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Central file

October 12, 1979

Mr. James G. Keppler, Director
Directorate of Inspection and
Enforcement - Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Subject: Dresden Station Units 2 and 3
Quad-Cities Station Units 1 and 2
Response to IE Bulletin No. 79-07
"Seismic Stress Analysis of
Safety-Related Piping"
NRC Docket Nos. 50-237/249/254/265

References (a): J. G. Keppler letter to B. Lee, Jr.
dated April 14, 1979

(b): C. Reed letter to J. G. Keppler
dated April 24, 1979

Dear Mr. Keppler:

Reference (a) transmitted IE Bulletin No. 79-07 requesting information regarding the seismic analysis of safety-related piping. Reference (b) was submitted in response to IE Bulletin No. 79-07 and stated that the seismic analysis subcontractor for General-Electric-supplied piping was preparing a response to IE Bulletin No. 79-07 which would be forwarded as soon as it was available. The seismic analysis of Dresden Station Units 2 & 3 and Quad-Cities Station Units 1 & 2 General-Electric-supplied piping was performed by URS/John A. Blume & Associates, Engineers. The 3DFRM and SMIS computer programs were used by URS/Blume for the seismic piping analysis. A description of these programs and the verification procedure used by URS/Blume is presented in Attachment 1 to this letter. The Blume report for Dresden Station Units 2 and 3 notes that studies that did use algebraic summation were performed in 1969. General Electric has verified that these studies were performed only to compare two calculational methods and not to justify the design.

Please address any questions you may have concerning this matter to this office.

Very truly yours,

D. L. Peoples

D. L. Peoples
Director of Nuclear Licensing

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attachment

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ATTACHMENT 1

Description of Computer Programs and the Verification Procedure Used by URS/John A. Blume & Associates, Engineer for the Seismic Analysis of General Electric Company Supplied Piping

URS/Blume Response to NRC IE Bulletin No. 79-07 for Dresden Nuclear Power Plant, Units 2 & 3

We have examined the seismic analysis of the piping systems in the two Dresden Units (2 and 3) analyzed by our firm for the General Electric Co. These analyses were examined for the first three questions raised on the subject bulletin. The five piping systems are:

1. Recirculation Loop Piping P1 (Ref. 1).
2. Recirculation Loop Piping P2 (Ref. 1).
3. Recirculation Loop Piping P3 (Ref. 1).
4. Recirculation Loop Auxiliary Piping - 16 in. Reactor Shutdown Lines (Ref. 2).
5. Recirculation Loop Auxiliary Piping 16 in. LPCI Shutdown Lines (Ref. 2).

Based on a brief review, our findings are as follows:

Question 1.

The seismic analysis of the Recirculation Loop Pipies (1 through 3) used the response spectrum modal analysis method. Algebraic summation of co-directional spatial components or codirectional intermodal components was not used. The modal inertial forces were calculated using standard response spectrum analysis procedures, and combined by the square-root-of-the-sum-of-the-squares (SRSS) method for each component. The codirectional inertial forces due to the horizontal and vertical components were then combined on an absolute sum basis. These inertial forces were then applied as static loads to obtain moments, forces, stresses, support reactions, etc.

The Recirculation Loop Auxiliary Reactor Shutdown Pipes and the Recirculation Loop Auxiliary LPCI Shutdown Pipes (4 & 5) described above were analyzed using the response spectrum modal analysis described above; however, we could not locate the computer outputs for these piping systems that correspond to the results shown in a report (Ref. 3 and 4) on that piping. We are not sure whether, if any, final report was issued to General Electric for these piping systems.

We have some additional computer output for Recirculation and Shutdown piping which seem to correspond to certain studies performed for General Electric Co. in July through September 1969. In these studies the codirectional component modal responses were added algebraically. These studies were performed to compare two different methods in calculating the stresses associated with the seismic responses. In the first method (Force Method) the modal displacements and inertial forces were combined using the 'square root sum of squares' (SRSS) method and the subsequent inertial forces and moments from the combined SRSS displacements were computed for the stress calculations. In the second method, (termed the RMS-stress method) all responses, i.e., displacements, inertial forces, moments, stresses and support reactions were computed for each mode and then combined by the SRSS method. However, in these studies, the codirectional component responses were in effect added algebraically in each mode. We do not know if the results of these studies were used by General Electric Company in the design and evaluation of the corresponding piping; they may have been for parametric study purposes only.

Question 2.

Two computer codes were used in our dynamic analyses of the Recirculation Loops: 3DFRM and SMIS (Ref. 5). SMIS was developed at the University of California at Berkeley and was used for matrix manipulation, eigenvalue solution, and response spectrum dynamic analysis. The program 3DFRM was used to develop the flexibility matrix, mass matrix, and stresses for the piping systems.

SMIS is a public domain program and has been widely used. A description and listing may be found in Ref. 5. A listing of 3DFRM is not readly available.

Question 3.

Verification for 3DFRM was performed at the time the program was written. This documentation is no longer available. As mentioned above, SMIS is a public domain program and has been widely used. Some aspects of the program are self verifying, such as orthogonality checks. In addition, the program was tested and verified by URS/Blume engineers when it was first used in the 1960's. However, verification documentation is not presently available.

References:

1. John A. Blume & Associates, Engineers, *DRESDEN Unit 2 and 3 Nuclear Power Plant, Earthquake Analysis: Recirculation Loop Piping*, prepared for General Electric Co., December 6, 1968.

2. John A. Blume & Associates, Engineers, *DRESDEN Unit 2 and 3 Nuclear Power Plant, Earthquake Analysis: Recirculation Loop Auxiliary Piping*, prepared for General Electric Co., October 8, 1969.

3. John A. Blume & Associates, Engineers, *DRESDEN Unit 2 and 3 Nuclear Power Plant, Earthquake Analysis: Recirculation Loop Auxiliary Piping-LPCI Shutdown*. (original undated)

4. John A. Blume & Associates, Engineers, *DRESDEN Unit 2 and 3 Nuclear Power Plant, Earthquake Analysis: Recirculation Loop Auxiliary Piping - Reactor Shutdown*. (original undated)

5. Wilson, E. L., *SMIS Symbolic Matrix Interpretative System*, Department of Civil Engineering, University of California, Berkeley.

URS/Blume Response to NRC IE Bulletin No. 79-07 for Quad Cities, Nuclear Power Plant.

We have examined the seismic analyses of the Quad Cities Recirculation Loop Piping analyzed by our firm for the General Electric Company. This analysis was examined for the first three questions raised on the subject bulletin. The three piping systems are:

1. Recirculation Loop Piping P1 (Ref. 1)
2. Recirculation Loop Piping P2 (Ref. 2)
3. Recirculation Loop Piping P3 (Ref. 1)

Based on a brief review, our findings are al follows:

Question 1.

The seismic analysis of the Recirculation Loop Pipes used the response spectrum modal analysis method. At this time, we could not locate the computer output corresponding to the results provided in the report. The SMIS computer run which would have given a positive indication of how the codirectional (horizontal & vertical) responses were added in the analysis. Since the Quad Cities Recirculation Loop Piping was analyzed at the same time as the analyses of the Dresden unit 2 & 3 Recirculation Loop Piping (December 1968), it may be reasonably concluded that observations made in Part I on Dresden 2 & 3 are valid here. These observations are as follows. The algebraic summation of codirectional spatial components of codirectional intermodal components was not used. The modal inertial forces were calculated using standard response spectrum analysis procedures, and combined by the square-root-of-the-squares (SRSS) method for each component. The codirectional inertial forces due to the horizontal and vertical components were then combined on an absolute sum basis. These inertial forces were then applied as static load to obtain moments, forces, stresses, support reaction, etc.

Question 2.

Two computer codes were used in our dynamic analyses of the Recirculation Loops: 3DFRM and SMIS (Ref. 3). SMIS was developed at the University of California at Berkeley and was used for matrix manipulation, eigenvalue

solutions, and response spectrum dynamic analysis. The program 3DFRM was used to develop the flexibility matrix for the loops and stresses. SMIS is a public domain program and has been widely used. A description and listing may be found in Ref. 3. A listing of 3DFRM is not readily available.

Question 3.

Verification for 3DFRM was performed at the time the program was written. This documentation is no longer available. As mentioned above, SMIS is a public domain program and has been widely used. Some aspects of the program are self verifying, such as the orthogonality checks. In addition, the program was tested and verified by URS/Blume engineers when it was first used in the 1960's. However, verification documentation is not presently available.

References:

1. John A. Blume & Associates, Engineers, *Quad-City Station Units Number One and Two, Earthquake Analysis: Recirculation Loop Piping*, prepared for General Electric Co., December 4, 1968.

2. Wilson, E. L., *SMIS Symbolic Matrix Interpretive System*, Department of Civil Engineering, University of California, Berkeley.