



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

AUG 29 1979

Power Engineering
ATTN: Mr. Frederic C. Olds
Senior Editor
1301 S Grove Avenue
Barrington, Illinois 60010

Dear Mr. Olds:

The article in the July 1979 issue of Power Engineering entitled, "No Cause for Seismic Shutdowns" was read with great interest. That editorial stated that the "NRC's actions had been somewhat precipitous" and "drastic..... when the potential risk to the public.....is remote". You also indicated that the basis for NRC's actions was not easily perceived. After reading the article I believe that it would be appropriate for me to make some observations and to provide some comments to hopefully clarify some misleading information.

For several months prior to the March 13 Show Cause Orders, the NRC had been investigating a significant difference in computed pipe stress at Beaver Valley when different computer codes were used. On March 8, 1979, during a meeting in Bethesda, Maryland at NRC Headquarters, the licensee for the Beaver Valley plant (based upon information provided by Stone and Webster Engineering) reported that the difference in pipe stress were due to differences in the method of modal summation in the computer codes and that the code SHOCK II used an algebraic summation of modal responses. (Enclosure A is a detailed chronology of events leading up to and following the March 8, 1979 meeting.)

Following the March 8 meeting, NRC personnel were sent to Stone and Webster Engineering Offices in Boston to review the results of reanalysis of additional pipe stress problems which were originally analyzed with SHOCK II. The results of the reanalysis showed piping systems which were overstressed by as much as three times code allowable values. In some instances the seismic stress increased by 3 to 6 times the original SHOCK II values. Additionally it was determined that systems whose failure would cause an accident, as well as systems designed to mitigate the accident and that systems necessary for safe shutdown were involved. The NRC's basic "defense-in-depth" philosophy for reactor safety was compromised in that a single event (in this case an earthquake) could cause an accident, could prevent mitigating systems from functioning and could disable systems necessary to safely shutdown.

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Based upon the information then available and not being able to demonstrate the adequacy of the plants design, the Beaver Valley licensee shut the plant down on March 9, 1979. Based upon the results of reanalysis of SHOCK II problems between March 10 and 12 and the extent of the safety systems involved, the NRC issued Show Cause Orders to the affected plants.

Therefore, the bases for the Orders is quite simple:

- (a) The licensee and his contractor informed the NRC that safety-related piping (including shutdown and emergency cooling piping) might be greatly overstressed should a major earthquake occur at a site.
- (b) The licensee and his contractor could not provide adequate assurance that the plant could safely operate and therefore shut down the Beaver Valley facility.
- (c) The contractor attributed the calculated overstressed condition to the use of the algebraic sum method.
- (d) The contractor stated that four other nuclear facilities had similar problems.
- (e) After a few days of recalculation, the licensee and Stone and Webster provided additional calculations which again confirmed the highly overstressed conditions.

Based on this information from the licensee and Stone and Webster, the NRC no longer had assurance that the public health and safety was being protected.

The editorial states that "other responsible organizations used the same technique for seismic pipe stress analysis in perhaps as many as 20 other nuclear power plants". It also referred to "the fact that the same computational method was in common use by others, and was accepted widely as good engineering practice at the time.....".

To the best of our knowledge about 20 operating reactors and four reactors still under construction used algebraic summation. Enclosure B (attached) is a plant-by-plant summary of each of these plants. While the number of plants referenced in the editorial is correct, it should be noted that the use of codes with such techniques were generally not widely used in these plants. While four independent computer codes [SHOCK II, ADLPIPE, WESTDYN (a version of ADLPIPE developed by Westinghouse), DAPS, and PIPDYN II] did have subroutines (sometimes options) for using the algebraic summation, other versions of these codes as well as many other codes do not use algebraic summation.

Reanalysis of piping systems at Beaver Valley, Surry and Fitzpatrick which were originally analyzed with SHOCK II resulted in identification of piping and support overstress. Modifications to correct overstress have been required at these plants.

Reanalysis to date of piping systems at other facilities analyzed with ADLPIPE, WESTDYN and DAPS have not resulted in overstress. However, some supports required modification to correct deficiencies in the "as built" condition at Brunswick 1 and 2 and Pilgrim which were found as a result of DAPS reanalysis. In each instance where the licensee had not already completed reanalysis, the NRC staff met with the licensee to review the method of original analysis to determine the potential for significant pipe overstress. For Indian Point 2 and 3 and Brunswick 1 and 2 it was determined that overstress was not likely and these plants were allowed to continue operation during reanalysis. Obviously, the 20 operating plants benefited from the publicity associated with the shutdown orders and in some instances were able to reanalyze the affected systems prior to responding to IE Bulletin 79-07. (Enclosure C). The important point is that reanalysis was performed and indicated that modifications were not required. Whether the original problem was algebraic summation, or some other feature of SHOCK II or improper system modeling, is not certain. What is known, based upon reanalysis, is that the plant piping designs on Surry 1, Beaver Valley and Fitzpatrick were inadequate and that modifications are necessary.

It is also important to clarify your comment that "earlier techniques had been approved by the regulatory authorities (and not disapproved until March 13, 1979)." The extent to which computer codes were reviewed and approved varies but in none of these cases was algebraic summation identified during the review or specifically approved by the NRC. The NRC issued Regulatory Guide 1.92 (Enclosure D) in December 1974; the staff generally approved either absolute summation or square root sum of square methods. The NRC staff has completed a review of the information previously submitted by licensees and has found only one instance (Salem 1) where algebraic summation was proposed by a licensee and apparently overlooked by the staff during its review. However, it can be shown, based upon basic principals, that algebraic summation is technically not correct because colinear modal response could cancel each other out resulting in no loading when a significant load may actually exist.

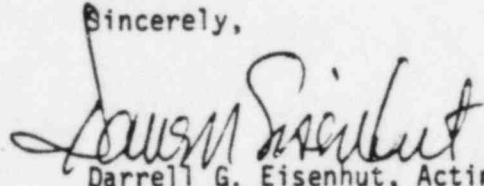
A final comment related to system modeling. Clearly no conclusions can be drawn about the adequacy of the design if the system model is not representative of the actual plant design. During the reanalysis of these plants

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significant differences between the "as built" condition in the plant and the original design (system models) have been identified. As a result of this discovery and reports by other licensees of missing and improperly installed supports, the NRC issued IE Bulletin 79-14 on July 2, 1979. This bulletin requires inspection to verify that the "as built" conditions conforms to the original design and to correct or show by analysis that any deviations are acceptable. (Enclosure E).

Sincerely,



Darrell G. Eisenhut, Acting Director
Division of Operating Reactors
Office of Nuclear Reactor Regulation

Enclosures:

- A. Chronology of Events
- B. Plant Summary
- C. IE Bulletin 79-07
- D. Regulatory Guide 1.92
- E. IE Bulletin 79-14

SUMMARY OF PLANTS USING ALGEBRAIC SUMMATION

PLANT	SHUTDOWN REQUIRED		EXTENT OF SYSTEMS ANALYZED USING ALGEBRAIC SUMMATION TECHNIQUE	COMMENTS
	ORDER	OTHER		
Beaver Valley 1	Yes		Extensive	Complete and Order Terminated 8/8/79
Brunswick 1,2*	No	Voluntary	Extensive	Reanalysis in progress. Analysis to date indicates modifications will not be required.
Cook 1, 2	No	No	Main Reactor Coolant Loop and some lines inside containment	Complete
Cooper	No	No	SRV lines	Under staff review
Fitzpatrick	Yes		Extensive	Order permitting startup issued 8/14/79
Ginna	No	No	Main Steam and RHR Lines	Complete
Indian Point 2	No	No	10 Lines	Reanalysis in progress. Unit is shutdown for refueling. Operation for 5 weeks to refueling permitted based upon preliminary analysis
Indian Point 3*	No	No	Extensive	Reanalysis in progress. Analysis to date indicates modifications will not be required
Maine Yankee	Yes		19 lines (Initially thought to be extensive)	Complete and Order terminated 5/24/79
Millstone 1	No	No	2 systems (Control Rod Drive Exhaust and CU2 Bypass)	Complete

* NRC Staff has reviewed basis for operation during reanalysis, concluded operation was acceptable, and documented the findings.

SUMMARY OF PLANTS USING ALGEBRAIC SUMMATION
(Continued)

PLANT	SHUTDOWN REQUIRED		EXTENT OF SYSTEMS ANALYZED USING ALGEBRAIC SUMMATION TECHNIQUE	COMMENTS
	ORDER	OTHER		
Millstone 2	No	No	6 systems (Volume Control Tank Changing Bypass, Nitrogen Addition, Charging, Diesel Generator Exhaust, RCP Top Root Valve Instrument, SI and Containment Spray Test Line)	Complete
Nine Mile Pt 1	No	No	7 systems (Reactor Recirculation, Shutdown Cooling, Emergency Condenser Returns, Reactor Cleanup, Reactor Drain, Reactor Feedwater CRD).	Complete
Pilgrim	No	Tech Spec	Recirculation and Main Steam lines	Complete
Pt. Beach 1,2	No	No	2 CCW and 2SW lines in radwaste system	Complete
Robinson 2	No	No	Main Reactor Coolant Loop	Complete
Salem 1		Extended Refuel.	Extensive	Unit shutdown for refueling
Surry 1, 2	Yes		Extensive	Order permitting operation of Surry 1 issued 8/22/79. Surry 2 shutdown for steam generator repair.
Turkey Pt. 3,4	No	No	Main Reactor Coolant Loop	Complete
Zion 1, 2	No	No	Main Reactor Coolant Loop	Complete

SUMMARY OF PLANTS USING ALGEBRAIC SUMMATION
(CONTINUED)

PLANT (Under Construction)	SHUTDOWN REQUIRED		EXTENT OF SYSTEMS ANALYZED USING ALGEBRAIC SUMMATION TECHNIQUE	COMMENTS
	ORDER	OTHER		
Salem 2			Extensive (Reactor Coolant System excluded)	Reanalyses and implementation of any required modifications prior to criticality.
Forked River			Containment Spray	Reanalyses and implementation of any required modifications prior to receipt of operating license.
MNP 1, 4			ASME Code Class 1 Reactor Coolant System Branch Lines	Reanalyses and implementation of any required modifications prior to receipt of operating license