Flare Gas Recovery (FGR) to Reduce Plant Flaring Operations
John Zink Background

- Privately owned by KI
- 75 years in business
- 1000+ employees
- Global locations
Quality, Safety, and Environment

ISO 14001 CERTIFIED
ISO 9001:2000 CERTIFIED
OHSAS 18001 SAFETY CERTIFICATION

National Environmental Performance Track
U.S. Environmental Protection Agency

VPP Voluntary Protection Programs
An OSHA Cooperative Program
John Zink Products

- JZ®
  - Process Burners
  - Flares
  - Thermal Oxidizers
  - Vapour Recovery and Combustion
  - Flare Gas Recovery
  - Refractory

- TODD® Combustion
  - Industrial and Marine Boiler Burners

- Gordon-Piatt™
  - Commercial Boiler Burners

- KEU GmbH
  - Thermal Oxidizers
  - Heat Recovery

- Kaldair®
  - Flares
John Zink has been for many years the leader in the design and manufacturing of industrial flares and related equipment.
In addition John Zink has been the industry leader in design and supply of vapour recovery units.
This experience is combined in FGR systems which recover valuable flare gasses to reuse as fuel or feedstock.
Why Flare Gas Recovery (FGR) ?

FGR provides the benefit of conservation of resources and reduction of emissions by recovering process vent gases, with often considerable HV, instead of flaring.

“Environmental control with good payback”
Benefits:

- Reduce Combustion Emissions including NO$_x$, CO, and SO$_x$
- Reduce Fuel Gas Consumption
- Reduce Flaring Light, Noise, and Odor
- Reduce Steam Consumption
- Extend Flare Tip Life
- No impact on existing safety relief system
- Improved PR & company image
Flare Gas Recovery Unit
FG is withdrawn from upstream of liquid seal drum and through LRC discharged into separator and available as plant gas. Positive P is maintained to prevent air ingress. If FG gas stream exceeds FGR full capacity gas will flow to flare, if FG stream is less than system will turndown by staging compressors and/or bypass.
FGR Equipment Scope

Skid Packaged Process and Equipment Design
  • Liquid Seal Drum
  • Gas Compressor
  • Gas/Liquid Separator
  • Heat Exchanger
  • System Control Logic

Existing KO drum, flare header, liquid seal and flare remain
Liquid Seal

To maintain a positive pressure in the flare header and prevent undesirable vacuum to pull in air from flare tip.

- Existing liquid seals may be too shallow to provide hydrostatic head and cause operating problems.
- JZ liquid seals warrant steady gas flow to flare tip which provides increased smokeless capacity.
Liquid Seals

- Special design internals are required to allow for a deeper FGR liquid seal.
Liquid Seals

- Typically new liquid seals are required.
- In some applications, new internals can be provided to be installed in an existing liquid seal.
Compressor Technologies

Compressors

Dynamic
- Centrifugal
- Axial
- Thermal / Jet

Positive Displacement
- Reciprocating
  - Piston
  - Diaphragm
- Rotary
  - Screw
  - Lobe
  - Liquid Ring
  - Sliding Vane
Liquid Ring Compressor
To compress the flare gas for discharge into separator.
Separator
To separate compressor seal liquid from flare gasses.
To separate condensed hydrocarbons from seal liquid.
To discharge compressed gasses into plant fuel gas system or feedstock.

Service Liquid Coolers
To remove the heat of compression.

System Control Logic
For fully automated unattended operation.
Typical System Project Scope

Stage 1 - Engineering Study, Site Investigation & Process Engineering

Stage 2 - Process/Mechanical Design Equipment Selection Procurement

Stage 3 - Fabrication & Assembly

Stage 4 - Installation Assistance

Stage 5 - Commissioning Support & Operator Training

Ongoing - Service & Maintenance
FGR Engineering Study

- Identify Use for Recovered Gas
- Review of the Existing Flare System
- Flare Header Flow and Positive Pressure
- Characterize Flare Gas Availability
- Evaluate Flare Gas Composition
- Select Gas Compressor Technology
- FGRU Design
- System Cost/Benefits Analysis
- FGRU Proposal
Process Simulation

- Process simulation aids in refining scope
- Stream Properties are calculated
- Determines the Material Balance for System
Engineering Study

- Determination of flare flow activity is important in establishing recovery system design capacity.
- Determination of the average flare gas flow rate is an important step in evaluating the project economics.
- Larger projects (higher average flow rates) offer the best return.
- Uses other than fuel may increase project return.
John Zink Capabilities

- Determination of flare flow activity to establish recovery system design capacity.
- Determination of the average flare gas flow rate to evaluating the project economics.
- Evaluation of flare process and available recovery technologies
- Integration with existing flare system
- Design of flares and liquid seal vessels
- Established field service & maintenance network
- Approx. 30 years experience in flare gas recovery
Commissioning, Start-Up, Training and Service

• John Zink engineers and technicians are involved in every start-up

• On-site or in-house training

• Service & Maintenance network
#1 Flare Gas Recovery Case Study

Oil Refinery in the Western U.S.

- FGR Design Recovery Flow Rate: 4,900,000 scfd
- FGR Mean Recovery Flow Rate: 2,400,000 scfd
  (97% Flare Activity Reduction)
- Year 1 Operating & Maintenance: $182,000
- Year 1 Value of Recovered Gas: $3,698,000

Flare Emissions Reduction

- NO\textsubscript{X}: 34.6 ton/yr
- CO: 188 ton/yr
- HC: 71.4 ton/yr
- SO\textsubscript{X}: 74.8 ton/yr

Payback in ~14 months
#2 Flare Gas Recovery Case Study

Large refinery process flare
Objective is to maximise economic nuisance flaring reduction
• Gas processing design rate: 12,000 scfm (17.3 MMscfd)
• Gas processing average rate: 10,400 scfm (15 MMscfd)
• Recovered gas HV: 688 Btu/scf
• Recovered gas utilized as fuel gas

Results:
• First year recovery: $11.3 MM
• Payback: 20 months
• Flaring reduction: 82%

Basis of Economics
• Fuel value: $3.00/MMBtu
• Cost of Electrical power: $0.062/kWh
Flare Gas Recovery Design
Flare Gas Recovery Unit
Flare Gas Recovery Unit
Flare Gas Recovery Unit
## John Zink Users List

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<thead>
<tr>
<th>Location</th>
<th>Compressor Type</th>
<th>Pressure</th>
<th>Year</th>
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<tr>
<td>Olin Chemicals-Brandenburg, KY</td>
<td>Sliding Vane</td>
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