hot piping systems. Including thermal loads in the faulted load combination affects only rigid supports which represent about 1500 of the 2200 supports. At the time WNP-2 committed to assess the NRC position on Confirmatory Issue No. 7, a design verification effort was being initiated on ASME piping supports. An evaluation of the thermal effect was included in the initial phases of that program.

Data was obtained on 1071 of the 1500 rigid, thermally loaded supports. As-builts of the remaining supports had not been submitted for design verification prior to conclusion of the assessment. This initial data showed that without conservatisms removed, the average load increase due to inclusion of thermal loads was within the envelope of existing design margins.

To demonstrate the actual design margin, a biased sample was selected from the 1071 design verified supports. The sample consisted of 191 supports, 16 of which were anchors and 175 of which were other type rigids, selected from reactor building piping required to function during and after faulted conditions.

The biased 18% sample can be shown to include: all supports with load increases greater than 50%; 25% of supports with load increases between 25% and 50%; and 18% of the remaining supports.

For this portion of the study, faulted load effects including thermal loads were recalculated and all supports were found to be acceptable.

Based upon the above study consisting of over 70% of the affected supports, it has been demonstrated that sufficient conservatism exists to comply with the NRC position regarding inclusion of thermal loads in the faulted condition.

C2808 piping complies with the NRC position regarding the effects of thermal expansion on piping, as discussed above.

F. Baseplate-Concrete Insert Design - IE Bulletin 79-02

The Confirmatory Issue No. 7 assessment included supports with baseplates and concrete inserts. The study showed that all baseplates complied with the WNP-2 response to IE Bulletin 79-02.(8)

IV. Contractor Summary

The material presented in Section III addressed each design contractor. With respect to the NRC position in Confirmatory Issue No. 7, the following table presents Section III in summary form:

	Piping Unaffected by Hydrodynamic Loads		Piping Affected By Hydrodynamic Loads	
Contract	Thermal	Seismic Anchor Point Motion	Thermal	Seismic Anchor Point Motion
C-220	Included by doubling normal/upset	Included by doubling normal/upset	Included	Implicitly included by specific design conservatisms
C-002	N/A	N/A	Included	Included
C-240	Included	Included	Included	Included
C-208	Included by doubling normal/upset	Included by doubling normal/upset	Included	Included
C-2808	Implicitly included by specific design conservatisms	Included	Implicitly included by specific design conservatisms	Included

V. Conclusion

As committed in Confirmatory Issue No. 7 of the SER (NUREG-0892), the Supply System has assessed component support design with respect to the stated NRC position.

In conclusion, the assessment findings indicate that either the subject loads (seismic anchor point motion and thermal expansion) have been included in the design of WNP-2 component supports or, the existing support designs are adequate to include these loads.

VI. Footnotes

1. Small bore piping is defined as all piping 2" diameter and smaller. Large bore piping is defined as all piping 2½" diameter and greater.

2. Hydrodynamic loads are those direct pressure or inertial loads resulting from loss of coolant accident or safety relief valve discharge. Design contractors were issued response spectra with combined hydrodynamic/seismic loads or separate spectra for each load.

3. OBE includes inertial effects as well as seismic anchor point movement effects where significant.

4. The faulted allowable used in C-220 design is 0.9 Sy.

5. For purposes of this assessment, seismic anchor point motions are those associated with faulted condition effects and thermal expansion of piping refers to normal condition effects.

6. The emergency allowable is 33% above normal upset (0.6 Sy x 1.33 = 0.8 Sy).

7. The faulted allowable used in C-208 is 1.2 Sy, 6% above 0.7 Su.

8. Letter, G02-82-380, RG Matlock, Supply System, to RH Engelken, NRC, subject, "IE Bulletin 79-02, Rev. 2", dated April 14, 1982.