FLARING

Towards zero routine flaring

New approaches are being taken to reduce routine flaring and venting of stranded gas, both on and offshore, explains *Robert Stokes*.

Around 140bn cm of associated natural gas from oil production is still burned off annually, according to World Bank analysis of satellite images from the US National Oceanic and Atmospheric Administration. Flares light up the night sky in regions such as the Arabian Desert and the US Bakken formation in North Dakota, where shale oil production is booming.

Apart from discharging greenhouse gases, flaring – and venting, where unburned natural gas is released – wastes a resource that could instead produce electricity, chemicals and fuels, notably for poorer countries. Aware of this, the World Bank has introduced a 'Zero Routine Flaring by 2030' initiative under which many governments, oil companies and development institutions will cooperate to achieve this target.

Companies and governments have been tackling the issue for some years, notably under agreements within the Global Gas Flaring Reduction Partnership, a World Bank-embedded body whose members include 30 governments and businesses, including virtually all leading international oil companies. The partnership's voluntary code of conduct on flaring acts as a *de facto* standard for members. Some national and international industry organisations also provide guidance. The International Petroleum Industry Environmental Conservation Association (IPIECA) provides examples of good practice to reduce continuous flaring, together with technology considerations and potential financial incentives.

Generally speaking, processing options for natural gas include gas-to-gas, gas-to-liquids, gas-to-solids and gas-to-wire technologies. All are applicable to flaring, depending on the situation, according to Michael Nikolaou, Professor of Chemical and Biomolecular Engineering at the University of Houston in Texas, US. However, natural gas is difficult to transport to processing plants that can be some distance away by road, rail, ship or, if it exists, pipeline. Gas that cannot viably be transported is termed 'stranded'.

'For the small quantities of gas involved in flaring, the pipeline solution for transport would be rather unappealing, due to inflexibility of a pipeline fixed in the ground,' Dr Nikolaou explains. So technologies that enable transport or equipment to process or use gas on-site are required.

Compression is one answer on the transport side. Technologies encountered in small and micro-scale applications include, among others, skid-mounted liquefied natural gas (LNG) and compressed natural gas (CNG). Small-scale LNG is a mature technology that reduces gas volume 600-fold. CNG reduces volume by a factor of 200 to 300. These are 'reasonable alternatives' to pipelines, Dr Nikolaou says. 'Mini- or micro-LNG plant has been developed for onshore applications and could be used for offshore applications as well. CNG is also an option, particularly for very small amounts of gas to be transported over short distances.'

Dr Nikolaou and colleagues Xiuli Wang and Michael J Economides have studied underlying principles and the specifics for situations where LNG or CNG would be preferable for monetising stranded gas. 'The bottom line is that LNG is a better option mainly for long-distance transport, CNG for shorter distance,' Dr Nikolaou says.

Chemical conversion of gas to liquid fuels or chemicals is also technically feasible, but economically less appealing for small-scale, he adds. 'Some recent efforts on mini or micro-GTL (gas-to-liquids), which trade economies of scale for heat transfer and chemical conversion efficiency, could perhaps change this. Direct conversion of gas to electricity through small-scale generators would also be an option.'

Size matters

Scale is critical. There are mature solutions for large-scale applications that pay their way. For example, US-based global oil and gas operator Hess Corporation – a large producer in the Bakken – has expanded its local Tioga gas plant, which in spring of 2014 was processing 120mn cf/d of gas to produce liquids propane, methane, butane, natural gasoline and industrial feedstock ethane. Tioga is viable because of the volume of gas that can be sourced with relative ease from Hess' numerous wells. The company also envisages handling 250mn cf/d of gas from other operators in the near future.

Technologies are far less proven for small-scale applications in 'stranded' sites. Yet, this is where most flaring and venting actually occurs, according to Martin Layfield, Gas Segment Director at Norway headquartered DNV GL. 'The largest volumes of gas vented and flared are in developing countries where the need for smaller scale, distributed energy solutions is often the highest,' he says.

In 2014, DNV GL reviewed the latest technologies for small-scale solutions and looked at associated market and economic scenarios, including small and micro applications. These included, among others, skid-mounted LNG, CNG, methanol and ammonia conversion, and offshore power generation in battery form. 'We need innovation in applying associated gas to energy intensive processes, such as air separation and water desalination. Although some solutions might be immature, there are a variety of them which are both technically and economically viable,' Layfield notes.

DNV GL plans to devise commercially viable concepts for gas capture in real locations and conditions both onshore and offshore, and involving upstream and downstream techniques. 'These concepts will cover a range of flow rates, gas compositions, geographical locations and other variables,' comments Robert Rawlinson-Smith, Director of DNV GL's Technology Programmes. 'The different combinations that we are looking at represent current flaring situations and require very diverse technology solutions. We are also considering how to make processing plants modular and flexible, allowing them to be used at different locations, as wells deplete.'

Concept to commercial

Many of these concepts will be based on existing technologies, an approach that could open up the possibility of a relatively fast-track from concept to commercial deployment. Other options being considered are mobile units that allow solutions to be used in a number of locations and for temporary use, such as exploration and appraisal well testing.

Modularity lies at the heart of the business plan of UK-based CompactGTL, chaired by former BP Chief Executive Tony Hayward. Its proprietary GTL reactor technology is designed specifically around volumes of associated gas that are routinely flared or cannot be otherwise monetised. For ease of deployment and maintenance, it is contained within standardised modules that have the same dimensions as standard shipping containers. Whole modules can simply be exchanged for spares, maximising plant uptime and containing operational expenditure.

Modular GTL plants allow associated gas to be converted, at the point of production, to diesel for local use, export or synthetic crude oil, for blending with the natural crude produced and exported via existing infrastructure. (See *Petroleum Review*, October 2014.)

For offshore fields, CompactGTL has worked extensively with SBM Offshore (the Netherlands) to engineer floating production, storage and offloading (FPSO) units incorporating fully integrated GTL facilities; again targeting typical flare gas volumes. The company announced in March 2014 plans to commit $300mn to realise a 3,000 b/d GTL project in Kazakhstan, which it describes as 'the first commercial deployment of small-scale GTL anywhere in the world'. The company generally considers projects economically viable from about 20mn cf/d up to about 100mn cf/d, producing approximately 2,000 b/d to 10,000 b/d of GTL liquid products respectively.

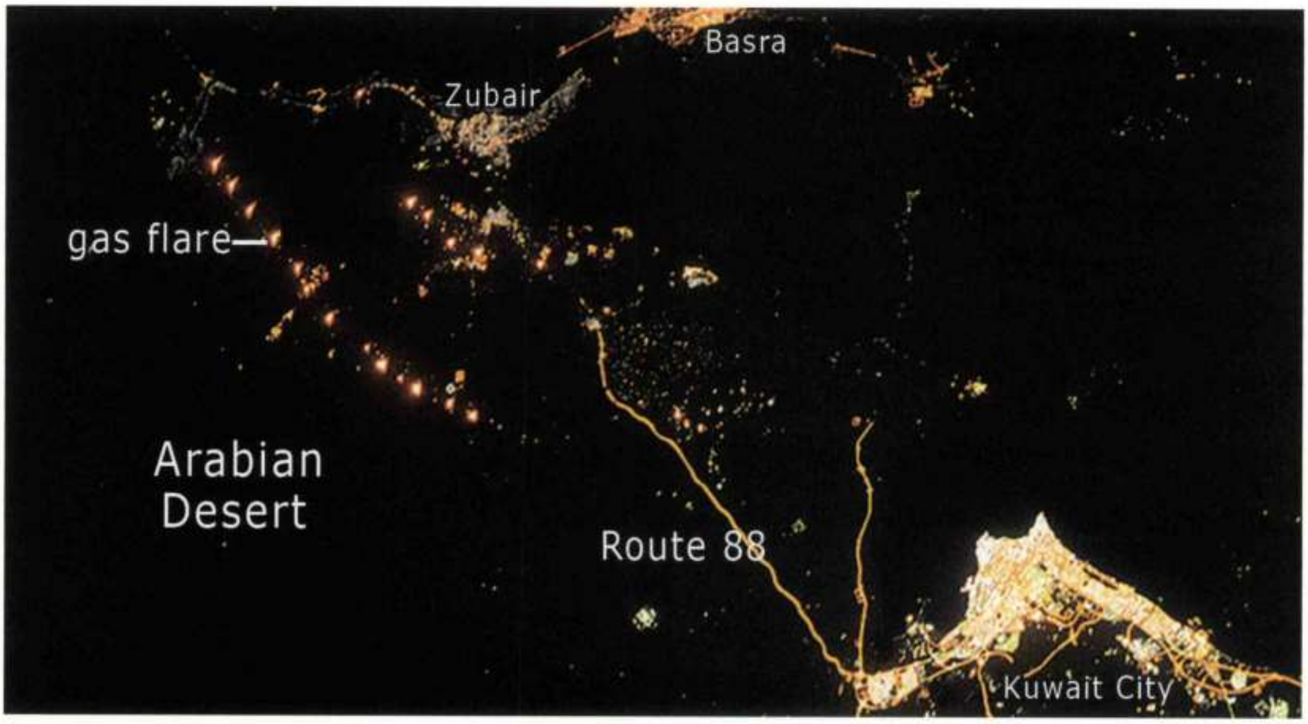
Market analyst Wood Mackenzie has suggested there are more than 800 existing oil fields worldwide where volumes of associated gas and local logistical constraints would be viable for modular GTL plants, onshore and offshore. These oil fields contain more than 70bn barrels of crude oil reserves. As Iain Baxter, CompactGTL's Chief Operations Officer, notes: 'This is a vast market opportunity, with plenty of room for numerous technologies geared to different circumstances.' ●

Driving innovation

Even smaller scale GTL solutions are being pursued or marketed. The US shale oil boom and an associated increase in flaring is driving innovation – 29% of all gas produced in the Bakken is flared, according to the University of North Dakota's Energy & Environmental Research Centre. Tellingly, almost half of this flared gas is from wells connected to gas-gathering networks that lack the capacity to handle more. North Dakota's government is working with companies to reduce flaring.

The research centre assessed some current technologies and their economics for small-scale GTL and for using associated gas for power production, transportation fuel and chemical production. It concluded that 'innovative approaches to effective implementation' are needed. Some are already being deployed, tested or proposed. For example, Norwegian operator Statoil uses diesel- and natural gas-fuelled drilling rigs in the Bakken. These are connected to General Electric's (GE) 'CNG in a Box' well site gas-processing equipment to generate compressed gas for local distribution by Ferus Natural Gas Fuels (US). This gets stranded gas to drilling sites where there is high fuel demand.

Another example is the Dow Chemical Company's adsorbent-based technology UCARSORB that removes natural gas liquids (NGLs) from wellhead gas. The NGLs are sold and the methane stream can be used in bi-fuel engines instead of having to install gas lines from areas producing associated gas to drilling locations where it is needed as fuel. ●



Satellite photography captures the glow of flared gas in the Arabian Desert
Source: NASA