PDR

Edward Hines

Detroit Edison

May 30, 1979
EF2-46,147

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

Dear Mr. Keppler:

Subject: Detroit Edison Response to IE Bulletin No. 79-07

This letter is in response to your IE Bulletin No. 79-07, dated April 14, 1979, which describes seismic stress analysis of safety-related piping.

Enclosed please find an interim response to your inquiry in our memorandum EF2-45,214 of May 25, 1979, advising you of the status of seismic analysis information received from our consultants/vendors.

Please advise us if you have any questions regarding our interim report on this matter.

Sincerely yours,

Edward Hines

RWB/lm

Attachments

cc: Mr. John G. Davis, Acting Director
Office of Inspection and Enforcement
Division of Reactor Inspection Programs
U.S. Nuclear Regulatory Commission
Washington D.C. 20555

JUN 01 1979

IE

7908030602

440 087

Detroit Edison

ENRICO FERMI UNIT 2 PROJECT
ENGINEERING

May 25, 1979

EG2 - 45214

To: R. W. Barr
Project Quality Assurance Director
206 Engineering Construction-Troy

From: F. E. Gregor
Principal Engineer - EF2
318 Engineering Construction-Troy

Reference: IE-Bulletin No. 79-07, dated April 14, 1979

Subject: Fermi 2 Interim Response to NRC - Bulletin 79-07

We have reviewed the above referenced bulletin and identified six consultants/vendors that have performed seismic analysis of safety related piping systems for the Fermi 2 plant. They are:

1. Stone & Webster Michigan, Inc., Cherry Hill
2. Sargent & Lundy Engineers, Chicago,
3. General Electric Company. San Jose
4. NUTECH, Inc., San Jose
5. Atomics International, Canoga Park
6. General Electric I&SE, Oak Brook, Illinois

Each individual consultant/vendor was requested to respond to the information request of the bulletin. In summary, none of the consultants/vendors utilized piping computer programs employing algebraic (considering signs) summation in performing response spectrum or time history dynamic piping analyses.

The individual responses are as follows:

1. STONE & WEBSTER MICHIGAN, INC.

   A detailed response to item (3) of the bulletin, computer program description and verification, is

being provided in response to the March 13, 1979 Order to Show Cause for the Surry Units 1 and 2, (see Attachment A). A program summary and verification data is given in the FSAR Section 3.13.4.1.

2. SARGENT & LUNDY ENGINEERS

The detailed response is provided in Attachment B. Their programs are also described in FSAR Section 3.13.1,26.

3. GENERAL ELECTRIC COMPANY, SAN JOSE

The General Electric response is provided in Attachment C. A generic submittal to the Commission in July, 1979 will provide verification data for the PISYS computer program, utilizing five NRC benchmark problems.

4. NUTECH, INC.

A complete response is given in Attachment D

5. ATOMICS INTERNATIONAL

Telegraphic response was received, stating that the methods in question have not been used in the dynamic analysis of the skid piping for the hydrogen recombiner systems. The complete assembled proto-type skid including the piping within the system have also been successfully subjected to a seismic shaker table test with a response spectra enveloping the applicable Fermi 2 seismic response spectra.

The detailed computer program description and verification will be submitted within 90 days.

6. GENERAL ELECTRIC I&SE

The control rod drive insert and withdraw piping and the scram volume discharge piping were analyzed by GE-I&SE and subcontracted to Teledyne. A detailed response was not received in time and will be provided within 90 days. It was confirmed by telephone, that the methods in question have NOT been used.

In conclusion, we will provide a follow-up report submitting the detailed responses of two of our consultants/vendors.

FEG/dk

cc: W. F. Colbert/E. Lusis/L. Bertani
M. G. Sigetich
G. Butterworth
T. Byrd
Document Control

APPROVED W. F. Colbert
W. F. Colbert
Project Engineer
Enrico Fermi 2

440 090

Copy to:

LRiccardi-3
CKeiberg
WTColbert
JConsiglio

ATTACHMENT (A)

Mr. F. Gregor
Systems Engineer
Enrico Fermi - Unit 2
2000 Second Avenue
Detroit, MI 48226

May 22, 1979

S.O. No. 17067.0
SWEC-520

Dear Mr. Gregor:

TASK NO. 00706
RESPONSE TO USNRC BULLETIN 79-07
ENRICO FERMI ATOMIC POWER PLANT - UNIT 2

Reference: DECO Letter No. EF2-44,670 dated May 10, 1979

Your referenced letter requested S&W response to USNRC Bulletin 79-07. Our response is as follows:

Items 1, 2, and 4: In response to Items 1, 2, and 4, no computer codes have been identified by S&W which used any of the methods described in Item 1 of the Bulletin.

Item 3: The computer program NUPIPE, Versions 0306 and 0310, has been used to analyze the safety-related portions of the following systems of Enrico Fermi-2:

a. Standby Liquid Control System

b. Main Steam Drain System

c. RPV Vent System

d. Main Steam Valve Leakage Control System.

Verification of computer programs used by S&W are being addressed in response to the April 2 Addendum to the March 13 Order to Show Cause for Surry Units 1 and 2. S&W's in-house benchmarking links all major versions of NUPIPE to Version 0310.

440 091

(A)

If you have any questions, please call.

Very truly yours,

G. E. Thornes
Project Engineer

BCD:DJR

ATTACHMENT (B)

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

May 15, 1979
Project No. 5285-16
SLM-1011

The Detroit Edison Company
Enrico Fermi - Unit 2

Reply to NRC IE Bulletin No. 79-07

Mr. F. E. Gregor, System Engineer
Enrico Fermi - Unit 2
The Detroit Edison Company
2000 Second Avenue
Detroit, Michigan 48226

Dear Mr. Gregor:

We have responded to your request in EF2 - 44, 674, dated May 10, 1979 by Mr. R. F. Scheibel's letter of May 2, 1979 addressed to Mr. W. F. Colbert. Attached is a copy of Mr. Scheibel's letter and Sargent & Lundy's response.

If there are any questions, please contact me.

Yours very truly,

D. R. Larson
Project Manager

DRL/dm
In duplicate
Attachment
Copies:
W. F. Colbert (1/1)
C. R. Seibert (1/1)
R. F. Scheibel (1/1)
F. P. Tsai (1/1)

440 093

D.R. LARSON-17

(2)

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

R. F. SCHEIBEL
PARTNER
312-269-3970

May 2, 1979

The Detroit Edison Company

Reply to NRC IE Bulletin Number 79-07

Mr. W. F. Colbert
Project Engineer
The Detroit Edison Company
2000 Second Avenue
Detroit, Michigan 48226

Dear Mr. Colbert:

The attached enclosure is in response to NRC IE Bulletin 79-07 - Seismic Stress Analysis of Safety-Related Piping. This 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 quadruplicate
Enclosure
Copies:
D. R. Larson (1/1)

440 .094

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:

(B)

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.

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(3)

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 those 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

GENERAL ELECTRIC

NUCLEAR ENERGY

PROJECTS DIVISION

GENERAL ELECTRIC COMPANY 175 CURTNER AVE. SAN JOSE, CALIFORNIA 95125
MC 391, (408) 925-2588

ATTACHMENT C

May 24, 1979
TDEC- 3619

Mr. F. E. Gregor, System Engineer
Enrico Fermi 2 Project
The Detroit Edison Company
Documentation Control - Room 361
2000 Second Ave.
Detroit, MI 48226

Dear Mr. Gregor:

SUBJECT: GE RESPONSE TO NRC
IE - BULLETIN 79-07

Reference: EF2-44672 dated 5/10/79

As requested in the referenced letter, the GE response to items 1 through 4 of IE-Bulletin 79-07 is as follows:

Item 1 & 2

None of the computer codes used for the seismic analysis of piping systems important to safety employed the techniques identified in item 1.

Item 3

The SAP/PISYS computer programs were used for seismic piping analysis. A description of these programs and the verification procedure is presented below.

SAP4G Verification

Program Description

SAP4G, a version of SAP, was originally developed for General Electric by F. A. Peterson and K. J. Bathe of the Engineering Analysis Corporation at Berkeley. The SAP program is a general purpose structure program used to perform static and dynamic analysis of mechanical and piping components by the finite element method.

Verification

All GE productions versions of SAP are verified using a special bench mark problem that exercises all the important features of the program. The bench mark problem has been analyzed for the effects of constraint of free end, distributed forces, and is dynamically analyzed to determine mode shapes and natural frequencies using Swanson System's ANSYS program. ANSYS was also used to predict dynamic response of the bench mark problem using the response spectra and time history integration methods. The predicted frequencies, mode shapes, and loads were compared to the corresponding SAP predictions. The SAP program prediction had to be consistent with those of ANSYS before SAP was qualified for production use. In order to test unique features of SAP that cannot be compared to the results of another program, a special problem is devised which has an equivalent computer or manually calculated solution. Before any new version of SAP is verified, for production application, the bench mark problem is reanalyzed to verify that the program changes have not changed predictions or reduced their accuracy.

PISYS Verification

Program Description

PISYS is a computer program specialized to analyze piping systems. The PISYS program provides a highly flexible user oriented input format for piping system modeling. The analysis modules of PISYS are taken directly form the SAP4G program.

Verification

Since PISYS analysis modules are identical to SAP4G, a SAP analysis of a typical BWR steam piping system is used as a bench mark problem for PISYS verification. The steam line is analyzed for thermal expansion, dead weight, and a variety of dynamic loads in order to exercise all the features of PISYS. PISYS was not verified as a production program until the predictions of SAP and PISYS were shown to be identical for practical purposes.

Before any new version of PISYS is verified for production application, the bench mark problem is reanalyzed to verify that the program changes have not changed the predictions or reduced their accuracy.

Five NRC bench mark problems will also be analyzed as a further verification of the PISYS code. This analysis is expected to be completed and submitted to the Commission for review by Jul 13, 1979.

Item 4

No further response is required.

440 100

Please call if you have any questions.

Very truly yours,

R. L. Smith for

C. K. Johnson
Project Manager
Enrico Fermi 2 Project

CKJ:pab/392-394

cc: D. R. Swanson, GE, Detroit
F. Gregor, Edison
H. A. Kenkle, GE Site
D. R. Pankratz, GE Site
File: 10.5/22-15

ATTACHMENT (D)

nutech 145 MARTINVALE LANE • SAN JOSE, CALIFORNIA 95119 • PHONE (408) 629-9600

May 18, 1979
DET-01-199

Mr. F. E. Gregor
Detroit Edison Company
333 Engineering Construction - Troy
2000 Seconda Avenue
Detroit MI 48226

Subject: Response to NRC IE Bulletin 79-07 - Seismic Analysis of Safety-Related Piping for Enrico Fermi Atomic Power Plant, Unit 2.

References:

1. Seismic Stress Analysis of Safety-Related Piping, NRC IE Bulletin 79-07, dated April 14, 1979.
2. PISTAR Verification Report, NUTECH Topical Report TR-76-001, Revision 0.
3. PISTAR User's Manual, NUTECH Topical Report TR-76-002, Revision 1.
4. Pressure Vessels and Piping, 1972 Computer Program Verification, The American Society of Mechanical Engineers, 1972, 72-94235.
5. ANSYS Engineering Analysis User's Manual Swanson Analysis Systems, Inc., 1975.
6. Enrico Fermio Power Plant, Unit 2, Primary Containment Stress Report for Pool Swell and Safety/Relief Valve Discharge Loads, NUTECH Report DET-01-157 (in preparation).

Dear Frank:

In response to the Detroit Edison letter of May 10, letter EF2-44671, the following information is provided concerning analysis of safety-related piping performed by NUTECH for the Enrico Fermi Atomic Power Plant, Unit 2. NUTECH performed seismic analysis for the following safety-related piping within the suppression chamber:

- Vacuum Breaker Pneumatic Piping
- HPCI Turbine Exhaust Piping
- RCIC Turbine Exhaust Piping
- HPCI Condensate Line
- RCIC Condensate Line
- RHR Test Line
- Core Spray Test Line

The results of these analyses are documented in Reference 6. NUTECH's piping program PISTAR was used to perform the analysis.

PISTAR is a NUTECH proprietary computer program developed to perform the analysis of power piping. The program is based on the well-known computer program, SAP-4, developed at the University of California at Berkeley. Complete user documentation for PISTAR, which includes a user's manual (Reference 3) and verification report (Reference 2), is available.

The concerns addressed in the NRC Bulletin (Reference 1) involved methods used in performing seismic analysis of safety-related piping. Specifically, the NRC is concerned with the methods used in combining the codirectional and modal responses due to earthquake motion, using either response spectrum or time-history techniques. A description of the response spectrum technique used in the analysis of the safety-related piping previously listed is given below. No seismic analysis was performed using time-history techniques and therefore this option need not be discussed.

Response to each item listed in Reference 1 is given below:

Item 1: The combination methods used in performing the seismic analysis of the safety-related piping listed above was Square-Root-Sum-of-the Squares (SRSS) method for both the co-directional responses, and modal responses due to earthquake motion.

Item 2: A complete listing for the dynamic response analysis portion of the computer program is required to be submitted to the NRC only if direct combination of codirectional or modal responses due to earthquake motion was used. Since the SRSS combination method was used, the listing of the program will not be submitted to the NRC at this time.

Item 3: The response spectrum analysis technique employed in PISTAR was verified using the ANSYS computer program (Reference 5). Problem No. 6, as defined in Reference 4, was solved on both PISTAR and ANSYS to verify the SRSS combination techniques. The PISTAR Verification Report (Reference 2) provides more detailed information on the program verification and is available upon request.

Item 4. No reevaluation of the safety-related piping listed above is required since the SRSS combination method was used.

If you have any other questions concerning this matter, please don't hesitate to call either of the undersigned.

Very truly yours,

J. R. Arterburn, P.E.
Engineer

A. B. Higginbotham, P.E.
Project Engineer

ABH/JRA:ba

cc: W. F. Colbert
D. F. Lehnert
File 50.301.0001