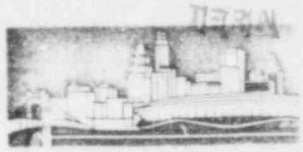
THE CINCINNATI GAS & ELECTRIC COMPANY



CINCINNATI, OHIO 45201

May 25, 1979

E. A. BORGMANN
VICE PRESIDENT - ENGINEERING

U.S. Regulatory Commission
Office of Inspection and Enforcement
Region III
7999 Roosevelt Road
Glen Ellyn, Illinois 60137

ATTN: Mr. James G. Keppler
Regional Director

RE: WM. H. ZIMMER NUCLEAR POWER STATION - UNIT 1
IE BULLETIN 79-07, SEISMIC STRESS ANALYSIS OF SAFETY-RELATED PIPING, DOCKET 50-358, W.O. 57300, JOB E-5590, FILE # 91

Gentlemen:

In response to your request please find the following information: Attachment (1) - S&L letter SLC-12855 dated May 18, 1979.

We believe this information provides a complete response to the subject NRC IE Bulletin.

Very truly yours,
THE CINCINNATI GAS & ELECTRIC COMPANY

E.A. BORGMANN, SENIOR VICE PRESIDENT

RWR/kjd
ENCLOSURE
cc: NRC Office of Inspection and Enforcement
Division of Reactor Inspection Programs
Washington, D.C. 20555

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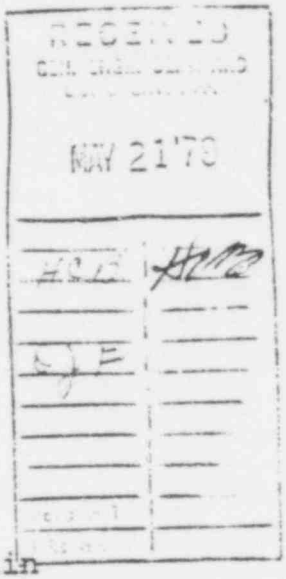
ATTACHMENT 1

SARGENT & LUNDY
ENGINEERS
FOUNDED BY FREDERICK SARGENT-1891
55 EAST MONROE STREET
CHICAGO, ILLINOIS 60603
TELEPHONE - 312-269-2000
CABLE ADDRESS - SARLUN-CHICAGO

R. F. SCHEIBEL
PARTNER
312-269-3970

SLC-12855
May 18, 1979

The Cincinnati Gas & Electric Company



Reply to NRC IE Bulletin Number 79-07

Mr. E. A. Borgmann
Senior Vice President
The Cincinnati Gas & Electric Company
P. O. Box 960
Cincinnati, Ohio 45201

Dear Mr. Borgmann:

The attached enclosure is in response to NRC IE Bulletin 79-07 - Seismic Stress Analysis of Safety-Related Piping and is a retransmittal of information sent on May 2, which apparently was not received. The enclosure is for your transmittal to the NRC.

Please contact us if there are any questions.

Very truly yours,

R. F. Scheibel
Project Director

RFS:klm
In triplicate
Enclosure
Copies:
R. J. Pruski (1/1)

PRELIMINARY REPLY TO NRC IE BULLETIN NO. 79-07

April 23, 1979

SEISMIC STRESS ANALYSIS OF SAFETY-RELATED PIPING

In IE Bulletin No. 79-07, dated April 14, 1979 the NRC raised questions concerning the methods of combination of earthquake directional response used for piping analysis for safety related piping systems in both operating nuclear plants and plants under construction. As the result of an investigation of stress analysis performed by an eastern based AE, the NRC ordered the shutdown of five nuclear stations when it was found that earthquake directional response (X,Y,Z direction) in the piping analyses were added algebraically at the modal level i.e., mode by mode. This resulted in some cancelling effect for the signed modal responses for a given local component of load. In some cases the calculated piping stresses and restraint and support loads were reportedly underestimated by as much as 50%.

The Dynapipe and PIPSYS programs that Sargent & Lundy used or currently uses for the seismic analysis of piping systems were developed independently of programs used by other AE's and other programs that were and are commercially available. Therefore, it is unlikely that any similar errors would be repeated in the Sargent & Lundy piping analysis. Furthermore, 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 for the plants the NRC shut down does not occur in the Sargent & Lundy seismic analysis.

In Bulletin No. 79-07 the NRC requests responses to four specific action items regarding the seismic analysis of safety related piping. Those action items along with appropriate responses are provided in the following:

NRC Item (1) Identify which, if any, of the methods specified below were employed or were used in computer codes for the seismic analysis of safety related piping in your plant and provide a list of safety systems (or portions thereof) affected:

Response Spectrum Model Analysis:

a. Algebraic (considering signs) summation of the codirectional spatial components (i.e., algebraic summation of the maximum values of the codirectional responses caused by each of the components of earthquake motion at a particular point in the mathematical model).

b. Algebraic (considering signs) summation of the codirectional inter model responses (i.e., for the number of modes considered, the maximum values of response for each mode summed algebraically).

Time History Analysis:

a. Algebraic summation of the codirectional maximum responses or the time dependent responses due to each of the components of earthquake motion acting simultaneously when the earthquake directional motions are not statistically independent.

Reply:

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.

NRC Item (2) Provide complete computer program listings for the dynamic response analysis portions for the codes which employed the techniques identified in Item 1 above.

Reply:

None of the computer programs used by Sargent & Lundy for the seismic analysis of safety related piping employ the algebraic techniques described in item (1), therefore we are not required to submit our computer program listings.

NRC Item (3) Verify that all piping computer programs were checked against either piping benchmark problems or compared to other piping computer programs. You are requested to identify the benchmark problems and/or the computer programs that were used for such verifications or describe in detail how it was determined that these programs yielded appropriate results (i.e., gave results which corresponded to the correct performance of their intended methodology).

Reply:

The S&L computer program DYNAPIPE (09.7.052) and PIPSYS (09.5.065) were used in piping seismic analyses. These programs have a long history of use within S&L - e.g., 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 S&L programs, the piping system given in example problem No. 2 of the MEC-21 computer code was analyzed by the S&L program. Seismic analysis was performed using the response spectrum 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, and joint displacements obtained from the two codes were compared and found to be in good agreement.

C. PIPSYS & 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 & 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.

References

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

2. MEC-21, 7094, "A Piping Flexibility Analysis Program for the IBM7090 and 7094," Los Alamos Scientific Laboratory, University of California, 1964.

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

In addition Sargent & Lundy would welcome a generic review of our piping program by the NRC Licensing Staff. This review could most effectively be conducted in our offices where all documentation and key personnel would be available to the staff.

NRC Item (4) If any of the methods listed in item 1 are identified, submit a plan of action and an estimated schedule for the re-evaluation of the safety related piping, supports, and equipment affected by these analysis techniques. Also provide an estimate of the degree to which the capability of the plant to safely withstand a seismic event in the interim is impacted.

Reply:

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

A. K. Singh
Supervisor
Structural Analytical Division

E. B. Branch
Associate, Head
Engineering Mechanics Division

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