

Flare System Pressure Drop Calculations Using COMSOL

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Abstract

COMSOL Multiphysics has been used to validate and check the design of a header transporting ammonia gases released from pressure safety valves (PSVs) to the tip of the flare. The header is part of a dedicated flaring system to contain emissions from ammonia storage tanks, storing liquid ammonia at 400 mm H₂O gauge and -33.4°C. The two main challenges are the low relief pressure and high capacity of the system. The PSVs open at 700 mm H₂O gauge, half of which is available as a pressure drop for the entire header. Another difficulty is the high relief capacity which amounts to 50,000 kg/hr for the four PSVs. Such constraints demand designing connections consuming low pressure drop and preventing back pressure build up against the PSVs. Moreover, due to the dual function of the PSVs, it is important that the pressure upstream the PSVs does not increase beyond the vacuum break pressure. COMSOL simulation results provided pressure profiles and velocity streamlines for the entire system. The profiles were useful in identifying the locations of vortices in the header, which may indicate possible mechanical stresses and/or pressure losses. Different design alternatives have been investigated and evaluated. Furthermore, the investigation considered scenarios in which not all PSVs are opened and the opening sequence of the valves. The study will be extended in future to include the thermal stresses on the header.