High Pressure Air Assist System and Flare Gas Recovery Technology for Continuous Flare Management

Presented at the

Jubail Gas Flaring Reduction 2013

19 20 February 2013 - Jubail Industrial City KSA

COMBUSTION AND ENVIRONMENTAL SOLUTIONS.
PURE AND SIMPLE.


BURNERS


FLARES


INCINERATORS


PARTS & SERVICE

Zeeco Products

Industrial Burners

Incineration Systems

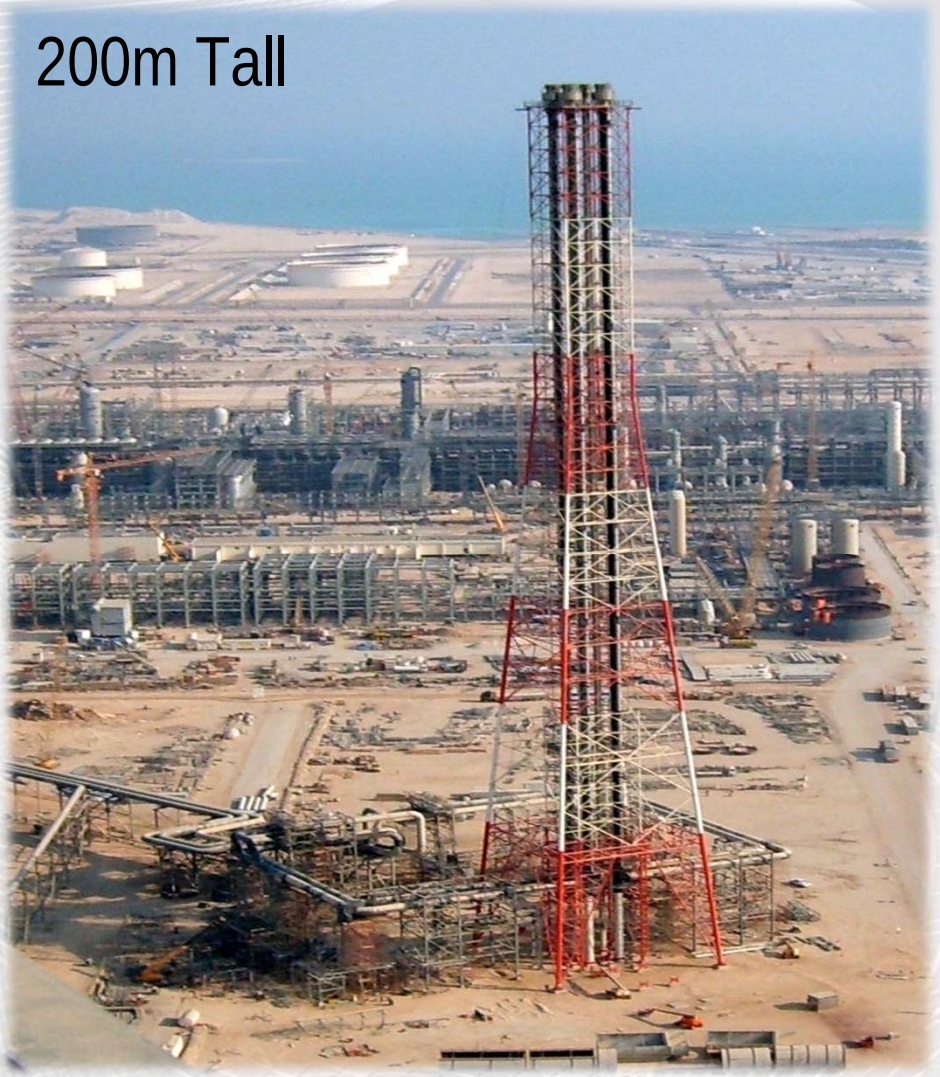
Flare Systems

Flare Gas Recovery Systems

Zeeco History

Zeeco is the international leader in industrial combustion technology, primarily serving the Oil and Gas, Petrochemical, and Power Generation industries worldwide.

- Location: Broken Arrow, OK
- Founded: 1979 by John Smith Zink
- Private Ownership by the Zink family since 1979



World's Tallest Demountable Flare (Qatar).

Zeeco Headquarters' Growth

Engineering Capabilities

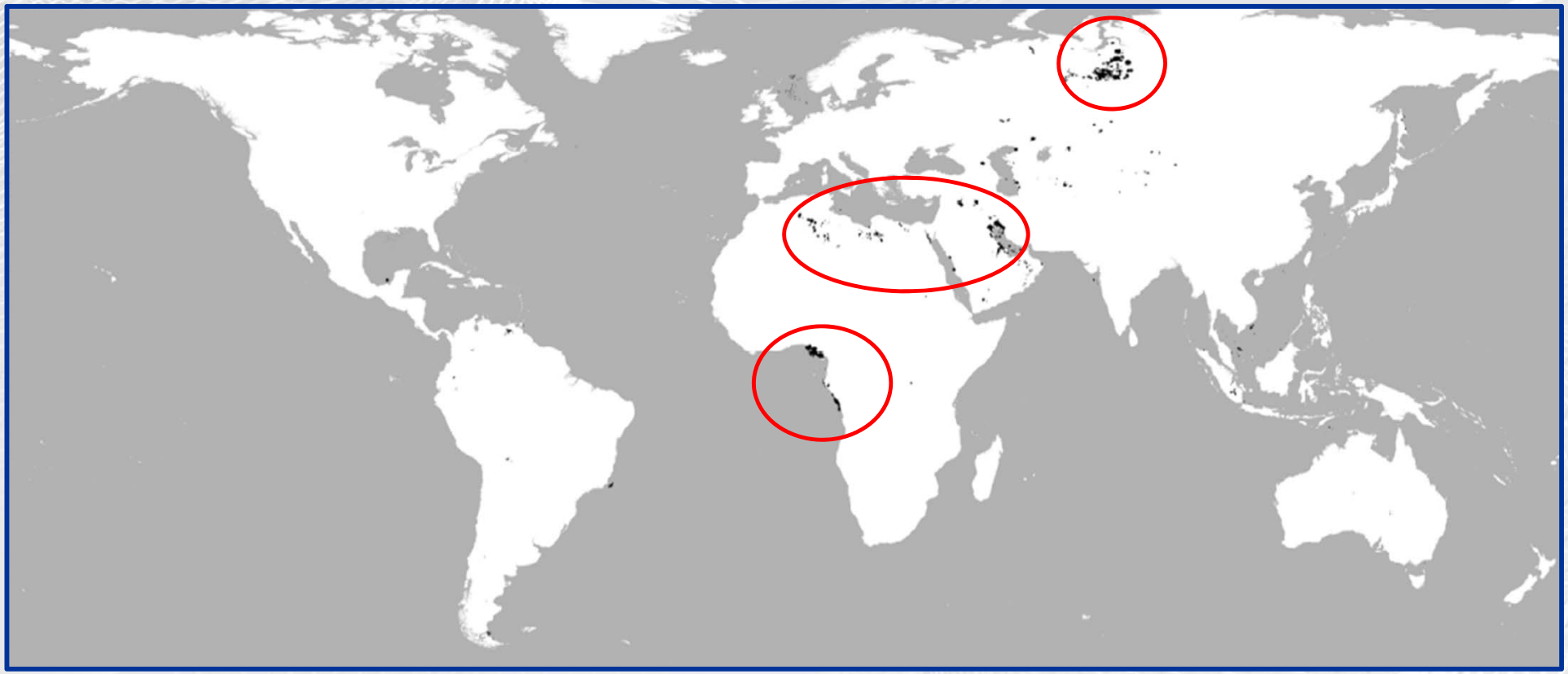
- Total Employees: 400+
- Engineering & Design Staff: 150
- World Headquarters: Broken Arrow, OK USA
- Global Offices:
  - Zeeco Europe: Stamford, UK
  - Zeeco Middle East: Al Khobar, Saudi Arabia
  - Zeeco India: Mumbai, India
  - Zeeco Korea: Seoul, South Korea

World's largest SRU Tail Gas Incineration System (Qatar).
One of 9 similar incineration systems supplied by Zeeco.

Partial List of Clients

- ABB LUMMUS
- ACCROVEN
- BASF
- BECHTEL
- BRITISH PETROLEUM
- CB&I / HOWE BAKER
- CHEVRON
- CHEVRON PHILLIPS
- CHIYODA
- CONOCO PHILLIPS
- CTCI
- DCP MIDSTREAM
- DEMENNO KERDOON
- DEVON ENERGY
- EAGLE ROCK ENERGY
- ENAP REFINERIAS
- ENCANA
- ENGINEERS INDIA LIMITED
- ESSAR REFINING
- ESSO IMPERIAL OIL
- EXTERRAN
- EXXONMOBIL
- FLUOR ENTERPRISES
- FORMOSA PLASTICS
- GALFAR
- GASCO
- GRAFIL, INC.
- GSE&C
- HINDUSTAN PETROLEUM
- HOUSTON ENERGY SERVICES
- HUNTSMAN
- HYUNDAI
- IKPT
- INA CROATIA
- INDIAN OIL COMPANY LIMITED
- INEOS JACOBS
- JGC KAZSTROY SERVICES
- KUWAIT NATIONAL PETROLEUM
- MEDCO
- MITSUBISHI
- MITSUI MITTAL ENERGY
- MOL PAKISTAN
- MOTIVA ENTERPRISES
- MOTOR OIL HELLAS
- ORIGIN ENERGY
- PEMEX
- PETROBRAS
- PETROCANADA
- PETROCHINA
- PETRORABIGH
- PRESSON DESCON
- QATAR PETROLEUM
- QATARGAS
- RASGAS
- RELIANCE PETROLEUM
- S&B ENGINEERS
- SABIC
- SAMSUNG
- SAUDI ARAMCO
- SAUDI KAYAN
- SINOPEC
- SIPCHEM
- SK REFINING
- SHELL PETROLEUM
- SOLVAY
- SUNCOR
- TAKREER
- TANECO REFINING
- TECHINT
- TECHNIP
- TECNICAS REUNIDAS
- TOTAL
- TOYO
- VALERO REFINING
- WILLIAMS MIDSTREAM
- WORLEY PARSONS

Why Flare Reduction? -- World Flaring



Source: A Twelve Year Record of National and Global Gas Flaring Volumes Estimated Using Satellite Data Final Report to the World Bank - May 30, 2007 Source:: US Government Accountability Office

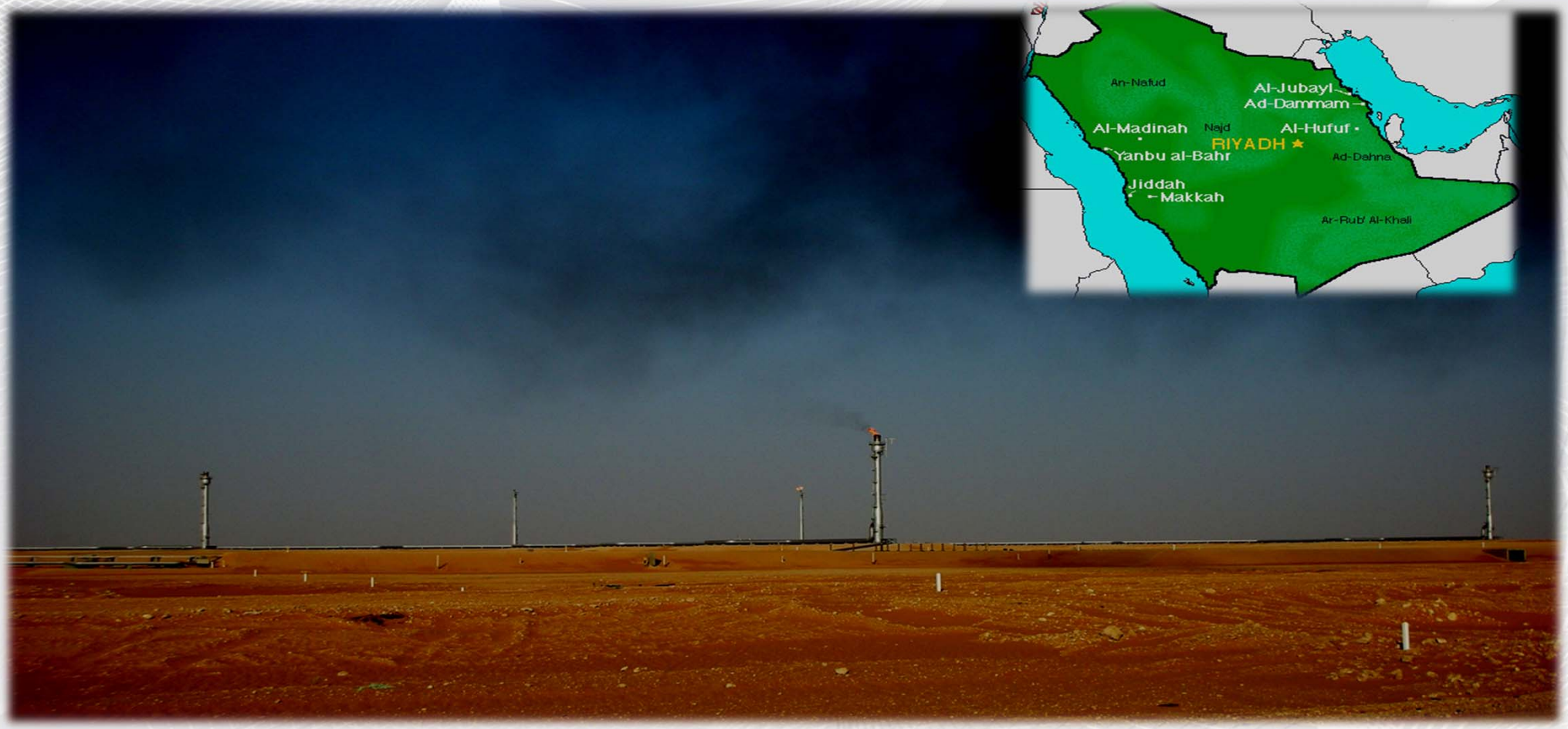
Why Flare Reduction?

- Worldwide push for reduction in flaring
  - Kyoto Protocol
  - Reduce CO Emissions
  - Reduce HC Emissions
- Recover gases that would normally be flared
  - Offset Plant Fuel Gas Usage

Why Flare Reduction?

- Additional Benefits
  - Increase life of flare system
  - Reduce visibility of flare system
  - Improve public perception for facility
  - FGRU eventually “pays for itself”

Utility Flares



Utility Flares - Drawbacks

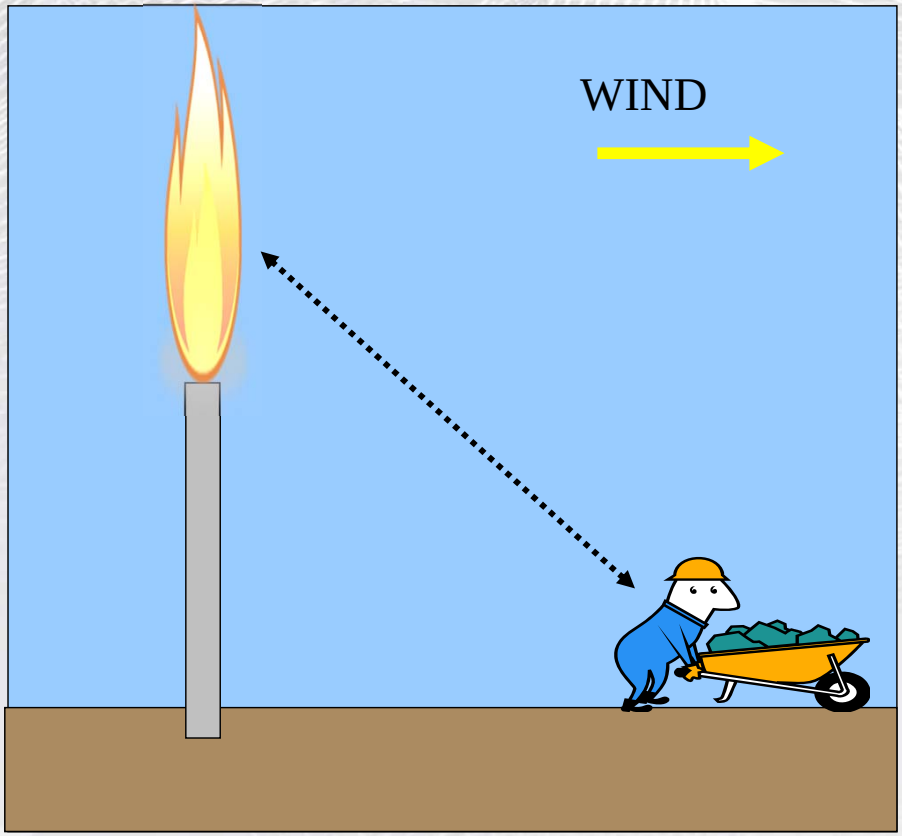
- Low Exit Velocity leads to:
  - Smoke
  - Flame Pulldown → Shorter Tip Life
  - Higher Radiation Levels
    - Flame Lean
    - Higher Flame Emissive Value

Utility Flares – Smoke

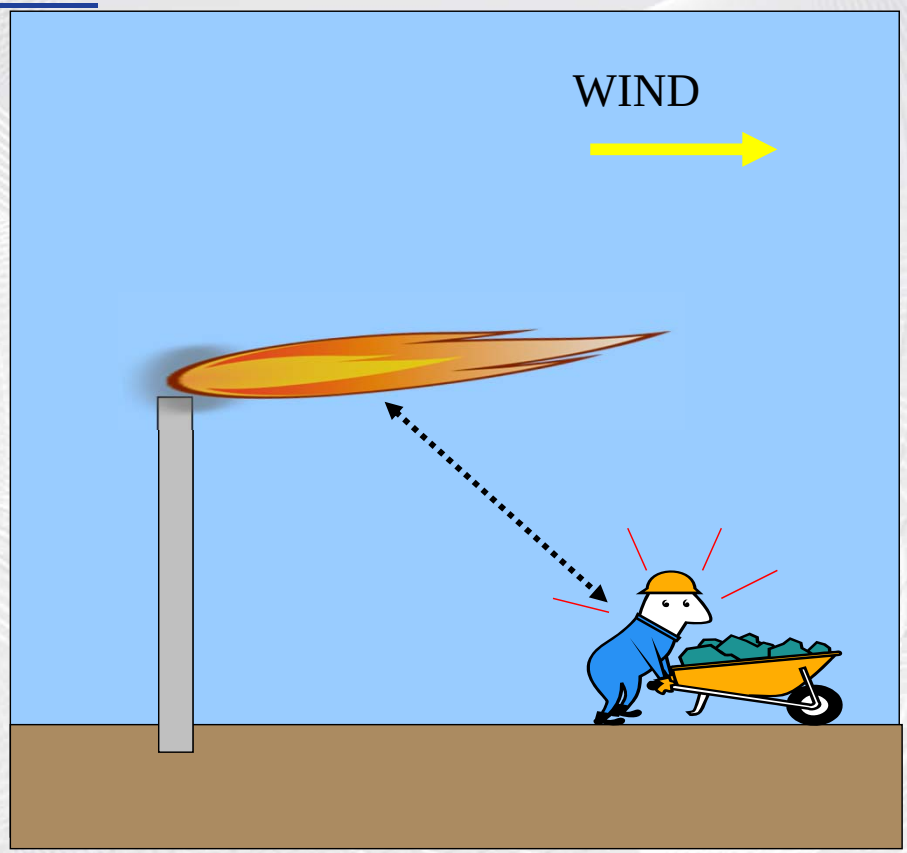
Poor Public Perception

Utility Flares – Higher Radiation Levels

HIGH EXIT VELOCITY FLAME

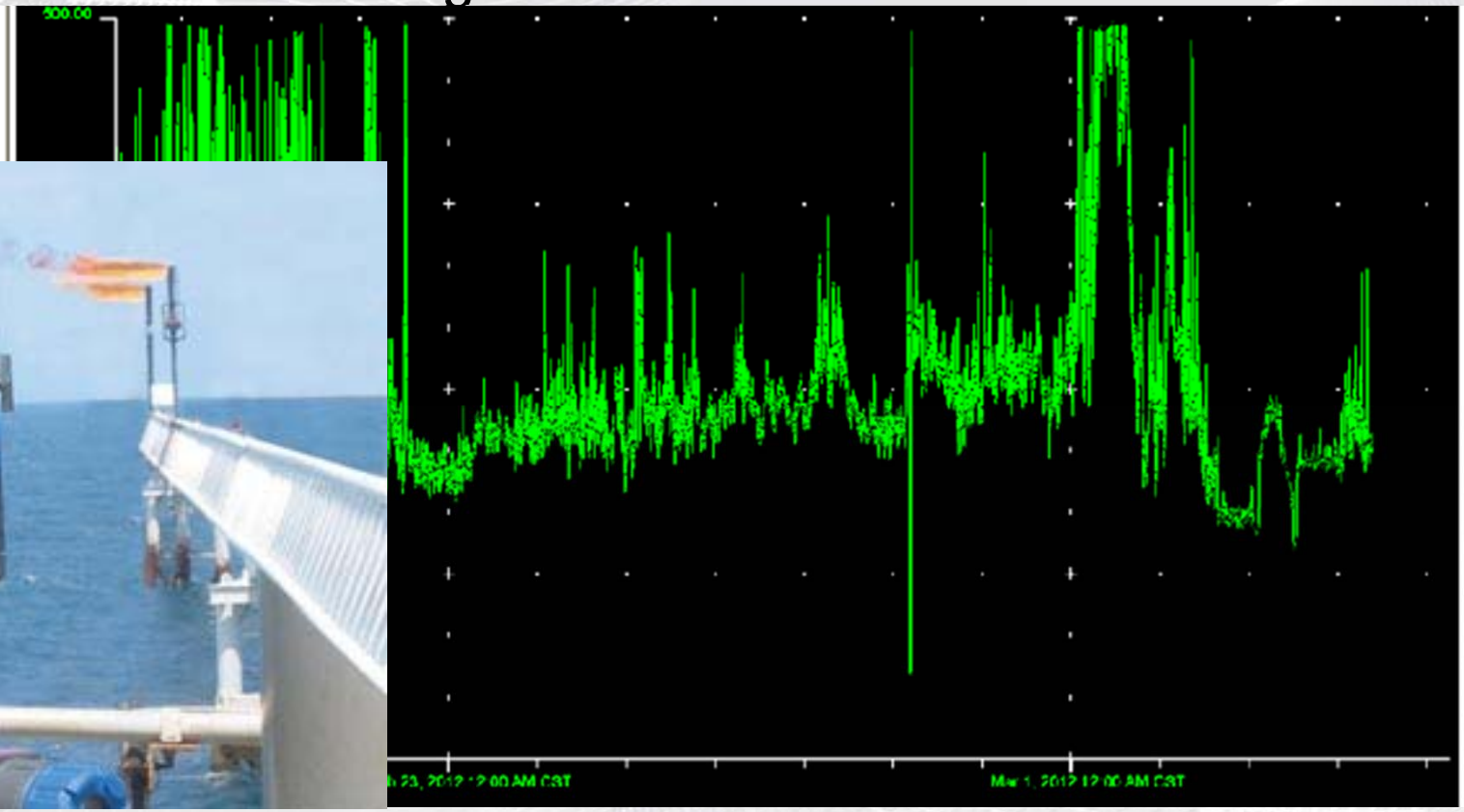


LOW EXIT VELOCITY FLAME



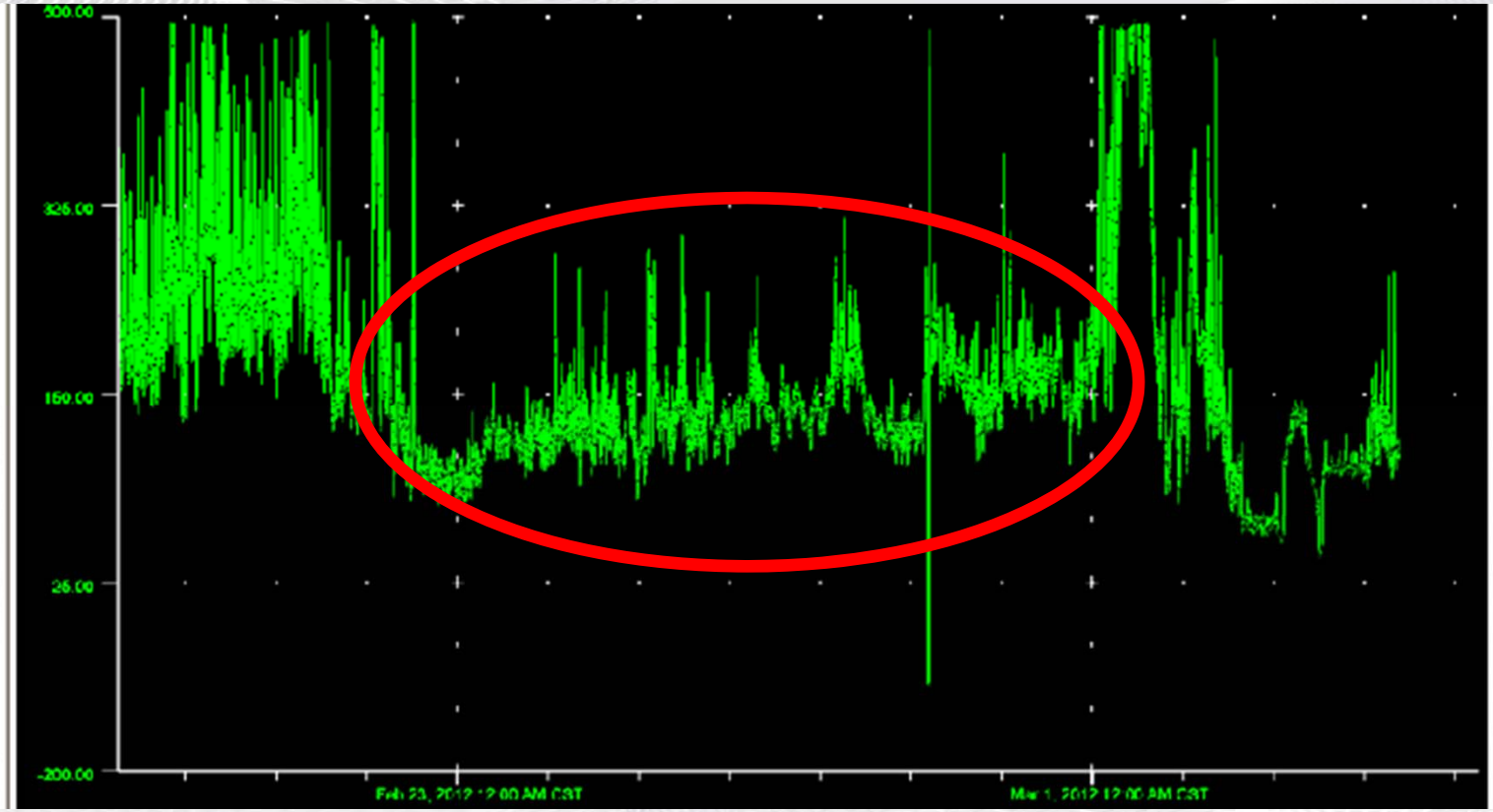
Flare Impact Mitigation Plan (FIMP)

- Understand the continuous flaring sources in a facility



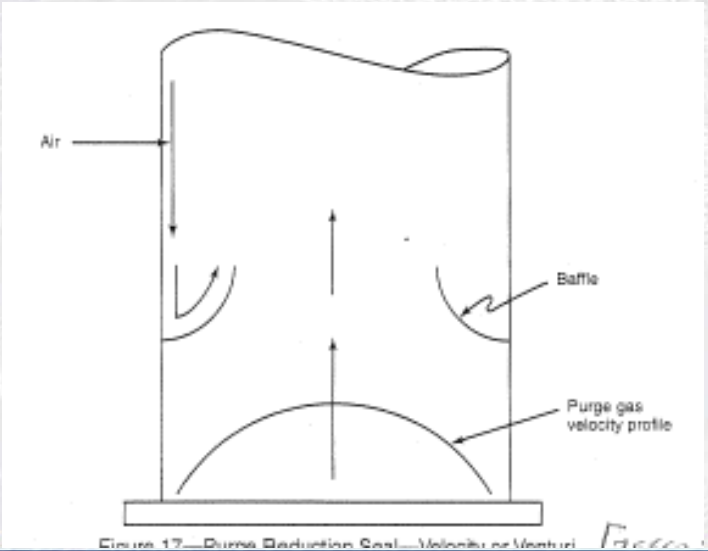
Flare Impact Mitigation Plan (FIMP)

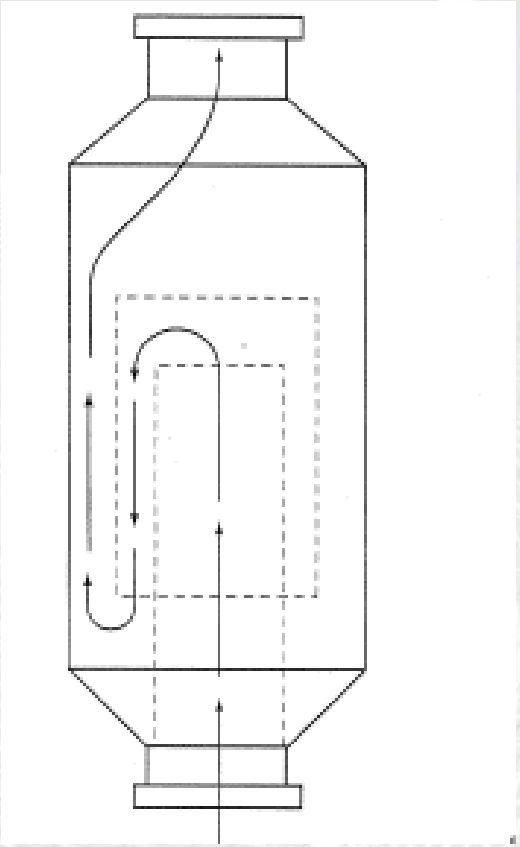
- Determine normal, continuous flowrate



Flare Impact Mitigation Plan (FIMP)

- Facility Improvements to Reduce Flaring
  - Reduce flare header sweep rates
  - Install purge reduction devices to reduce continuous purge rate





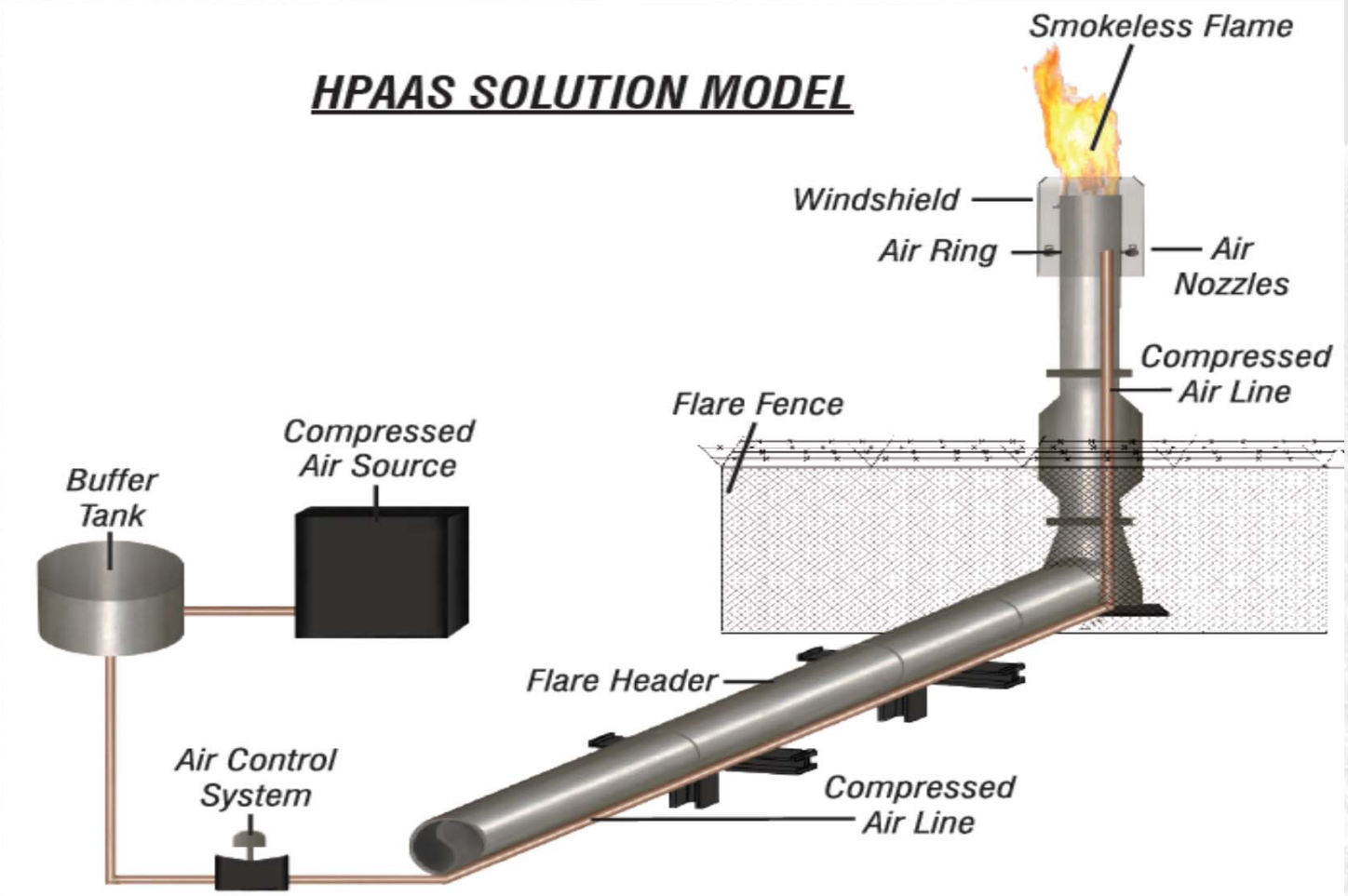
Flare Impact Mitigation Plan (FIMP)

- What to do next????

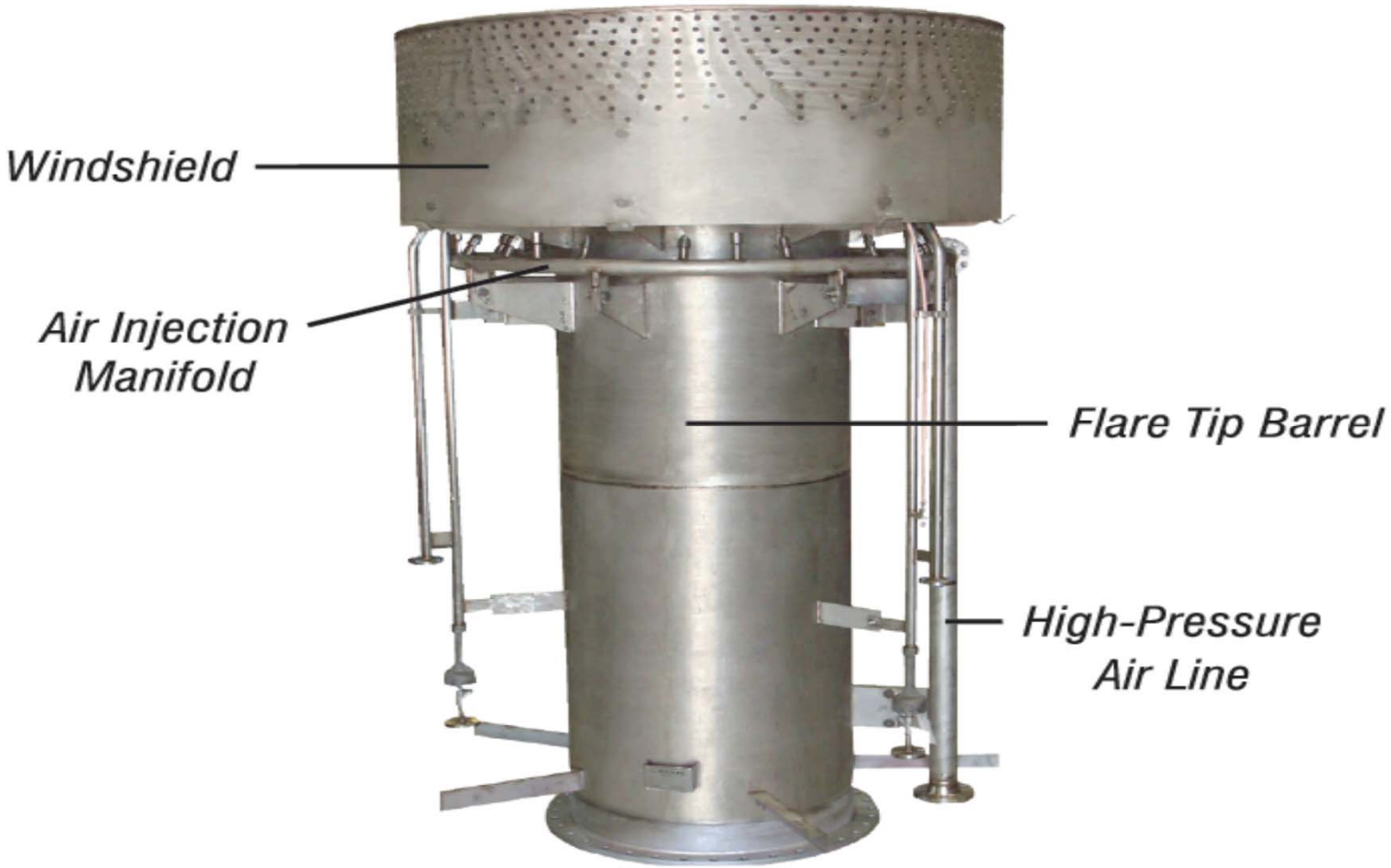
Saudi Aramco Solution: Solution 1 - HPAAS

- High Pressure Air Assist System
- Developed and tested at Saudi Aramco's facilities
- Invented by Mazen Mashour of Saudi Aramco
- Patented Technology

Saudi Aramco Solution: HPAAS



HPAAS Flare Tip Components



HPAAS Advantages

- Quick and Easy Retrofit
- Minor Impact to Existing Flare Structures

HPAAS Advantages:
Quick and Easy Retrofit

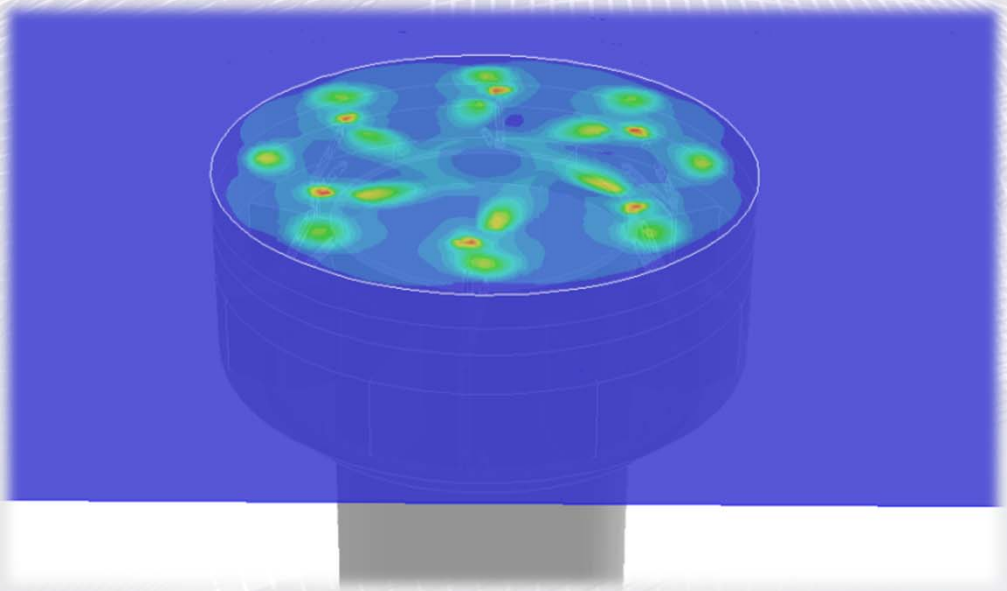
- Flare tip bolts in place
- 2” or 3” air supply line added to flare stack
- Air compressor can ship as a modular unit
- Average installation time

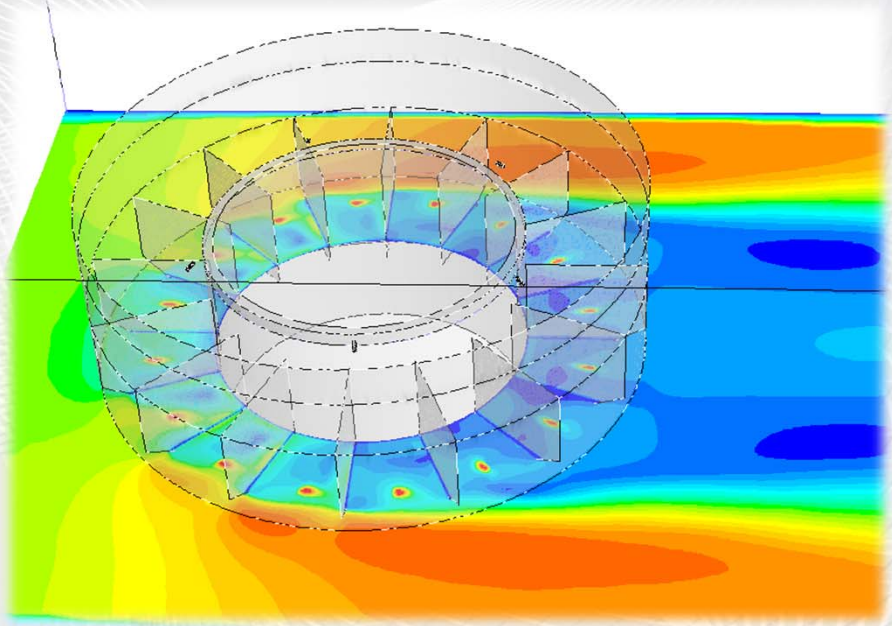
→ **1 week or less**

Zeeco Southern Area Smokeless Upgrade Project

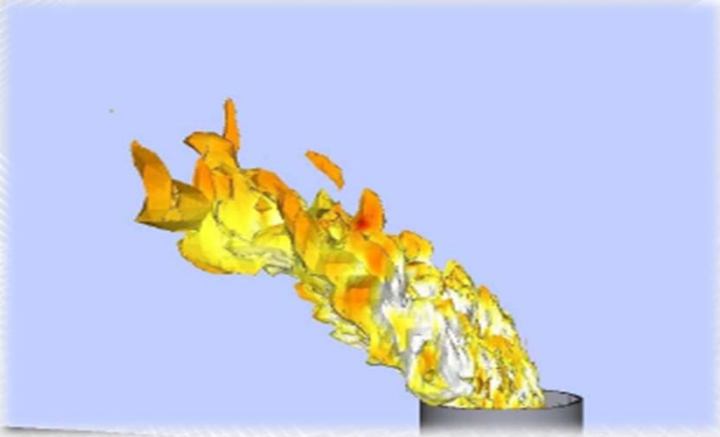
- Upgrade Twenty-Eight (28) Flare Systems in the Saudi Aramco Southern Area Development
  - HPAAS Smokeless Flare System Upgrades
  - CFD Modeling
  - Combustion Testing
  - New Flare Pilots
  - New FFG Ignition Systems
  - Retractable Thermocouples

CFD Modeling – Cold Flow Modeling for System Layout



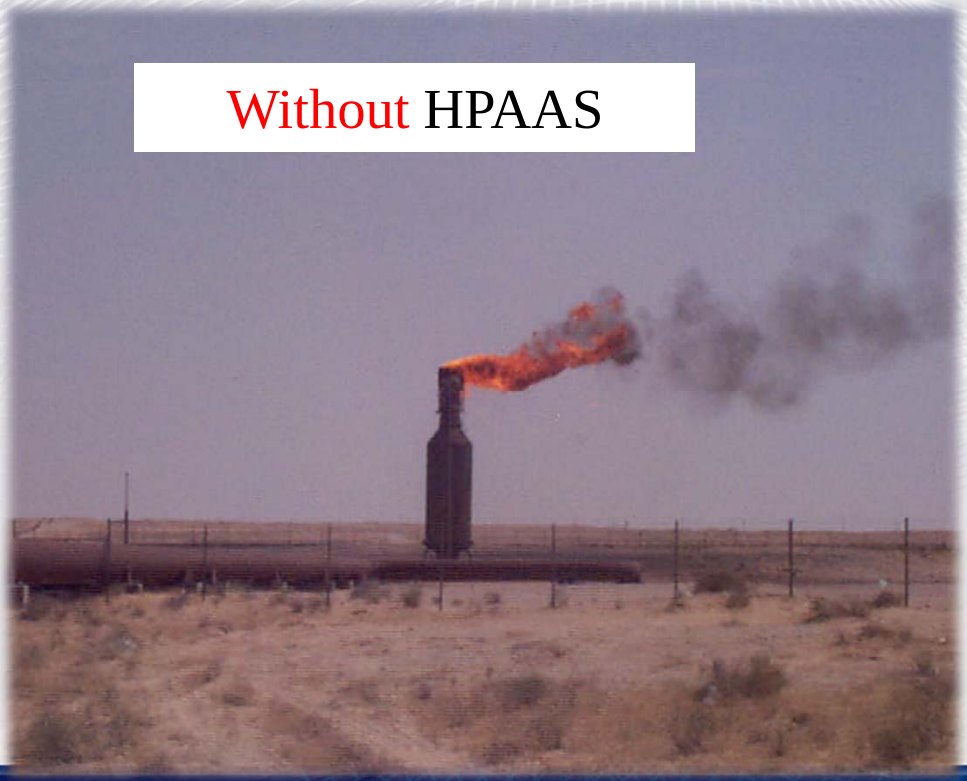


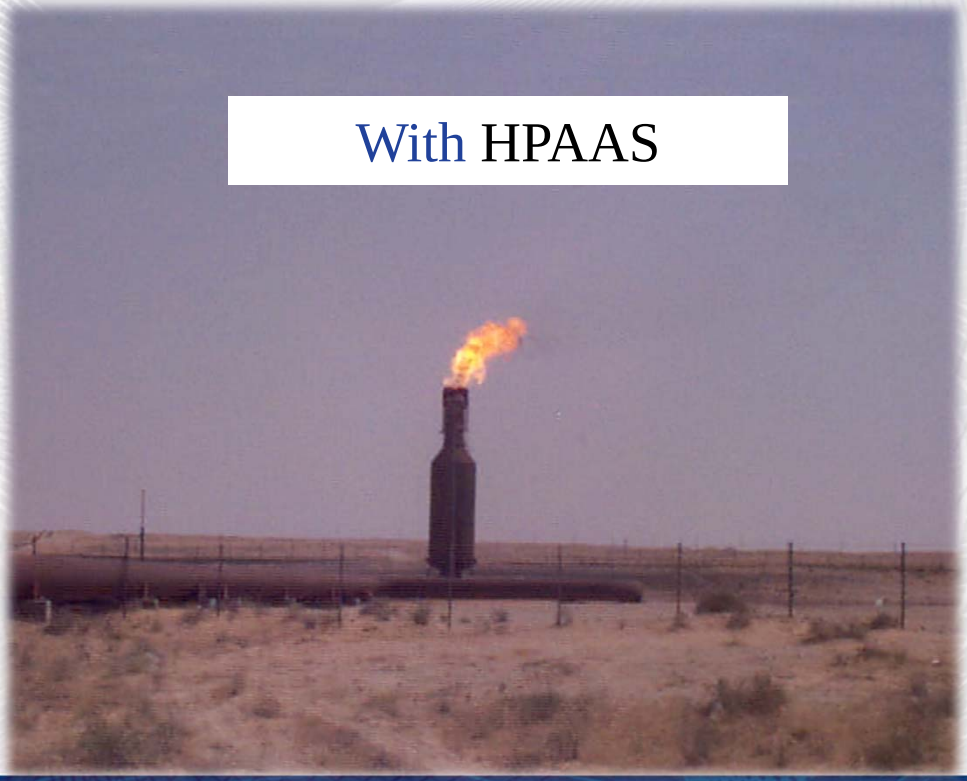
CFD Modeling – Combustion Model



Full-Scale Combustion Testing: Video

Before and After



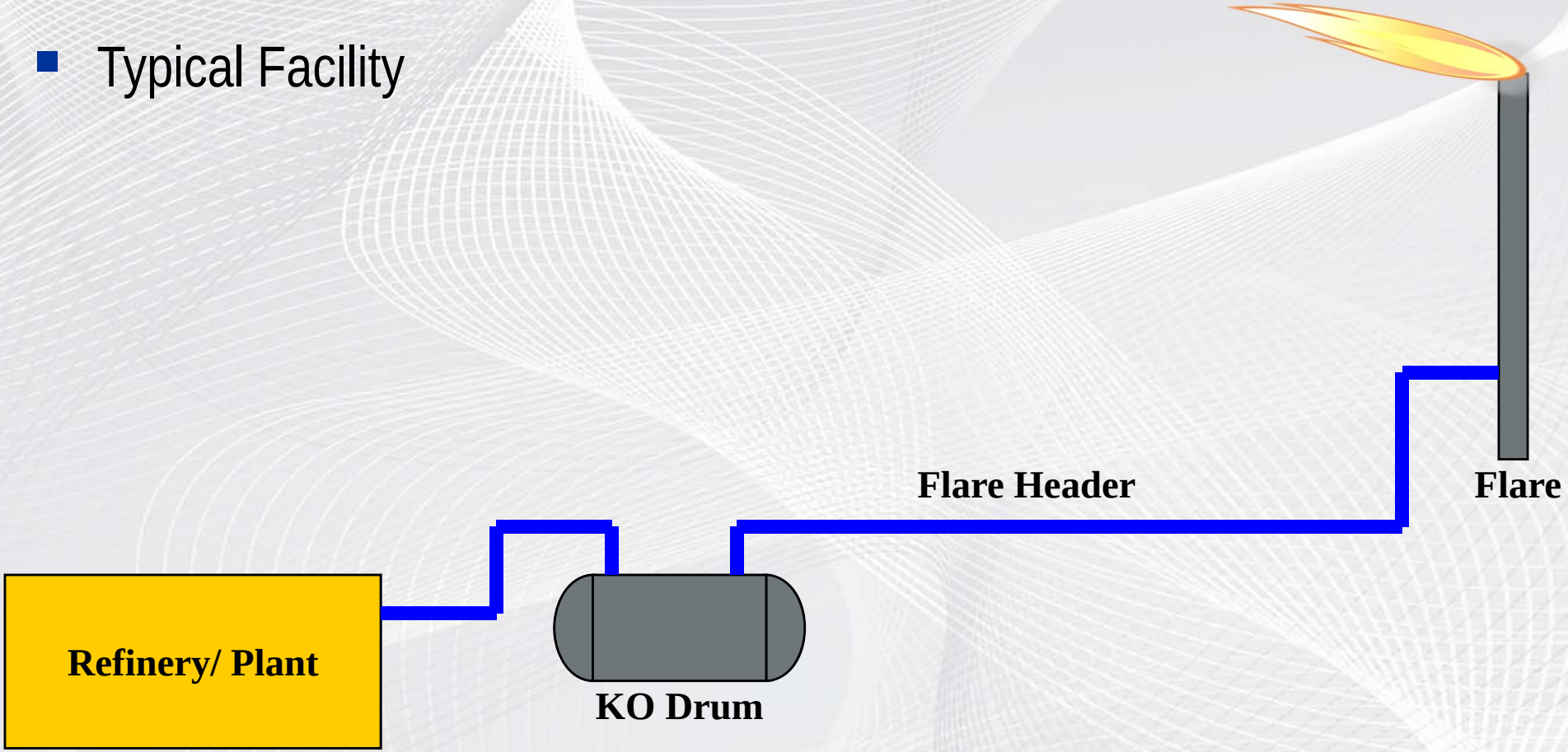


Solution 2 - FGRU

- Typical Facility
  - All waste gases go to flare
    - Relief Valve Leakage
    - Control Valve Leakage
    - Normal Gas Flow Rates
    - Purge Gas
    - Header Sweep Gas
    - Emergency Releases

Flare Gas Recovery – Main Components

- Typical Facility

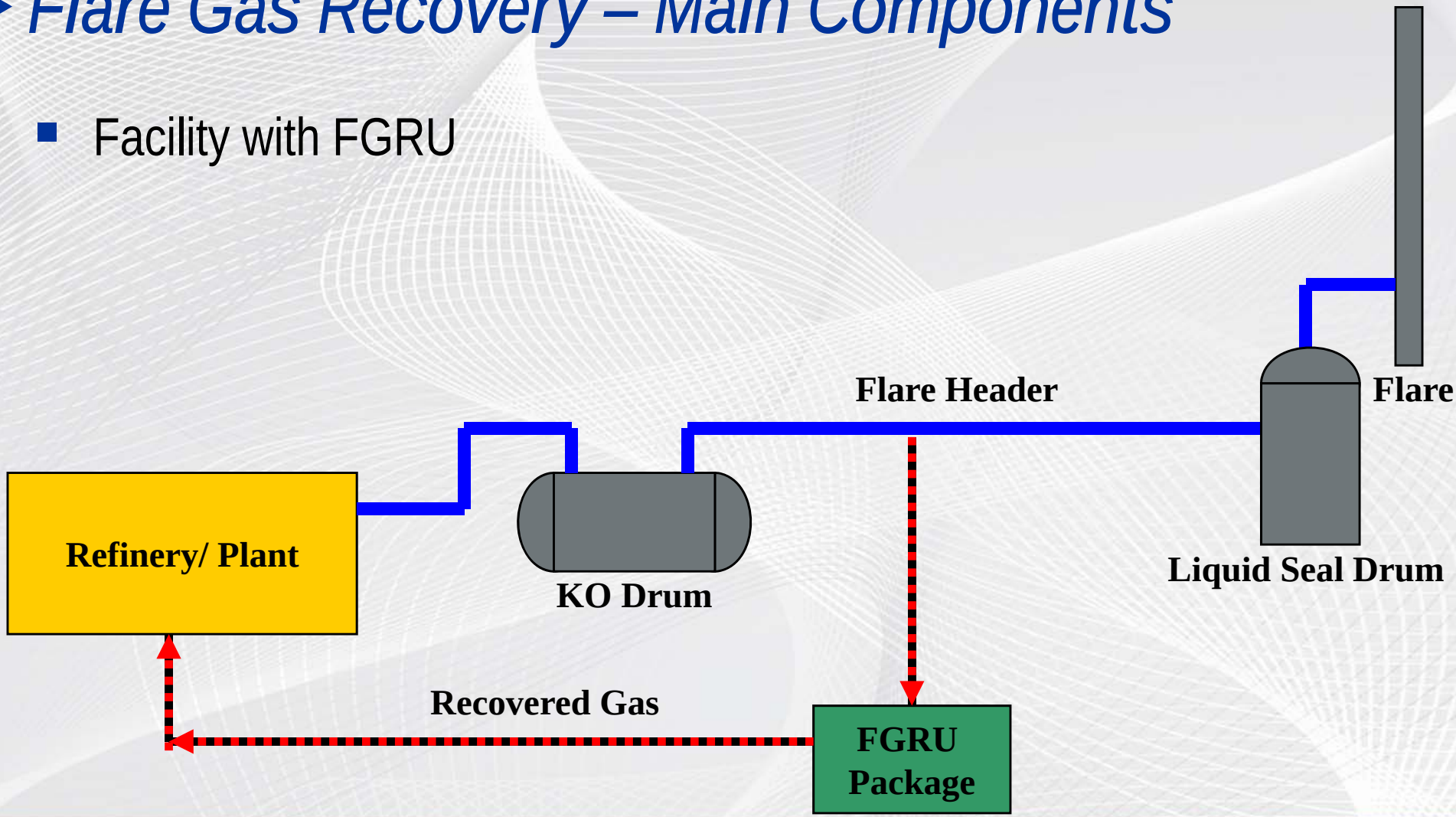


FGRU – How does it work?

- Facility with FGRU
  - Normal Gas Flow Rates to a flare to be captured by FGRS
  - Compressed Gas Leaves FGRU System and Returned Back to the Plant
  - Emergency Releases are Sent to Flare – Safe Relief Path

Flare Gas Recovery – Main Components

- Facility with FGRU



Flare Gas Recovery – Main Equipment

- Liquid Seal
- Staging Valve

Flare Gas Recovery – Auxiliary Equipment

- Scrubbers

Flare Gas Recovery – Auxiliary Equipment

- Scrubbers
- Coolers

Flare Gas Recovery – Auxiliary Equipment

- Suction Scrubbers
- Coolers
- Pumps

Flare Gas Recovery – Auxiliary Equipment

- Suction Scrubbers
- Coolers
- Pumps
- Noise Enclosures

Flare Gas Recovery – Auxiliary Equipment

- Suction Scrubbers
- Coolers
- Pumps
- Noise Enclosures
- Separators

Common Compressor Types

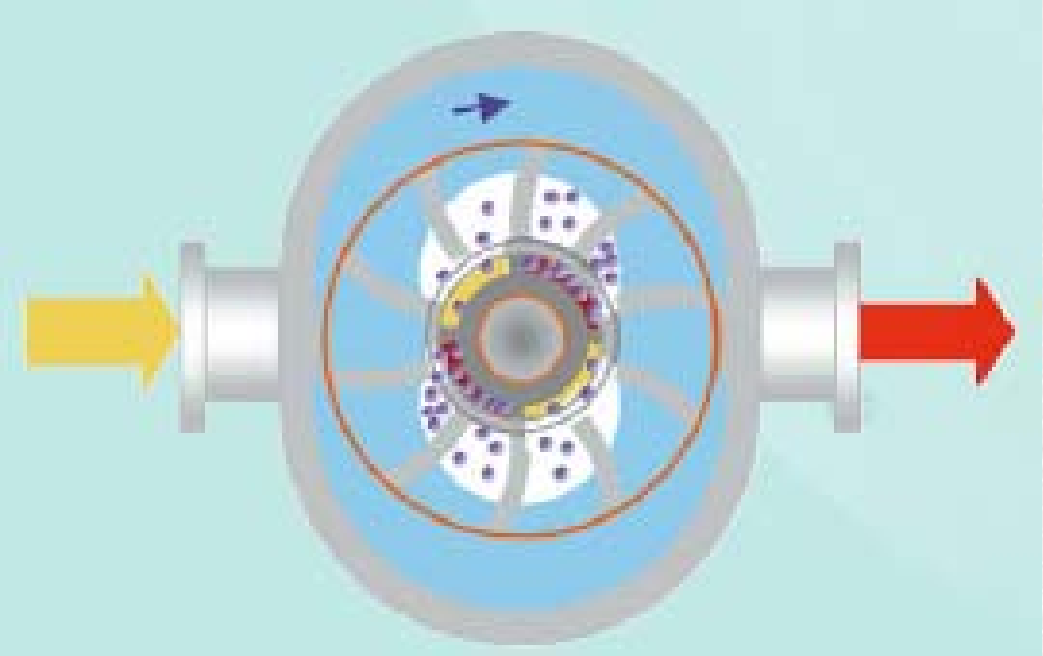
- Sliding Vane Compressors
- Liquid Ring Compressors
- Dry Screw Compressors
- Flooded Screw Compressors
- Reciprocating Compressors
- Eductors (**)

Compressor Types – Sliding Vane Compressors

- Advantages
  - Small plot space
  - Low cost
  - System turndown with a VFD
- Disadvantages
  - Cast/Nodular Iron Construction
  - Discharge Pressure Limited to ~150psig
  - Continuous Oil Use
  - Inability to meet strict specs

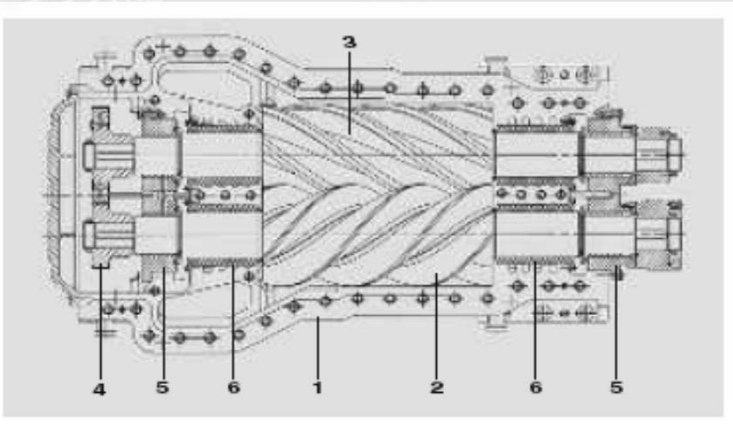
Compressor Types – Liquid Ring Compressors

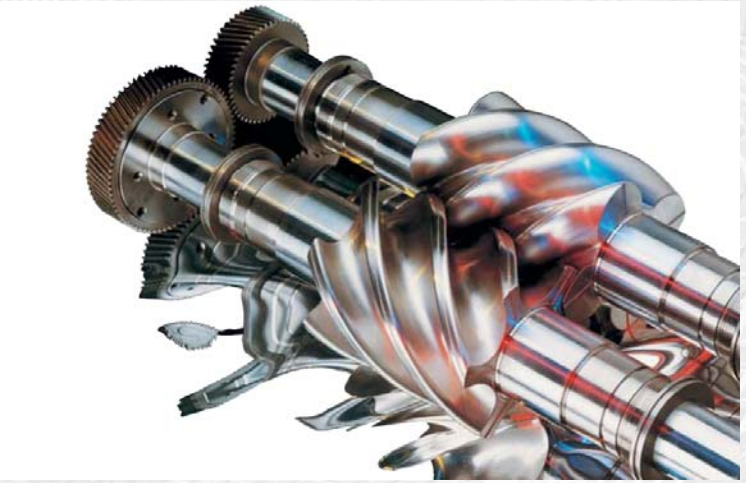
- Operating Concept
  - Rotating impeller produces a rotating ring of liquid.
  - Flare gas is injected into the housing and is compressed by the impeller and liquid ring.



Compressor Types – Dry Screw Compressor

- Operating Concept
  - Male and female rotors (screws) rotate in opposite directions.
  - Gas flow area is reduced along length of rotors to compress gas.
  - Timing chain is used to allow operation without male/female rotors touching – eliminates need for oil in housing.



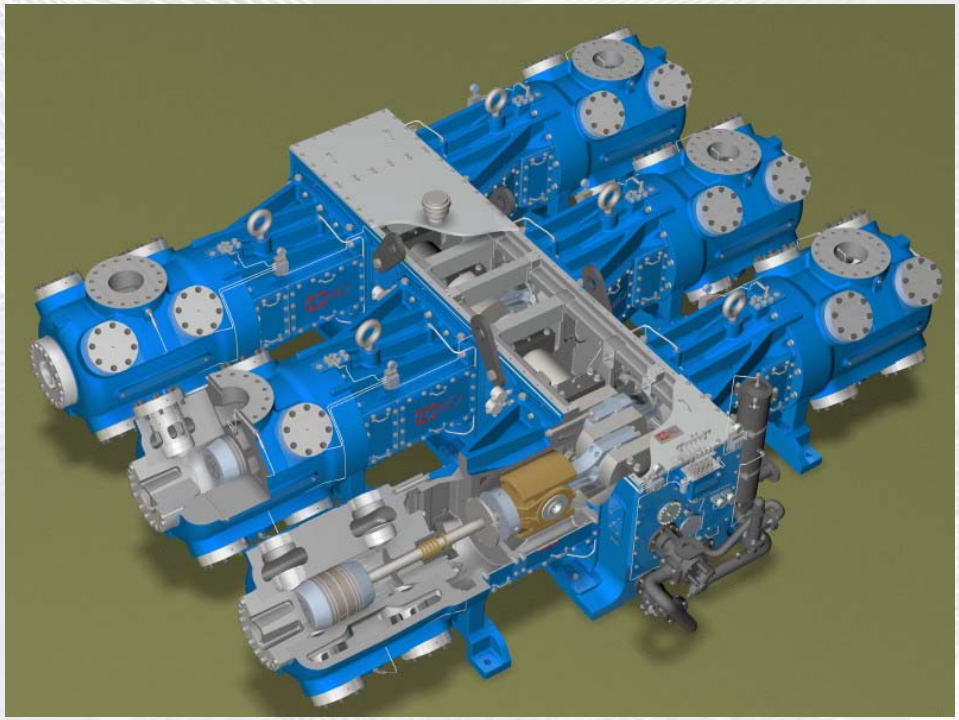


Compressor Types –Flooded Screw Compressor

- Operating Concept
  - Male and female rotors (screws) rotate in opposite directions.
  - Gas flow area is reduced along length of rotors to compress gas.
  - Male Rotor Drives the Female Rotor, eliminating the timing chain – oil is used to lubricate the rotors.

Compressor Types – Reciprocating Compressors

- Operating Concept
  - Reciprocating Pistons Compress Gas



Design Parameters for FGRU

- System Capacity – Flow & Pressure (suction and discharge)
- Flare Gas Composition
- Gas Temperatures
- Location of FGRU
- Available Utilities
- How many flares will be tied into the FGRU?
- Payback Period
- System Turndown

Proper System Design – Safety and Operation Concerns

- The concept of Flare Gas Recovery seems simple; however, the flare system is the single most important piece of safety equipment in the entire facility. Whoever is working on design changes involving the flare system must COMPLETELY understand the implications of changes and the dangers / risks associated with these changes.

Proper System Design – Safety and Operation Concerns

- *Yes its possible to combine flares into a single FGR system!*

However design is very critical

Proper System Design – Safety and Operation Concerns

- Its important not to let this happen on your plant
- Ensure correct Air Flow Into Flare System
  - Improper Seal Design
  - Improper Turndown Design

Proper System Design – Safety and Operation Concerns

- FGRU System Downtime
  - Loss of recovered gas
  - Increased time for system payback
  - Ensure you have the right flow rate for recovery

FGRU – Feasibility and System Design - ZEECO

- Zeeco can offer full service support for FGRU applications including:
  - Feasibility Study
  - Detailed System Design and Supply.
  - Installation and Startup Assistance

FGRU – Feasibility and System Design - ZEECO

- Feasibility Study
  - Installation and monitoring of flare gas flowmeters
  - Data acquisition and analysis
  - Plant layout – FGRU site selection
  - Preliminary System design and sizing
  - Preliminary System Pricing, Operating Costs, and Payback Period

Conclusion

- Flare Impact Mitigation Plan (FIMP)
  - Mitigate flaring first
  - Consider reducing impact of flaring via smokeless flare technology
  - Reduce flaring with FGR systems (or consider this anyway to save money)
- Choose the right partner, be sure they know what effect the Flare gas recovery will have on your flare…..

Contact Information

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