

# MOBILE SOLUTIONS FOR GAS FLARE REDUCTION

By Nataša Kubíková

Innovative technologies for more efficient and environmentally friendly utilization of associated petroleum gas are flooding the market. There is a plethora of available products to choose from that will help replace gas flaring with other more economically viable and energy efficient alternatives. The technologies were developed for countries that cannot adopt standard solutions such as building expensive gas pipelines that would transport associated gas. Benefits that these products can deliver range from helping eliminate destructive gas flaring practices, improve operation sites economics, ensure energy efficiency, and achieve production optimization in oil fields.

## Gas Pipelines Option

Egypt with its specificities - high number of small flaring sites with variable volume of associated gas in locations distant from national grid - has a plethora of technological products and schemes at hand to employ.

Primary gas utilization outlets at gas flaring sites in Egypt are not available, according to preliminary findings of a study commissioned by the European Bank for Reconstruction and Development. As Torleif Haugland, Senior Partner of Carbon Limits, an EBRD collaborator, explained at a gas flaring workshop held in Cairo in March, there are several options for efficient utilization of associated petroleum gas (APG) ranging from gas delivery via pipelines to the market, replacing diesel with gas to generate power at sites, gas delivery by mobile equipments - CNG, LNG, small size gas-to-liquid (GTL), production of condensate, and reinjection of gas to oil fields.

Although gas delivery via pipeline is a principal option for flare elimination, in Egypt, the distance of gas flare sites from the market and low volumes of gas are critical factors that suggest against it. Pipeline solutions define as a viable threshold of 15-20 km distances for small-sized fields with low volume of associated gas and a limit of 35-40 km for larger volumes. However, Egypt records 70% of flaring occurring at sites with less than 5mscf/d of associated gas, whereby only 7 sites flare more than 5mscf/d. In addition, a large number of small flaring sites is distant from the market. This would imply that heavy weigh conventional gas pipeline technologies are less economic and impractical with higher capital spending. Instead, other scalable and portable options would be a smarter choice for Egypt and a more viable business model for the country, experts at the workshop concluded.

## Available Mobile Technologies

Torleif Haugland therefore stressed that other options for utilizing gas in oil fields may be more interesting for Egypt.

Utilizing gas for power at sites, when gas generators replace diesel, is economically much more attractive. Similarly, GTL's costs are coming down, which would offer another viable business opportunity, however, so far only few commercial projects are underway. Mobile LNG and CNG solutions may be yet another way to go for Egypt as these appear more suitable for small flaring sites and 'stranded gas,' of which Egypt has a high count.

As Filippo Munna, Hexagon Composites'

Director of Sales Gas Distribution, told Egypt Oil&Gas, "small sites with a relatively brief life span - like the ones in Egypt - require the flexibility offered by a CNG Mobile Pipeline™ in order to be efficient. When an oil site is exhausted, gas transportation products can be moved elsewhere and continue the delivery. Hexagon Composites specializes in the gas transportation models focused on CNG."

Mobile pipeline solutions appear economically more viable also due to the fact that oil wells lifespan is rather short, rigs are moved at a fast pace as new wells are continuously drilled. As there is a limited time and capital for building intra-basin infrastructure, argued Munna at the workshop, and further restrictions are imposed on oil production over gas flare levels, flexible mobile solutions are more feasible to employ.

The advantages of scalable and mobile solutions thus outweigh complexities and financial costs of standard pipelines. Munna added that "a Mobile Pipeline™ can be put in place in as short time as nine months. Pipelines, on the other hand, require years to be built and are much more disruptive for the environment. This factor is to be considered in developing countries with their high demand for energy. The countries also need to take into account the fact that pipelines are an easy target for possible terrorist attacks and require expensive and extensive surveillance, whereas a trailer can be protected in a much easier fashion. A country as big as Egypt, has ideal conditions for light weight products that transport considerable amount of gas."

Yet, CNG and LNG technological processes also present some challenges.

## CNG versus LNG

In the case of LNG there are various obstacles, as Tractebel Engineering's Head of Process Department, Xavier Sturbois, explained at the workshop. Flare gas comes with low pressure, heavy hydrocarbons content, variable flow with time, space availability limitations, and gas quality does not match requirements for liquefaction. Therefore, for the liquefaction processes to be successful and cost-effective, the gas is to be freed from CO<sub>2</sub> and H<sub>2</sub>S, mercury and heavy hydrocarbons, and it is to be dehydrated with limited content of nitrogen. The associated gas is therefore to be pre-treated before being liquefied. A complex system of liquefaction of APG requires specialized technologies and needs higher capital investments. Presently there are several suppliers able to offer relevant technologies such as single mixed refrigerants, nitrogen based, and open cycles technologies.

The CNG option, on the other hand, may be a safer bet. Even though necessary gas pre-treatment requirements apply also in this case, onshore CNG transportation is already a rather mature technology. Sturbois therefore concluded that gas utilization via the CNG option is less demanding, yet comes with a higher safety risk. Regardless of this factor, according to Tractebel projections, CNG is more suitable for smaller capacity gas transportation on shorter distances of 800km and with up to 5mscf capacity.

As business rationale implies, gas flaring



reduction projects generate higher costs for small volume flaring sites at longer distances. This is one of the challenges that the Egyptian oil sector and foreign operators currently face.

Therefore, in a comparative perspective, CNG may become a more desirable option for Egypt than LNG thanks to being more cost-effective. Total costs consisting of gas treatment, processing, transportation, and delivery associated with LNG amount to \$11.62/mBtu in the case of sites at longer distances, and \$8.12/mBtu at shorter distances. In contrast, overall costs for CNG projects come down to \$10.46/mBtu at longer distances and to surprisingly low \$3.85/mBtu at shorter distances.

In addition, Hexagon Composites, the market leader in sustainable lightweight solutions for mobile pipeline applications, calculated that the energy cost differential represents a 10%-25% cost savings on fuel in total. There is no doubt that the pricing will likely be a primary motivating factor for gas conversions also in Egypt.

## Moving Gas Not Steel

Innovative and tested technologies processing associated gas in the form of CNG could be the new hit in the country's petroleum industry.

Currently, there are several different products in the market, as Hexagon Composites' Director presented to the Egyptian oil sector representatives at the workshop in Cairo. The company specializes in mobile pipelines, developing composite pressure vessels, cylinders, and trailers. Hexagon's Mobile Pipeline technology is the largest Type 4 commercial pressure vessel worldwide offering high-capacity, low-weight, and cost-effective transportation of gas, explained Filippo Munna. It is ideal for large gas consumption businesses that come at a high flow rate, but are not operational via pipelines. The technological solution suggests a series of benefits for the Egyptian oil and gas sector, given the parameters of associated gas production in the country.

Further, APG can be also stored for future use. Hexagon's 20ft SMARTSTORE® and 40ft TITAN 4® modules can store and transport respectively 7,000 scm and 10,000 scm. Another attractive characteristic is that the TITAN 4®, an approved ISO container, can also be used for road, marine, and railway transportation. In case the need arises, there are also available technologies tested in harsh conditions in dif-

ferent volatile parts of the world.

As Munna further noted to Egypt Oil&Gas, Hexagon Composites' technology is designed for a wide use in the oil and gas upstream sector for drilling rigs, fracking fleets, and flare gas recovery. It offers composite material vessels as well as by far the largest composite material tanks currently available in the market. These technologies are able to accommodate APG in oil fields that are developed quickly without accompanying infrastructure to process and transport associated gas.

Further, these are also economically viable solutions. According to Hexagon's data, the available CNG scheme contributes to reducing emissions and generates savings on fuel costs. Savings of over \$9 million can be easily achievable in a single project.

Potential of mobile technologies is huge. Companies have also developed mobile gas processing plants that can additionally help in eliminating gas flaring by producing NGLs such as ethane, propane, and butane and consumer quality dry natural gas such as methane.

In spite of the challenges, it is encouraging to know that technologies have been innovated to the level when companies, such as Hexagon Composites, serve the entire process-transportation of the CNG to be offloaded at different customers' decompression stations.

## Gas Flare Elimination Investments

Uncertainty about future gas volumes in Egypt poses a question for flare elimination investments, as Torleif Haugland emphasized, however, the growing market for rental of mobile equipments for the transportation of associated gas - as opposed to flaring - would improve the attractiveness of CNG in the near future.

In general, CNG is less sensitive to gas flow volumes than pipelines, for instance, but it is slightly more susceptible to gas price shifts than pipelines and highly sensitive to feed-in-tariffs. Therefore introducing the levels of feed-in-tariffs closer to renewables can make a difference, concluded Haugland.

The CNG option is currently employed only in few sites in Egypt. But in the conditions when small and medium fields decline rapidly, these mobile technologies could provide a viable solution for the country's oil industry.

# GeoSphere Reservoir Mapping-While-Drilling System Improves Well Placement and Field Development

# Schlumberger

Safety, efficiency, and accuracy are fundamental goals of well construction. But as the search for new oil and gas resources pushes into deeper waters and increasingly complex reservoirs, meeting these goals has become more challenging.

A better understanding of the subsurface is one of the most efficient ways to mitigate drilling risk and optimize operations' performances. The ability to map the reservoir in real time, while drilling, contributes to step change, such as understanding sweep efficiency in horizontal wells, landing and maximizing the length of drain within the optimal zone of the reservoir, and avoiding time consuming sidetracks or pilot holes.

Schlumberger's GeoSphere reservoir mapping-while-drilling service was officially commercialized in May 2014. The service underwent several years of field testing, and it already has been run successfully in more than 220 wells in the North Sea, Europe, Africa, Russia, North America, South America, Australia and the Middle East. Key benefits include increasing potential production and ultimate recovery, unlocking access to new or marginal reserves, minimizing water production, avoiding drilling hazards, improving the accuracy of reserve estimates, eliminating geological sidetracks and refining seismic interpretations.

The technology uses a transmitter placed close to the drillbit on the bottomhole assembly (BHA) to send multifrequency EM signals into the formation at frequencies as much as 50 times lower than legacy technology.

Two receiver subs, with more directional antennas than previous tools, are placed on the BHA behind the transmitter at distances up to 30 m, depending on the thickness of the reservoir and the operator's specific drilling objectives. Increasing the spacing increases the tool's depth of investigation (DOI).

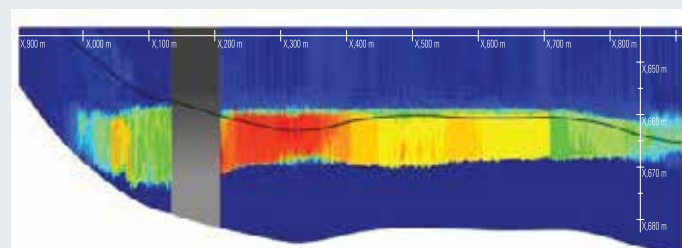
Each antenna receives deep EM signals from the formation, providing a unique set of azimuthal resistivity measurements at multiple depths of investigation while drilling. Readings are sent to the surface in real time through the MWD tool and fed into an advanced stochastic inversion algorithm. This novel proprietary technique automatically compares the measurements with hundreds of thousands of mathematical models.

When it finds a match, the inversion generates an interpretation, incrementally displaying a color-coded resistivity map that allows detection of multiple layers in and around the reservoir along the well trajectory in real time.



## MAXIMIZE RESERVOIR EXPOSURE

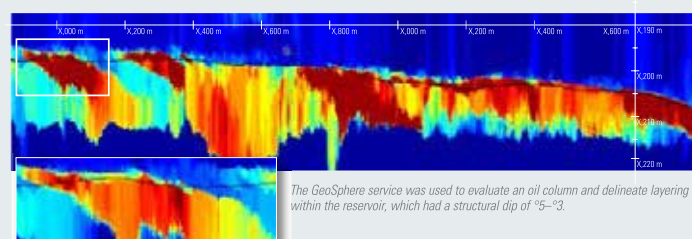
The GeoSphere service enables operators to precisely land wells by detecting the reservoir top and subsurface layers tens of feet before intersecting the reservoir without the use of a pilot hole. This maximizes reservoir exposure by preventing reservoir lateral loss and early water breakthrough.



Top of reservoir detected -49ft (-15m) TVD below well path using the GeoSphere service, leaving considerable room to land and steer the well. Note: interval shown in gray drilled without use of the GeoSphere service.

## STAY IN SWEET SPOT

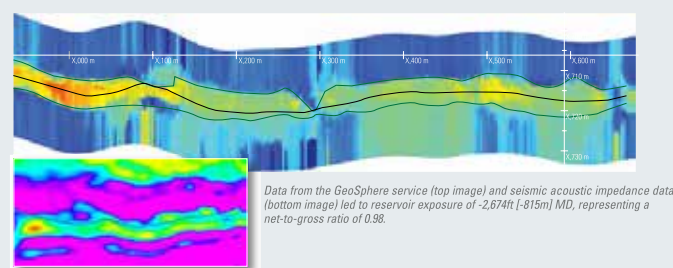
Real-time mapping data enables operators to stay in the sweet spot by steering the well strategically and avoiding unplanned reservoir exits. In high-angle and horizontal wells, the GeoSphere service data can be combined with seismic interpretations to predict oncoming strata and formations.



This is a detailed view of the on-target landing of the well in the image above, as indicated by the white box.

## REFINE FIELD DEVELOPMENT PLANS

Unlike the near-wellbore measurements of conventional LWD tools, the GeoSphere service's depth of investigation exceeds 100 ft [30 m]. By mapping multiple reservoir boundaries, this service enables operators to improve reservoir characterization, refine field development plans, and optimize production potential.



Data from the GeoSphere service (top image) and seismic acoustic impedance data (bottom image) led to reservoir exposure of -2,674ft (-815m) MD, representing a net-to-gross ratio of 0.98.

The GeoSphere service has been successfully used on more than 220 jobs and counting to optimize landing, maximize reservoir exposure and increase production potential in onshore and offshore operations worldwide. Below are some of the areas where Geosphere was successfully deployed.

### North Sea

- Shell Maximizes Potential Recovery with Optimized Landing
- DONG E&P Steers well 96% in Zone in Challenging Remobilized Sand Reservoir

### Offshore Brazil

- Petrobras Lands Multiple-Target Wells Without Pilot Holes
- Shell Accurately Steers Horizontal Well Sections

### Offshore Australia

- Santos Maps Top of Reservoir Determines Optimal Entry Point
- Apache Maximizes Reservoir Contact by Landing Four Wells on Target
- Operator Maps Complex Gas Sands and avoid risky sidetrack

To learn more about GeoSphere reservoir mapping while drilling service, visit [www.slb.com/GeoSphere](http://www.slb.com/GeoSphere)