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Washington Public Power Supply System
A JOINT OPERATING AGENCY

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Docket Nos. 50-460 and 50-513

June 12, 1979
G01-79-350

Nuclear Regulatory Commission
Region V
Suite 202, Walnut Creek Plaza
1990 N. California Boulevard
Walnut Creek, CA 94996

Attention: Mr. R. H. Engelken
Director

Subject: WPPSS NUCLEAR PROJECTS NOS. 1 & 4
IE BULLETIN NO. 79-07

Reference: Letter, R. H. Engelken to N. O. Strand, Same Subject, April 14, 1979.

Dear Mr. Engelken:

In response to the subject bulletin WPPSS submits the attached for its Projects WNP-1 and 4.

Should you have any questions with regard to this response, please contact me.

Very truly yours,

DL Renberger

D. L. RENBERGER
Assistant Director -
Technology

DLR:ADCK:ct

Attachment

cc: C. R. Bryant, BPA
NRC - Office of Inspection & Enforcement (Washington D.C.)

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ATTACHMENT

WNP-1/4 RESPONSE TO NRC IE-BULLETIN 79-07

I. PIPING OTHER THAN REACTOR COOLANT HOT LEG, COLD LEG, SURGE, AND PRESSURIZER SPRAY

1) None of the methods specified in IE-BULLETIN 79-07, that is, Response Spectrum Modal Analysis Methods (a) and (b) and Time History Analysis Method (a) has been employed in computer codes for the seismic analysis of safety-related piping performed by United Engineers and Constructors.

2) No computer program lists for dynamic response analysis are provided since the techniques identified in item (1) above have not been employed.

3) The following piping computer programs were utilized by United Engineers and Constructors in the analysis of safety-related piping.

   a. UE&C-ADLPIPE-2

   b. ADLPIPE

   UE&C-ADLPIPE-2 is a piping computer program maintained, documented and verified by United Engineers and Constructors. ADLPIPE is a piping computer program proprietary to A. D. Little, Inc. and is utilized by United Engineers and Constructors through the Control Data Corporation Computer System. Code maintenance, documentation and verification is the responsibility of A. D. Little, Inc./ Control Data Corporation.

   The details of the verifications performed for these computer programs are as follows:

   Verification Approach for the UE&C-ADLPIPE-2 Program

   The results of the UE&C-ADLPIPE-2 program have been verified by direct comparison with computer results obtained from the following codes:

   ADLPIPE

   STARDYNE

   MEL-40

   Where computations performed by UE&C-ADLPIPE-2 were not features in the codes mentioned above, hand calculations were made to verify the UE&C-ADLPIPE-2 results.

The choice of the above computer codes or hand calculations to verify the results of UE&C-ADLPIPE-2 code can be summarized as follows:

A) Where it was required to check calculations made by UE&C-ADLPIPE-2 which included comparisons of mode shapes and frequencies for dynamic analysis, the STARDYNE program was utilized.

B) Where it was required to check those features in UE&C-ADLPIPE-2 which related to piping component stress evaluation and methods for combining intra and inter modal responses for dynamic analysis, hand calculations were utilized to verify each and every modification.

C) The MEL-40 and the original version of ADLPIPE program were utilized where results of static analysis were to be verified.

In addition, the results of the UE&C-ADLPIPE-2 program have also been verified by direct comparison with computer results obtained from the five benchmark piping problems contained in Reference (1).

These benchmark problems are as follows:

Problem 1 - Static Response of Hovgaard Bend

Problem 2 - Dynamic Response of Hovgaard Bend

Problem 3 - Dynamic Analysis of Coffee Table

Problem 4 - Static Analysis of Spence's Pipe Work Problem

Problem 5 - Dynamic Analysis of Low Frequency Coffee Table

Reference (1) BNL-NUREG-21241-R2
INFORMAL REPORT
"DEVELOPMENT OF SOLUTIONS TO BENCHMARK PIPING PROBLEMS"

by M. Reich, T. T. Chang, S. Prachuktam, and M. Hartzman, Department of Nuclear Energy Brookhaven National Laboratory, Upton, New York, December 1977 - - Work sponsored by the Mechanical Engineering Branch, Division of Systems Safety, United States Nuclear Regulatory Commission

Verification Approach for the ADLPIPE Program

Verification of ADLPIPE was undertaken in a series of fundamental checks. In important modifications, a supporting document was prepared as an ADLPIPE reference. The verification procedure was as follows.

The thermal and deadweight loadings were checked by a Hovgaard Bend and hand calculated systems given in "Design of Piping Systems", M. W. Kellogg, Second Edition, 1956, and "Formulas of Stress and Strain", R. J. Roark, McGraw-Hill.

The dynamic analyses were checked by "Response of Structural Systems to Ground Shock", Shock and Structural Response, ASME, 1960, in "ADLPIPE Results of Model Given by Young"*, and "Dynamic Behavior of a Foundation-Like Structure", Mechanical Impedance Methods, ASME, 1958, in "Experimental Verification of ADLPIPE Mod 1"*.

The thermal transient analysis was verified by a separate analysis, "Transient Thermal Gradient Stresses", E. B. Branch, Heating, Piping and Air Conditioning, Volume 43, 1971, Pages 132-136, "ADLPIPE Thermal Transient Analysis"*.

The computation of intra and inter modal moment component summation has been verified by a separate computer program for that purpose. A report "ADLPIPE Modal Response Combination for Closely Spaced Modes"*, is available.

The time history analysis was checked by a separate analytical solution of the problem given in "Analytical Methods of Vibrations", Page 395, Leonard Meirovitch, "ADLPIPE Time History Response Compared with a Known Solution for a Heavily Damped System"*. A second check was made using "Pressure Vessel and Piping 1972 Computer Programs Verification", ASME, 1972 (Problem 5).

Various calculation procedures required by ASME Section III were verified in references entitled "ADLPIPE Computation of Bending Stress in Tees and Branch Connections, ASME Section III, Class 1 Piping", "ADLPIPE Computation of Resultant Moments for Section III Class 2 and 3 Stresses", and "ADLPIPE Stress Computation of Piping Components: A comparison with Hand Calculations for ANSI B31 and ASME Section III"*.

In 1978 an independent third party review of ADLPIPE (Section III, Class 1) was performed "Verification of ADLPIPE, ASME Section III, Class 1 Piping Stress Program", Teledyne Engineering Services, Report No. TR-2884-1, August 11, 1978.

4) None of the specific methods listed in Item (1) above were employed in the analysis of ASME III piping for WNP-1/4.

* These references are available from Arthur D. Little, Inc.

However, the original analysis for ASME III, Class I, piping used computer program UE&C-ADLPIPE-1 which algebraically summed loads rather than summing loads using the square-root-of-the-sum-of-squares technique. Re-analysis of all Class 1 pipe using UE&C-ADLPIPE-2, which does use square-root-of-the-sum-of-squares technique, gave the following results:

A) No piping is overstressed.

B) Four(4) pipe hangers of a total of 476 Class 1 hangers are potentially in an overstressed condition. These have been placed on hold. Two of the hangers are on the jobsite, one is in the fabricator's shop, and one has not been released from UE&C for fabrication. The evaluation of the four hangers, and redesign if required, will be completed by August 1, 1979.

C) Various NSSS equipment nozzle loads increased and require investigation. The NSSS Contractor, Babcock and Wilcox, has been advised of the change. Because the increases were generally marginal, UE&C believes that no changes will be required to piping, pipe hangers, or NSSS equipment. The investigation will be complete by September 1, 1979.

II. REACTOR COOLANT HOT LEG, COLD LEG, SURGE, AND PRESSURIZER SPRAY PIPING

1) A review of modal results in the piping analyses clearly establishes that the spectral methods in IE Bulletin 79-07 were not used. Modal reactions were determined, then the modal contributions for the entire structure were combined by the Double Sum Method (Reference 2) to account for closely spaced modes. Stresses were calculated using the square root of the sum of the squares (SRSS) of the responses of the three earthquake directions.

2) Not applicable.

3) The analyses of all piping within Babcock & Wilcox's Scope (hot leg, cold leg, surge and spray piping) were performed using ST3DS/LUMS (References 3 and 4). These computer codes were verified using sample problems contained in the users manuals. The combination of modal reactions by double sum was verified by hand calculation as being more conservative than SRSS of modal reactions, and the SRSS combination of directional earthquake response was verified by hand calculation.

4) Not applicable.

Reference (2) NRC Regulatory Guide 1.92, "Combining Modal Responses and Spatial Components in Seismic Response Analysis", February 1976.

Reference (3) A. S. Kadakia, P. G. Tuttle: "Users Manual, ST3DS Piping Flexibility Analysis Program as Modified for B&W Application", NPGD-TM-126, Babcock & Wilcox, P.O. Box 1260, Lynchburg, Virginia 24505, May 1971.

Reference (4) P. G. Tuttle, A. S. Kadakia: "Users Manual, Piping Flexibility Analysis Program LUMS as Modified for B&W Application", NPGD-TM-127, Babcock & Wilcox, P. O. Box 1260, Lynchburg, Virginia 24505, January 1971.