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Central Files - Topical Reports

Mr. Ivan F. Stuart, Manager
Safety and Licensing
Nuclear Energy Division
175 Curtner Avenue
San Jose, California 95114

Dear Mr. Stuart:

We have reviewed the General Electric Company topical report NEDE-20942-P, "Safety Relief Valve Discharge Analytical Model," and have identified the following three areas where additional information is required:

1. The topical report does not provide sufficient evidence to demonstrate that air bubbles discharging from relief valve lines will oscillate in a random manner. The combined pressure loads from several relief valve operations will be significantly higher if the bubbles oscillate in phase.

2. The topical report does not consider several parameters which may be important in the relief valve analysis. We believe that the following effects should be included.

   (a) pool motion;
   (b) pressure wave from adjacent relief valve operation; and
   (c) sequential actuations of relief valve.

3. The topical report does not justify neglecting some key parameters, such as bubble size and bubble distance from the wall, in the method of images employed to analyze boundary effects on bubble motion.

We require your response to the enclosed Request for Additional Information to continue our review of NEDE-20942-P.

Sincerely,

Original signed by
Walter Butler

Walter R. Butler, Chief
Light Water Reactors Branch 1-2
Division of Reactor Licensing

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PDR FOIA
FIRESTO85-665 PDR

Enclosure:
As stated

D-35

cc: See page 2

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DATE ▶	10/15/75	10/15/75	10/16/75			

cc: Mr. L. Gifford
General Electric Company
4720 Montgomery Lane, Suite 1107
Bethesda, Maryland 20014

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DATE ▶						

REQUEST FOR ADDITIONAL INFORMATIO

Report Number: NEDE-20942-P
Report Title: Safety-Relief Valve Discharge Analytical Model, May 1975
Originating Organization: General Electric Company
Reviewed By: Containment Systems Branch

1. On Page 5, Section 2.5, it is stated that "Since one complete cycle of bubble oscillation is about 0.1 seconds, variations in pipe length, opening time, submergence, etc., are sufficient to give a random distribution of the phase angle among bubbles produced by simultaneous activation of several valves. The resulting load at any point is, therefore lower than it would be if all bubbles were in phase."
   (a) Analytically show that bubble oscillations cannot be in phase if two lines have different pipe length, valve opening time and submergence. It should be noted that a relatively short pipe length coupled with relatively deep submergence could result in bubble oscillation in phase;
   (b) Provide an analysis to show that the pressure oscillation resulting from the two bubbles generated from the same ramshead will not be in phase.

2. Provide a transient analysis of vent clearing, pool dynamic, and bubble pressure phenomena as a result of <u>multiple actuations</u> of relief valves. Include the following:
   (a) Description of the analytical model, including all assumptions and equations.

(b) Graph showing the vent clearing time and pool dynamic and bubble pressure as a function of the sequential actuations of relief valves. The number of sequential actuations of relief valves analyzed should be large enough to clearly indicate that the bubble pressure due to multiple actuations has reached the maximum value.

(c) Graph showing the peak wall pressure, positive as well as negative, as a function of the sequential actuations of relief valves.

(d) Verification of the analytical results by comparing them with experimental data.

3. It appears that equation (8), on page 9, describing the motion of the water plug, was not developed using the assumptions in the model. According to the assumptions, the velocity of the water leg is not a function of the water leg length. Clarify this discrepancy.

4. On Page 9, Section 3.1.3, it is assumed that the pool initially is motionless and that pool pressure and temperature are at normal operating conditions. Provide the effect on the calculation if the following conditions are considered:

   (a) Pool is in motion such s agitation by adjacent relief valve(s) operation; and

   (b) Suppression chamber pressure and temperature have been elevated due to other relief valve(s) operation.

5. On Page 16, Section 3.2.3, the initial bubble radius is taken to be the same as the inside radius of the ramshead. With this assumed bubble size and the bubble initial pressure calculated from the vent clearing model, the bubble mass is completely determined. Does this determined bubble mass agree with the air inventory initially inside the pipe?

6. On Page 22, Section 3.3.3, it is stated that, "The following function meets all the requirements, provided the distance between adjacent bubbles and sinks is much greater than the bubble diameter." Quantify the limits on the "is much greater" criterion in this statement.

7. Equation (35) appears to be extrapolated from the equation (34), which was developed from the analytical model by assuming single bubble theory without boundary effects. On the other hand, equation (35) is intended to include the boundary effect (Method of Images). Discuss and justify analytically how equation (35) was derived to include boundary effects.

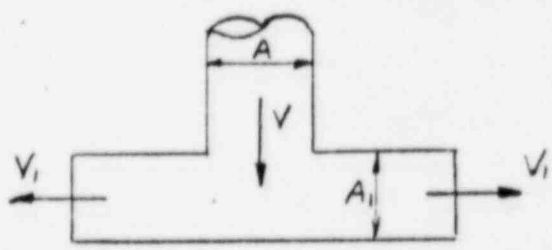
8. The Method of Images has been developed by simply neglecting many parameters such as bubble size, bubble distance from the boundaries and pool water motion due to adjacent bubbles such as the bubble formed in the other end of the ramshead. Justify this simplification in your analytical model.

9. On Page 25, Section 3.4, it is stated that the buoyancy force acting on the bubble is assumed to be one-half the displaced mass.

Justify this assumption analytically.

10. Identify which test of the Quad Cities' tests has been used for Figure 11.

11. On Page 50, Appendix B, it is stated that "the flow is sonic at both sections. . . .", while it is also stated on Page 11, Section 3.14 that "After the water plug is expelled, the air leaves the pipe at sonic velocity." The inconsistency of these two statements is illustrated by the following:



Appendix B specifies that the velocity V_1 is sonic, while Section 3.14 says V is sonic. Since A_1 is equal to A and flow rate passing A_1 is equal to one-half of that flowing through Section A, the velocity V_1 should be one-half of the velocity V. Explain this discrepancy and reanalyze the pool response if necessary.

FIGURE 3

MARK I HEADER LOAD CONSERVATISMS (GE)

BOUNDARY CONDITIONS

ASSUMED ALL AIR CARRY OVER

USED BREAKTHROUGH HEIGHT OF 2 X SUBMERGENCE
BODEGA INDICATED 1.5 X

USED INFINITE OCEAN (SOLID WATER)

1-2'LIGAMENT EXPECTED AT HEADER ELEVATION
PEAK DW PRESSURE CONSERVATISMS

MODEL

CALCULATED LOAD IS 20% HIGHER THAN MEASURED(USING TEST BOUNDARY CONDITIONS)

CONCLUSION: TOTAL CONSERVATISM MAY BE AS HIGH AS FACTOR OF TWO

DAR 4.9.75