OUR WORK

CHOKE VALVE – JOULE-THOMSON EFFECT

Head Office: PDL Solutions (Europe) Ltd

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PDL ENGINEERS CARRIED OUT ANALYSIS TO ASSESS THE STEADY-STATE COMPRESSIBLE FLOW BEHAVIOUR OF A REAL GAS MIXTURE FLOWING THROUGH A CHOKE VALVE

PDL is a global provider of exemplary engineering design and analysis consultancy services. Our engineering capabilities mitigate risk, shorten development timescales and reduce development costs.

PDL engineers supported a world leading supplier of choke valves to the oil and gas industry.

PDL engineers carried out a computational fluid dynamics (CFD) analysis using ANSYS CFX to assess the steady-state compressible flow behaviour, and associated Joule-Thomson effect, of a real gas mixture flowing through a choke valve.

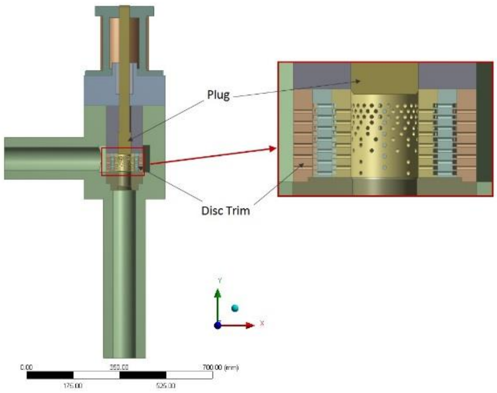

Figure 1: Valve geometry

WHEN GAS FLOWS THROUGH THE CHOKE VALVE THERE IS A LARGE PRESSURE DROP, WHICH RESULTS IN A COOLING EFFECT, KNOWN AS THE JOULE THOMSON EFFECT

The choke valve was a critical component in a well control system. When gas flows through the choke valve there is a large pressure drop, which results in a cooling effect, known as the Joule Thomson effect.

The main objective of the CFD project was to assess the fall in temperature as a result of the Joule-Thomson effect due to the choking of the flow, together with the real gas flow properties, and to ensure that temperature remained above the valve minimum allowable value.

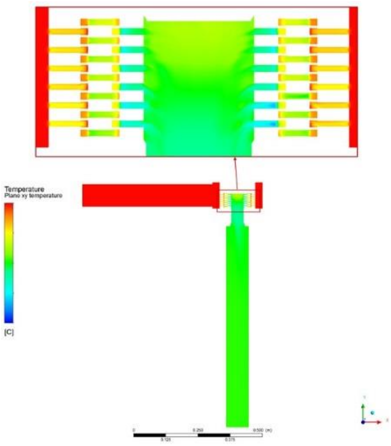

Figure 2: Temperature Contour

THE REAL GAS PROPERTIES WERE MODELLED USING THE PENG-ROBINSON EQUATION OF STATE

The fluid was modelled as a mixture of pure gases. The real gas properties were modelled using the Peng-Robinson equation of state, with pseudo-critical constants obtained for the gas mixture using real gas mixing rules.

The fluid domain was modelled with adiabatic conditions at the wall boundaries, although further work considered heat transfer through the valve body and surrounding sea water.

Turbulence was modelled using the Shear Stress Transport model with the High Speed model for turbulent wall functions. Heat transfer within the fluid domain was modelled using Total Energy, which is consistent with the high speed compressible nature of the flow, allowing kinetic energy effects to be included. Viscous work was included.

Absolute pressures were specified at the inlet and outlet to the valve and the required mass flow rate to achieve this pressure drop was determined as part of the solution.

The final report for the project was presented to the end client and was submitted for 3rd party approval by DNV, which was accepted.

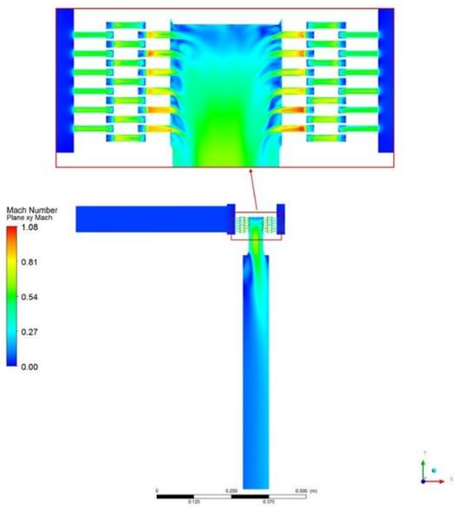

Figure 3: Mach number Contour

For further information regarding PDL's engineering capabilities please email: solutions@pdl-group.com or phone our head office.