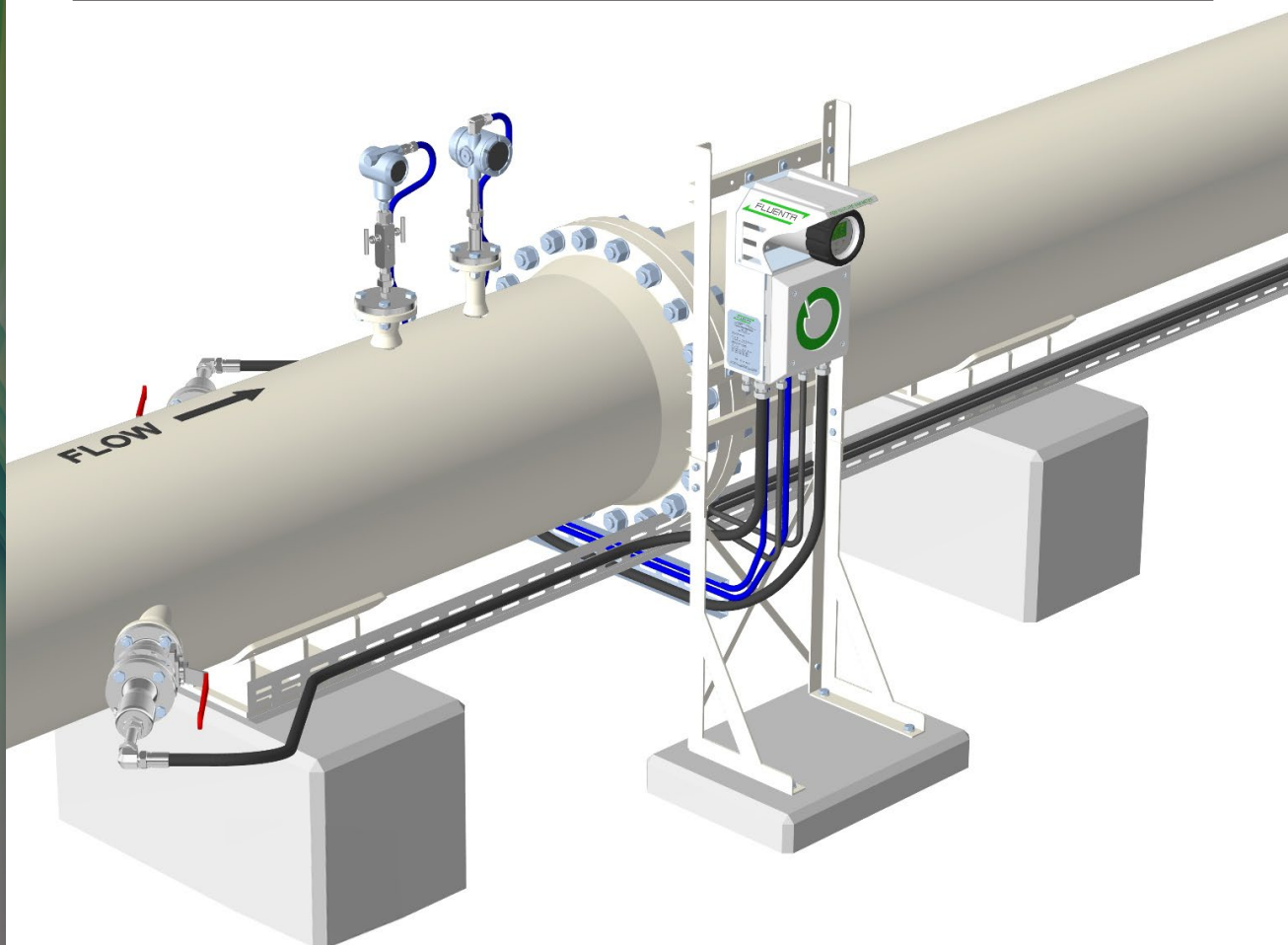


Use Of Nitrogen Purge In Flare And Vent Systems



For offshore installations, flare and atmospheric vent headers are required to be purged in order to prevent oxygen ingress to the flare and atmospheric vent systems. This is required in order to avoid the formation of volatile mixtures in the headers, which could lead to explosions if ignited.

Fuel gas or nitrogen can be used as purge gas. The purge gas is injected at different locations in the systems in order to maintain a positive pressure in the flare headers thus preventing air ingress. Cold vents (atmospheric vent headers) are used to vent hydrocarbon gas from low pressure sources where insufficient pressure is available to allow the gas to be flared. Under normal operating conditions the volume of gas vented via the cold vent is minimal.

The use of fuel gas in flare and vent headers for purging purposes results in environmental emissions. These can be in the form of CO₂ or NO_x when the fuel gas used in the HP and LP flare headers is burnt or in the form of CH₄ and other species present in the atmospheric vent header purge gas when this is cold vented. The greenhouse effect associated with the CH₄ is around 23 times worse than that for the CO₂ emissions.

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The replacement of the use of fuel gas with nitrogen for purging the flare and atmospheric vent headers is one of the options currently being investigated in order to reduce environmental impact. The use of nitrogen will eliminate the environmental emissions described in the above paragraph. It should be noted that, when replacing purge fuel gas with nitrogen for Atmospheric Vent headers, the NOx emissions increase. This is due to the NOx emissions produced in the gas turbines when generating the necessary power for N2 generation. However, the environmental impact of cold venting in terms of CO2 emissions is seen as much higher than that of the increased NOx emissions for nitrogen generation.

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Nitrogen is currently being used on the Dong Energy Siri facilities for purging the flare system. A flare recovery system is planned to be installed on Hess South Arne Facility which will eliminate the need to purge the flare headers with nitrogen. In the case that Flare Gas Recovery is installed on any of the DUC platforms, it will not be necessary to replace the use of fuel gas with nitrogen for purging purposes as the purge fuel gas would be recovered and sent back to the process. If the payback time for changing from fuel gas to nitrogen purge is significantly less than an expected implementation time for a flare gas recovery system, nitrogen purge should be considered. Nitrogen will still be required in order to purge the flare stack, downstream of the Fast Opening Valves that are normally installed in the main headers as part of flare recovery projects.

As this initiative gains momentum, some thought must be given to metering the flow of nitrogen purge to the flare and atmospheric vent headers. ABLE have been contracted to provide this measurement for a number of North Sea Oil & Gas operators and has selected the most pragmatic and cost effective solution in the form of a Variable Area Metal (316L stainless steel) Tube Flowmeter which has been typically installed on the 1" nitrogen purge line to the HP & LP Flare Headers.

The nitrogen purge flowmeter represents a complimentary product to ABLE's industry proven Fluenta FGM160-II Ultrasonic Flare Gas Meter (over 2000 installations worldwide). Through the measurement of molecular weights, the FGM160-II assists in accurately calculating the composition of flare and CO2 emissions. Precise measurement, in-turn, enhances the operator's ability to comply with increasingly stringent regulatory requirements.

Under such purging conditions as those discussed in this document, a significant amount of the gas flow in

the flare is nitrogen. The CO2 emissions data must be reported to authorities. In order to get a realistic report of the CO2 emissions, the nitrogen purging should be subtracted from the total combustible gas flow. To this end, Fluenta are developing a variant of their operator software called SoftFlow Nitro.

In addition to the volumetric flow rate, the Fluenta FGM160-II Ultrasonic Flare Gas Meter also measures the velocity of sound. From this measured velocity of sound, in combination with pressure and temperature, the density of the flare gas is estimated, and also the mass flow rate can thus be found. Through the speed of sound there is also a potential for estimation of nitrogen molar fraction in cases

where nitrogen purging is a significant part of the flow. Beta testing of SoftFlow Nitro, which utilises such an algorithm, are currently being conducted at StatoilHydro's process plant at Kollsnes. Under these tests, both purging and flaring conditions have been evaluated.

*Dansk Undergrunds Consortium, DUC, is a joint venture between A.P. Møller - Mærsk, Shell, Chevron and Nordsøfonden. Mærsk Olie og Gas AS is operator for all DUC's activities



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