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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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E. Butcher, Program Manager, LWR 2 1-2, RL

REVIEW OF GENERAL ELECTRIC TOPICAL REPORT NEDE-2094-P (TAR-1270)

Report Number: NEDE-2094-P
Report Title: Safety Relief Valve Discharge Analytical Model
Responsible Branch: LWR 1-2
DRL Program Manager: E. Butcher
Requested Completion Date: N/S
Review Status: Incomplete

As requested, the Containment Systems Branch has reviewed the GE Topical Report (NEDE-2094-P) and has prepared the enclosed question list regarding additional information.

In the course of our review we have identified the following as significant review items:

1. The applicant has not provided sufficient evidence to prove that air bubbles discharging from relief valve lines will oscillate randomly. The combined pressure loads from several relief valve operation will be significantly higher if the bubbles would oscillate in phase.

2. The applicant has not considered 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 applicant has not justified the negligence of some key parameters such as bubble size and bubble distance from the wall in the method of images, which was employed to analyze boundary effects on bubble motion.

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Enclosure:
As stated

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REQUEST FOR ADDITIONAL INFORMATION

Report Number: NEDE-2094-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 tnat bubble oscillations can not 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 an analysis for predicing vent clearing transient, pool dynamic and bubble pressure as a result of multiple actuations of relief valve. Include the following:

   Description of the analytical model, including all assumptions and equations

   (1) Provide the analytical model including all assumptions and equations;

(2) Graphically show the vent clearing time, pool dynamic and bubble pressure as a function of the sequential actuations of relief valve. The number of sequential actuations of relief valve ~~required to be~~ analyzed should be large enough to clearly indicate that the bubble pressure due to multiple actuations has reached the maximum value;

(3) Graphically show the peak wall pressure, positive as well as negative, as a function of the sequential actuations of relief valve; and

(4) Justify the analytical results by comparing with experimental data.

3. On Page 9, ~~Equation (8)~~ for the motion of the water plug ~~appears that it~~ was not developed ~~based on~~ the assumptions used in the model. According to the assumptions, the velocity of 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 remains motionless and that pool pressure and temperature are at normal operating conditions. Provide the effect on the calculation if the following conditions should be considered:

(a) Pool is in motion such as agitated 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 on
Provide the criteria to which this statement can be applied.
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).
how equation (35) was derived to
Discuss and justify analytically the applicability of equation (35).
include boundary effects

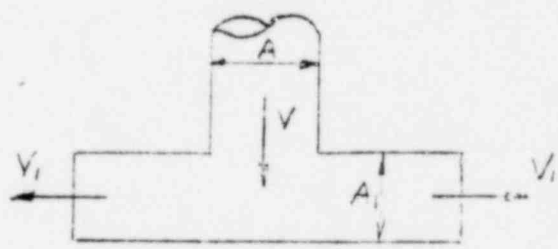
8. The Method of Images has been developed by simply neglecting many parameters such as bubble size, bubble distance from the boundaries and the flow from adjacent bubbles such as the bubble formed in the other end of the ramshead. Justify this simplicity of your analytical model.

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 ~~could be easily explained by the following graph~~ is illustrated by the following graph:



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.