

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF INSPECTION AND ENFORCEMENT  
WASHINGTON, D.C. 20555

March 23, 1979

IE Information Notice No. 79-06

STRESS ANALYSIS OF SAFETY-RELATED PIPING

Summary:

On March 13, 1979, the Nuclear Regulatory Commission issued Orders to licensees for five power reactors to shut down within 48 hours and to show cause why they should not remain shutdown pending reanalysis of certain safety-related piping systems and pending completion of any modifications indicated by the reanalysis. This action was based on the discovery of a potentially unconservative calculational technique within a computer program that has been used by an architect-engineer for analysis of certain piping.

Description of Circumstances:

During construction of Unit 1 at the Beaver Valley Power Station and the four other reactor units involved in the above orders, a version of a computer program, PIPESTRESS, was used by Stone & Webster in performing "as built" stress analyses of piping requiring a seismic analysis for which the architect-engineer was responsible. Later, modification of the safety injection system at BVPS-1 to improve net positive suction head and correction of an error in the weight of some components in that system led to re-evaluation of the stresses in this piping and associated pipe attachments. These components whose weights had been incorrectly entered were six-inch check valves manufactured by Velan Valve company. The error in weight was caused by an incorrect weight shown on Velan drawings. As a result of this reanalysis, the licensee reported the existence of stress levels above those stated in the FSAR to the NRC on October 26, 1978. NRC review of the Licensee Event Report and inspection followup identified the existence of significant discrepancies between stresses calculated by the PIPESTRESS code and by NUPIPE, a code currently used by Stone & Webster.

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In some instances, NUPIPE yielded stress results which were significantly higher than those obtained with PIPESTRESS. The differences in the results are attributable to the force summation method utilized by SHOCK 2, a subroutine of the PIPESTRESS computer code. Based on an examination of a sample run, the NRC staff learned on March 8, 1979 that this computer program subroutine algebraically summed horizontal response components from the seismic input components. It also algebraically summed vertical response components from the seismic input components. Such response loads should not be algebraically added (with predicted loads in the negative direction offsetting predicted loads in the positive direction) unless far more complex time-history analyses are performed. Rather, to properly account for the effects of earthquakes, as required by General Design Criterion 2 for systems important to safety, such response loads should be combined absolutely or, as is the case in the newer codes, using techniques such as the square root of the sum of the squares (SRSS). This conforms to current industry practice and Reg Guide 1.92.

Stone & Webster also used the SHOCK 2 subroutine of PIPESTRESS in the analysis of piping in safety systems for FitzPatrick, Maine Yankee, and Surry 1 and 2. NRC review on March 10-13, 1979, of preliminary results from the reanalysis of portions of the Beaver Valley piping at Stone & Webster's offices in Boston, Massachusetts, indicated several instances of pipe stress beyond allowable limits. In the face of this deficiency information, the NRC concluded that until full reanalysis of all potentially affected piping systems important to safety has been completed with a piping analysis computer code which does not contain the algebraic summation method, it would be prudent to assume that the potential for reducing intended design margins at each of the facilities in question exists in the event of an earthquake and could be sufficiently widespread such that the basic defense-in-depth provided by redundant safety systems may be compromised.

On March 13, 1979, NRC issued to licensees for these facilities, Orders to Show Cause why: (1) potentially affected safety system piping should not be reanalyzed using an appropriate computer program; (2) modifications indicated by reanalysis should not be done; and

(3) facility operation should not be suspended pending completion of this work. Because of the safety significance of this problem, these Orders were made effective immediately to require that these facilities be in the cold shutdown condition within 48 hours of receipt of the Order and remain in that condition until further Orders are issued.

This Information Notice provides details of a significant occurrence that is still under review by the NRC staff. After completion of the staff review, this Information Notice will be followed with specific actions to be taken by licensees.

No written reponse is required. If you desire additional information regarding this matter, please contact the Director of the appropriate NRC Regional Office.

Enclosure:  
List of IE Information  
Notices Issued in 1979

LISTING OF IE INFORMATION NOTICES  
ISSUED IN 1979

Information Notice No.	Subject	Date Issued	Issued To
79-01	Bergen-Paterson Hydraulic Shock and Sway Arrestor	2/2/79	All power reactor facilities with an OL or a CP
79-02	Attempted Extortion - Low Enriched Uranium	2/2/79	All Fuel Facilities
79-03	Limiterorque Valve Geared Limit Switch Lubricant	2/9/79	All power reactor facilities with an OL or a CP
79-04	Degradation of Engineered Safety Features	2/16/79	All power reactor facilities with an OL or a CP
79-05	Use of Improper Materials In Safety-Related Components	3/21/79	All power reactor facilities with an OL or a CP
79-06	Stress Analysis of Safety-Related Piping	3/23/79	All power reactor facilities with an OL or a CP

Enclosure