

# **EPA/State and Local Tenth Annual Air Inspector Workshop**

**Oil and Gas Production Process  
and Emission Sources**

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# Outline

- ☛ Introduction
- ☛ Air Pollutants of Concern
- ☛ O&G Emission Sources
- ☛ Methods for Estimating Emissions
- ☛ Emission Sources of Interest
- ☛ Helpful Hints

# Regulated Air Pollutants of Concern

- ☛ Nitrogen oxides
- ☛ Carbon monoxide
- ☛ Hydrogen sulfide
- ☛ Sulfur dioxide
- ☛ Ozone - 1-hr standard; 8-hr standard
- ☛ Particulate matter - PM10 and PM2.5
- ☛ Volatile organic compounds (VOCs)
- ☛ Hazardous Air Pollutants

# Unregulated Air Pollutants

- ☛ Methane
- ☛ Ethane
- ☛ Carbon dioxide

# Oil & Gas Emission Sources

- ☛ Combustion of fossil fuels (natural gas, diesel fuel) - primarily natural gas for oil and gas production operations
- ☛ Venting of natural gas and crude oil vapors
- ☛ Sources that concentrate pollutants

# Oil & Gas Emission Sources

☞ Sources that Burn Natural Gas or Diesel fuel:

- Internal combustion engines - reciprocating and turbines that drive compressors, generators, pumps, cranes
- Heaters, reboilers and boilers
- Flares

# Fuel Combustion Pollutants

- ☛ Oxides of Nitrogen - NO<sub>x</sub>
- ☛ Carbon Monoxide - CO
- ☛ Volatile Organic Compounds (VOCs) - nonmethane/nonethane hydrocarbons
- ☛ Sulfur Dioxide - SO<sub>2</sub> - sour gas
- ☛ Hydrogen Sulfide - H<sub>2</sub>S - sour gas
- ☛ Particulate Matter - diesel/gasoline
- ☛ Formaldehyde - hazardous air pollutant
- ☛ Acetaldehyde - hazardous air pollutant

# Venting O&G Sources

- ☞ Storage Tanks
- ☞ Emergency/Process Vents - Cold Vents
- ☞ Gas Actuated Pumps - Wilden/Aro/Texsteam
- ☞ Glycol Dehydrators Still Column & Flash Tank
- ☞ Compressor Seals - esp. turbines
- ☞ Pressure/Level Controllers
- ☞ Loading/Unloading Facilities
- ☞ Amine Gas Sweetening Units
- ☞ Fugitive Emissions



# Venting Pollutants of Concern

☞ Pollutants from venting of natural gas and hydrocarbon vapors:

- VOCs
- HAPs
- H<sub>2</sub>S other reduced sulfur compounds

# Venting O&G Sources

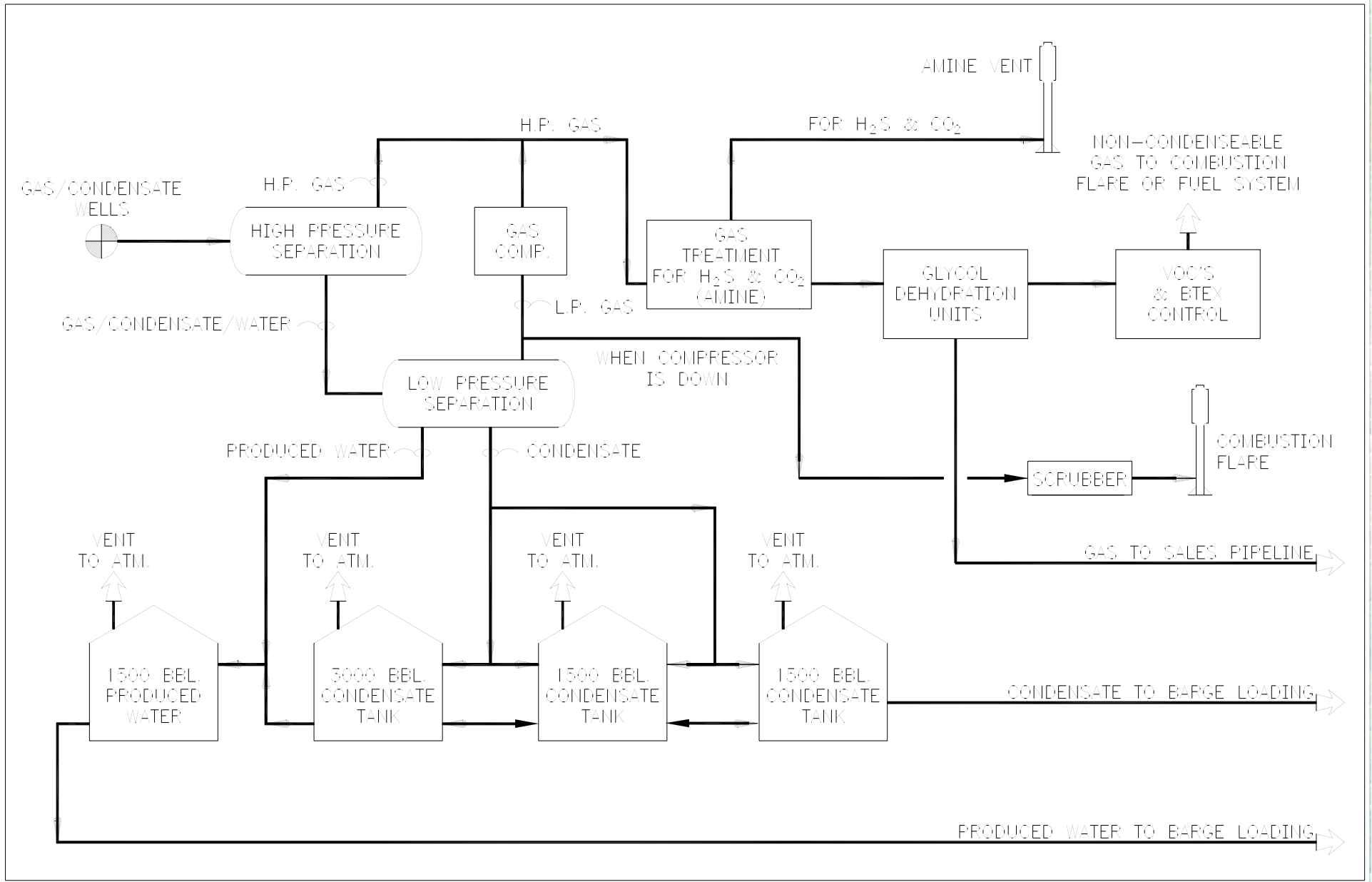
- ☞ Storage Tanks – VRU, flare
- ☞ Cold Vents – flare
- ☞ Gas Actuated Pumps – electric, compressed air
- ☞ Glycol Dehydrators – condenser, flare
- ☞ Compressor Seals – new and low venting seals
- ☞ Pressure/Level Controllers - compressed air & low bleed units
- ☞ Loading/Unloading of tanks – flare, VRU
- ☞ Amine Units - VRU, flare
- ☞ Fugitive Emissions – DIM
- ☞ Well unloading – smart automation system

# Venting Pollutants of Concern

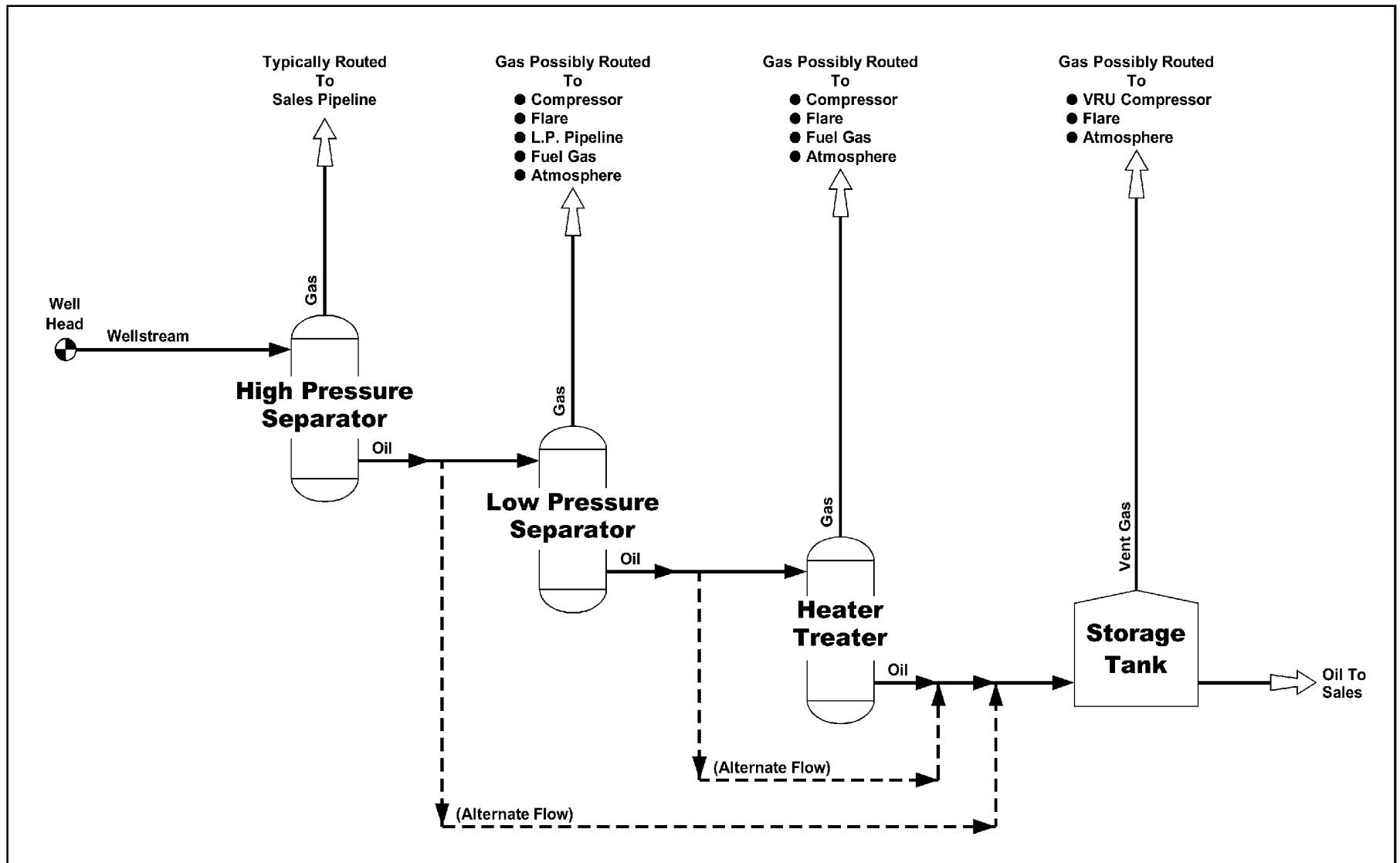
## ☞ VOC HAPs from Venting:

- benzene
- toluene
- ethylbenzene
- xylenes
- n-hexane
- 2,2,4-trimethylpentane (iso-octane)

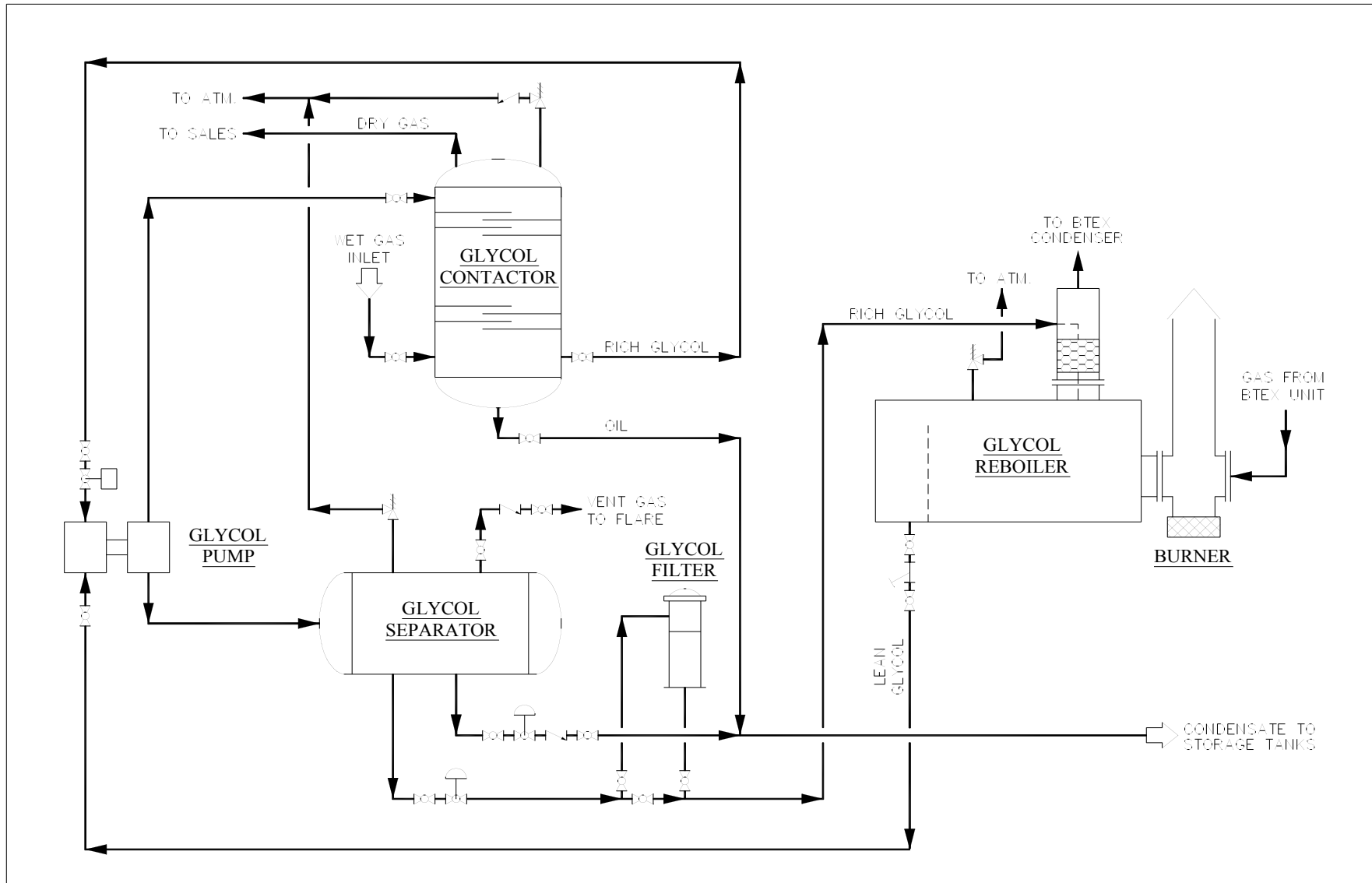
BTEX



# Flash Losses



# Dehydrator Process Flow



# Oilfield terms

- ☞ “Flaring Gas” can mean venting gas and can mean burning gas. Always ask what they mean by “flaring gas”
- ☞ Blowdown gas – depressure compressor and compressor shuts in and lag time to shut well in; gas vented or flared from compressor and from wellstream. Sent to atm or burning flare as a safety measure. Often means vent to atmosphere.
- ☞ Unload a well – venting of gas from well

# Emission Estimation Methods

- ☞ Direct Measurement - stack testing engines, tank/vent gas measurement, gas analyses, pressurized oil sample
- ☞ Emission Factors – AP-42, manufacturer data
- ☞ Engineering Calculations
- ☞ Simulation Software – TANKS4, EPTANK, GLYCalc, AMINCalc, HYSIS, HYSIM, PROSYM



# Emission Sources of Interest

- ✿ Engines
- ✿ Glycol Dehydration Units
- ✿ Crude/Condensate Storage Tanks
- ✿ Flashing Losses
- ✿ Flares
- ✿ Pneumatic Devices

# Engines – Emission Controls

- ✿ For 4-cycle engines use nonselective catalytic converter (NSCR) on rich burn engines to reduce NOx and CO
- ✿ For 2-cycle engines, use selective catalytic converter (SCR) to reduce NOx
- ✿ Use “clean burn” engines with inherent low NOx and CO

# Engines - Helpful Hints

- ☞ Emission controls installed and operating?  
Catalyst material in converter?
- ☞ Check most recent stack test
- ☞ O<sub>2</sub> sensor for exhaust for NSCR – near zero for 4-cycle engine with NSCR.
- ☞ Compressor runtime log vs gas vented and reported in emission inventory – estimate or metered?
- ☞ How often is compressor blowdown per month and volume blowdown?

# Engines - Helpful Hints

- ☞ Gas destination if compressor down—burning flare or to atmosphere?
- ☞ Use IR temp gun – check stack test results

# Glycol Dehydrator Controls

- ☞ Still column vent controls use condenser, flare, condenser + flare or VRU as emission controls
- ☞ Lower circulation rate, install smaller pump
- ☞ Install flash tank and route to system or as fuel for reboiler; send flash gas to vapor recovery unit (VRU) or flare

# Dehydrators - Helpful Hints

- ☞ Ensure all emission controls operating – trace control piping
- ☞ Will controls installed condense liquids?
- ☞ Steam should not be existing the condenser
- ☞ Check glycol circ. rate – use pump curve to convert from strokes/minute to gpm - (Kimray pumps see [www.kimray.com](http://www.kimray.com))
- ☞ Determine destination of gas from flash tank (aka gas-condensate-glycol separator)
- ☞ Can reboiler burn all of gas from condenser and/or flash tank based on design capacity?

# Dehydrators - Helpful Hints

- ☞ Check GLYCalc inputs vs actual operations
- ☞ Important GLYCalc inputs:
  - Gas analysis sample upstream of contactor – (C1-C10+ and BTEX and n-hexane)
  - Gas contactor temperature
  - Gas contactor pressure
  - Presence/absence of flash tank
  - Exit temperature of condenser
  - Stripping gas used? (Stripping gas reduces efficiency of the condenser)

# Storage Tanks - Controls

- ☞ Lower pressure drop between separator and storage tanks
- ☞ Vapor Recovery
- ☞ Flares



# Storage Tanks - Helpful Hints

- ☞ Determine if emission controls installed and operating - VRU, flares
- ☞ Is VRU adequately sized?
- ☞ Is VRU connected and operation?
- ☞ Hatches sealed?
- ☞ Wait for it to cycle on.
- ☞ Trace piping from tank to controls
- ☞ Permit includes flash, standing/working losses?

# Helpful Hints - Storage Tanks

- ☞ Check gas analysis used to speciate tank vapors – VOC content accuracy
- ☞ Check flash calculations for changes from permitted operating conditions
- ☞ Tank hatches open or closed
- ☞ If route to flare, is there enough motive force to send gas to flare tip

# Helpful Hints - Flash VOC Losses

- ☞ Sources: separators, heater treaters, storage tanks, dehydrator flash tanks
- ☞ Check destination of flash gas - atmosphere, VRU, compressor suction – trace piping onsite
- ☞ Check flash calculations for changes from permitted operating conditions
- ☞ Higher the pressure drop, the greater the expected flash scf per barrel of oil

# Helpful Hints – Flares (burning)

- ☞ Trace piping to determine what routed to flare
- ☞ Ensure that all sources routed to flare have enough motive force to get gas to flare tip
- ☞ Ensure that flare pilot lit or flare equipped with continuous sparking device
- ☞ Use IR temp. gun to check if pilot and flare burning – flame may not be visible
- ☞ Observe smoking condition
- ☞ Determine how gas volume measured or estimated; recordkeeping method used

# Pneumatic Devices - Controls

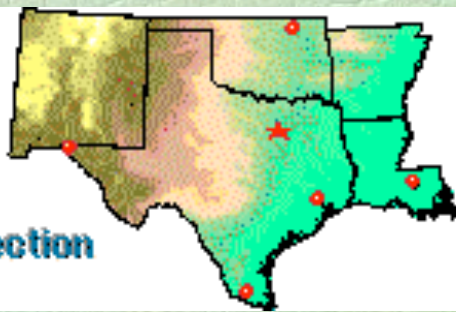
- ☞ Low bleed units
- ☞ Electric units
- ☞ Compressed air in some locations

# Pneumatic Devices

- ☞ Include in permit – natural gas operated pressure /level controllers, diaphragm pumps, chemical injection pumps
- ☞ Determine diaphragm pumps (e.g., Wilden M-8) pumps actual operating hours per year
- ☞ Emission factors (bleed rates) used – manufacturer data and EPA Gas STAR web page ([www.epa.gov/gasstar](http://www.epa.gov/gasstar))

# O&G Facilities - General

- ☞ Listen and look for signs of leaking gas
- ☞ Housekeeping
- ☞ Operator knowledge - contract or company operator; how long at the facility
- ☞ Morning reports – oil & gas production rates – reported daily, engine downtime/runtime, blowdown of natural gas
- ☞ Emission Inventory data on venting
- ☞ Upsets and start-up emissions



**REGION 6**  
Arkansas Louisiana  
New Mexico  
Oklahoma Texas



**ADEQ** State of Arkansas  
Department of Environmental Quality  
*"To protect, enhance and restore the natural environment for the well-being of all Arkansans."*





# EPA Gas STAR Program

- ✿ Flexible, voluntary partnership between EPA and the oil and natural gas industry designed to cost-effectively reduce methane emissions from natural gas operations
- ✿ Roger Fernandez, Program Manager  
EPA  
(202) 343-9386  
fernandez.roger@epa.gov
- ✿ see [www.epa.gov/gasstar](http://www.epa.gov/gasstar)

# Emission Factors

- Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources
- For AP-42 web link see:  
<http://www.epa.gov/ttn/chief/>

# Emission Estimation Methods

- ☛ USEPA Emission Inventory Improvement Program (EIIP) Volume II, Point Sources, Chapter 10 - Preferred and Alternative Methods for Estimating Air Emissions from Oil and Gas Field Production and Processing Operations. September 1999
- ☛ For EIIP Document web link see:  
<http://www.epa.gov/ttn/chief/eiip/>

# Use of Emission Factors

- ☛ Fugitive Emissions - API Publication 4638
- ☛ Factors based on lbs of pollutant (e.g., VOC, methane) per component assuming the components leak 24/7
- ☛ Gives weight percents for each pollutant such as VOC, BTEX, methane

# Emission Factors

☞ AP-42 used for:

- Engines (if no test or manufacturer data available)
- Heaters/Boilers/Reboilers
- Flares
- Tanks standing and working losses
- Unloading losses from tanks and barges

# Use of Simulation Software

- ☛ Storage Tanks Breathing and Working Losses - AP-42 TANKS4
- ☛ Storage Tanks with flash - E&P TANK program from API ([www.api.org](http://www.api.org)); HYSIS; HYSIM, PROSYM
- ☛ Glycol Dehydration Units' Still Column Vents and flash tanks - GRI-GLYCalc 4.0 – from Gas Technology Institute ([www.gastechnology.org](http://www.gastechnology.org))
- ☛ Amine units - AMINECalc from API