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SUBJECT: HRT Core and Blanket Vent Piping (Lines 127 and 227)

TO: S. E. Beall

FROM: H. A. McLain

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The vent lines (Lines 127 and 227) and the vent valves are so arranged that a condensate leg is always present on the high pressure side of the valves. The presence of this condensate can cause a delay in the venting and a lag in control of the reactor overpressure. A maximum delay of approximately 6 seconds (with a 1/4 inch schedule 80 line) is not considered excessive. The use of this small diameter line also permits the pitching of the lines toward the valves and eliminates the need for insulation or heat tracing of these lines.

Calculations assuming a vent valve C_v of 0.07 and a liquid temperature of 100°F show a flow of 0.17 l/sec at a 1500 psi upstream pressure and 0.20 l/sec at a 2000 psi upstream pressure. If the upstream liquid is at the saturation temperature at 2000 psia, and if flashing takes place in the throat of the valve, the flow of the liquid through the valve is only 0.076 l/sec. (Based on the upstream conditions).¹ The latter calculation is based on thermodynamic equilibrium in the throat of the valve, but actual flow data indicate that normal rates are probably higher.^{2,3}

The volumes of 1/4 inch and 1/2 inch schedule 80 pipes are as follows:

1/4" pipe	0.01409 liters/ft
1/2" pipe	0.04610 liters/ft

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1. Method of calculation described by Allen, W. F. Jr., Flow of a Flashing Mixture of Water and Steam through Pipe and Valves, Paper 50-5-27, A.S.M.E. Meeting (Sept. 19-21, 1950), Worcester, Mass.
 2. Benjamin, M. W., and Miller, J. G., Trans. A.S.M.E., 63, 419-429, (1941) "The Flow of Saturated Water Through Throttling Orifices."
 3. Benjamin, M. W., and Miller, J. G., Trans. A.S.M.E., 63, 657-669 (1942) "The Flow of Flashing Mixtures of Water and Steam Through Pipes."

The time to drain the vent line if full with condensate (34.1 ft long) is:

	<u>1/4"</u>	<u>1/2"</u>
Flashing	6.32 sec	20.7 sec
No Flashing	2.40 sec	7.87 sec

Fluid flow calculations show that the 1/4 inch has less than a two pound pressure drop for a flow of 0.3 l/sec. Therefore it is recommended that the 1/4 inch pipe be used for line 127. Vent valve flow tests⁴ also further confirm this conclusion.

The flow rates are a little sluggish during this period for a sudden reactor shutdown without a dump.⁵ However the postulated situation is very conservative and will only occur in a case where there is a sudden flow stoppage or sudden loss of steam in the heat exchanger.⁶ The amount of conservatism warrants the use of rupture discs for these extreme situations while the vent valve would relieve any overpressure during the normal operation of the reactor.

H. A. McLain

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4. Gabbard, C. H. and McLain, H.A., HRT Vent Valve Tests, CF 56-4-125, 2/17/56.
 5. Rosenthal, M. W. and Claiborne, H. C., Effects of Heat Generation and Heat Removal on HRT Shutdown and Dump, ORNL CF 56-2-128, 2/8/56.
 6. Rosenthal, M. W., Personal Communication