NRC PDR

JUL 10 1979

MEMORANDUM FOR: E. Reeves, Lead Engineer, Operating Reactors Branch #1
Division of Operating Reactors

FROM: G. Lainas, Chief, Plant Systems Branch, Division of Operating Reactors

SUBJECT: CONTAINMENT PURGING GENERIC TASK B-24

Enclosed are our analyses of the probable post-LOCA flow conditions across containment purge valves for use by the Engineering Branch in evaluating valve operability. The maximum differential pressure across the containment purge valve in the BWR analyzed was found to be 45 psid. PWR valves were found to experience a maximum differential pressure of 38 psid. These specific differential pressures are plant specific and should be provided by the licensees if it is an important parameter in your evaluation.

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ENCLOSURE

ANALYSES OF POST-LOCA FLOW CONDITIONS ACROSS CONTAINMENT PURGE VALVES

A sensitivity study was performed using the COMPARE code to find the most probable limiting flow conditions which could exist across the containment purge valves after a DBA. Flow conditions in both a BWR (Peach Bottom) and a PWR (Trojan) were simulated. The sensitivity of the response to valve size, vent length, valve closure time, Moody flow multiplier, valve closure initiation time, and one isolation valve failed open were examined.

The valve size (36" and 72" for the PWR's and 18" and 24" diameters for the BWR's) was found to have no influence on vent flow conditions. The differences in flow conditions between the BWR and the PWR valves are due to differences in the containment back pressures.

Two vent piping lengths (5 and 10 feet) were simulated to examine the effect of inertia on flow conditions. The results of these cases indicated that inertial effects could be neglected.

Valve closure times of 2, 5 and 10 seconds were simulated. The largest valve differential pressure occurred with a closure time of 10 seconds. The rate of increasing differential pressure was largest with a valve closure time of 2 seconds.

Two values for the Moody flow multipler, 1.0 and 0.6, were used and were found to have no appreciable effect on the vent flow conditions.

Calculations were performed in which one of the two containment isolation valves in a line was simulated as being failed open. This caused the differential pressures across both the BWR and PWR valves to increase by 50%.

Cases were run in which valve closure was not initiated until containment pressure tripped the isolation signal (PWR at 4 psig; BWR at 2 psig). Containment pressure tripped the signals very shortly after initiation of blowdown. This time delay contributed insignificantly to the nominal vent flow conditions. Table I summarizes the cases which were run during the sensitivity portion of this task.

Generic assumptions used in all analyses were:

1. Valves closed at a constant rate.

2. For butterfly valves, angle-dependent Idel'chik loss coefficients[1] were used, K=exp (1.03θ - 1.66).

3. The entrance loss from containment into the purge line was set to 0.78; the exit loss from the purge line to atmosphere was set to 1.0.

4. Only one vent line was modeled for conservatism in dynamic loading on the valve.

5. The vent line was assumed to be a straight line of piping connecting the containment with the outside atmosphere.

Conditions in the vent piping upstream of the valve were found by letting the upstream stagnation volume consist of the containment (vent piping entrance loss = .78). The downstream stagnation volume consisted of the vent piping downstream of the valve and the outside air (vent exit loss = (Idel'chik K + 1.0)). Conditions in the vent piping downstream of the valve were found by performing an additional calculation in which the upstream stagnation volume consisted of the containment and the vent piping upstream of the valve (vent entrance loss = (Idel'chik K + 0.78)); the downstream stagnation volume consisted of only the outside environment (vent exit loss = 1.0).

The attached figures summarize the most limiting flow conditions for both the BWR and the PWR examined. The BWR case is for an 18" valve (results identical to 24" valve) with one isolation valve failed open, a valve closure time of 10 seconds (initiated at start of blowdown), and a Moody flow multiplier of 0.6. The PWR case is for a 72" valve with one isolation valve failed open, a valve closure time of 10 seconds (initiated at start of blowdown), and a Moody flow multiplier of 0.6. The differential pressure across the valve is plotted in Figure 1. The graphs were terminated when the valves completely closed. After this time, only a static pressure differential exists across the valve. Impingement forces on the valve can be found by using Figures 2 and 3 which graphically show the fluid velocity and density in the vent piping upstream of the isolation valve.

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[1] I.E. Idel'chik, Handbook of Hydraulic Resistance Coefficients of Local Resistance and of Friction, AEC-TR-6630, United States Clearinghouse for Federal Scientific and Technical Information (1966).

TABLE I - SENSITIVITY STUDY SUMMARY

BWR

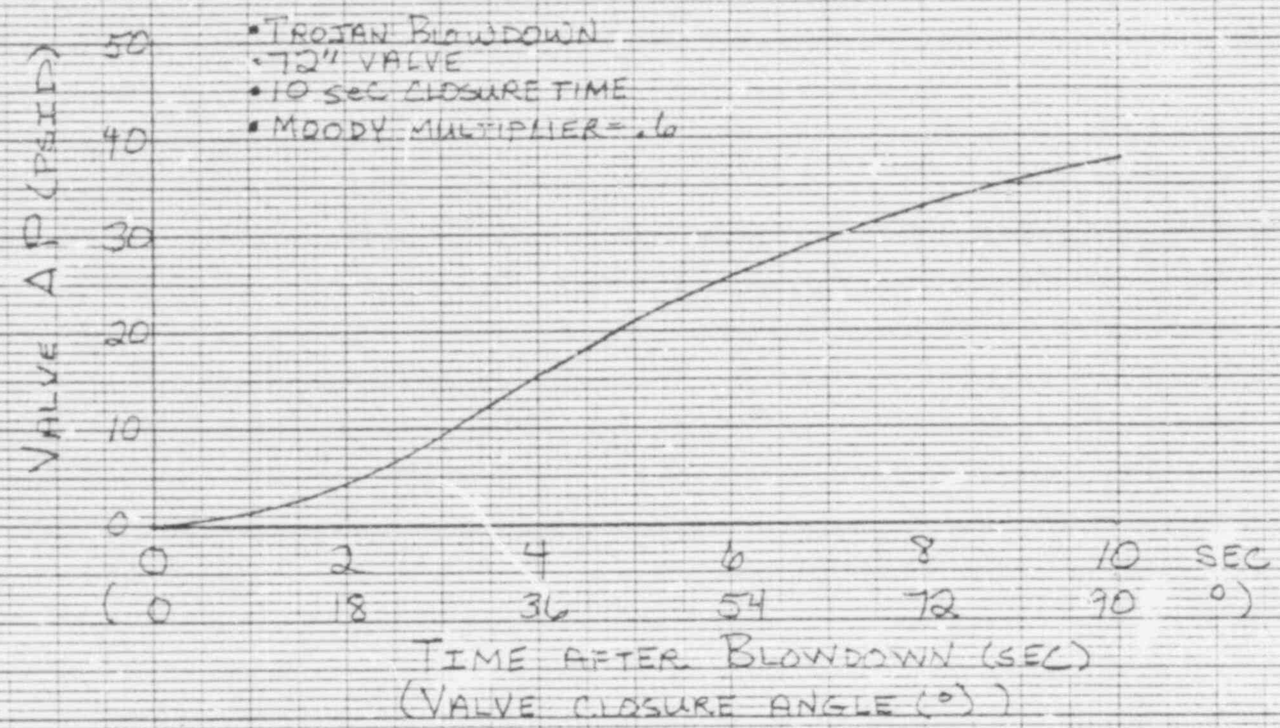
Case	Valve Size	Inertial Effects	Moody Multiplier	Valve Closure Time	No. of Valves	Initiation of Valve Closure
1	18"	0	0.6	5	2	blowdown
2	24"	0	0.6	5	2	blowdown
3	18"	0	1.0	5	2	blowdown
4	18"	0	0.6	2	2	blowdown
5	18"	0	0.6	10	2	blowdown
6	24"	0	0.6	10	2	blowdown
7	24"	5'	0.6	10	2	blowdown
8	24"	10'	0.6	10	2	blowdown
9	18"	0	0.6	5	1	blowdown
10	18"	0	0.6	10	2	containment pressure=2 psig
11*	18"	0	0.6	10	1	blowdown

PWR

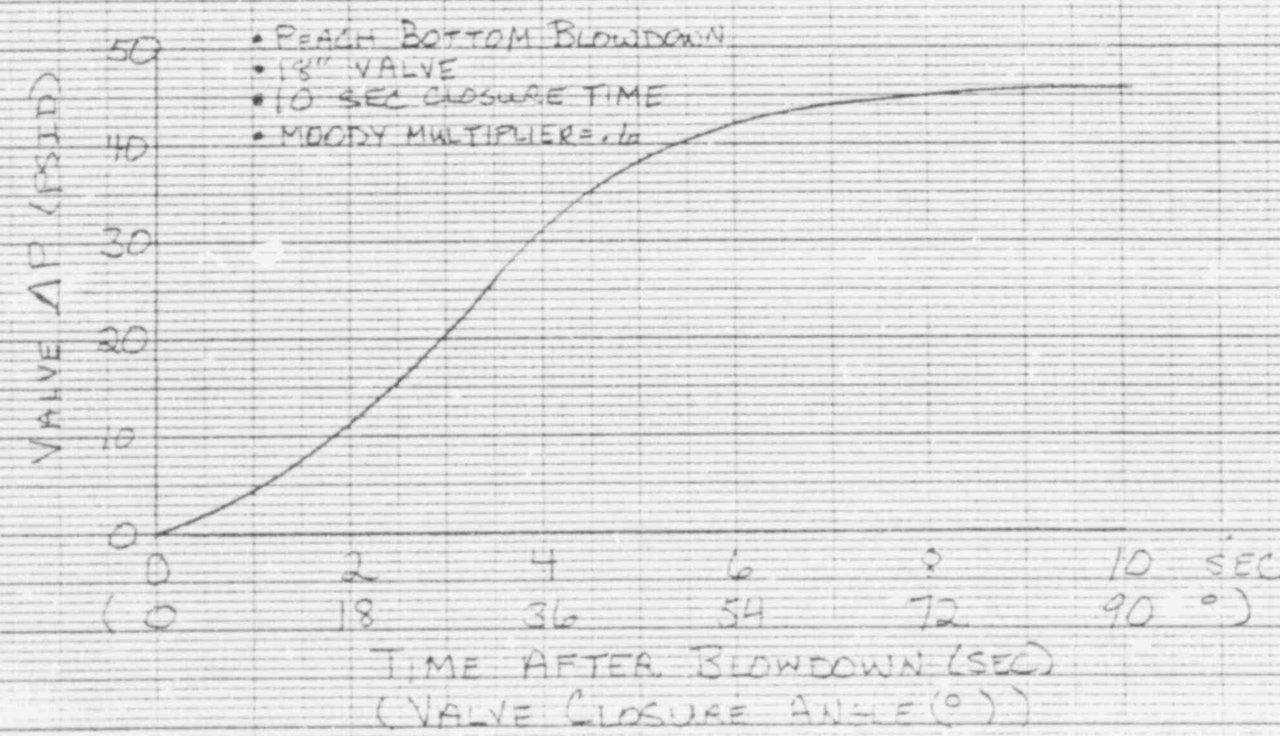
Case	Valve Size	Inertial Effects	Moody Multiplier	Valve Closure Time	No. of Valves	Initiation of Valve Closure
1	36"	0	0.6	5	2	blowdown
2	72"	0	0.6	5	2	blowdown
3	72"	0	1.0	5	2	blowdown
4	72"	0	0.6	2	2	blowdown
5	72"	0	0.6	10	2	blowdown
6	36"	0	0.6	10	2	blowdown
7	72"	5'	0.6	10	2	blowdown
8	72"	10'	0.6	10	2	blowdown
9	72"	0	0.6	5	1	blowdown
10	72"	0	0.6	5	2	containment pressure=4psig
11*	72"	0	0.6	10	1	blowdown

*most limiting case

FIGURE 1: VALVE DIFFERENTIAL PRESSURE



a) DIFFERENTIAL PRESSURE ACROSS PWR VALVE



b) DIFFERENTIAL PRESSURE ACROSS BWR VALVE

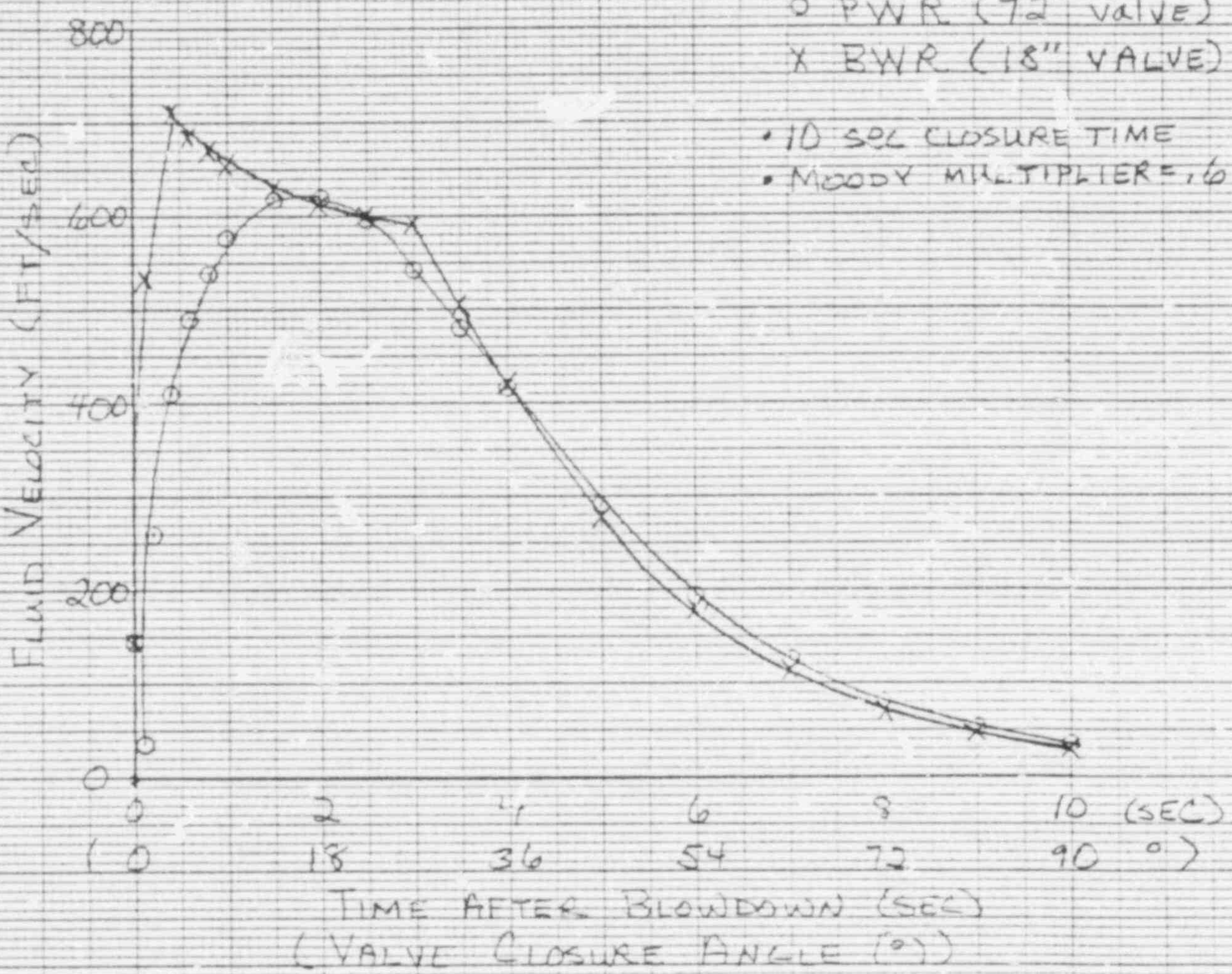
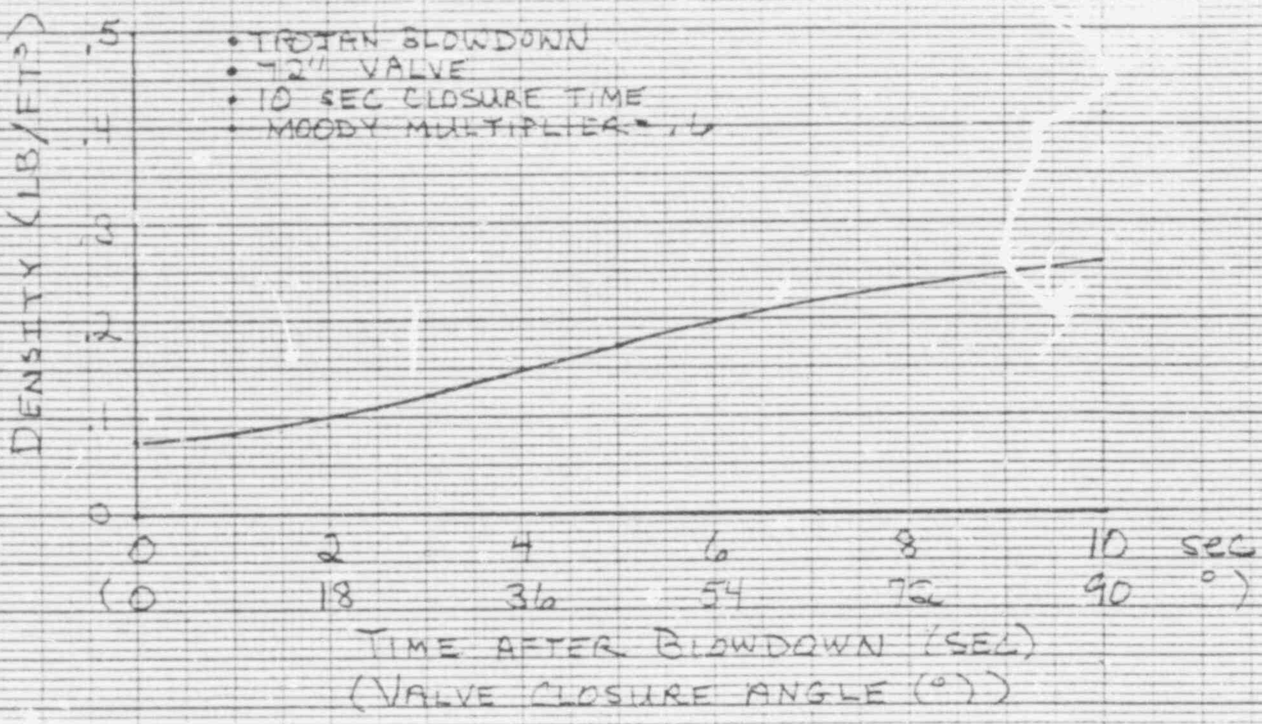
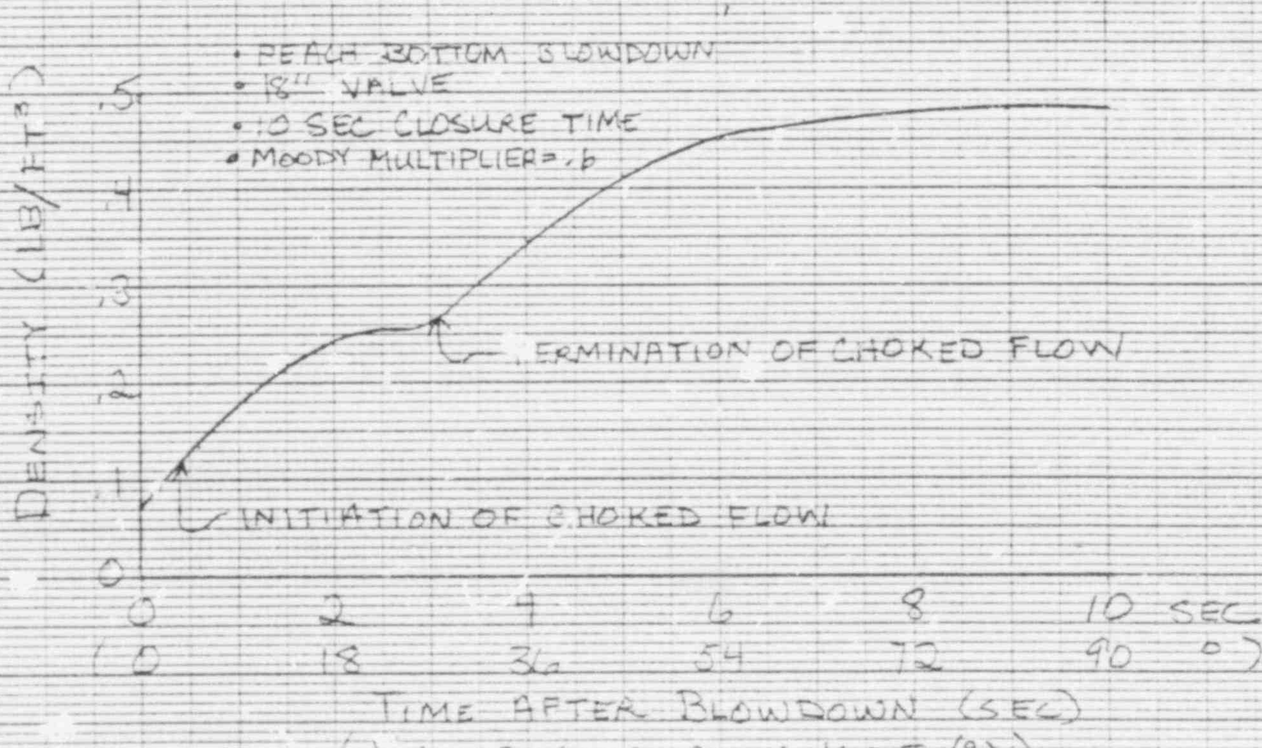


FIGURE 2 : FLUID VELOCITY

FIGURE 3: FLUID DENSITY



a) FLUID DENSITY IN PWR VENT



b) FLUID DENSITY IN BWR VENT