



OFFICE OF THE
CHAIRMAN

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

COMM.
COVER.

June 6, 1979

The Honorable Paul Tribble
United States House of Representatives
Washington, D.C. 20515

Dear Congressman Tribble:

I have received your letter of March 22, 1979 regarding the shutting down of the two unit Surry Power Station due to concerns regarding the level of protection provided against postulated earthquakes. A Federal Register notice summarizing the information which led to the Nuclear Regulatory Commission staff decision of March 13, 1979 to shut down these and the other three nuclear plants is enclosed.

Following the Nuclear Regulatory Commission order of March 13, 1979 to shut down the five nuclear power plants, including the two-unit Surry Power Station, independent review teams for each affected power plant were established within the staff of the Office of Nuclear Reactor Regulation. In particular, the staff review team for the Surry facility is dedicated to prompt review and analysis of submittals by the Virginia Electric and Power Company (VEPCO) in support of lifting the Surry shutdown order. The Surry review team has met with the licensee at the site of the Surry facility and has travelled to the Stone and Webster offices in Boston to review the preliminary reanalysis results. The Surry review team shares no members with review teams for the other affected power plants and remains ready to promptly review VEPCO's reanalyses.

Currently, VEPCO is reanalyzing the affected piping systems of Surry Unit No. 1 only. Surry Unit No. 2 had been previously shut down for steam generator replacement which is scheduled for completion by this Fall. Accordingly, VEPCO has indicated that a stress analyses of the Unit No. 2 piping systems will be performed subsequent to the current reanalysis effort for Unit No. 1. The staff review team for the Surry Power Station will remain available for prompt review of the VEPCO submittals for both Unit No. 1 and Unit No. 2.

One important characteristic of the Surry site is that the facility rests on about 1300 feet of sediments which overlay rock. This condition, including the characteristics of overburden damping and amplification of vibrations from bedrock to the surface, was considered in establishing the seismic design basis for the facility. However,

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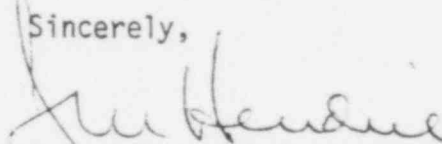
Honorable Paul Tribble

the 1300 feet of overburden at the Surry site masks the basement rock so that faulting cannot be identified in the area. This is true for most of the eastern United States. Since the tectonic structures which give rise to earthquakes cannot be identified and localized, our practice is to assume that earthquakes at least as severe as any previously recorded in the region could occur anywhere in the region. In addition, in establishing the seismic design bases for a nuclear power plant, we take into account the impacts on that plant of more distant earthquakes. For example, the Charleston, South Carolina earthquake of 1886 was felt in the region of the Surry site.

To determine Surry Plant response motion to seismic event VEPCO is considering using an advanced analysis method which takes into account soil-structure interactions. This refined analysis could lead to use of a reduced seismic forcing function in the Surry pipe stress reanalysis. This method was used by VEPCO for the design of the now-cancelled Surry Unit Nos. 3 and 4. However, it was not used in the original design analysis for Surry Unit Nos. 1 and 2. We have maintained a dialogue with VEPCO regarding the use of this technique for Unit Nos. 1 and 2, and VEPCO is aware of our requirements in this matter.

While we continue to meet with VEPCO and Stone and Webster representatives to discuss preliminary results of their reanalyses, we are at this time awaiting formal submittal of these results by VEPCO for staff evaluation. Following the staff evaluation of the VEPCO submittals for each reactor unit, we will be in a position to reconsider whether continued suspension of operations at that unit remains necessary or appropriate. The staff's recommendation concerning possible resumption of operation will be considered by the Commission before a final decision is made.

Sincerely,



Joseph M. Hendrie
Chairman

Enclosure:
As Stated

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NUCLEAR REGULATORY COMMISSION
ABNORMAL OCCURRENCE EVENT
DEFICIENCIES IN PIPING DESIGN

Section 208 of the Energy Reorganization Act of 1974, as amended, requires the NRC to disseminate information on abnormal occurrences (i.e., unscheduled incidents or events which the Commission determines are significant from the standpoint of public health and safety). The following incident was determined to be an abnormal occurrence using the criteria published in the FEDERAL REGISTER on February 24, 1977 (42 FR 10950). Appendix A (Example I.D.2) of the Policy Statement notes that a major deficiency in design, construction or operation having safety implications (affecting five plants in this case) requiring immediate remedial action can be considered an abnormal occurrence. The following description of the event also contains the remedial actions taken.

Date and Place - During design and construction, an incorrect summation of earthquake loads affected the design of safety related piping systems and associated pipe supports at five nuclear power plants. On December 6, 1978, a Licensee Event Report from Duquesne Light Company mentioned differences between computer codes used in analyses of force summations, but did not elaborate on them. Then, the NRC learned of an incorrect summing of loads in one of the codes on March 8, 1979, at a meeting in Bethesda, Maryland with Stone and Webster, an architect engineering firm and the Duquesne Light Company (DLC), the licensee for Beaver Valley Unit 1,

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- 2 -

a pressurized water nuclear plant located in Beaver County, Pennsylvania. On March 9, NRC learned that the incorrect summation technique affected four other plants:

<u>Plant</u>	<u>Location</u>
FitzPatrick	Oswego County, New York
Maine Yankee	Lincoln County, Maine
Surry 1 & 2	Surry County, Virginia

Nature and Probable Consequences - In October 1978, Duquesne Light Company, the licensee of the Beaver Valley plant, was informed by Stone and Webster that for loading conditions associated with postulated earthquakes, pipe supports associated with Safety Injection System piping would be overstressed. Stone and Webster (S&W) was reanalyzing stresses in connection with a system modification required by the NRC staff to correct a design deficiency not related to protection against postulated earthquakes. During this reanalysis effort, the S&W engineers also came across information that had been provided to them by Westinghouse in May 1978 that showed some check valves in these lines were actually heavier than assumed in the earlier analysis.

Sometime during this reanalysis, either in connection with the planned modification or in reexamining the effect of the increased valve weights, S&W discovered a misapplication of a hand calculation method. In correcting this misapplication, S&W found some instances of local overstress. The

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- 3 -

correction consisted of adding a snubber and modifying one support. In doing the analysis related to making this correction, S&W used two computer programs. A new one, NUPIPE, predicted much higher stresses than the one, PIPESTRESS, used during a 1974 as-built check of these lines. On October 26, 1978, the licensee orally notified the NRC Office of Inspection and Enforcement about the design error (hand calculations method misapplication) which required correction. No explanation was provided for the differences in stresses predicted by the two codes at that time.

Repeated NRC contacts with the licensee and S&W to identify the reason for the differences were not effective, since without the actual computer runs to look at there was a communications problem. During a meeting held on March 8, 1979 to discuss these matters, the Beaver Valley licensee informed the NRC staff that the differences in predicted piping stresses between the two computer codes were attributable to the fact that the SHOCK2 subroutine of the PIPESTRESS code uses an algebraic summation of the loads calculated separately for the horizontal and the vertical component of earthquake motion.

The use of algebraic summation is only acceptable if the time phasing of these loads is known. The algebraic technique as used in SHOCK2 is not conservative for response spectrum modal analysis because, in such analyses, time phasing is not considered.

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The analytical treatment of load combinations becomes significant because horizontal earthquake motions can produce piping movement in both the horizontal and vertical direction and the vertical earthquake motions can also produce piping movement in both horizontal and vertical directions. For some designs the calculated piping stresses may differ significantly depending on the load summation techniques used in each mode of response.

Based on the three piping systems that had been reanalyzed by the newer code on Beaver Valley at the time of the March 8, 1979 meeting, stresses over allowable values were expected to be found primarily in piping supports although significant increases in piping stresses had been observed.

NRC staff reviewers were sent to S&W's Boston office to determine the extent of this problem on Beaver Valley 1 and other potentially affected plants.

In following the course of the reanalysis at the S&W offices over the weekend of March 10, 11 and 12, based on the information then available, it became apparent that, when the NUPIPE code was used, a number of piping systems had calculated stresses over the allowable value for the design basis earthquake. Also, for a few of these systems the more probable operating basis earthquake resulted in stresses above the allowable value. In addition, the structural integrity and performance of pumps, valves and other essential equipment could be

- 5 -

degraded. Although results were still incomplete on March 12, information available at that time indicated that high stresses were calculated in a number of systems important to safety.

Because the overstressing of piping and supports was predicted even for earthquakes which might occur during the lifetimes of these facilities, the problem took on considerable safety significance. Some of the systems identified at that time as having overstressed conditions under earthquake loadings were part of the reactor coolant pressure boundary, whose failure could cause a loss of coolant accident. In addition, systems which would be needed to shut the plant down safely in the event of a loss of coolant accident were also affected. Thus an earthquake, of not extremely low likelihood, would have the potential both for causing an accident and for preventing safety systems, designed to cope with that accident, from operating. A secondary concern was whether or not systems needed to provide adequate long term cooling for the plant in the event of an earthquake without a LOCA could be assured.

Concurrent with the NRC Beaver Valley review, NRC staff records were reviewed to determine whether or not other facilities had used these same analysis techniques. Based on the review of these records and information provided by S&W, the NRC staff concluded that four other facilities used the same techniques. The four facilities are Maine Yankee, FitzPatrick and Surry Units 1 and 2.

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The NRC staff concluded the potential for serious adverse effects in the event of an earthquake was sufficiently widespread that the basic defense in depth provided by redundant safety systems may be compromised. The NRC Director for Nuclear Reactor Regulation concluded that the public health and safety required that the affected facilities be placed in a cold shutdown condition pending further order of the Commission. Orders to this effect were issued to the licensees of the above reactors.

The Orders provide that within 20 days each licensee ~~must~~ respond with respect to:

- (1) why the licensee should not reanalyze the facility piping systems for seismic loads on the piping system and any other affected safety systems using an appropriate piping analysis computer code which does not combine loads algebraically,
- (2) why the licensee should not make any modifications to the facility piping systems indicated by the reanalysis, and
- (3) why facility operation should not continue to be suspended until completion of the reanalysis and any required ~~modifications~~.

All of the plants are now in a cold shutdown condition. (Surry Unit 2 was already in an extended outage for steam generator replacement.)

Cause or Causes - The uncertainty in the calculated piping stresses and support loadings in safety-related piping systems at the five plants is attributable to the incorrect application of the algebraic summation technique in the SHOCK2 subroutine of the PIPESTRESS computer code, proprietary to Stone and Webster.

Actions Taken to Prevent Recurrence


Licensee/Architect Engineer - Identification of all safety related systems that have been analyzed with a piping computer code involving a program deficiency is underway. Computer inputs are being checked to assure that all reanalyzed piping will reflect the as-built condition at each plant. Piping analyses are being rerun and piping and supports exceeding allowable stresses will be identified. Modifications will be made as necessary.

NRC - The NRC ordered each of the utilities of the five identified nuclear power plants to shut down their plants within 48 hours. The utilities are to remain shutdown pending further order of the Commission. The NRC is in contact with the licensees and the architect engineer on actions being taken. Piping stress computer codes to be used for reanalysis of the piping will be tested with NRC established benchmark problems. Also, an independent audit of selected piping runs will be conducted by NRC consultants to verify the piping stress reanalysis.

- 8 -

In addition to reviewing the licensees' corrective actions, the NRC is reviewing any generic implications at other facilities. The NRC's Office of Inspection and Enforcement issued Information Notice (IN) No. 79-06, which described the event, on March 23, 1979, to all holders of reactor operating licenses and construction permits. On April 14, 1979, the NRC's Office of Inspection and Enforcement issued Bulletin No. 79-07 to applicable licensees which identified actions to be taken. This includes identification of the methods of analyses used, how they were verified, safety systems affected, and a plan of action to assure plant safety. As of May 9, 1979, the NRC has received responses to Bulletin No. 79-07 from all licensees of operating reactors except for Three Mile Island Units 1 and 2 which are shut down. The NRC staff is reviewing these responses on a high priority basis. Additional actions will be taken as appropriate.

For the Nuclear Regulatory Commission


Samuel J. Chalk
Secretary of the Commission

Dated at Washington, D. C. this 14th day of May 1979.

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ADMINISTRATIVE ASSISTANT

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Congress of the United States
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March 22, 1979

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Mr. Joseph M. Hendrie
Chairman, Nuclear Regulatory
Commission
1717 H Street, N. W.
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Dear Mr. Chairman:

Several of my constituents
have contacted me regarding their
concern over the shutdown of nuclear
generating plants in Virginia because
of possible earthquakes.

I would appreciate your
reviewing this matter and offering me
your advise.

Sincerely,
Paul Tribble

Paul Tribble

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