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SUBJECT: Forwards addl info re design of piping supports at facility, in response to preliminary findings of NRC pipe support design audit on 850604 & 05 & as followup to SER Confirmatory Item 5.

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Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT
UNIT NO. 1 - DOCKET NO. 50-400
PIPE SUPPORT DESIGN AUDIT

Dear Mr. Denton:

Carolina Power & Light Company (CP&L) hereby submits additional information concerning the design of piping supports at the Shearon Harris Nuclear Power Plant. This information is submitted in response to the preliminary findings of the NRC pipe support design audit conducted on June 4-5, 1985 as a follow-up to Safety Evaluation Report Confirmatory Item No. 5. Attached are the CP&L responses to each of the four preliminary audit findings transmitted by NRC letter dated October 25, 1985. Also attached are the applicable portions of the Harris Plant Engineering Section Manual of Instructions, Guideline 7.2.C, which is referenced in response to items 1 and 4.

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

Yours very truly,

S. R. Zimmerman
Manager
Nuclear Licensing Section

JHE/ccc (3045JDK)

Attachment

cc: Mr. B. C. Buckley (NRC)
Mr. G. F. Maxwell (NRC-SHNPP)
Dr. J. Nelson Grace (NRC-RII)
Mr. D. Terao (NRC-MEB)
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SHEARON HARRIS NUCLEAR POWER PLANT
SER CONFIRMATORY ITEM NO. 5
NRC DESIGN AUDIT ITEM 1

The applicant will identify tube steel sizes with a chord thinness ratio (D/2t) greater than 10 in order to assess the significance of punching shear effects and web crippling on stepped and matched connections, respectively.

RESPONSE

CP&L has reviewed the sizes of tube steel which were and are available for the design and construction of supports/restraints at SHNPP and it has been determined that a D/2t ratio as high as 16 has been used at SHNPP. In order to ensure the use of this tube steel does not violate code requirements, a review of the supports/restraints is being undertaken. This is an ongoing review concurrent with the normal final verification process. When the D/2t ratio is greater than 10, then the member will be checked for punching shear and web crippling in stepped connections and matched connections, respectively. Calculations for this check will be performed in accordance with AWS D1.1, Section 10. This code provides detailed guidance for the evaluation of the potential local failure in stepped and matched connections.

HPES Manual of Instructions, Guideline 7.2.C (attached) has been revised to identify punching shear and web crippling as a verification check, using D/2t greater than 10 as a criteria to determine if a check is required. Inclusion of the check in 7.2.C ensures that the supports to be final design verified will be reviewed for this item.

SHEARON HARRIS NUCLEAR POWER PLANT
SER CONFIRMATORY ITEM NO. 5
NRC DESIGN AUDIT ITEM 2

The applicant will perform a dynamic analysis of the piping system including U-bolt stiffnesses in the support modeling to determine the effect on the system response.

RESPONSE

CP&L has re-analyzed the main steam piping in question with the impact of the relative stiffness of support MS-H-27 incorporated into the design. The line was also reviewed for other supports which used the U-bolt arrangement. Support MS-H-32 was the only other support on this line with U-bolts. However, since the U-bolt was 1 1/2 inches in diameter, the stiffness was approximately the same as the default stiffness used in the analysis.

The stiffness of support MS-H-27 was calculated to be 713 kips/in. as opposed to the default stiffness of 1000 kips/in. The results of the piping analysis using this stiffness were typical of what would be expected when the stiffness of one support in a math model is changed. The stresses throughout the piping system analyzed did not vary more than 2%. Only one modal frequency varied from the previous analysis by more than 1%, and that was mode 27 of 29 which changed by 4%. The frequency (31 Hz) was close to the rigid cutoff frequency of 33 Hz. The changes in these parameters, stresses and modal frequencies are considered negligible.

Loads on supports in the vicinity of MS-H-27 did vary due to the change in stiffness of MS-H-27. As expected, the loads on MS-H-27 did reduce with the supports on each side of it (MS-H-28, MS-H-30, and MS-H-32) picking up an additional load. MS-H-28 and MS-H-30 loads (seismic only) increase by 10 and 13% respectively. This increase is considered to be within the design margin for supports, but they were reviewed and found to be acceptable for the increased loads. Support MS-H-32 saw a load increase of 20% and was reviewed and found to be acceptable.

From the above synopsis of the piping analysis, changing the support stiffness of MS-H-27 has no significant impact on piping and support design. Furthermore, if the analysis was reanalyzed using the damping criteria and peak shifting methodology of Code Cases N-411 and N-397, respectively, instead of Reg Guide 1.61 and peak broadening, additional margins in design parameters would most likely be recognized.

(3045JDK/ccc)

SHEARON HARRIS NUCLEAR POWER PLANT
SER CONFIRMATORY ITEM NO. 5
NRC DESIGN AUDIT ITEM 3

The applicant will assess the impact of including the dead weight and seismic effects of the offset support mass on the local stresses associated with the welded pipe attachment.

RESPONSE

CP&L has performed an analysis of the main steam header to determine the impact of the eccentric weight added to the pipe as part of the design of supports MS-H-63 and MS-H-65. The analysis consisted of calculating the weight of the eccentric mass, the frequency of the piping system, the moments due to weight and seismic loads, and the stresses to be used in equations 8 and 9 of the ASME Section III Code, paragraph NC-3652 as well as the pipe break exclusion stress.

The weight of the eccentric mass is 7790 lbs. and is cantilevered 21.125 inches from the outer surface of the pipe. The frequency analysis determined that the fundamental frequency of this piping system is 35 Hz, which allows the use of the zero period acceleration (ZPA) for calculating the seismic load. The bending stresses used in equations 8 and 9 increased less than 1% due to this weight. Local stresses were calculated using Welding Research Council Bulletin WRC 107 and added to the equation 8 and 9 stresses. The stresses for these two equations increased by 7 and 12%, respectively, but were still well below the allowables. The pipe break stresses increased by 7% but were still well below the threshold allowable of 37800 psi calculated using the equation $.8(S_h + S_a)$.

In conclusion, the analysis performed of the main steam piping with the eccentric mass has shown that stresses are not adversely impacted and are within the code allowables and pipe break limits.

(3045JDK/ccc)

SHEARON HARRIS NUCLEAR POWER PLANT
SER CONFIRMATORY ITEM NO. 5
NRC DESIGN AUDIT ITEM 4

The applicant will identify any other potentially unstable pipe support designs (similar to support CC-H-323) and discuss with the staff the proposed resolution.

RESPONSE

CP&L has reviewed approximately 4000 supports/restraints to identify any potentially unstable designs (similar to support CC-H-323). Of the designs reviewed, no configurations similar to CC-H-323 have been identified. Hanger CC-H-323 has been revised to eliminate the possibility of the hanger swinging laterally during a seismic event or twisting enough to prevent the struts from carrying an upward load.

HPES, Manual of Instructions, Guideline 7.2.C (attached) has been revised to identify the type of support which the auditors considered unstable. The revision also outlines methods for resolution of the problem. Inclusion of the verification item in 7.2.C ensures that supports to be final design verified will be reviewed for this item.

(3045JDK/ccc)

D. Abbreviations and Definitions

Common abbreviations and definitions shall be in accordance with the applicable section of the Design Guidelines 7.2.A.

E. Approval and Maintenance

Design Guidelines, including revisions, shall be approved by the Principal Engineer - HPES, and maintained by the Project Engineer, Hanger - HPES.

III. PROCEDURES

A. Design Calculations

1. Should any previous calculations be non-existent, or determined by the HPES Final Review/Checker to be inadequate and/or inappropriate to verify the constructed hanger assembly, additional calculations shall be generated by the Office or Field Design Engineer in accordance with the requirements of the applicable paragraphs in the Design Guidelines 7.2.A.

2. Engineering judgement may be exercised by the engineer in the performance of design calculations based on a comparison of relative magnitudes between loads, stresses, deflections, and geometry (i.e., member stresses qualified by engineering judgement, based on member stress qualification by calculation for a hanger member of comparable or smaller cross-section with comparable or larger loads). The basis of engineering judgement by an engineer performing calculations must be documented whenever judgement is applied. This documentation shall be in the form of a written comment at the point in the calculation/evaluation where judgement is invoked.

3. Based on item from NRR review on June 4 and 5, 1985, Hanger Unit engineers shall review all "double strut/snubber" hangers to ensure the configuration is stable. If the hanger configuration is unstable, the design will be revised to eliminate the instability in the configuration. A "double strut/snubber" hanger is considered unstable if the pipe attachment portion of the hanger can move freely relative to the pipe either axially or laterally. This movement is a result of excessive gaps between the pipe and the pipe attachment. Figure III.A.4-1 (following this paragraph) illustrates a typical "double

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strut/snubber" hanger where instability can occur. If the sum of A and B is greater than the calculated cumulative gap size required for the thermal radial expansion of the pipe, then the support is considered unstable. A U-bolt would be preferable as a pipe attachment in this situation, but shimming the hanger pipe attachment to eliminate the excessive gaps is the most expeditious solution for existing hangers.

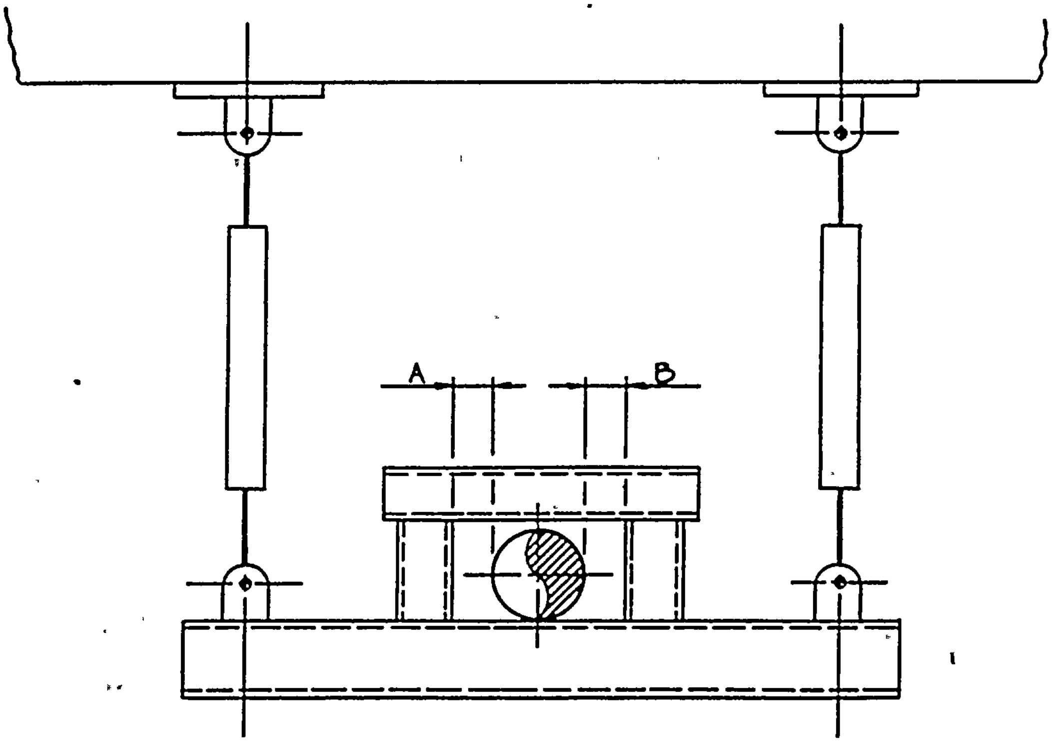

FIGURE III. A. 4-1

4. Based on NRC IDI Item D3.4-1 (dated 4-15-85), the design of unbraced slender members for seismic supports shall be avoided. If the use of an unbraced slender member is the only support design available, then a dynamic self weight excitation calculation shall be performed on the member. Analysis for calculations addressing self weight excitation shall be as follows:

   a. The member weight shall be applied at the centroid of the member.

   b. If there is an attached strut, one half of the strut weight shall be applied at the free end of the structural member.

5. Load and Movement Verification (Exhibit 4)
6. Applicable Computer Outputs (loose)
7. Superseded Cover Sheet (Exhibit 3) (loose)

NOTE:

1. Original Computer Outputs shall be cross-referenced to the applicable calculation pages. They may be bound in a separate binder, if necessary.

2. Superseded Design Calculation packages, and Superseded Computer Outputs shall be labeled with the Hanger Mark Number and Stress Iso. Number, marked "SUPERSEDED", and will be stored separately, in the HPES Hanger Unit Document Center Subunit files. Superseded information/data are not considered necessary to the documentation requirements and will not be transmitted to the permanent plant QA Records.

8. Based on NRC IDI Item D3.1-5 (dated 4-15-85), beams with clip-end connections shall never use single angles as the beam member for any seismic application (Reference B-P part E102). Any such members found during final design verification shall be redesigned.

9. In order to provide closure of NRC Item 400/84-02-01 dated 2/17/84 (SER Item 275), all seismic to non-seismic interface anchors shall be reviewed to ensure the anchor design complies with the design criteria stated in Design Guideline 7.2.A, Paragraph III.C.6.

   These anchors shall be identified by the 79-14 Stress Analysis Group.

10. Based on item from NRR Review on June 4 and 5, 1985, Hanger Unit Engineers shall review all structural tubing used as hanger members to ensure compliance with the following criteria. IF D/2t>10 (where D=section depth and t=wall thickness), then the member shall be checked for punching shear and web crippling in stepped connections and matched connections, respectively. Calculations for this check shall be performed in accordance with AWS D1.1, Section 10. This code provides detailed guidance for the evaluation of the potential local failure in stepped and matched connections.