Central files

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Vice Chairman
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April 24, 1979
AEP:NRC:00186

Donald C. Cook Nuclear Plant Units 1 and 2
Docket Nos. 50-315 and 50-316
License Nos. DPR-58 and DPR-74
Seismic Stress Analysis of Safety-Related Piping

Mr. J. G. Keppler, Regional Director
U.S. Nuclear Regulatory Commission
Office of Inspection and Enforcement
Region III
799 Roosevelt Road
Glen Ellyn, IL 60137

Dear Mr. Keppler:

Attachments I, II and III to this letter contain our response to IE Bulletin No. 79-07 entitled "Seismic Stress Analysis of Safety-Related Piping" and dated April 14, 1979 which was telecopied to us on April 17, 1979.

Attachment I contains a listing of the programs that have been used in the design of the safety-related piping at the Cook Plant and the benchmark problems/comparison programs used for verifications.

With the exception of some of the systems originally calculated by Westinghouse, the absolute sum method and/or the square root of the sum of the squares method (SRSS) were used to compute the maximum loads due to earthquakes in all other analyzed systems. Westinghouse informed us on April 20, 1979 that 24 individual piping lines analyzed prior to November 1971, had been done using an earlier version of the WESTDYN program which incorporated the algebraic sum of intramodal responses. (Attachment II gives a brief description of the WESTDYN programs.) However, a majority of these lines were subsequently reanalyzed using absolute summation or SRSS technique. Attachment III lists those lines which were not.

Westinghouse is presently reanalyzing these lines utilizing an updated version of WESTDYN which combines the intramodal responses through absolute summation. This reanalysis should be completed by April 27 and upon review the results will be transmitted to you. Preliminary results from these reanalyses indicate that the subsequent peak calculated stresses in each of these lines will remain below the allowable limits. It is Westinghouse's belief,

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from previous experience, that the final reanalysis of the impacted auxiliary branch lines will not result in a significant reduction in the margin that presently exists between calculated and allowable stresses (see Table I in Attachment III).

As a result of all of the above and of the information contained in the Attachments to this letter we conclude that the capability of the Donald C. Cook Nuclear Plant to withstand a seismic event is not adversely affected.

Very truly yours,

John E. Dolan

JED:clb
Attachments

Sworn and subscribed to before me
this 25th day of April, 1979 in

Georgie B. Seay
Notary Public
State of West Virginia
County of Kanawha
My commission expires Dec. 19, 1952

cc: (attached)

ATTACHMENT I

COMPUTER PROGRAMS USED IN
THE DESIGN OF SAFETY-RELATED
PIPING AT THE D. C. COOK PLANT

Name	Author/Owner/User	Remarks
WESTDYN (pre-Nov./71) (based on ADLPIPE)	Westinghouse	Westinghouse's scope of work included a number of auxiliary system branch lines inside containment, some of them re-analyzed later.
WESTDYN (post-Nov.71) (based on ADLPIPE)	Westinghouse	Code modified to incorporate the absolute summation of the intramodal response. Used to calculate the main reactor coolant loop and more recently the 6" hot leg safety injection lines (Velan valve lines).
DYNAPIPE and PIPSYS	Sargent & Lundy	Utilizes the SRSS method to calculate seismic stresses. Sargent & Lundy does not use the time history method for seismic analysis of piping.
PISOL-IA	EDS Nuclear	Spatial and intermodal responses were combined in absolute value. All seismic analysis performed for the Cook Plant used response spectrum model analysis method.
FELAP	Franklin Research Institute; used by AEPSC	Determines seismic stresses by the SRSS method.
DYNAFLEX	Auton Computing Corporation	The response for each mode can be computed by direct summation of absolute values or by the SRSS method.

ATTACHMENT I (Continued)

BENCHMARK CALCULATIONS

WESTDYN (pre Nov/71): Not required see Attachment II

WESTDYN (pst Nov/71): Benchmark solutions were contained in WCAP-8252-Rev.1 which was previously documented to the NRC by Westinghouse

DYNAPIPE:PIPSYS: The seismic portions of the program, were 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 (1969)

A typical hot reheat piping system was analyzed on DYNAPIPE and DYNAL. 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. 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.

C. PIPSYS & DYNAPIPE Check Against DYNAL and NASTRAN (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.

PISOL-IA	ASME Sample Problem No. 1 contained in ASME publication, "Pressure Vessel and Piping 1972, Computer Programs Verification". In addition, it has been verified on dynamic piping analysis by Bechtel Power Corporation of San Francisco.
FELAP	ASME Pressure Vessel and Piping Division, File Reference PVQL-1 dated 2/7/72, "Table Top Problem, a problem on Dynamic Analysis of a Three-Dimensional Structure."
DYNAFLEX	PIPESD by the Auton Computing Company. This program is available through the Control Data Corporation.

ATTACHMENT II

DESCRIPTION OF COMPUTER PROGRAMS

WESTDYN:

The WESTDYN program is a Westinghouse adaptation of the A. D. Little Company program ADLPIPE. This digital computer program provides an elastic analysis of redundant piping systems subjected to thermal, static, and dynamic loads. WESTDYN is a special-purpose program designed for the static and dynamic solution of redundant piping systems with arbitrary loads and boundary conditions. At any point in the piping system it computes the stresses, forces, moments, translations, and rotations which result from the imposed anchor or junction loads in any combination of the three orthogonal axes. The section properties have been specialized to piping cross sections plus the addition of curved members or elbows. Valves may also be represented as stiffer members. The piping system may contain a number of sections, a section being defined as a sequence of straight and/or curved members lying between two network points. A network point is defined as: 1) a junction of two or more pipes; 2) an anchor or any point at which motion is prescribed; or 3) any arbitrary point.

The response to seismic excitation is determined by using normal mode techniques with a lumped mass system. The maximum spectral acceleration is applied for each mode at its corresponding frequency from response spectra. A basic assumption is that the maximum modal excitation of each mode occurs simultaneously. WESTDYN computer code was revised by Westinghouse in November 1971 and the revised version incorporates an absolute summation of the intramodal responses. This code was documented to the NRC in WCAP 8252 - Rev. 1 "Documentation of Selected Westinghouse Structural Analysis Computer Codes" May 1977. Benchmark solutions are contained in this report.

Since it is Westinghouse's position that computer listings are proprietary, the subroutine of the WESTDYN program which performed the dynamic response combinations will be provided to the NRC separately by the Westinghouse Electric Corporation. This is in response to Item (2) of IE Bulletin 79-07.

DONALD C. COOK NUCLEAR PLANT
UNITS 1 AND 2

The following lines have been analyzed utilizing an algebraic intramodal response combination:

- Two 6" lower volume conainment spray lines from floor elevation 612' sleeves in quadrant number 1 to elevation 612' sleeves in quadrant number 2.

- Two 8" low head SI lines to two 8" SI lines.

- The 14" pressurizer surge line.

The results of the previous (1971) Westinghouse analysis of the identified auxiliary system lines are summarized on the attached table. As is indicated in the results, the minimum margin between the calculated peak stress and the allowable stress limit for any of these lines is 55%.

TABLE 1

Summary of 1971 Analytical Results for D. C. Cook Units 1 and 2 Auxiliary System Branch Lines.

AUXILIARY SYSTEM BRANCH LINE	CALCULATED STRESS	ALLOWABLE STRESS	MARGIN
14" Surge Line	8078 psi	17,940 psi	9,862 psi
6" Containment Spray Lines	5177 psi	21,972 psi	16,795 psi
Two 8" Low Head SI Lines to Two 8" SI Lines	9039 psi	20,124 psi	11,085 psi