

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

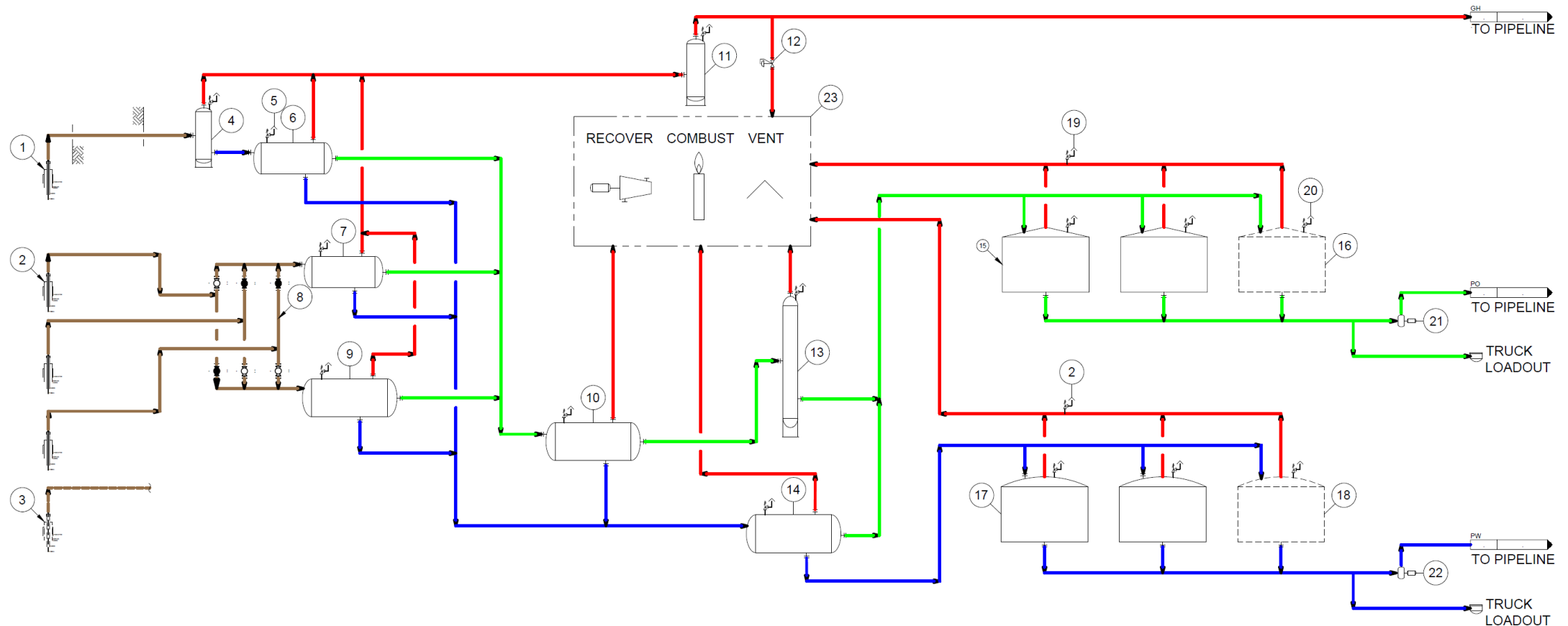
Upstream Process Overview

- Process Raw Production – Oil, Gas & Water
- Goal
 - Maximize Recovery
 - Minimize Cost
- Challenges
 - Safe
 - Compliant
 - Effective
- Resources
 - Pressure
 - Temperature
 - Etc.

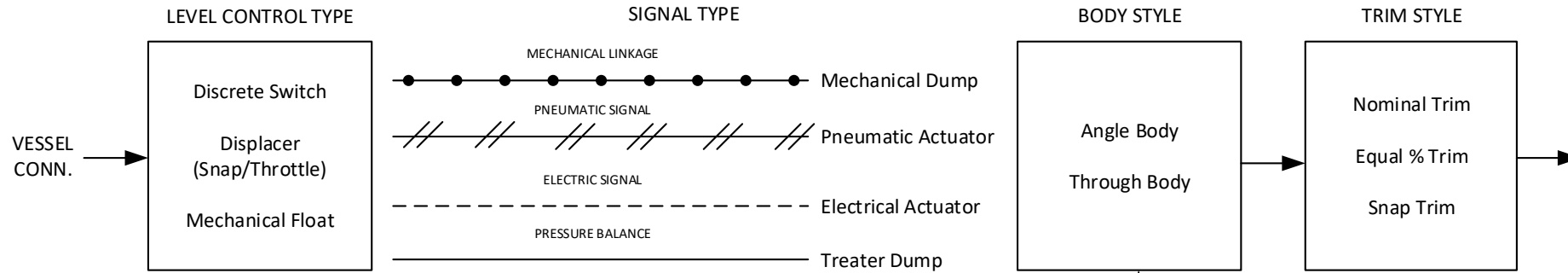
Upstream Process Overview

ANNOTATIONS

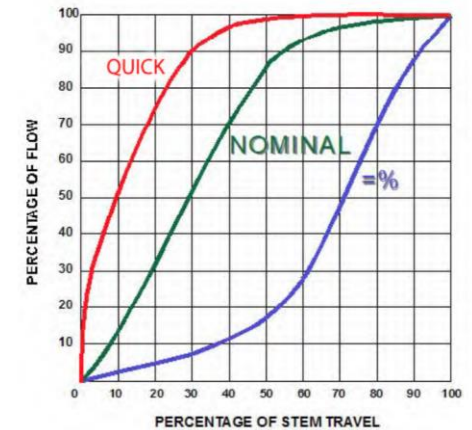
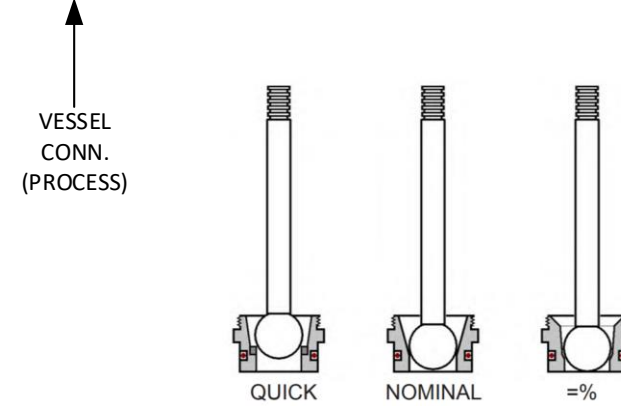
- | | | | |
|-------------------------------|--|---------------------------|---------------------------------|
| 1 - REMOTE "OFF-PAD" WELLHEAD | 6 - INLET 3-PHASE SEPARATOR | 12 - BACK PRESSURE VALVE | 18 - ADDITIONAL WATER TANKS |
| 2 - LOCAL "ON-PAD" WELLHEAD | 7 - TEST SEPARATOR | 13 - ULPS/VRT |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

	RECOVER	COMBUST	VENT
STRENGTHS	<ul style="list-style-type: none"> Gas to Sales >95% Efficient Centralized Production Opportunities <u>OOOOa</u> Enforceable if Applicable 	<ul style="list-style-type: none"> Not as complex as recovery <ul style="list-style-type: none"> No 3rd Party Maintenance More reliable than recovery >95% Efficient <u>OOOOa</u> Enforceable is Applicable 	<ul style="list-style-type: none"> Negligible Complexity Negligible Cost
CHALLENGES	<ul style="list-style-type: none"> Requires Compression Requires Power/Fuel Measurement Complexity <ul style="list-style-type: none"> Mechanical Design Considerations <ul style="list-style-type: none"> Suction Piping Design Discharge Piping Design Placement of Equipment I&E Design Considerations <ul style="list-style-type: none"> Installation of Instrumentation Selection of Instrumentation PLC Communications Vendor/Unit Selection (Tanks) Incorrect Composition <ul style="list-style-type: none"> Oxygen Blanket Gas (Tanks) Set Point Limitations <ul style="list-style-type: none"> Retrofit Complications Area Classification Downtime Considerations Maintenance <ul style="list-style-type: none"> Service in the area? Operational Deviations <ul style="list-style-type: none"> Training Thief Hatches Suction Pressure Control Sensitivity <ul style="list-style-type: none"> VFD, etc. Construction Deviations <ul style="list-style-type: none"> Equipment Verification 	<ul style="list-style-type: none"> Requires Flare/VCU <ul style="list-style-type: none"> "Off the shelf" Custom Design Requires Power/Fuel (LP Only) Difficult to Measure Complexity <ul style="list-style-type: none"> Mechanical Design Considerations <ul style="list-style-type: none"> Vent Header Design (ΔP) Stack Height I&E Design Considerations <ul style="list-style-type: none"> Installation of Instrumentation Selection of Instrumentation PLC Communications (LP Only) Smokeless Combustion Incorrect Composition <ul style="list-style-type: none"> Arrestor Limited Protection Large Radius of Exposure Downtime Considerations Operational Deviations <ul style="list-style-type: none"> Training Thief Hatches Construction Deviations <ul style="list-style-type: none"> Equipment Verification 	<ul style="list-style-type: none"> 0% Efficient Safety: Risk to Personnel <ul style="list-style-type: none"> Toxicity Asphyxiation LEL

- 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