The 1st FERIA Conference, University of Nottingham

An Alternative Route to Minimum Flaring: Plant Optimised Flare Gas Recovery Systems using Ejector Technology

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THE GROUP

• Design and manufacturing facility for full range of flares and ancillaries.
• Established in 1984 as a JV with Airoil Flaregas UK becoming independent in 2011.
• Over 300 flares and 18,000 burner installations worldwide.
• Designs meet API 521 and 537 standards.

• Design centre for burners, flare gas recovery and thermal oxidisers.
• Headquarters and registered in the UK.
• Over 250 years of combustion experience and expertise.
• Full range of burners and thermal equipment for petrochemical, refinery and fertiliser industries.
• Established international supply chain.
“Thousands of gas flares at oil production and petrochemical sites around the globe burn approximately 140 billion cubic meters of natural gas annually, causing more than 300 million tons of CO2 to be emitted to the atmosphere.”

- The World Bank 2018 figures

The EU and UK contributes around 4.4 Million tons of CO2 which would relate to 2.05 billion cubic meters of natural gas flared.

Historically 7 countries (USA, Russia, Iraq, Iran, Algeria, Venezuela and Nigeria) have been the top gas flares in the last 9 years, while accounting for 40% of global oil production they account for 65% of global flaring.
What is Zero Flaring? Can this be achieved.

While we are driving to net zero, are there savings that can be made in our current operations particularly in flaring.

Are we really achieving the 98% Destruction Efficiency expected by our flaring? How does vary during the life of the flare and does that change our FGR goals.

Is plant optimized flare gas recovery achievable and preferable to historical “plug and play” designs.

The goal of an adaptable flexible operating system to maximise uptime.
Why do we flare?
• Control of process conditions by venting of gases/liquids
• Key safety system to protect site employees, the public and facilities.
• How do we minimize the impact (environmentally and commercially) but maintain the protection to the plant?

Challenges faced
• Composition of gases widely variable
• Enormous turndown ratio with low flare rates typically at very low pressures.
• Understanding the specific client requirements – one size does not fit all.
• How is the recovered flare gas to be used?
• Understanding “Zero Flaring”.
• Safely isolate the flare when recovering gases.
  • Maintaining Purge and Ignition Sources.
  • Maintaining Maximum Stable Capacity.
How do we reduce flaring and flaring emissions?

Plant Practices

The easiest way to reduce flaring is to update site flaring practices and understand the mechanisms by which processes produce waste gas. By minimising this, a substantial amount of day to day flaring can be reduced.

It should also be noted that many plants purge at much higher than required rates in order to maintain flame stability.

Are the flares doing their jobs? We are seeing more and more extremely damaged flares being pushed past the end of their life spans. Are we still achieving required destruction efficiencies or should we be maintaining the condition of the flare tips in an improved manner.
How do we reduce flaring?

FGRS (Flare Gas Recovery System)

As a follow on to minimising the day to day flaring, a FGRS can be designed to capture waste gases that would normally go to flare.

The advantages of an FGRS are:

• Recover high calorific value gases that can be used as a fuel elsewhere or as a sales gas.
• Recovery product that can be recirculated into the plant
• Reduce visible flame, noise and emissions.
• Reduce steam / air requirements for smokeless flare tips
• Improve the life of the flare tip.
• 95% Rule – 95% of the year you likely achieve 50% of your total flaring with the remaining 50% related to trip events. This 50% (Normal Flaring) is the target for recovery.
FGRS – Basic Principles

- Slight backpressure builds up in the flare header. This will mean that the FGRS operates slightly positive pressure to prevent air ingress into the system. This back pressure is developed either by isolation valves or a liquid seal.
- Process vent gasses are recovered from the flare header.
- Pressure is boosted by means of a compressor or ejector systems.
- If a liquid ring compressor or liquid motive ejector is used then the gases pass to a liquid separator. A three phase separator may be used to remove easily condensed HC liquid components.
- The gas is sent for further treatment or directly on for use.
TYPICAL LAYOUT COMPRESSOR

TRADITIONAL FGRS - COMPRESSOR BASED
APPLYING AN ALTERNATIVE APPROACH

Working together to apply unique customer focused FGR systems

Combining the extensive Flare and Thermal Systems knowledge of Greens Combustion and AFG Combustion with the ejector based experience of Transvac Ejector Systems.
WHAT IS AN EJECTOR?

Ejector Principles

• Simple device that uses the energy within a high pressure fluid to entrain and compress a low pressure fluid to an intermediate pressure.
Why Ejectors?

- Simple robust design – avoid having corrosive gas in contact with rotating equipment.
- Gas / Liquid Motive Fluid
  - Key Design “Rules of Thumb”
    - Single Stage Gas Ejectors 8:1 Compression Ratio
    - Single Stage Liquid Ejectors 150:1 Compression Ratio
- Performance easily modified to meet changing site conditions.
- Low weight and small footprint.
- Low noise.
- Can handle more abrasive constituents
- ATEX not applicable so less complicated for Hazardous areas.
- On / Off operation much easier to handle.
Ejector Advantages

- Easily optimisable during plant life.
- Removable internals for maintenance.
- Flare gas is not in contact with rotating equipment.
- CAPEX approximately 30% of comparable compressor based systems.
- OPEX generally lower than equivalent compressor based systems.
- Why weren't they used historically?
  - Efficiency was lower
  - Primary players in the market pushed compressor systems.
A system that can adapt to changing plant conditions.

- Recognition that plant conditions change over time.
- It is not always possible to completely identify all operating conditions during design phase and optimisation is usually required during commissioning and the early years of a systems life.
- Simple internal alteration can be done with low cost impact and minimal plant disruption.
- Many traditional systems have not had the ability to adjust to real plant variability with the result that most do not see action past the commissioning phase.
Applying FGR within the constraints of each site.

Available Motive Fluids.

1. HP Gas
2. Closed Loop Contained Systems
3. HP Liquid
EJECTOR FLEXIBILITIES

Optimising the design based on plant requirements

The simplicity of the ejector design means that whatever the site requirements or available utilities an optimized solution can be offered. Key to this is working with the site to ensure that the recovered flare gases are best used to reduce environmental impact and maximise return on investment.

Targeted ROI’s are in the order of 6 to 10 months for ejector based systems up to 18 to 24 months for compressor based systems.
Tailored Design

Recovery of off-spec plant does raise the question of where this gases can be used. Greens experience in combustion systems means that holistic analysis can be performed across the plant reviewing both site usage requirements and minimizing emissions.
CASE STUDY – UK ONSHORE

Problem Statement

• Environmentally sensitive location near a world heritage site on the UK South Coast.
• 3 Enclosed Ground Flare Systems with HP, LP, LLP and LT Flare Headers.
• Looking to maximise flare gas recovery and remove any routine flaring.
• One of the largest onshore drilling sites in Europe with available produced water as motive fluid.
• Height and noise limitations critical.
• Very large flare headers requiring non continuous operation of the system.
• Flare system relief required specialized isolation.
Solution

- 4 uniquely operated systems feeding into a common recovery header.
- System cycles on and off 4 to 5 times per hour to remove gas building up in flare headers.
- GCL supplied fully skid mounted packages to fit client specification in extremely constrained locations.
- GCL supplied loose isolation buckling pin, fast opening control valves and liquid seal devices.
- Day to day flaring reduced from 600 kg/hr per unit to purge rates only. (Target reductions of 27,000 tons/year CO2)
- Nitrogen purge to reduce CO2 emissions.
- Height and noise limitations met.
Flare Gas Recovery needs to be approached in a manner that encompasses the requirements of changing sites.

Ejector based systems present a fundamental shift in the technological approach of flare gas recovery. It creates systems that are more adaptable and therefore more likely to be maintained in use.

In spite of moves towards Zero Flaring and Hydrogen Rich Fuels there are still many strides to be made in the reduction of day to day flaring that can serve to minimize flaring CO2, NOx and UHC emission levels.

Installation of FGR Systems will reduce thermal cycling on flare tips, improve their life spans and very likely substantially improve their emissions performance as well as reducing pilot and purge requirements. More research is needed into condition based emissions from flares.

Flaring representing approximately 1% of global CO2 emissions still represent a significant area for improvement with the application of the correct care and technology.
THANK YOU AND QUESTIONS?