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January 18, 1989

U. S. Nuclear Regulatory Commission
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Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Additional Information Related to NRC Bulletin 79-14

Reference: 1) Letter from J. J. Harrison (NRC Region III) to C. E. Larson
(NSP) dated October 12, 1988

This submittal provides information requested by Mr. J. Gavula, (NRC-R.III)
during a telephone conversation with Mr. D. J. Ropson (WPSC).

The practice of excluding torsional moments when calculating stresses due to
occasional loads was questioned during an NRC Region III inspection of the IEB
79-14 Reconciliation Program for Prairie Island Nuclear Generating Plant. This
inspection was performed at Fluor Daniel, which is the architect-engineer for
both Kewaunee and Prairie Island. Attachment 1 provides the requested infor-
mation which was prepared by Fluor Daniel.

Attachment 2 provides the criteria prepared for the Kewaunee piping stress analy-
ses for determination of interim operability. This criteria is essentially that
which has been previously reviewed and found acceptable by NRC for application
to Prairie Island.⁽¹⁾

In summary, we believe that Fluor Daniel has made proper interpretations of the
applicable code, consistent with the commitments of the Kewaunee USAR.
Furthermore, based on our evaluation of this issue thus far, there is no indi-
cation that this is a safety concern.

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We will continue to evaluate the affects of torsional moments and prepare additional information concerning this investigation by approximately March 1, 1989.

Sincerely,

A handwritten signature in cursive script, reading "C. R. Steinhardt", followed by a horizontal line.

C. R. Steinhardt
Manager - Nuclear Power

DR/jms

Attach.

cc - Mr. Robert Nelson, US NRC
US NRC, Region III
J. A. Gavula - US NRC, Region III

DEFINITION OF THE ISSUE

During a recent NRC Region III inspection of the IEB 79-14 Reconciliation Program of the Prairie Island Nuclear Generating Plant, a question was raised in regard to the exclusion of torsional moments when calculating seismic stresses. Fluor Daniel explained that because the USAS B31.1.0 - 1967, Power Piping, code requires, "The sum of the longitudinal stresses produced by internal pressure, live and dead loads and those produced by occasional loads . . ." (paragraph 102.3.3(a)), torsional moments, as discussed in the following pages, were not considered when combining the stresses due to pressure, dead weight and dynamic seismic loads.

The USAS B31.1.0 - 1967 nuclear version of the Fluor Daniel PIPESTRESS computer program includes torsional moments when calculating individual stresses due to dead weight, thermal expansion and dynamic seismic loads. However, the PIPESTRESS computer program does not consider torsional moments in the combined stress subroutine when calculating stresses for the upset and faulted stress combinations consistent with USAS B31.1.0 - 1967 code requirements. Therefore, in regard to the USAR stress combinations, the upset condition (Pressure + Dead Weight + Operational Basis Earthquake) and the faulted condition (Pressure + Dead Weight + Design Basis Earthquake) stress combinations only are affected by this issue.

Torsional moments are included in the thermal expansion stresses which are summarized by the combined stress routine. Therefore, thermal expansion stresses are not affected by this issue.

Among other changes, including the .75 factor in equation 12, in later editions of the code (for example ASME/ANSI B31.1, Power Piping, - summer 1973 addendum) the term longitudinal stress was formulated to include torsional moments in combining stresses. These equations were also adopted by the ASME Boiler and Pressure Vessel Code, Section III, and became widely used in the industry. Since USAS B31.1.0 - 1967 was the licensing basis for Kewaunee Nuclear Power Plant, the later editions of the code were not incorporated.

The issue is, therefore, defined as follows:

"Did the inclusion of bending moments only, meet the intent of USAS B31.1.0 - 1967, Power Piping, when calculating the combined longitudinal stresses for the upset and faulted conditions?"

EVALUATION OF THE SIGNIFICANCE OF THIS ISSUE

The following reasons are presented in support of Fluor Daniel's interpretation of USAS B31.1.0 - 1967 when calculating longitudinal stresses. These reasons defend this interpretation and demonstrate that this is not a safety concern.

Engineering methodologies and their ultimate distillation into simplified formulas that are validated and verified into design codes have been evolutionary and reflect, at each stage, the "state-of-the-art" existing at that time. Also good engineering practice requires that the governing codes and standards be adhered to in the development of the designs. This requirement is most commonly deemed as being satisfied through the strict interpretation of the design codes as was the practice of Fluor Daniel for Kewaunee Nuclear Power Plant.

The above thought process has been logically applied by Fluor Daniel's PIPESTRESS computer program to the code provisions for the computations of longitudinal stress given in USAS B31.1.0 - 1967 Code. The term longitudinal stress in the engineering mechanics terminology has always been strictly defined to be those tensile or compressive stresses that are parallel to the longitudinal axis of the analytical element. This is in contrast with the definitions of circumferential stresses and shear stresses.

Later editions of ANSI B31.1 Power Piping have implied that "longitudinal" stresses include the combination of torsional stresses with true longitudinal stresses even though torsional moments do not create "longitudinal" stresses. The term "longitudinal" to qualify the above interpreted stresses is inappropriate because the direction of this stress is not truly longitudinal nor is this stress a direct tension or compressive stress but some combination of shear and direct stress.

At the time Kewaunee Nuclear Power Plant was designed, there were no explicit load combinations and allowable stress limit criteria defined in the codes to be used in pipe stress analysis for nuclear power plants. The criteria which exist in the USAR for pipe stress analysis, including the stress limits which provide adequate safety margins for various load combinations was, therefore, developed specifically for Kewaunee Nuclear Power Plant. This criteria used the engineering mechanics definition of "longitudinal" stress in establishing the load combinations and their allowable stress limits.

Additionally, identical statements including the word "longitudinal" stress appear in ASME/ANSI B31.3, Chemical Plant and Petroleum Refinery piping

(paragraph 302.3.5). It is Fluor Daniel's experience that, users of this code have interpreted, and continue to interpret, these statements as excluding torsional moments when calculating stresses due to weight and occasional loadings.

A preliminary evaluation of a small sample of existing analyses was performed to determine the affects of the inclusion of torsional moments. This preliminary evaluation included different pipe sizes. The resulting stresses including the torsional moments were within, or only marginally exceeded, the USAR allowable stress criteria. All stresses are significantly below the allowable stress criteria presented in Section 2.1 of the attached "Criteria For Determining Justification For Continued Operation of Safety Related Piping When Calculated Stresses Exceed USAR Allowables," dated 1/5/89. Based on this preliminary evaluation, it is Fluor Daniel's judgment that there is no operability concern nor significant safety issue.

SUMMARY AND CONCLUSIONS

In summary, Fluor Daniel is confident that it has consistently applied the requirements of the applicable code with the proper interpretations appropriate for that period of time.

We will pursue a program to independently assess this USAS B31.1.0 - 1967 code interpretation and provide additional information concerning this interpretation. We will also continue with the evaluation to determine the affects of torsional moments. We anticipate that this program will be complete by approximately March 1, 1989, and it will be forwarded to you for your information.