NMED/EMNRD MAP
SEPARATORS / HEATERS / STORAGE TANKS

Upstream Design Considerations for Emissions
10/24/19

Joe Leonard – Facilities Engineer – Devon Energy
Outline

• Within Scope
  • Upstream Process Overview
  • Dump Valves
  • What Causes Emissions?
  • Strategy Strengths & Challenges
  • Retrofits

• Other MAP Topics (e.g. LDAR, Pneumatics, etc.) not addressed
Upstream Process Overview

• Process Raw Production – Oil, Gas & Water

• Goal
  • Maximize Recovery
  • Minimize Cost

• Challenges
  • Safe
  • Compliant
  • Effective

• Resources
  • Pressure
  • Temperature
  • Etc.
Upstream Process Overview

Annotations:
1 - REMOTE "OFF-PAD" WELLHEAD
2 - LOCAL "ON-PAD" WELLHEAD
3 - ADDITIONAL WELLS
4 - INLET 2-PHASE SEPARATOR
5 - PRESSURE RELIEF VALVE
6 - INLET 3-PHASE SEPARATOR
7 - TEST SEPARATOR
8 - TEST PRODUCTION MANIFOLD
9 - BULK SEPARATOR
10 - HEATER TREATER
11 - SALES GAS 'LAST CHANCE' SEPARATOR
12 - BACK PRESSURE VALVE
13 - ULP/SVRT
14 - FWKO/GUN BARREL
15 - OIL STORAGE TANK
16 - ADDITIONAL OIL TANKS
17 - WATER STORAGE TANK
18 - ADDITIONAL WATER TANKS
19 - PVRV
20 - THIEF HATCH
21 - LACT
22 - WATER TRANSFER PUMP
23 - HYDROCARBON GAS STRATEGIES
Dump Valves

- Facilities are not a steady state process
- Selection affects instantaneous dump rate
- Failures Occur – Upset Condition
  - Erosion
  - Debris
- Rarely Catastrophic
- Can result in Pressure Relief Scenario
What Causes Emissions?

• Mechanic: Pressure
  • $\uparrow P_{\text{stream}} = \uparrow \text{Gas in Liquid Phase}$
  • Highest at Inlet
    • Gas – Sales Pressure (Some Variability)
    • Oil & Water – Atmospheric (Constant)
  • $\downarrow P_{\text{facility}} = \uparrow \text{EUR}$
  • Limit set by:
    • Sales Line Pressure (Gas)
    • Liquid Dump

• Mechanic: Temperature
  • $\downarrow T_{\text{stream}} = \uparrow \text{Gas in Liquid Phase}$
  • Converges to ambient
    • Avg Low: 20 °F
    • Avg High: 85 °F
    • Avg Annual: 50 °F
  • Heater Treaters used in Permian

*Process Modeling (Permit Evaluation) Results can vary drastically based on Pressure, Temperature & Rate assumptions*
What Causes Emissions?

• Other Mechanics:
  • Tanks – Working Losses
  • Tanks – Breathing Losses
  • Truck Loading – Agitation
What Causes Emissions?

• Unforeseen Operating Conditions (changes in rate, pressure, composition, etc.)
• Improper Design
• Improper Construction
• Improper Operation
• Improper Maintenance
• Malfunction
  • Dump Valve Failure
  • Seal Failure
  • Etc.
## Strategy Strengths & Challenges

<table>
<thead>
<tr>
<th>RECOVER</th>
<th>COMBUST</th>
<th>VENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STRENGTHS</strong>&lt;br&gt;• Gas to Sales&lt;br&gt;• &gt;95% Efficient&lt;br&gt;• Centralized Production Opportunities&lt;br&gt;• QOQO Qs Enforceable if Applicable&lt;br&gt;• Complex&lt;br&gt;  - Mechanical Design Considerations&lt;br&gt;    ▪ Suction Piping Design&lt;br&gt;    ▪ Discharge Piping Design&lt;br&gt;    ▪ Placement of Equipment&lt;br&gt;  - I&amp;IE Design Considerations&lt;br&gt;    ▪ Installation of Instrumentation&lt;br&gt;    ▪ Selection of Instrumentation&lt;br&gt;    ▪ PLC&lt;br&gt;  - Communications&lt;br&gt;    ▪ Vendor/Unit Selection&lt;br&gt;    ▪ (Tanks) Incorrect Composition&lt;br&gt;      ▪ Oxygen&lt;br&gt;      ▪ Blanket Gas&lt;br&gt;    ▪ (Tanks) Set Point Limitations&lt;br&gt;    ▪ Retrofit Complications&lt;br&gt;• Area Classification&lt;br&gt;• Downtime Considerations&lt;br&gt;• Maintenance&lt;br&gt;• Service in the area?&lt;br&gt;• Operational Deviations&lt;br&gt;  - Training&lt;br&gt;  - Theft Hatches&lt;br&gt;  - Suction Pressure Control Sensitivity&lt;br&gt;      ▪ VFD, etc.&lt;br&gt;• Construction Deviations&lt;br&gt;  - Equipment Verification</td>
<td>• Not as complex as recovery&lt;br&gt;  - No 3rd Party Maintenance&lt;br&gt;  • More reliable than recovery&lt;br&gt;  • &gt;95% Efficient&lt;br&gt;  • QOQO Enforceable is Applicable&lt;br&gt;• Complex&lt;br&gt;  - Mechanical Design Considerations&lt;br&gt;    ▪ Vent Header Design (AP)&lt;br&gt;    ▪ Stack Height&lt;br&gt;  - I&amp;IE Design Considerations&lt;br&gt;    ▪ Installation of Instrumentation&lt;br&gt;    ▪ Selection of Instrumentation&lt;br&gt;    ▪ PLC&lt;br&gt;  - Communications&lt;br&gt;    ▪ (LP Only) Smokeless Combustion&lt;br&gt;• Incorrect Composition&lt;br&gt;  - Arrestor Limited Protection&lt;br&gt;  • Large Radius of Exposure&lt;br&gt;  • Downtime Considerations&lt;br&gt;  • Operational Deviations&lt;br&gt;    - Training&lt;br&gt;    - Theft Hatches&lt;br&gt;• Construction Deviations&lt;br&gt;  - Equipment Verification</td>
<td>• Negligible Complexity&lt;br&gt;• Negligible Cost&lt;br&gt;• 0% Efficient&lt;br&gt;• Safety: Risk to Personnel&lt;br&gt;  - Toxicity&lt;br&gt;  - Asphyxiation&lt;br&gt;  - LEL</td>
</tr>
</tbody>
</table>

- **Overcoming challenges manifests in the form of additional cost**
- **Choosing strategies is a cost/benefit/risk evaluation**
- **Choosing strategies is operator and often site specific**
- **Infinite amount of engineering solutions**
Retrofits

• Range: Easy & Inexpensive ↔ Complex & Costly
  • Site & Scope Specific

• What data is available?
  • Hand sketch or P&ID’s?

• What other modifications need to be made?
  • Is power required and available?
  • Major/Minor Equipment
  • Piping
  • I&E, PLC & Communications

• What training is required for the modification?
• What maintenance is required for the modification?

• Example 1: Downsizing an existing flare
• Example 2: Adding a flare to an existing site
Summary

• Facility Design is not “one size fits all”
• Dump Valve “Right Sizing” is important
• Careful consideration must be made when modeling a process
  • Pressure, Temperature & Rates
• Choosing strategies is a site specific cost/benefit/risk evaluation
• Caution against prescriptive solutions
• Retrofit complexity & cost is project specific
THANK YOU