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Vapor Recovery

Presentation Outline

- Vapor Recovery?
  - What are we trying to recover
  - How do we recover it (compression)
- Five Steps for Assessing VRU (Central Facility)
  1. Identify possible locations for VRU installation
  2. Quantify the volume of vapor emissions
  3. Determine the value of the recovered emissions
  4. Determine the cost of VRU project
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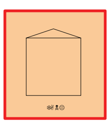
What are we trying to recover

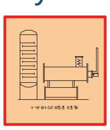
- Methane
  - $$$$
  - Natural Gas is a limited resource
  - Identified as an greenhouse gas
- Volatile Organic Compounds (VOC)
  - $$$$
  - Natural Gas is a limited resource
  - Contributes to the global concentration of ozone (O3)
    - Ozone is an air pollutant associated with respiratory health issues
- Hazardous Air Pollutants (HAP)
  - Benzene, Toluene, Ethyl Benzene, Xylene (BTEX)
  - Hydrogen Sulfide (H2S)

What are we trying to recover

- ATM Storage Tank Vapors

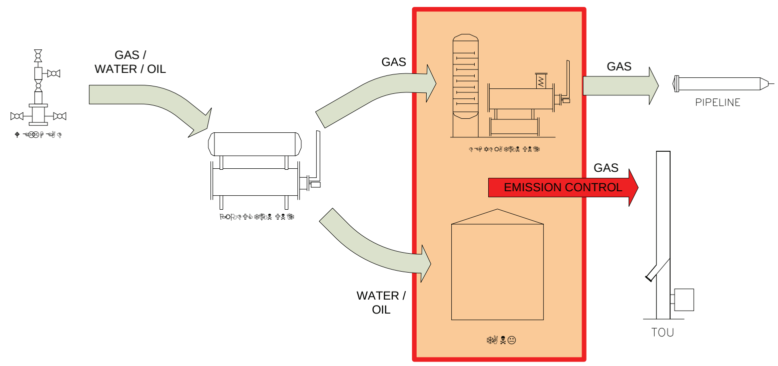


  - Flash Losses – Occurs from pressure drop from a higher pressure vessels to the ATM tank
  - Breathing Losses – Occurs from ambient temperature changes
  - Working Losses – Occurs from changing tank fluid levels and agitation of tank contents
- Dehydration Still Non Condensible



  - Glycol Absorbed Methane, VOC & HAP
  - Stripping Gas
  - Pump Gas

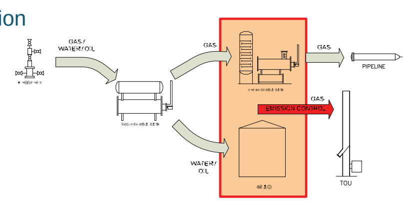
What are we trying to recover



[Jonah Field, Wyoming]

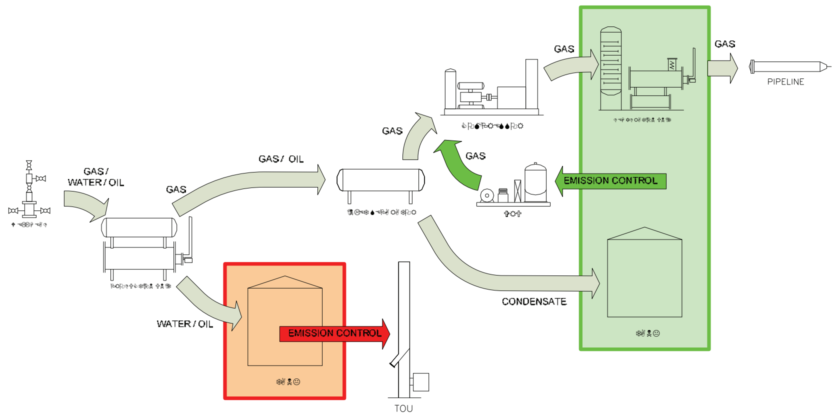
What are we trying to recover

– Advantages:
  - Reduced down stream pipeline corrosion
  - Dehy & Tanks are in the same area
– Disadvantages:
  - Possible down stream dehy
  - No power
  - Higher line pressure
  - Spread out flash volumes
  - Higher potential to over circulate TEG
  - Recovery device on every location



[Jonah Field, Wyoming]

What are we trying to recover

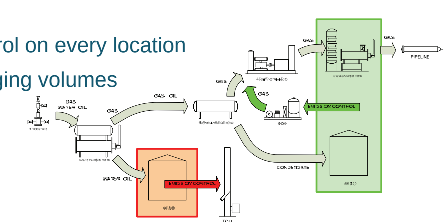


[Rifle, Colorado]

What are we trying to recover

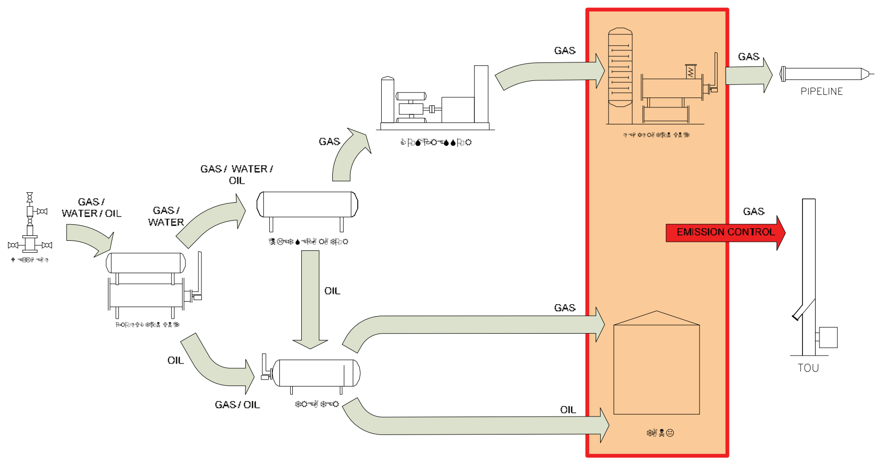
– Advantages:
  - Reduce number Dehy
  - Station Dehy & Tanks are in the same area
  - Power at Station
  - Lower line pressure
  - More consistent line pressure

– Disadvantages:
  - Gathering pipeline corrosion
  - Spread out well flash volumes
  - No power at location
  - Possible tank emission control on every location
  - VRU has to be sized for pigging volumes



[Rifle, Colorado]

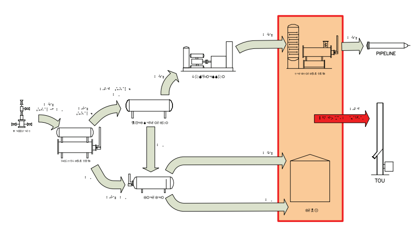
What are we trying to recover



Frenchie Draw, Wyoming

What are we trying to recover

- Advantages:
  - Reduce number Dehy contacts
  - Tank emissions in one location
  - Station Dehy & Tanks are in the same area
  - Power
  - Lower line pressure
  - More consistent line pressure
  - No control at locations
- Disadvantages:
  - Gathering pipeline corrosion
  - Oil pipeline corrosion



Frenchie Draw, Wyoming

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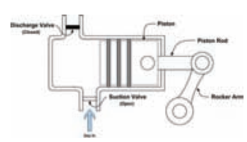
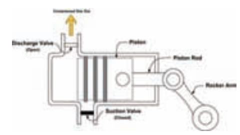
How do we recover it



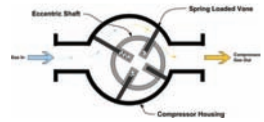


- **Reciprocating Compressors:**
  - Advantages:
    - High Volumes (excess of 20 MMSCFD)
    - High Pressures (diff 2000-3000 psig)
  - Disadvantages:
    - Low suction pressure results in large first stage cylinder
    - Inefficient at low pressure
    - Rings and valve fail in wet gas application
    - Control is difficult at atmospheric pressure

DATA SOURCE: HY-BON Engineering Company, Inc.

How do we recover it (Compressors)

- **Rotary Vanes Compressors:**

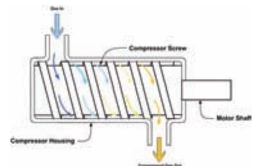


  - Advantages:
    - Excellent for relatively high volumes and relatively low differential pressures (0.015 – 2 MMSCFD)
    - Efficient at low pressures
    - Can handle wet gas relatively easy
    - Comparatively low initial cost and ongoing maintenance
  - Disadvantages:
    - Limited as to discharge pressure (60 psig differential)
    - Limited as to suction temperature capabilities (120 F)
    - Free liquid causes blade breakage problems

DATA SOURCE: HY-BON Engineering Company, Inc.

How do we recover it (Compressors)

- **Flooded Screws:**
  - **Advantages:**
    - **Excellent in a large volume/medium differential pressure range (0.02-2.5 MMSCFD)**
    - **Can handle wet gas better than rotary vanes**
    - **Excellent temperature control for controlling condensate fallout (180 F)**
  - **Disadvantages:**
    - **Higher maintenance**
    - **Higher operational expense (oil, filters, etc.)**
    - **Extremely limited on discharge pressure**
    - **Used primarily in vacuum applications**



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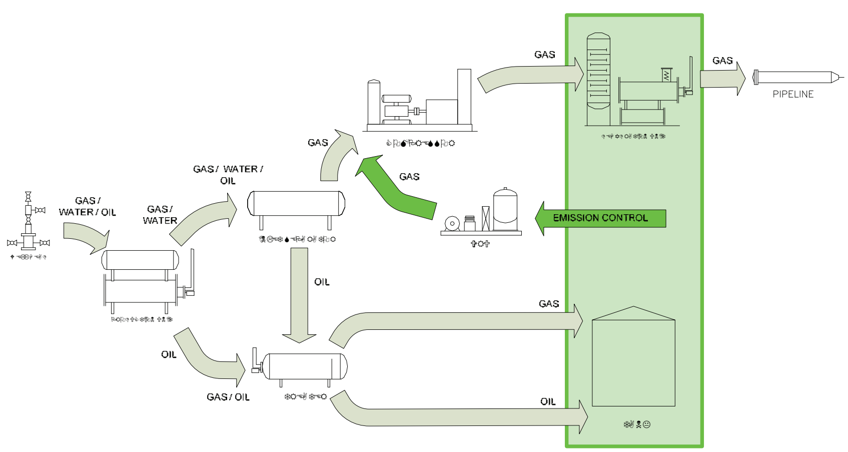
1. Identify possible locations for VRU installation



Frenchie Draw, Wyoming (Central Facility)

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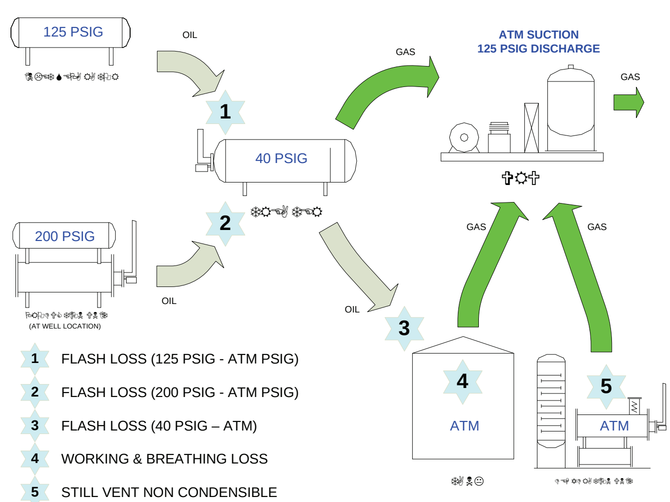
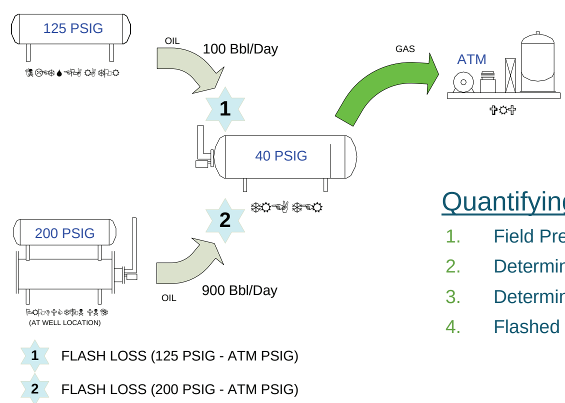
2. Quantify the volume of vapor emissions (Central Facility)



2. Quantify the volume of vapor emissions (Central Facility)

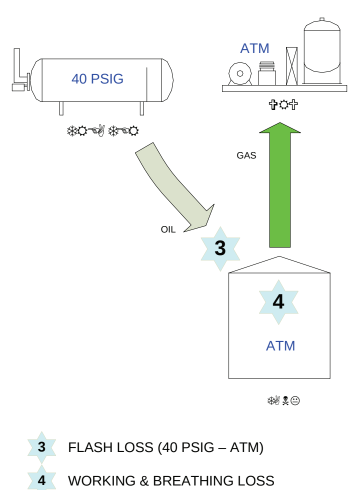


Quantifying Treater Emissions

1. Field Pressurized Oil Sample
2. Determine Production Rates
3. Determine Vessel Operating Conditions
4. Flashed with Process Simulator

Inlet Separator/Treater Flash –	**11 MSCFD**
Production Unit/Treater Flash -	**154 MSCFD**
Total Treater Flash-	**165 MSCFD**

2. Quantify the volume of vapor emissions (Central Facility)

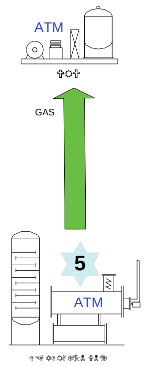


Quantifying Tank Emissions

1. Field Pressurized Oil Sample
2. Know Production Rates
3. Know Vessel Operating Conditions
4. Flashed with Process Simulator
5. Used E&P Tank for Working Loss
6. Used E&P Tank for Breathing Loss

Total Tank Flash-	**61 MSCFD**

2. Quantify the volume of vapor emissions (Central Facility)



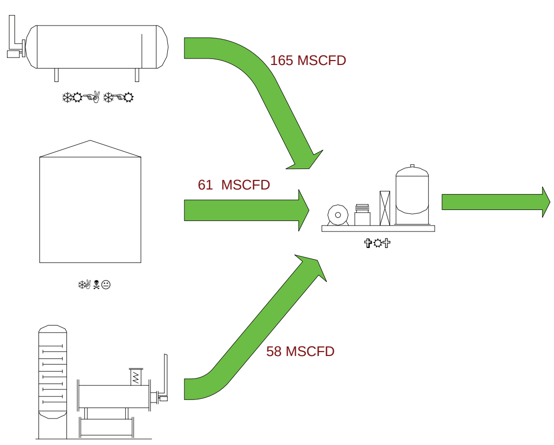
5 STILL VENT NON CONDENSABLES

Quantifying Dehy Emissions

1. Field Extended Gas Analysis (w/ BTEX)
2. Know Production Rates
3. Know System Operating Conditions
4. Use GRI-GLYCalc

Total Treater Flash- 58 MSCFD

2. Quantify the volume of vapor emissions (Central Facility)



Total Emissions- 284 MSCFD

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3. Determine the value of the recovered emissions (Central Facility)

R = Q X P

R = The gross revenue

Q = The rate of vapor recovery (Mcf/day)

P = The price of natural gas

Calculate:

Q = 270 Mcfd (95% of 284)

P = $8.00/Mcf

R = 270 Mcfd X $8/Mcf =

$2,160/day

$65,700/month

$788,400/year

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3. Determine the cost of VRU project (Central Facility)

Installation

VRU Unit (500 Mcfd) -	$90,000
Generator-	$85,000
Vent Header-	$25,000
Labor-	$200,000
TOTAL	$400,000

O & M

VRU Unit (500 Mcfd) -	$15,000
Generator-	$18,000
Fuel-	$73,000
TOTAL	$106,000

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3. Evaluate VRU economics (Central Facility)

Capacity–	500 Mcfd
Installation Cost -	$400,000
O&M-	$106,000/yr
Value of Gas-	$788,400/yr
Payback-	7 months
Return on Investment-	170%

What now?

- Started rebuilding our vent system
- Started measuring TOU volumes
- Finalizing compression design

Questions?