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James Coughlin
Vice President -
Nuclear

May 15, 1979

Mr. James G. Keppler, Director
U. S. Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Docket Nos: STN 50-546
STN 50-547

Construction Project Nos: CPPR-170
CPPR-171

MARBLE HILL NUCLEAR GENERATING STATION, UNITS 1&2

I&E BULLETIN NO. 79-07

Dear Mr. Keppler:

Public Service Company of Indiana, Inc. (PSI) has evaluated your request for information concerning seismic stress analysis of safety related piping contained in I&E Bulletin No. 79-07. As a result of that evaluation, PSI has determined that the DYNAPIPE and PIPSYS computer programs are used by our architect engineer, Sargent & Lundy, for seismic analysis of Marble Hill piping systems. These programs were developed independently of programs used by other architect engineers and other programs that are commercially available. The Sargent & Lundy programs work first with each direction of response (X, Y, or Z) and combine modal responses for a given direction per applicable regulatory guide requirements. The combined responses for each direction are then added by the SRSS method. Thus, the cancelling effect experienced in the piping analysis performed by other architect engineers does not occur in the Sargent & Lundy seismic analysis.

The following responses address the four specific items requested in I&E Bulletin No. 79-07:

Reply to NRC Item 1:

The DYNAPIPE and PIPSYS programs used by Sargent & Lundy for the response spectra seismic analysis of safety related piping do not employ algebraic summation routines for combining responses, either intermodal or for any other component of response. Sargent & Lundy does not use the time history method for the seismic analysis of piping.

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Reply to NRC Item 2:

None of the computer programs used by Sargent & Lundy for the seismic analysis of safety related piping employ algebraic techniques. Therefore no such computer programs are required to be submitted to the NRC.

Reply to NRC Item 3:

The Sargent & Lundy computer programs DYNAPIPE and PIPSYS were used in piping seismic analyses. These programs have a long history of use within Sargent & Lundy; for example, DYNAPIPE since 1969 and PIPSYS since 1972. They have been validated several times during their long history of use. For the seismic portions of the program, this has been done by checking computer results by hand calculations, checking results against public domain programs, and by checking results from PIPSYS against DYNAPIPE. Each new version of the program is extensively checked against the older version through a series of test problems. The following validation procedure was followed in the initial validation:

A. Check Against DYNAL[1] (1969)

A typical hot reheat piping system was analyzed on DYNAPIPE and DYNAL[1]. The element forces for a specified response spectra were compared and were found to be comparable. The frequencies of modes 1 through 6 were also in close agreement.

B. Check Against MEC-21[2] (1969)

In 1969, no public domain seismic analysis code had the capability of curved elements to model pipe elbows. To validate this feature of the Sargent & Lundy programs, the piping system given in example problem #2 of the MEC-21 computer code was analyzed by the Sargent & Lundy program. Seismic analysis was performed using the response spectra method. Member forces, joint displacements, and joint inertia forces were printed for each mode. The same system was then analyzed using the MEC-21 code with a static load equal to the modal inertia-free forces. The joint displacements obtained from the two codes were compared and found to be in good agreement.

C. PIPSYS and DYNAPIPE Comparison (1972)

In 1972, when the PIPSYS program was developed, it was extensively benchmarked against the DYNAPIPE program. Typical piping systems were run on the two programs and found to yield the same responses on the two codes.

D. PIPSYS and DYNAPIPE Check Against DYNAL[1] and NASTRAN[3] (1972)

In 1972, the modal periods and time history of response to pipe transients using the modal time history method on PIPSYS and DYNAPIPE were checked against those obtained from DYNAL and NASTRAN. Good agreement was obtained in responses from the four codes.

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References:

1. ICES DYNAL User's Manual, McDonnell-Douglas Automation.

2. MEC-21, 7094, "A Piping Flexibility Analysis Program for the IBM 7090 and 7094" Los Alamos Scientific Laboratory, University of California, 1964.

3. NASTRAN User's Manual, NASA SP-221.

Reply to NRC Item 4:

None of the computer programs used by Sargent & Lundy for seismic analysis of safety related piping employ the algebraic techniques described in NRC Item 1. Therefore, no reanalysis of any safety related piping is necessary.

If you have any questions concerning this response, please contact me.

Sincerely,

James Coughlin
Vice President-Nuclear

PAB:jep

cc: U. S. Nuclear Regulatory Commission
Office of Inspection & Enforcement
Division of Reactor Construction Inspection
Washington, D. C. 20555

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