Ethylene MACT

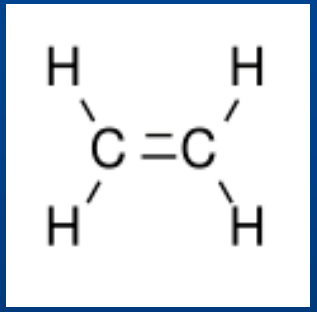
Jennifer Gibbs
and Steve Thompson
EPA Region 6

Ethylene MACT

- Overview of Industry
- Overview of the Ethylene MACT
- Region 6 Experiences
  - Inspection Focus
  - Common Areas of Concern
- Ethylene Industry and HRVOCs
- Ethylene Flaring

The Ethylene Industry

- What is ethylene?
  - Short chain hydrocarbon
  - Key building block chemical



- Feedstock is cracked in furnace using steam
- Products are separated by compression and distillation

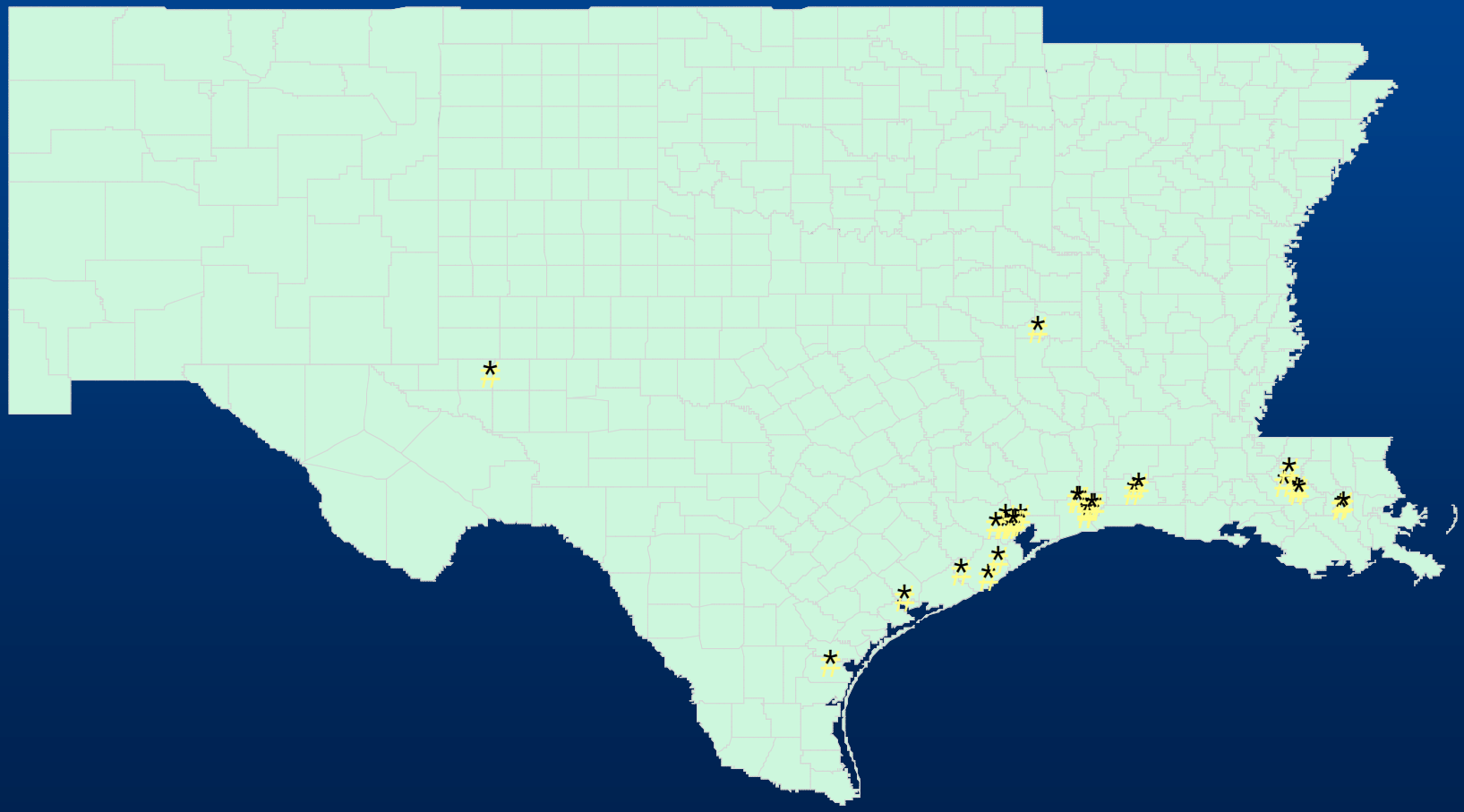
The Ethylene Industry

- Common Feedstocks
  - Ethane
  - Propane
  - Naphtha
- Primary Products
  - Ethylene
  - Propylene
  - Crude C4
  - Crude C5
  - Pyrolysis gasoline

The Ethylene Industry

- 16 corporate entities
- Operating 44 units
- Located in 6 states
  - 25% of mfg capacity in Louisiana
  - 67% of mfg capacity in Texas

Regional Map of Ethylene Facilities



Overview of the Ethylene MACT

- Ethylene MACT is specifically intended to control the emissions of organic HAPs from the ethylene manufacturing process
- Compliance date: July 12, 2005
- Applicability: Chemical mfg units in which ethylene and/or propylene are produced by separation from petroleum refining process streams or by subjecting hydrocarbons to high temperatures in the presence of steam
- Exemption: Processes and equipment that are subject to the Refinery MACT (Part 63 Subpart CC) or the HON (Part 63 Subparts F, G, and H)

The Ethylene MACT

- Emission points included in the ethylene production affected source are:
  - Storage vessels
  - Process vents
  - Transfer racks
  - Equipment (i.e., fugitive losses)
  - Waste streams
  - Heat exchange systems
  - Ethylene cracking furnaces and associated decoking operations

The Ethylene MACT

- Storage Vessels
  - Key focus is on floating roof tanks
  - Design and performance based criteria depending on vapor pressure of total organic HAP
- Process Vents
  - Reduce emissions of organic HAP to 98% by weight or 20 ppmv by venting emissions through closed vent system to a control device
- Transfer Racks
  - Reduce emissions of organic HAP to 98% by weight or 20 ppmv by venting emissions through closed vent system to a control device

The Ethylene MACT

- Equipment Leaks
  - Specific requirements are found in Subpart UU
  - Similar to requirements of Subpart VV and HON
- Waste operations
  - Specific requirements are found in Subpart XX
  - Similar to requirements for Benzene NESHAP with the addition of requirements for waste streams containing butadiene

The Ethylene MACT

- Heat Exchange Systems
  - Specific requirements are found in Subpart XX
  - Monitor cooling water for presence of Appendix D HAPs; trigger for leak is exit concentration of greater than or equal to 10% above the entrance concentration, and 6.75 lbs/hr of HAP
  - Repair the leak within 45 days of receipt of results or option to delay repair

The Ethylene MACT

- Startup, Shutdown and Malfunction
  - Includes decoking operations
  - Requirement to have an SSM plan
  - Requires facility to maintain good air pollution control practices during all startup, shutdown and malfunction events
  - Specific reporting and recordkeeping requirements

The Ethylene MACT

- Appendix D: Organic HAPs
  - Benzene
  - 1,3-Butadiene
  - Cumene
  - Ethyl benzene
  - Hexane
  - Naphthalene
  - Styrene
  - Toluene
  - o-Xylene
  - m-xylene
  - p-xylene

Ethylene MACT Compliance Manual

http://www.epa.gov/ttn/atw/gmact/EMACT_ComplianceManual_Final-1-24-07.pdf

- Compliance assistance manual
- Developed by Olefins Environmental Issues Task Group of the American Chemistry Council in conjunction with EPA
- Detailed document that walks through the individual MACT elements
- Utilize as a resource for pre-inspection planning and while in the field

Ethylene MACT and Region 6: The Inspection Process

Process Based Inspection

- Detailed discussion of production processes from feedstock to product, including the identification and destination of waste streams
- Investigation includes review of documents in office as well as detailed plant tour, including interviews of plant operators
- Typically conduct multimedia inspection to address potential cross-cutting programmatic concerns and leverage the greatest environmental benefit in settlement

Primary Compliance Focus and Common Areas of Concern

- Leak Detection and Repair
- Benzene Waste Operations
- Wastewater Treatment and Offsite Waste
- Flaring and Excess Emissions Events

Leak Detection and Repair

- Review initial compliance notification and last semi-annual or quarterly report
- Ask how LDAR program is run and implemented
- Acquire electronic copy of database
- Comparative monitoring
  - Observe contractor
  - Have contractor verify leaks

Leak Detection and Repair

- Common areas of concern:
  - Failure to make first attempt in 5 days
  - Failure to make final attempt in 15 days
  - Failure to re-monitor after finding a leak
  - Failure to conduct Method 21 correctly
  - Open-ended lines

Benzene Waste Operations

- Requirements are similar to the Benzene NESHAP
- Review total annual benzene reports for last 3 years
- Review sampling locations and methodology
- Review process flow diagrams to determine which units should be controlled

Benzene Waste Operations

- Common Areas of Concern
  - Incorrect point of generation
  - Failure to include all waste streams
  - Insufficient or inadequate sampling data to determine annual benzene quantity
  - Inadequate controls on units

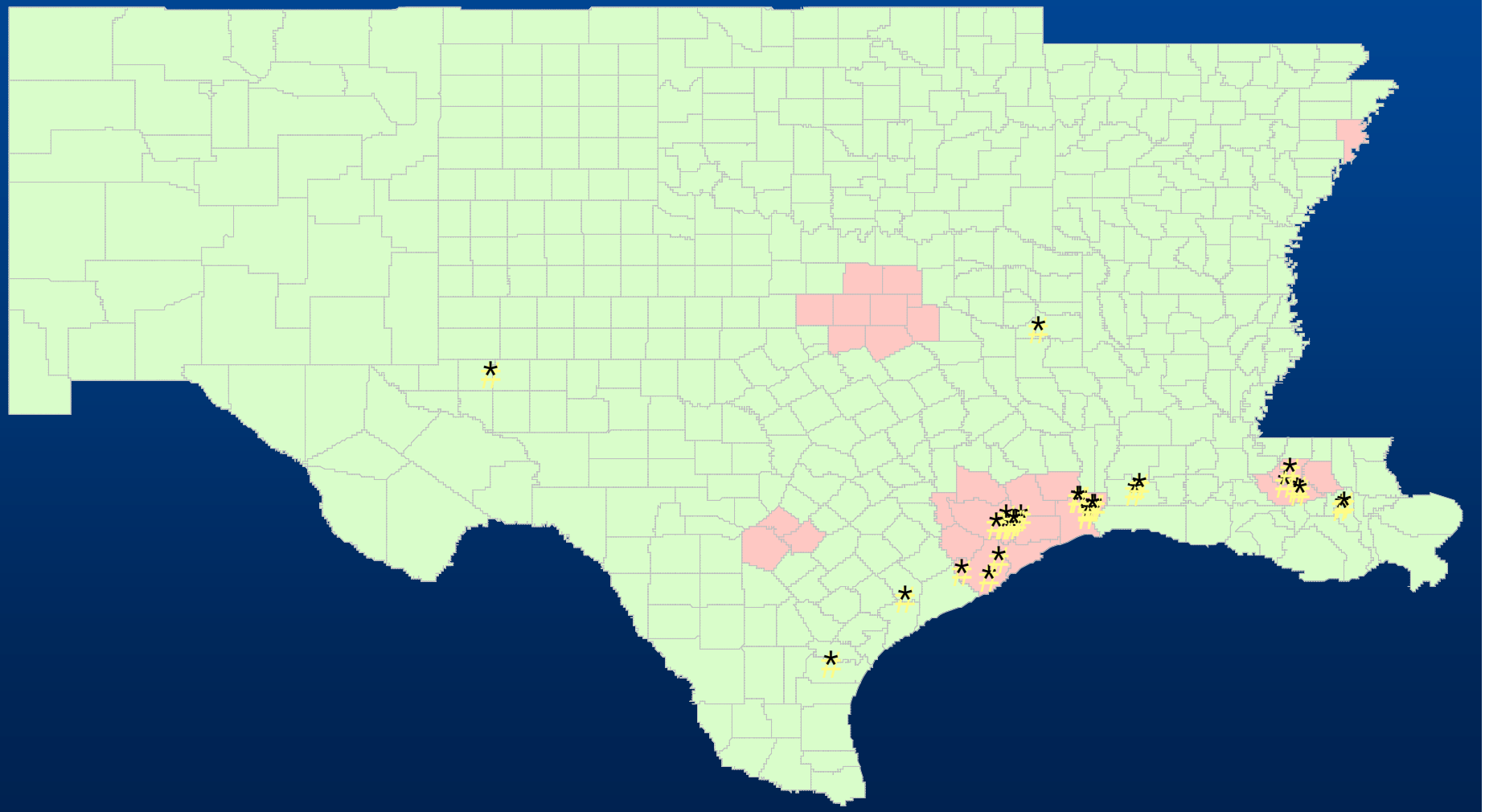
Wastewater Treatment

- Uncontrolled conveyances
  - Unreported emissions of highly volatile chemicals
- Surface impoundments
  - Aeration basins as enhanced biodegradation units and Benzene NESHAP issues (Subpart FF)
  - Possible RCRA concerns for land disposal of hazardous waste
- Offsite waste
  - Wastewater treatment plant is owned by another corporate entity
  - Possible Off-Site Waste MACT (Subpart DD) implications

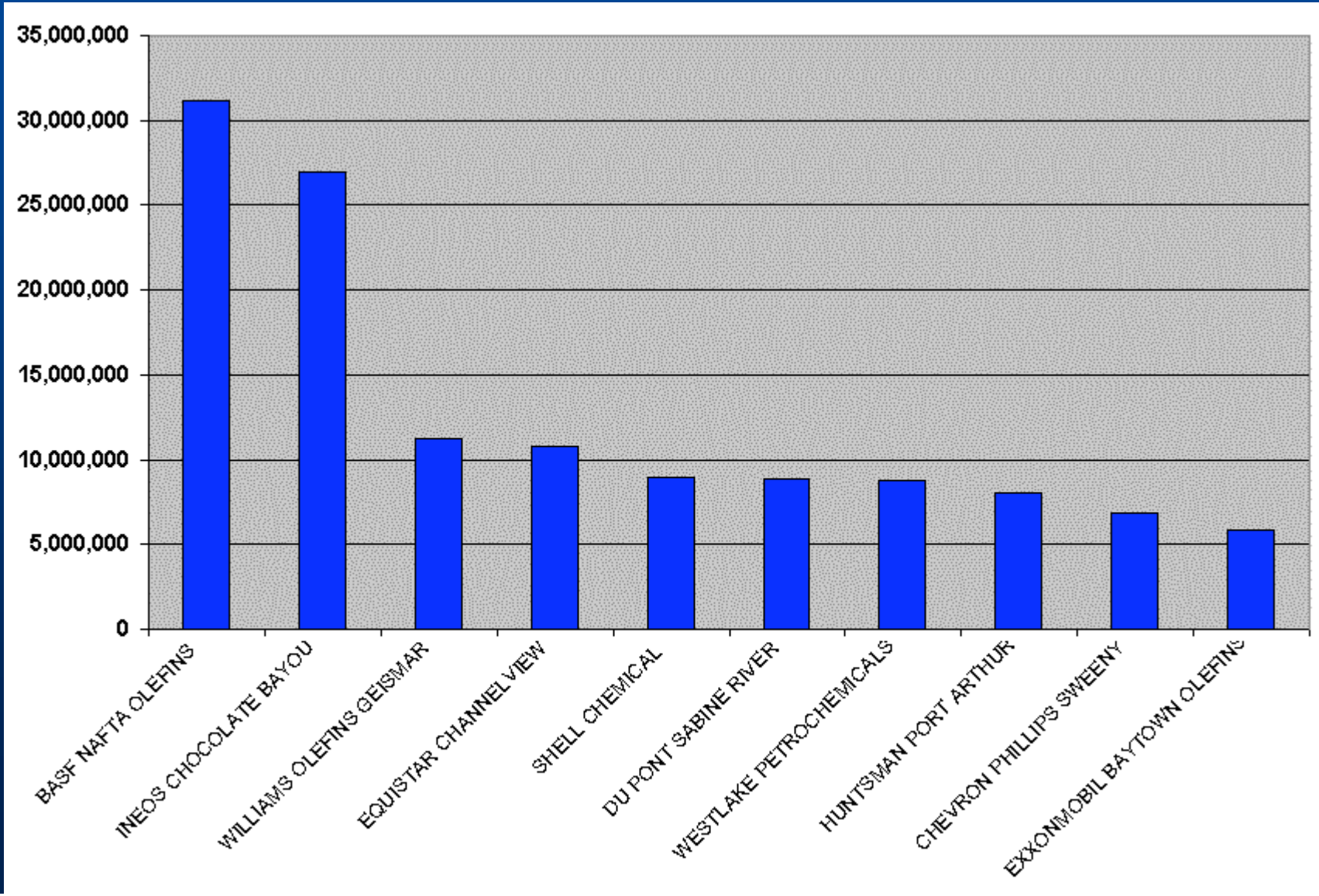
Ethylene Industry and HRVOCs

- The Ethylene industry is a significant source for highly reactive volatile organic compounds (HRVOCs)
- Impact on rapid ozone formation
- Key HRVOCs
  - Ethylene
  - Propylene
  - 1,3-Butadiene
- Only 1,3-Butadiene is listed in Appendix D of the Ethylene MACT
- Texas HRVOC Rule (30 TAC Chapter 115)
- LDEQ HRVOC Task Force

Ethylene Facilities and Regional Ozone Nonattainment Areas



2005 Ethylene Treated On-site (Flaring)



Ethylene Flaring Investigatory Approaches

- Event Focused
  - Focus on individual events, their root causes and the steps the facility took to mitigate the event
  - Evaluation focuses on whether event was recurring or preventable
  - Difficult evaluation because challenging the facility requires extensive industry knowledge

Ethylene Flaring Investigatory Approaches

- Flare Operation Focused
  - Investigation focuses on the key operating parameters (40 CFR 60.18) for the control device that ensure high combustion efficiency
  - Ethylene facilities are currently utilizing a 98 or 99% DRE when calculating their emissions
  - Key Parameters
    - BTU content of material flared
    - Velocity of waste gas
    - Steam Assist gas ratio

BTU content

- Regulatory BTU value is 300 (BTU/SCF)
- Typical waste gas at an ethylene plant has sufficiently high BTU value
- During turnarounds or facility maintenance events gases such as nitrogen are often utilized to purge lines and may influence the BTU value of the flare
- Records: Online calorimeter, speciation monitoring data, vent stream operating scenarios

Velocity of Waste Gas

- Flares at ethylene facilities should be designed to handle enormous volumes of waste gas
- Large emission events can be evaluated to investigate whether the maximum velocity was exceeded during the event

Steam Assist Concerns

- Facilities utilize steam to promote mixing and turbulence to reduce the likelihood of a smoking flare
- Exceeding the flare manufacturers operating recommendations for steam assist ratio can considerably impact flare DRE
  - Zeeco analysis on the impact of oversteaming
    - Steam to HC Ratios of 3.5 to 1 or less had 98% plus DRE
    - Steam to HC Ratio of 5.8 to 1 had 82% DRE
    - Steam to HC Ratio of 6.7 to 1 had 69% DRE
- Steam accounting records should be available within the facilities DCS system

Example Investigatory Approach for Flare Operations

- Request inventory of flares
- Request individual vents/process areas that route to each specific flare
- Request the manufacturers defined operating parameters for the flare
- Request DCS records and other records documenting the pilot condition, the net heating value calculations, and the steam quantities sent to the flare
- Request operator SOP's for all operator controlled steam assist systems
  - How do operators respond to a smoking flare

In Conclusion…