Flare Task Force Stakeholder Group

March 30 and April 2, 2009

Overview

- Flare Task Force
  - Goals, timeline, participation
- Texas Flares
  - Background information, flare regulations
- Flare Issues Under Evaluation
  - Flare performance
  - Flare monitoring
  - Alternatives to flaring routine emissions
- Informal Comments
- Questions and Discussion

Flare Task Force

Goals

- Comprehensive evaluation of all aspects of flares
  - How flares factor into state air quality issues with respect to air toxics and ozone
  - The understanding of flare use and efficiency
  - The adequacy of state regulation of flares
- Develop staff report with options, considerations, and recommendations
  - Improving state air quality
  - Improving our understanding and regulation of flares
- Anticipate submitting the final staff report to the Executive Director in Fall 2009

TCEQ Participants

- Office of the Executive Director
  - Small Business and Environmental Assistance Division
  - Special Counsel to the Executive Director
- Chief Engineer's Office
  - Air Quality Division
  - Toxicology Division
- Office of Permitting and Registration
  - Air Permits Division
- Office of Compliance and Enforcement
  - Field Operations Division
  - Monitoring Operations Division
  - Enforcement Division
- Office of Legal Services
  - Environmental Law Division
  - Litigation Division

Stakeholder Involvement

- Flare Task Force Stakeholder Group is open participation
- Encourage open dialogue and information sharing
- Informal written comments accepted until May 1, 2009
  - Communicate your expertise and unique perspective
  - Provide scientific data and concrete solutions to problems
  - Details at the end of the presentation
- Anticipate additional stakeholder meetings this spring/summer

Texas Flares

Number of Flares in Texas

Flares Reported in the 2006 TCEQ Emissions Inventory	
Statewide	1132
Houston-Galveston-Brazoria	521
Beaumont-Port Arthur	118

Flare Service Types

Service Type Reported in 2006 TCEQ Emissions Inventory	HGB	BPA
Routine	110	12
Upset/Maintenance	63	15
Both	280	65
Not Specified	68	26

Industrial Flares by Service Type

Protecting Texas by Reducing and Preventing Pollution

TCEQ

Texas Commission on Environmental Quality
Chief Engineer's Office
Air Quality Division
P.O. Box 13087 (MC-164)
Austin, Texas 78711-3087

January 29, 2009

Source: Flare data extracted from the State of Texas Air Reporting System (STARS) database. Data as reported by sites that met the TCEQ reporting requirements as stated in 30 Texas Administrative Code, Section 101.10.

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HGB-Industrial Flares by Service Type

Protecting Texas by Reducing and Preventing Pollution
TCEQ
Texas Commission on Environmental Quality
Chief Engineer's Office
Air Quality Division
P.O. Box 13087 (MC-164)
Austin, Texas 78711-3087

January 29, 2009

Legend

Flares

- Routine
- Upset/Maint
- Both
- Not Specified

- Monitors
- Cities

Source: Flare data extracted from the State of Texas Air Reporting System (STARS) database. Data as reported by sites that met the TCEQ reporting requirements as stated in 30 Texas Administrative Code, Section 101.201.

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BPA-Industrial Flares by Service Type

Protecting Texas by Reducing and Preventing Pollution
TCEQ
Texas Commission on Environmental Quality
Chief Engineer's Office
Air Quality Division
P.O. Box 13087 (MC-164)
Austin, Texas 78711-3087

January 29, 2009

Legend

Flares

- Routine
- Upset/Maint
- Both
- Not Specified
- Monitors
- Cities

Source: Flare data extracted from the State of Texas Air Reporting System (STARS) database. Data as reported by sites that met the TCEQ reporting requirements as stated in 30 Texas Administrative Code, Section 101.20.

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State Regulations

- 30 TAC Chapter 106 – Permits by Rule
  - Permit by rule §106.492 for flares
  - Sources that meet these requirements are authorized by rule
- 30 TAC Chapter 116 – Permits for New/Modified Sources
  - Requires case-by-case permit review for new/modified flares
  - Required to meet BACT: compliance with 40 CFR §60.18
  - Hydrocarbon destruction and removal efficiency is assumed to be 98% or 99% when the flare meets 40 CFR §60.18 requirements
  - Pollution control project standard permit
- 30 TAC Chapter 111 – Visible Emissions
  - Visible emissions from non-emergency process flares limited to no more than 5 minutes in any 2-hour period

State Regulations

- 30 TAC Chapter 115 – Volatile Organic Compounds
  - Control requirements for VOC emissions in nonattainment and near nonattainment areas
  - Compliance with 40 CFR §60.18 for flares used to control affected waste gas streams

- 30 TAC Chapter 115, Subchapter H – HRVOC
  - Control requirements for HRVOC vent gas streams in HGB area
  - Harris County sources subject to the HECT program
  - Continuous monitoring of flow rate, net heating value, and gas stream composition
  - Destruction efficiency is assumed to be 98-99% when the flare meets the requirements in 40 CFR §60.18
  - Destruction efficiency is assumed to be 93% when the flare does not meets the requirements in 40 CFR §60.18

Federal Regulations

- 40 CFR §60.18 and §63.11 contain requirements for the operation and monitoring of affected flares

- Rule requirements
  - Limit visible emissions
  - Flame present at all times
  - Maximum flare tip exit velocity
  - Net heating value content
  - Operate using good engineering practices

- If flare meets requirements of §60.18 or §63.11 the destruction efficiency is assumed to be 98%

Flare Issues Under Evaluation:

Flare Performance

Summary of Issues Identified

- Examine how flare performance might be impacted by
  - Meteorology
  - Flare waste gas stream flow rate
  - Flare waste gas stream composition
  - Physical design characteristics and maintenance
  - Assist flow rates

- Evaluate existing flare combustion efficiency and destruction efficiency estimates used to calculate emissions
  - Practical and technical basis for determining the destruction and removal efficiency (DRE) estimates
  - Potential research

Flare Performance Impacts

- Meteorological Conditions
  - Wind
  - Ambient temperature
  - Humidity
  - Other conditions?

- Potential Performance Impacts
  - High winds can cause flame separation and result in increased emissions
  - University of Alberta study found crosswinds greater than 5 miles per hour reduced combustion efficiency (CE)
  - Meteorological conditions are not accounted for in DRE assumptions

Flare Performance Impacts

- Flare Waste Gas Stream Flow Rate
  - Flares used for both emergency service and routine waste gas disposal often operate with a high turndown ratio
  - Turndown ratio is the total design capacity compared to the actual flare waste gas stream flow rate
  - Survey of HRVOC flares found that flare waste gas flow rates are typically less than 1% of the design capacity
  - No minimum exit velocity requirements for flare waste gas streams
- Potential Performance Impacts
  - DRE estimates may not be accurate when the flare is operating with a high turndown ratio

Flare Performance Impacts

- Flare Waste Gas Stream Composition
  - Flare waste gas stream composition can be highly variable
- Potential Performance Impacts
  - DRE estimates are based on EPA research that primarily tested waste gas streams containing simple hydrocarbons
  - DRE estimates may not be accurate for waste gas streams with more complex VOC

Flare Performance Impacts

- Physical Design Characteristics and Maintenance
  - Flare tip design, maintenance, and replacement schedule
  - Pilot condition
- Potential Performance Impacts
  - Damaged flare tip or pilots can reduce DRE
  - Could the design and maintenance of other flare system components impact performance?

Flare Performance Impacts

- Improper Flare Air- or Steam-Assist Operation
  - Flares are often designed to minimize visible emissions and noise to comply with applicable regulations
  - Air- or steam-assist used for smokeless operation
  - Assist gas to waste gas ratio and assist gas flow rate are not typically monitored

- Potential Performance Impacts
  - VOC contaminated steam-assist can reduce DRE
  - Severe over-assist can extinguish the flame
  - Excess assist gas to waste gas ratios can potentially reduce combustion efficiency due to cooling the combustion zone
  - One TCEQ study noted ratio of assist gas to waste gas is highly variable, ranging from 2 to more than 50

Flare Performance Impacts

Flare Performance Impacts

Comparison of Flare Performance

Bottom Line

- TexAQS II research indicates VOC concentrations in the HGB area are consistent with higher VOC emissions than reported in the TCEQ Point Source Emissions Inventory
- Small differences between the assumed DRE and the actual DRE can result in big differences between the actual and the reported emissions
- For example
  - If DRE is 99% then the estimated VOC emissions are 2 tpy
  - If DRE is 98% then the estimated VOC emissions doubles to 4 tpy
  - The 1% decrease in DRE results in a 100% increase in emissions

Assessing Flare Efficiency

- DRE estimates are based on EPA studies (1980s)
  - DRE is assumed to be 98% or 99% if flare meets 40 CFR §60.18
- Recent field studies using Differential Absorption Lidar (DIAL) indicate DRE for flares warrants further evaluation
- Emission measurement problems identified by EPA (1983) include:
  - Effects of high temperatures and radiant heat on test equipment
  - Effects of wind and intrinsic turbulence on the flame
  - Undefined dilution of flare emission plumes with ambient air
  - Lack of suitable sampling locations

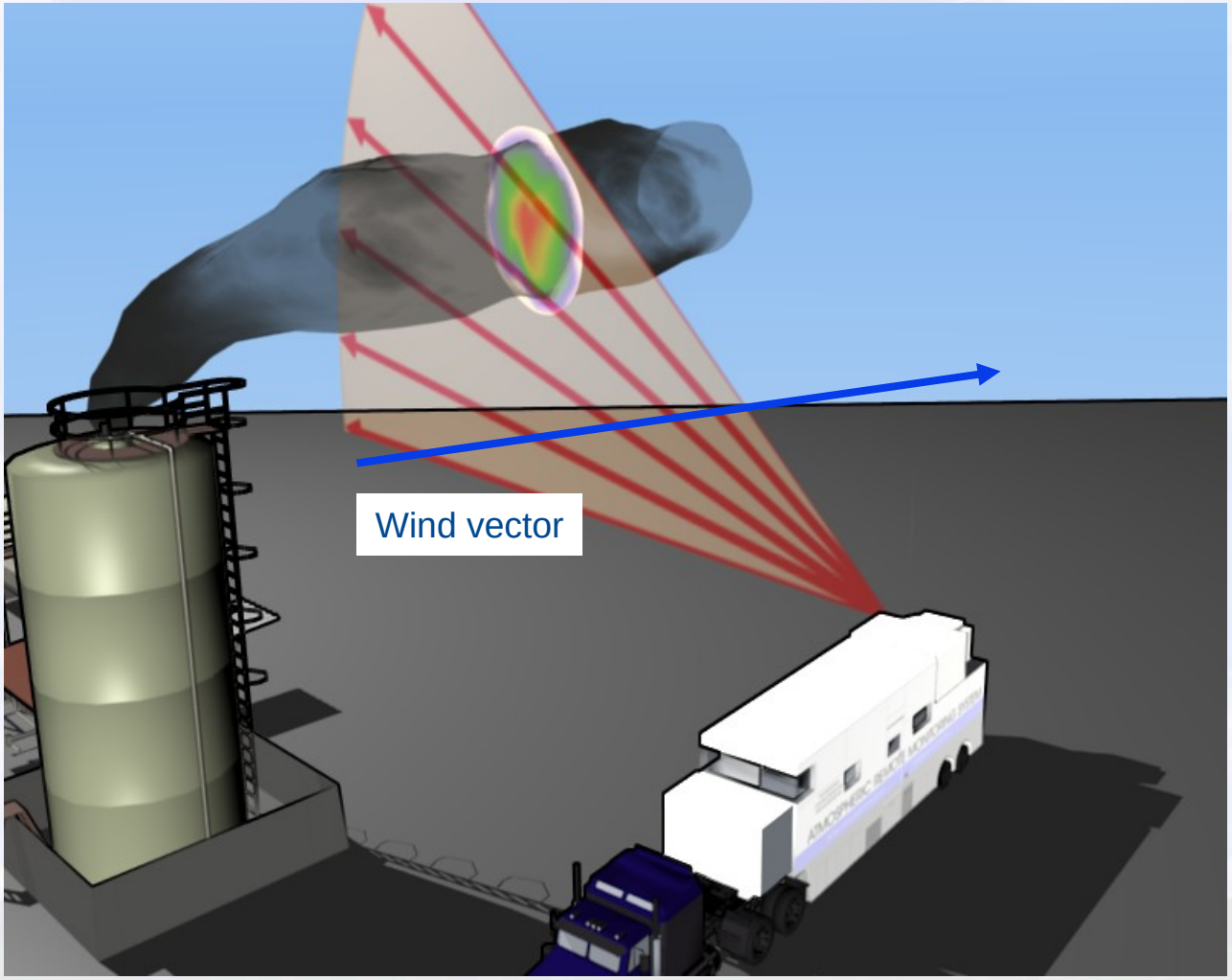
Upcoming TCEQ Research

- Measure flare emissions in a controlled environment
  - Direct measurement techniques and remote sensing technologies
- Assess flare DRE and CE during various operating conditions
  - 40 CFR §60.18 specifications
  - Flare gas flow rate (turndown ratio)
  - Assist flow rate
  - Limited hydrocarbon mixtures in waste gas stream
  - Mechanical condition
- Compare to traditional material balance emissions determinations
- Determine the hydrocarbon species in flare plumes currently visualized by passive IR cameras using remote sensing spectrometer

Remote Sensing Technology

Differential Absorption Lidar (DIAL)

- Can measure emissions remotely
- Vertical scans enable plume mapping and flux calculation
- Combine integrated concentrations with simple wind field to determine emissions flux



Flare Issues Under Evaluation:

Flare Monitoring

Summary of Issues Identified

- Determine the necessity of monitoring flare operating parameters to ensure flare DRE and CE

- Examine the adequacy of existing monitoring requirements to ensure the proper operation of flares
  - Flare gas flow rate
  - Air-assist or steam-assist flow rate
  - Flare gas composition
  - Flare gas net heating value
  - Other monitoring approaches

- Evaluate special considerations associated with monitoring flares used in various types of service

Flare Monitoring

- Monitoring Flare Gas Flow Rate
- Goals
  - Determine the amount of material being sent to the flare
  - Maintain exit velocity below the limit in 40 CFR §60.18
  - For assisted flares, determine the assist gas to waste gas ratio
- Techniques
  - Most common monitoring technology – ultrasonic flow meters
  - Examples of others: pressure differential, optical sensors, etc.
- Frequency
  - Flow sensors are typically instantaneous but data averaging and recordkeeping is typically done in block periods
  - What block averaging time is sufficient?

Flare Monitoring

- Monitoring Flare Air- or Steam-Assist Flow Rate
- Goals
  - Determine assist gas to waste gas ratio
  - Help ensure better flare performance by maintaining appropriate assist gas to waste gas ratio
- Techniques
  - Mass flow or volumetric flow necessary to achieve goal
  - Flow indicators or valve position monitors not adequate
- Frequency
  - Flow sensors are typically instantaneous
  - What block averaging time is sufficient?

Flare Monitoring

- Monitoring Flare Gas Composition
- Goals
  - Determine the composition of waste gas stream sent to the flare
- Techniques
  - Total VOC analyzer
  - Online analyzers for speciation (e.g., gas chromatograph)
- Frequency
  - Total VOC analyzers can operate near instantaneous
  - Online speciation cycle typically once every 5-7 minutes depending on the level of speciation
  - What block averaging time is sufficient?

Flare Monitoring

- Monitoring Flare Gas Net Heating Value
- Goal
  - Maintain the minimum net heating value for proper operation
- Techniques
  - Online calorimeter
  - Online speciation to calculate net heating value
  - Alternative: Continuously maintain assist fuel gas sufficient to maintain minimum net heating value while assuming zero net heating value from waste gas
- Frequency
  - Some are near instantaneous and some are periodic
  - What block averaging time is sufficient?

Flare Monitoring

- Options and Considerations
- What other monitoring options or approaches are available to help ensure proper flare operation?
- Considerations for special categories of flares or unique situations
  - Extreme service
    - Metal alkyls
    - Liquid burning flares
    - Others
  - Limited use / portable flares
  - Others

Flare Issues Under Evaluation:

Alternatives to Flaring Routine Emissions

Summary of Issues Identified

- Best Management Practices
  - Strategies to minimize routine flaring
  - Implementation options
- Alternative Control Devices
  - Flare gas recovery systems
  - Vapor combustors, thermal oxidizers
  - Staged flares
- Additional Alternatives
  - Re-evaluate flaring as BACT for routine emissions
  - Revise the flare PBR
  - Revise the pollution control standard permit for flares
  - Revise the Chapter 111 rules for visible emissions

Best Management Practices

- Strategies to Minimize Routine Flaring
  - Flare minimization plans are required by some California districts
  - Root cause analysis
  - Operational or procedural changes
  - Other BMP to reduce flaring routine emissions?

- Implementation Options
  - Incentives to encourage the use of BMP
  - Voluntary measures
  - Implement strategies similar to those in California
  - Create other regulatory requirements for BMP
  - Agreed orders
  - Other alternative strategies?

Alternative Control Devices

- Flare Gas Recovery Systems
  - Process gasses are collected, compressed, and reused
  - Can be added to existing flare systems without compromising the safety
- Advantages
  - Reduced emissions, including NOx
  - Reduced purchase gas requirements and/or increased product
  - Extended flare-tip life
  - Reduced steam consumption
- Disadvantages
  - Inability to handle high volumes
  - Siting constraints
  - Upfront capital investment

Alternative Control Devices

- Vapor Combustors, Thermal Oxidizers
  - Enclosed combustion chamber devices
- Advantages
  - Monitoring and compliance testing
  - Reliability of destruction efficiency
  - Reduced emissions
  - Reduced fuel costs
  - Less noise, hidden flame, lower radiation
- Disadvantages
  - Increased NOx emissions
  - Inability to handle high volumes
  - Siting constraints
  - Cost

Alternative Control Devices

- Staged Flare Systems
  - In staged flare systems or flares in series, one flare handles routine gas volumes and a larger flare handles emergencies
- Advantages
  - Separates low flows from high flows
  - Can be added to existing flare systems without compromising the safety function of the flare system
- Disadvantages
  - Siting constraints
  - Cost

Additional Alternatives

- Evaluate BACT
  - Limit the use of flares as Tier 1 BACT for routine emissions
  - Consider operational parameters during BACT evaluation
  - Cost of changing existing control devices
- Revise Flare PBR
  - Limit scope
  - Improve monitoring requirements
  - Require flares to meet specific operating parameters (40 CFR §60.18)
- Revise Pollution Control Standard Permit
  - Limit scope with regard to changes to flares
- Consider Revising Visible Emissions Limits
  - Do the requirements encourage flare design and/or operation in a way that decreases destruction efficiency?

Informal Comments

Informal Comments

- Requesting informal comments on:
  - Issues currently identified for evaluation
  - Additional issues for evaluation
  - Specific research or control strategy concepts
  - Data from existing research studies
  - Technical and economic feasibility
  - Implementation options

- When submitting comments:
  - Provide as much detail and technical information as possible
  - Provide a copy, web link, or citation for any specific documents referenced (e.g., a research study, state rule, etc.)
  - Explain the economic information on a dollar per ton basis
  - Clearly identify any confidential information

Informal Comments

- Please submit comments by **May 1, 2009**
- Electronic comments are preferable, and may be submitted via e-mail to siprules@tceq.state.tx.us
  - All electronic comments should reference “Flare Task Force Stakeholder Group” in the subject line
- Mail comments to Lindley Anderson, TCEQ Air Quality Division, MC-206, P.O. Box 13087, Austin, TX 78711-3087
- Fax comments to (512) 239-5687

Questions and Discussion