2015 Bakken Oil Show
Dickinson ND
April 15-16, 2015

Regulatory Update – Flare Options and Performance
Michael Clinton
Zeeeco Key Account Manager
Zeeco Product Lines

- Process & Power Burners
- Gas & Liquid Flares
- Gas & Liquid Incinerators
- Flare Gas Recovery Systems
Test Facility and Testing Capabilities

(16) Full Scale Test Furnaces and Boiler

Flare R&D and Testing Facility
Flare System Applications

- Well site for NSPS Quad O compliance
- Central Wellpad Gathering Facility for safely flaring of vents, Air Assist Flares
- Gas Processing plants for safely flaring of relief vents, Multipoint Flares
- Flare monitoring advancements
- Causes for low destruction removal efficiency (DRE)
Well Site flare applications

- On November 21, 2013, the US EPA amended the final ruling for the first federal air standards for oil and natural gas production.

- New Source Performance Standards (NSPS, 40 CFR Part 60, Subpart OOOO) for crude oil and natural gas production, transmission and distribution. Ruling applies to new and modified affected facilities that commenced construction after August 23, 2011 “Quad O”.

- National Emission Standards and Hazardous Air Pollutants (NESHAP, 40 CFR Part 63 subpart HH & HHH) directly impacts the oil and gas production and natural gas transmission and storage facilities. Revised rule, applies to existing and new affected facilities.

- [www.epa.gov/airquality/oilandgas](http://www.epa.gov/airquality/oilandgas)
Standards for Storage Tanks

- Includes storage tanks located at well site, gathering & boosting stations, NG processing facilities and compressor stations

- Targets sites with VOC emissions level of six tons per year or more (opt out if less than 4 tpy)

- Have until April 15, 2014 (Group 2) or April 15, 2015 (Group 1), to install necessary controls

- NSPS requires 95% VOC reduction, no visible emissions (EPA Method 22)

- Properly designed, engineered flare will achieve 98% VOC reduction
Well site Flare Options

PROCESS FLOW DIAGRAM

FLARE

PRODUCED OIL TANK

WATER TANK

H.T.

GAS

SALES

FLARE

WELLHEAD

OIL

OIL/H₂O

H₂O

TRUCK LOADING

TRUCK LOADING
Well site flare options – Open flame

- Engineered flare system design
- High pressure vents off separator
- Low pressure vents off the tanks
- Combination flare for both streams
- Multiple Flares for scalability
Well site flare options – Enclosed flame

- High pressure vents off separator
- Low pressure vents off the tanks
- Combination flare for both streams
- Properly designed, engineered enclosed flare will provide for greater than 98% VOC reduction
Recent Flare Monitoring Advancements

- Infrared camera technology
  - Can pinpoint emission sources
Pilot Flame Issues

Inspection in Permian Basin
• 46% of sites with pilot flame loss
  • 101 Combustors
  • 119 Flares

Possible Causes
• Poorly Designed Pilots
  • Does it Meet API 537?
• Insufficient Pilot Gas
• Liquids in Pilot/Flare Gas

Existing Solutions
• Monitoring Equipment
  • IR Camera
  • Thermocouple
  • Flame Ionization
• Datalogging
• Liquid Knock-Out/Scrubber
• Redundant Systems
Pilot Stability Testing

- Pilot should be designed per API 537 and tested to industry standards to ensure flare will meet environmental performance requirements
- Stable flame in minimum wind speeds of 150 mph with 10 inches of rain/hour
- Ability to reignite automatically without operator interface or electric power
- Ability to monitor for the presence of a flame and record for environmental records verification
- **Continuous Burning Pilot Flame required by NSPS during “ALL” times of operation.**
Air Assisted Flare Tip Types

- Air Injection Nozzles
- Air Plenum
Air Assisted Flares
Current Flare Emissions Regulations

- 40 CFR 60.11 to 60.18
- US EPA AP 42 Chapter 13.5
- Chemical Manufacturers Association testing
  - At least 98% combustion efficiency when properly operated
TCEQ Flare VOC
Air Assist Control Methods

- Single speed fan
- Two speed fan
- Multiple fans
- Variable frequency drive (VFD)
- Variable inlet vane dampers
- Combinations of the above
Central Processing Plant Facilities

- Forthcoming EPA regulations will likely require additional controls if assist media is being utilized for smokeless operation, typically steam or low pressure air blowers, to reduce excessive VOC emissions (CZNHV)


- Affected facility operators need to remain aware of both the newly published and likely forthcoming regulations and consider a potential engineered flare system design that would meet requirements for new facilities
Multipoint Ground Flare History

- Developed Early 1970's
- Zeeco founder was one of the original inventors and listed on Original Patent
- Original Installation In 1972
- Many Improvements over past 43 years in Burner technology
- Basic Overall Concept Today is Same as Original
Burner Development in Past Years
Common MPGF Design Concept

- Many small burners – each able to pull in air
- Staging system to Ensure Operation in Optimum Pressure Band – leading to smokeless operation
- Burners in Service are Proportional to Gas Flow
- Typically Used for High Pressure, Heavy Hydrocarbon Service
- Allows for Controlled Flame Length from Burners
Typical Installations
Sonic Flare Testing at Zeeco for DRE

- Natural Gas
- Propylene
- Propane
- Inert / H2 Mixtures
- Consistently over 99.5% DE
- Summer 2013, Fall 2013, Fall 2014, Spring 2015
Multipoint Sonic Flare Testing at Zeeco
# Details for Recent Sonic Testing

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<tr>
<th>Flare Gas Fuel Type</th>
<th>Flare Gas Lower Heating Value (Btu/SCF)</th>
<th>Max Allowable Exit Velocity per 40 CFR 60.18 Regulation (ft/s)</th>
<th>Flare Gas Exit Velocity in ZeeCo Test Facility (ft/s)</th>
<th>Destruction Efficiency % from Extractive Sampling of ZeeCo Flares</th>
<th>Combustion Efficiency % from Extractive Sampling</th>
<th>Combustion Efficiency % from IMACC PFTIR Measurement</th>
<th>Operating Pressure (psig)</th>
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Destruction Efficiency, Sonic Velocity

Destruction Efficiency versus Flare Gas Exit Velocity

- **Assumed Destruction Efficiency per 40 CFR 60.18**
- **Measured Destruction Efficiency from Extractive Sampling**
- **Maximum Allowable Exit Velocity per 40 CFR 60.18**
Conclusions - Flare System Applications

- NSPS Quad O compliance flares with 98%+ DRE
- Central Wellpad Gathering Facility for safely flaring of vents, Air Assist Flares with 98%+ DRE
- Gas Processing plants for safely flaring of relief vents, Multipoint Flares with 99.5%+DRE
- Causes for low destruction removal efficiency (DRE)
  1. Pilots per API 537 design and tested
  2. Engineered Flare Systems, right MOC…
  3. Technical Resources and Field support
Thank you!