Flare Gas Recovery in the Symmetry* Process Software Platform

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“Zero Routine Flaring by 2030”, introduced by the World Bank, is one of a growing number of initiatives worldwide calling for oil companies to reduce routine flaring. This practice of sending excess gas to flare when it is the most economic option leads to wasteful burning of billions of cubic meters of natural gas annually. Figure 1 shows the total amount of flared gas in different countries between 2012 and 2018.

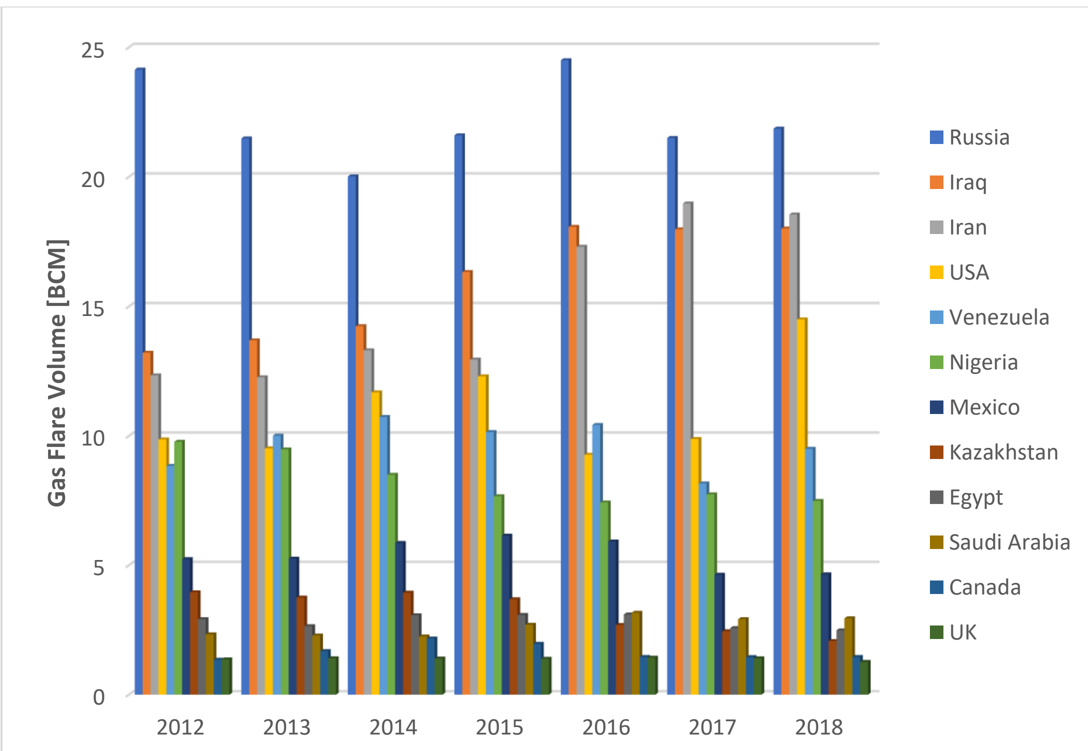

Figure 1. Volume of gas flared in different countries. Source: skytruth.org

Companies across the industry are answering the call to action and successfully implementing flare reduction strategies. Such projects may be driven by tightening regulations, concern for environmental impact and public relations awareness, yet they have shown that selecting the right strategy can have economic benefits as well with up to millions of dollars in added annual returns. Symmetry can be used to design and evaluate a variety of flare reduction strategies through modelling of the complete system from production to facilities along with the flare system and gas recovery method of choice.

The flare system is an essential safety component in any oil and gas production or processing operation. Sources of flow to the flare are generally categorized into three major groups consisting of i) emergency, ii) episodic and iii) continuous flows. Initiatives to reduce flaring generally target continuous flows, since these are expected to have the biggest environmental impact and be the most economically feasible for recovery. Continuous flaring is used to dispose of gas from a variety of sources including gas lift, blanket gases, tank breathing and working losses, purge or leakage gases, process equipment trips and maintenance. An alternative to flaring would recover this excess gas before it reaches the flare and process it, which may be economically feasible even with traditional compression technology. Innovative approaches will be required to reduce the flaring of immense amounts of associated gas in oil production sites around the world where investment into pipelines, compressors and other traditional recovery infrastructure may be cost prohibitive.

Oil and gas operating companies are actively looking for different approaches to mitigate gas flaring. Strategies can employ a combination of recovery and processing technologies including Flare Gas Recovery (FGR), Compressed Natural Gas (CNG), gas re-injection, power generation and Liquified Natural Gas (LNG). Compression technology selection is critical to the economic success of the project and thus should consider a variety of compressor types (screw, liquid ring, reciprocating, sliding vane) as well as passive devices in the form of surface jet pumps (SJPs) or ejectors and even hydraulics design. The optimal flare mitigation strategy will depend on project economics, infrastructure availability and frequency of flaring.

Symmetry provides all the functionality needed for the design and evaluation of various gas recovery strategies. This workflow is made efficient and seamless with unprecedented integration between gathering networks, facilities, and flare system models.

FGRU Simulation in Symmetry

In this series of articles, we will evaluate a variety of compression technologies to select an optimal design for a Flare Gas Recovery Unit (FGRU) in a typical oil and gas processing plant. This article describes the system and the model.

The main source of continuous flaring in this system will be blanket gas from the oil storage tanks. Blanket gas is used to maintain a stable positive pressure in the tanks and must be removed in response to sudden pressure rises, in this case by being sent to flare. Since the facility is not large enough to warrant the cost of a nitrogen processing plant, natural gas is used as the blanket gas. Secondary flare sources include the plant's compressor station when its capacity is exceeded and relief valve leaks.

Low-pressure gas will be routed to the FGRU from the piping downstream of the knockout drum and upstream of the water seal drum (or rupture disk). The safety system must remain uncompromised, so the flare will remain capable of protecting the system in case of overpressure. Gas is compressed in the FGRU using either compressors or ejectors and then recycled to the process for power generation.

The full system is modelled in Symmetry in order to evaluate FGRU design alternatives. This integrated model consists of gas separation and oil storage, a compressor station, a TEG unit, and the flare network, with a VRU and FGRU. A schematic of the processing plant model is presented in Figure 2 below. Continuous flows from blanket gas, venting, and the compressor station bypass are sent to the flare.

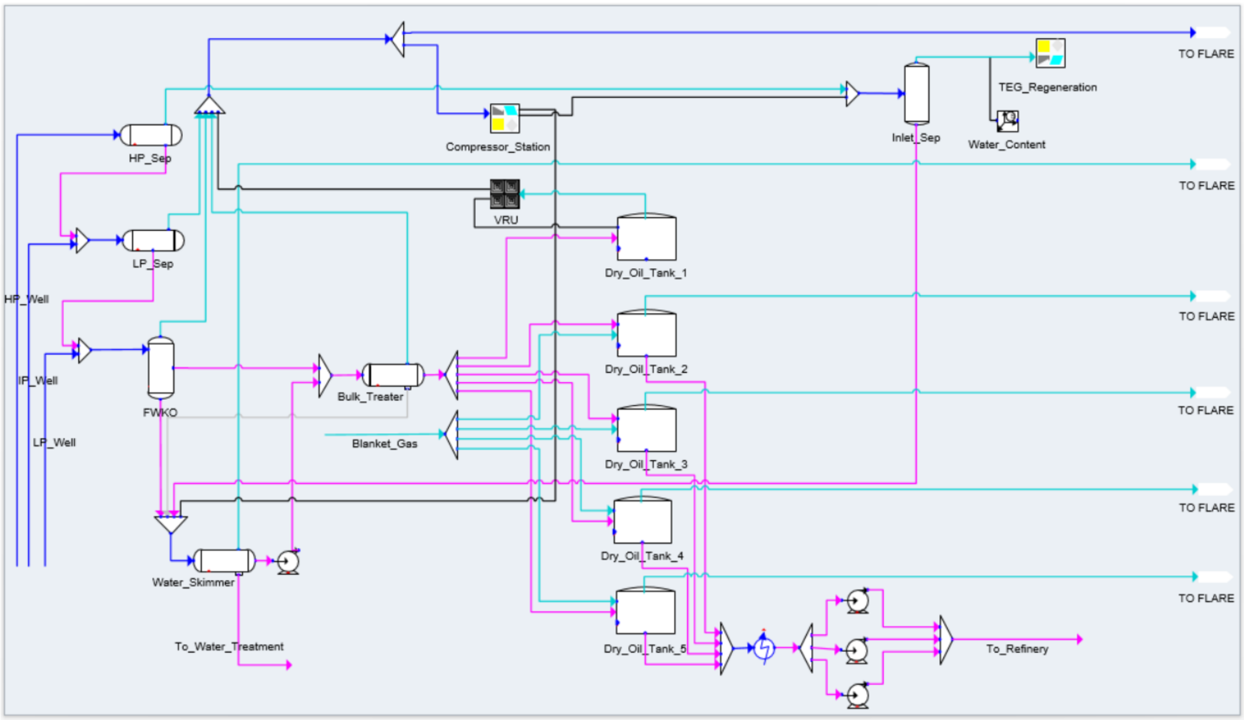

Figure 2. Schematic of processing plant

Figure 3 presents details of the flare network model. Relief valve leaks are considered in addition to continuous flows from the processing plant. The FGRU is located downstream of the knockout drum, and backpressure created by the water seal drum drives low-pressure gas to the FGRU line for recovery.

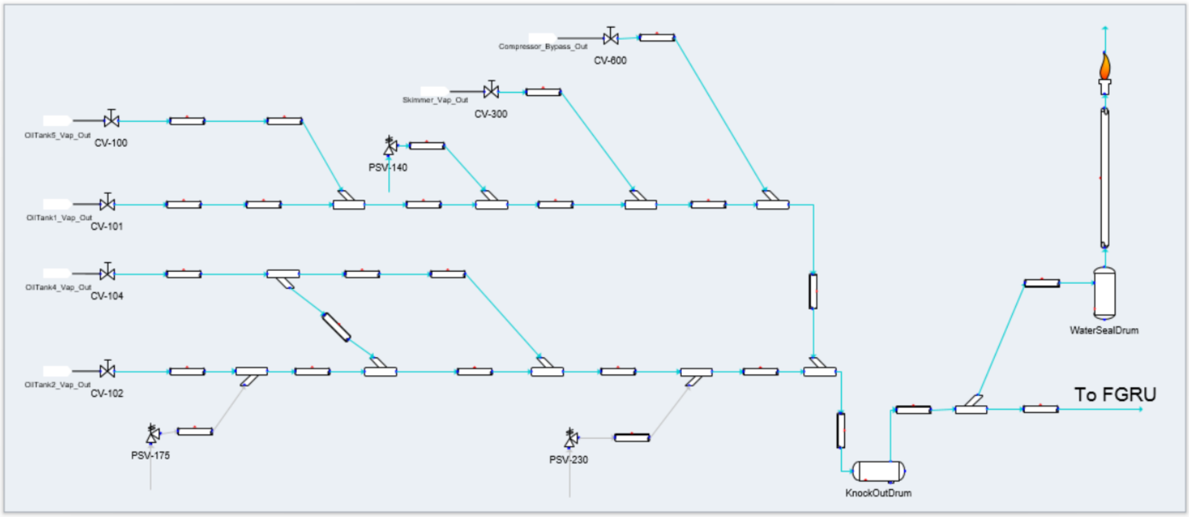

Figure 3. Schematic of flare network

Figure 4 shows a typical FGRU. The gas is fed to a scrubber where any entrained liquid is removed before it is sent to the compressor. Then, the gas is compressed in a two-stage compressor with inter-stage cooling. The pressurized gas is cooled down and passed through a final scrubber to separate liquids. The recovered gas is sent back to the process for power generation.

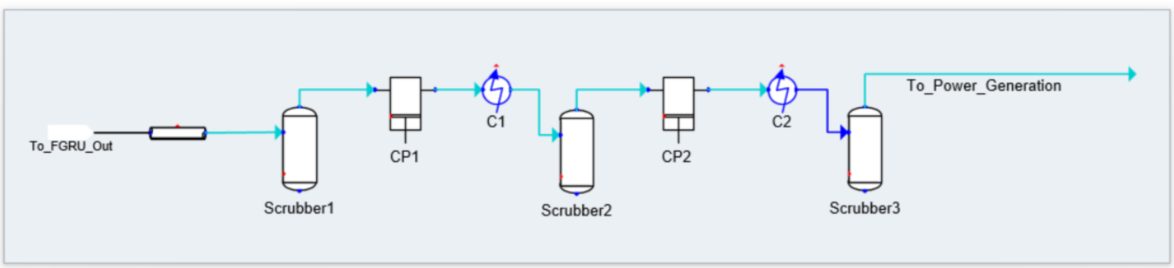

Figure 4. Schematic of FGRU

In-depth study of the flare network hydraulics and FGRU can thus be performed, and the safety of the flare network and relief system can be verified for all emergency scenarios in the Symmetry Flare workspace.

Design details and economic evaluation for this case will be featured in an upcoming issue of the newsletter.

References

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