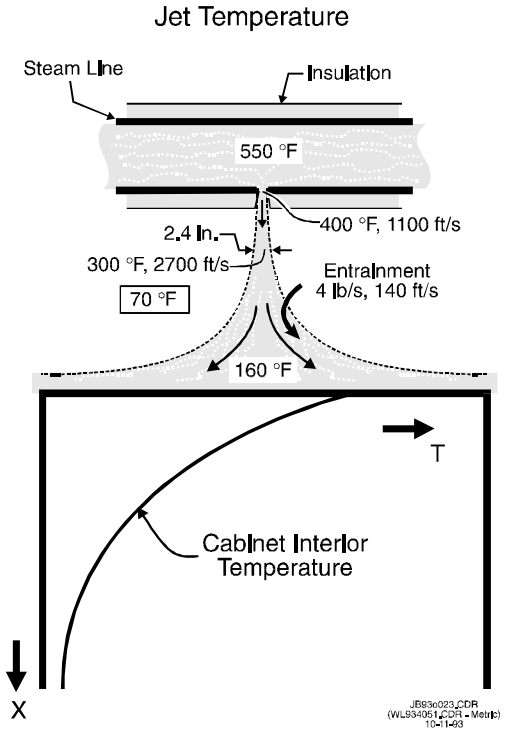
Fauske & Associates, Inc.
16W070 West 83rd Street, Burr Ridge, Illinois 60521

THERMAL IMPACT OF LINE BREAK ON EQUIPMENT



Engineers performing walkdowns, design reviews and related activities occasionally identify key equipment located near high or moderate energy steam lines. The initial response may be to assess the importance of the equipment relative to plant safety and possibly schedule its reconfiguration or relocation to a safer distance from such energy sources. It may be possible, however, to avoid such a modification by analyzing the effect of a postulated line break on the equipment. This impact can be bounded by applying the hand calculation described below.

The steam line is characterized by its pressure (P_o) and density (D_o). Assuming a break area A, the mass flow rate of steam is then

$$\dot{m}_s = 0.585\, A\sqrt{\gamma P_o \rho_o}$$

To determine whether the room will pressurize as a result of the break, a balance between the break flowrate and the room venting rate is performed. Depending on the equipment location, the jet expansion may need to be considered. Through a series of calculations, a maximum jet temperature can be derived.

As the jet leaves the break, it expands and entrains cooler air (see figure). The expansion phase occurs a few break diameters downstream of the break. The diameter of the jet at this point is given by

$$D_j = D_o \left\{\frac{G}{\rho_j U_j}\right\}^{1/2},$$

where D_o represents the break diameter, G is the mass flux, and U_j is the jet velocity. The rate of entrainment is given by

$$M_e = \frac{0.08}{2}(\rho_\infty \rho_j)^{1/2}\, U_j\, \pi\, D_j\, Z,$$

where Z represents the distance from the break to the cabinet top.

The resulting jet temperature can be readily calculated. Assuming that the maximum jet temperature is uniformly distributed across the equipment top, heat transfer calculations are then performed to ascertain the maximum temperature internal to the cabinet at the location

of critical components. These calculations are dependent, of course, upon the time at which the break would be isolated.

FAI has performed calculations as described above according to 10CFR50 Appendix B Quality Assurance requirements. These calculations have been supported by in-house testing using an actual steam jet. We welcome the opportunity to provide you with additional details regarding this technical bulletin.

Technical Contact: *Jim Burelbach*