Fundamentals of Vapor Recovery

“Associated Gas” IS LOST PRODUCT
And LOST REVENUE

Presented by:
Larry S. Richards
Hy-Bon Engineering Co.
As the oil resides in the tanks, it gives off vapors, thereby increasing the pressure inside the tank.
Sources of Methane Losses

- Approximately 9 Bcf/yr of Methane are lost from storage tanks in the United States market alone
  - Flash losses
    - occur when crude is transferred from containment at a high pressure to containment at a lower pressure
  - Working losses
    - occur when crude levels change and when crude in the tank is agitated
  - Standing losses
    - occur with daily and seasonal temperature and pressure changes

Source: Natural Gas STAR Partners
WHY LET $ ESCAPE INTO THE AIR?

Besides being an environmental hazard, escaping vapors actually cost the operator money. What money? Uncaptured profits!! An average tank battery can emit from $15,000 to $50,000 in natural gas per
NOTES
All lines must be horizontal, or sloped down to V.R.U. suction as shown
Scrubber fluid is piped back to tanks or to waste
The system must be closed — no air entry.
Standard Vapor Recovery Unit

Crude Oil Stock Tank(s)

Control Pilot

Vent Line Back Pressure Valve

Electric Control Panel

Suction Scrubber

Suction Line

Condensate Transfer Pump

Sales Return

Gas Sales Meter Run

Gas

Bypass Valve

Check Valve

Electric Driven Rotary Compressor

Liquid
VAPOR RECOVERY

Typical stock tank vapor recovery unit in operation. This unit is configured to capture 90 mcfd of gas and discharge into a 40 psig sales line.
Benefits of Vapor Recovery Units

- Capture up to 95 percent of hydrocarbon vapors that accumulate in tanks
- Recovered vapors have much higher Btu content than pipeline quality natural gas
- Recovered vapors can be more valuable than methane alone
- Reduce regulatory & liability exposure
Identify possible locations for VRUs

Quantify the volume of losses

Determine the value of recoverable losses

Determine the cost of a VRU project

Evaluate VRU project economics
Quantify Volume of Losses

- Estimate losses from chart based on oil characteristics, pressure, and temperature at each location.
- Estimate emissions using the *E&P Tank Model*.
- Measure losses using orifice well tester and recording manometer.
Estimated Volume of Tank Vapors

<table>
<thead>
<tr>
<th>Vapor Vented from Tanks-SCF/BBL - GOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>90</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>70</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

Pressure of Vessel Dumping to Tank (Psig)

- Under 30° API
- 30° API to 39° API
- 40° API and Over
- 43° API and Over

Under 30° API
30° API to 39° API
40° API and Over
Estimating Tank Emissions

Chart method is a quick and easy way to get a fast ballpark estimate.

Notice the impact of higher gravity oil, as well as higher separator pressures.

This method is VERY CONSERVATIVE and generally underestimates actual emission levels.
Quantify Volume of Losses

**E&P Tank Model**
- Computer software developed by API and GRI
- Estimates flash, working, and standing losses
- Calculates losses using specific operating conditions for each tank
- Provides composition of hydrocarbon losses
<table>
<thead>
<tr>
<th>Component</th>
<th>Uncontrolled [ton/yr]</th>
<th>Uncontrolled [lb/hr]</th>
<th>Controlled [ton/yr]</th>
<th>Controlled [lb/hr]</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2S</td>
<td>12.137</td>
<td>2.771</td>
<td>0.607</td>
<td>0.139</td>
</tr>
<tr>
<td>O2</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>CO2</td>
<td>85.667</td>
<td>19.559</td>
<td>85.667</td>
<td>19.559</td>
</tr>
<tr>
<td>N2</td>
<td>2.284</td>
<td>0.521</td>
<td>2.284</td>
<td>0.521</td>
</tr>
<tr>
<td>C1</td>
<td>122.391</td>
<td>27.943</td>
<td>6.120</td>
<td>1.397</td>
</tr>
<tr>
<td>C2</td>
<td>159.072</td>
<td>36.318</td>
<td>7.954</td>
<td>1.816</td>
</tr>
<tr>
<td>C3</td>
<td>415.158</td>
<td>94.785</td>
<td>20.758</td>
<td>4.739</td>
</tr>
<tr>
<td>i-C4</td>
<td>96.442</td>
<td>22.019</td>
<td>4.822</td>
<td>1.101</td>
</tr>
<tr>
<td>n-C4</td>
<td>261.360</td>
<td>59.671</td>
<td>13.068</td>
<td>2.984</td>
</tr>
<tr>
<td>i-C5</td>
<td>82.901</td>
<td>18.927</td>
<td>4.145</td>
<td>0.946</td>
</tr>
<tr>
<td>n-C5</td>
<td>97.357</td>
<td>22.228</td>
<td>4.868</td>
<td>1.111</td>
</tr>
<tr>
<td>C6</td>
<td>28.130</td>
<td>6.422</td>
<td>1.407</td>
<td>0.321</td>
</tr>
<tr>
<td>C7</td>
<td>26.984</td>
<td>6.161</td>
<td>1.349</td>
<td>0.308</td>
</tr>
<tr>
<td>C8</td>
<td>10.294</td>
<td>2.350</td>
<td>0.515</td>
<td>0.118</td>
</tr>
<tr>
<td>C9</td>
<td>2.081</td>
<td>0.475</td>
<td>0.104</td>
<td>0.024</td>
</tr>
<tr>
<td>C10+</td>
<td>0.544</td>
<td>0.124</td>
<td>0.027</td>
<td>0.006</td>
</tr>
<tr>
<td>Benzene</td>
<td>2.029</td>
<td>0.463</td>
<td>0.101</td>
<td>0.023</td>
</tr>
<tr>
<td>Toluene</td>
<td>0.250</td>
<td>0.057</td>
<td>0.013</td>
<td>0.003</td>
</tr>
<tr>
<td>E-Benzene</td>
<td>0.032</td>
<td>0.007</td>
<td>0.002</td>
<td>0.000</td>
</tr>
<tr>
<td>Xylenes</td>
<td>0.264</td>
<td>0.060</td>
<td>0.013</td>
<td>0.003</td>
</tr>
<tr>
<td>n-C6</td>
<td>19.202</td>
<td>4.384</td>
<td>0.960</td>
<td>0.219</td>
</tr>
<tr>
<td>224 Trimethylp</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Total</td>
<td>1424.579</td>
<td>325.246</td>
<td>71.229</td>
<td>16.262</td>
</tr>
</tbody>
</table>
## Emission Summary

<table>
<thead>
<tr>
<th>Item</th>
<th>Uncontrolled [ton/yr]</th>
<th>Uncontrolled [lb/hr]</th>
<th>Controlled [ton/yr]</th>
<th>Controlled [lb/hr]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total HAPs</td>
<td>21.780</td>
<td>4.973</td>
<td>1.089</td>
<td>0.249</td>
</tr>
<tr>
<td>Total HC</td>
<td>1324.491</td>
<td>302.395</td>
<td>66.225</td>
<td>15.120</td>
</tr>
<tr>
<td>VOCs, C2+</td>
<td>1202.100</td>
<td>274.452</td>
<td>60.105</td>
<td>13.723</td>
</tr>
<tr>
<td>VOCs, C3+</td>
<td>1043.029</td>
<td>238.134</td>
<td>52.151</td>
<td>11.907</td>
</tr>
</tbody>
</table>

### Uncontrolled Recovery Info.

- Vapor: 71.3400 [MSCFD]
- HC Vapor: 66.3900 [MSCFD]
- GOR: 35.67 [SCF/bbl]
A chart recorder is set up on the tank battery for a 24-hour pressure test. The resultant chart is brought into the office for evaluation. Information such as ambient temperature, test apparatus size and orifice size is recorded and used in the calculation of volume of tank vapors.
TANK TEST

Ultrasonic meters and Mass flow meters are also effective.

The key is DURATION – a minimum of 24 hours of emissions must be charted for accurate results.
Value of Recovered Gas

Gross revenue per year = \((Q \times P \times 365 \times B) + NGL\)

- \(Q\) = Rate of vapor recovery (Mcfd)
- \(P\) = Price of natural gas
- \(B\) = Btu adjustment (typically 2.5)
- \(NGL\) = Value of natural gas liquids
To evaluate this practice for your situation, fill in the values below and click "Calculate Results".

**NATURAL GAS & CRUDE OIL TANK VALUES**

- Pressure of the vessel dumping to the tank (PSIG): 23 psi
- API gravity (degrees): 42 api gravity
- Amount of crude oil cycled through the tank (bbl/d): 2,000 bbl/day
- Number of days per year the Vapor Recovery Unit will be operated (days/yr): 351 days

**CALCULATE CAPITAL AND O&M COST ESTIMATES**

Click to calculate estimates for capital equipment costs and O&M costs.

Calculate
Enter your own values for the capital equipment listed below or accept the estimates.

Vapor Recovery Unit cost ($) $30,068
Vapor Recovery Unit installation cost ($) $22,551
Depreciable life of equipment (Years) 10
Vapor Recovery Unit O&M cost ($/year) $8,649

http://www.ergweb.com/gasstar/analytical_tool/VaporRecovery.asp
## GENERAL ECONOMIC VALUES

- Natural gas cost ($/Mcf)
- Natural gas cost escalator (%)
- O&M cost escalator (%)
- Discount rate (%)
- Marginal tax rate* (%)
- Investment tax credit (%)
- Working interest for capital costs (%)

Each variable can be added based on your companies specific conditions and contract terms

- Working interest for O&M costs (%)
- Working interest for gas savings (%)

EPA Website – PRO Tools
Analysis results for: INSTALLING VAPOR RECOVERY UNITS ON CRUDE OIL STORAGE TANKS

<table>
<thead>
<tr>
<th>Gas emission reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Year gas savings</td>
</tr>
<tr>
<td>First Year gas savings</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Without-tax effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Year NPV</td>
</tr>
<tr>
<td>Payback (Years)</td>
</tr>
<tr>
<td>DCFIRR</td>
</tr>
<tr>
<td>Simple ROI</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>With-tax effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Year NPV (AT)</td>
</tr>
<tr>
<td>Payback (AT) (Years)</td>
</tr>
<tr>
<td>DCFIRR (AT)</td>
</tr>
<tr>
<td>Simple ROI (AT)</td>
</tr>
</tbody>
</table>

To save this specific case for viewing in the Results Summary page, provide a name and click "Save"
Cumulative Net Cash Flow -

- Cumulative Cash Flow - Without-tax effect
- Cumulative Cash Flow - With-tax effect
CASE STUDIES
100 MSCFD, 500 psi, 1131 BTU/cu. ft

70 MSCFD, 80 psi, 1401 BTU/cu. ft

90 MSCFD, 25 psi, 1588 BTU/cu. ft

100 MSCFD, 0 psi, 2534 BTU/cu. ft

**Vented**

**Gross Sales Per Day**

$5.00 \times 1.13 \times$

1000 MSCFD = $5650

$5.00 \times 0$ MSCFD = $0

$5.00 \times 0$ MSCFD = $0

$5.00 \times 0$ MSCFD = $0

**TOTAL GAS SALES**

= $5650

**NOTE:** Price based upon $5.00/MMMBTU
A system was designed to allow the customer to capture the vented gas from all phases of his separation process. A multi-stage unit was designed and built that took the gas from the tank vapors at atmospheric pressure, gathered the vent gas from the other separators and delivered the stream to the sales line at 500 psig.
Crude Oil Analysis

600 PSIG SEPARATION
At 500 psig separation pressure, the gas has a BTU content of 1131 BTU/cu. ft.

### 500 PSIG SEPARATION

<table>
<thead>
<tr>
<th>Component</th>
<th>Mol. %</th>
<th>G.P.M.</th>
<th>Liquid Vol. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ne</td>
<td>0.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethane</td>
<td>0.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n-Butane</td>
<td>68.48</td>
<td>1.712</td>
<td></td>
</tr>
<tr>
<td>i-Butane</td>
<td>6.42</td>
<td>1.712</td>
<td></td>
</tr>
<tr>
<td>n-Pentane</td>
<td>7.13</td>
<td>0.585</td>
<td></td>
</tr>
<tr>
<td>i-Pentane</td>
<td>8.29</td>
<td>0.124</td>
<td></td>
</tr>
<tr>
<td>Hexane</td>
<td>6.64</td>
<td>0.201</td>
<td></td>
</tr>
<tr>
<td>Methane</td>
<td>0.21</td>
<td>0.077</td>
<td></td>
</tr>
<tr>
<td>n-Heptane</td>
<td>0.24</td>
<td>0.087</td>
<td></td>
</tr>
<tr>
<td>i-Heptane</td>
<td>0.28</td>
<td>0.164</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Determined on laboratory sample.*
At 80 psig separation pressure the gas has reached a BTU value of 1401 BTU/ cu. ft.

80 PSIG SEPARATION
At 25 psig separation, the gas stream is at its richest point yet, with a BTU value of 1588 BTU/cu. ft.
This gas stream reaches its most valuable point during storage in the oil tank. This gas has a BTU value of 2514 BTU/ cu. Ft. Obviously, this gas is worth capturing!
1000 MSCFD
500 psi
1131 BTU/cu. ft

70 MSCFD
80 psi
1401 BTU/cu. ft

90 MSCFD
25 psi
1588 BTU/cu. ft

100 MSCFD
0 psi
2534 BTU/cu. ft

$5.00 \times 1.13 \times 1000 \text{ MSCFD} = \$5650$

$5.00 \times 1.40 \times 70 \text{ MSCFD} = \$490$

$5.00 \times 1.59 \times 90 \text{ MSCFD} = \$716$

$5.00 \times 2.53 \times 100 \text{ MSCFD} = \$1267$

**TOTAL GAS SALES**

= \$8123

**MONTHLY GAS SALES INCREASE**

= \$74,190

*NOTE: Price based upon \$5.00/MMBTU*
Case Study 2

Mid Size Independent in Hobbs, NM area March ‘04
Installation of 2 VRU’s on 2 stock tank batteries, each emitting approximately 90 MSCFD of 2500 btu tank vapors / 45 psig sales line

Previous gas sales revenue: $0 (venting)

Monthly gas revenue: $5 X 2.5 X 90 MSCFD X 30 days x 2 tanks = $ 67,500

Capital expense: $24,000 X 2 units = $48,000

Payback: 21 DAYS
Case Study 3

Large Independent in North Texas in June ‘04
Installation of 1 VRU on a stock tank battery emitting approximately 190 MSCFD of 2400 btu tank vapors / 50 psig sales line

Previous gas sales revenue: $0 (venting)

Monthly gas revenue: $5 X 2.4 X 190 MSCFD X 30 days
= $68,400

Capital expense: $32,000

Payback: 14 DAYS
Case Study 4 – Chevron

Chevron installed eight VRUs at crude oil stock tanks in 1996

<table>
<thead>
<tr>
<th>Project Economics – Chevron</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Methane Loss Reduction (Mcf/unit/yr)</strong></td>
</tr>
<tr>
<td>21,900</td>
</tr>
</tbody>
</table>

\(^1\) Assumes a $2 per Mcf gas price; excludes value of recovered NGLs. Refer to the *Lessons Learned* for more information.

Source: Natural Gas Star Partners
This flare in Eastern Venezuela was causing a variety of health and environmental concerns – a gas stream now generating over $150,000 per month in additional revenue. Methane gas has 23 times the impact as a greenhouse gas as CO2 – although almost 100% of industry focus is currently on CO2.
Dual VRU bound for Venezuela... one of 17 units capturing gas currently for Petroleos de Venezuela. What started as an environmental project in one area became an economic addition to every major production station. Flooded screw compressor for volumes to 5.0 MMSCFD; up to
VAPOR RECOVERY

At this installation, three dual rotary screws compressor packages are set in tandem to move 15 MMSCFD of 2500-2600 BTU/cu ft. tank vapors. Condensate recovery more than doubled PDVSa estimates.
Two large rotary screw compressor systems installed by ENI in Dacion, Venezuela—designed to move 1.4 MMcfd of gas at pressures to 230 psig. Each skid is now recovering between 100 and 150 barrels of 70 API condensate PER DAY from gas stream previously vented to the atmosphere.
Condensate recovery was maximized on the ENI project by utilizing large heat exchangers to reduce the temperature of the gas.
A 2004 project for Amerada Hess for service in Algeria. This unit is a dual rotary vane system capable of moving 4MMCFD at pressures from 0 to 40 psig.
This VRU for Anadarko is currently capturing 300 mcfd of tank vapors and compressing them to 70 psi discharge in Rock Springs, WY (installed 2004)
Burlington Resources has installed 9 VRU’s in their Montana and North Dakota fields in 2005 on tank batteries ranging from 50 mcfd to 200 mcfd in methane emissions, and discharging into a 40 psig pipeline.
HY-BON ENGINEERING COMPANY, INC.

Setting a New Standard!!

HY-BON®
COMPRESSOR SELECTION CRITERIA

HOW DO WE CHOOSE THE APPROPRIATE COMPRESSOR?
TYPICAL COMPRESSOR TYPES
USED IN LOW PRESSURE

Rotary Vane Compressors

- Eccentrically mounted rotor
- Centrifugal force causes vanes to slide in or out
- Gas is forced into decreasing space thereby causing compression
- Jacket water cooling system
- RPM range 400 to 1600
Gas enters the suction flange at low pressure. The rotor is mounted eccentrically toward the bottom of the compressor. Centrifugal force imparted as the rotor turns forces the blades out against the cylinder wall. The gas is forced into a ever decreasing space, thereby compressing the gas which then exits the discharge. The rotor clearance at the bottom (typically .005”) is sealed with lubricating oil to create a closed system within the cylinder.
Rotary Vane Compressor

Typical Operating Parameters

- Differential pressure equal to or less than 60 psig (for single-stage models).
- Volume from approximately 15 MSCFD to 2 MMSCFD (for single-compressor units).
- Relatively low suction temperatures (< 120° F)
Rotary Vanes

Advantages

- Excellent for relatively high volumes and relatively low differential pressures
- Efficient at low pressures
- Can handle wet gas relatively easy
- Comparatively low initial cost and ongoing maintenance

Disadvantages

- Limited as to discharge pressure
- Limited as to suction temperature capabilities
- Free liquid causes blade breakage problems
TYPICAL COMPRESSOR TYPES USED IN LOW PRESSURE

Flooded Screw Compressors

- Twin helical rotors
- Oil is both the cooling medium and the compression medium
- Various configurations of gears, internal porting and loader/unloader valves available
- Gas mixed with oil. Must be separated after compression
Rotary Screw Packages
General Principle - Rotary Screws
3-D MODEL

FINISHED PRODUCT
Oil Flooded Screw Compressor

Typical Operating Parameters

- Differential pressure equal to or less than 300 psig (for single-stage models).
- Volume from approximately 20 MSCFD to 2.5 MMSCFD (for single-compressor units).
- Virtually any temperature (< 180° F)
# Oil Flooded Screws

## Advantages
- Excellent in a large volume/medium differential pressure range
- Can handle wet gas better than rotary vanes
- Excellent temperature control for controlling condensate fallout

## Disadvantages
- More sophisticated system w oil/gas separator
- Higher maintenance
- Higher operational expense (oil, filters, etc.)
TYPICAL COMPRESSOR TYPES USED IN LOW PRESSURE

Liquid Ring Compressors
- Vacuum pump technology
- Uses lobes rather than vanes
- Gas is mixed with non-lubricating oil. Must be separated after compression.
- Good for extremely low differential pressures.
- Compression oil must be segregated from lubrication oil
Liquid Ring Compressor Typical Operating Parameters

- Differential pressure equal to or less than 25 psig (for single-stage models).
- Volume from approximately 15 MSCFD to 2.5 MMSCFD (for single-compressor units).
- Virtually any suction temperature (< 180° F)
Liquid Rings

**Advantages**
- High volumetric efficiency
- Few moving parts

**Disadvantages**
- Extremely limited on discharge pressure
- Used primarily in vacuum applications
- Higher operational expense (oil, filters, etc.)
TYPICAL COMPRESSOR TYPES USED IN LOW PRESSURE

Reciprocating Compressors

- Piston/cylinder arrangement
- May be air, water or oil cooled
- Ages old technology
- May be slow speed or high speed
Reciprocating Compressor

Typical Operating Parameters

- Differential pressure in excess of 2000-3000 psig (for multi-stage models).
- Volumes in excess of 20 MMSCFD (dependent upon suction pressure).
- Relatively high suction temperatures (< 200° F)
Reciprocating Compressors

Advantages
- High volume/high pressure
- Able to handle spikes in pressure
- Relatively low maintenance

Disadvantages
- Low suction pressure results in large first stage cylinder size
- Inefficient at low pressures
- Rings and valves fail in wet gas applications
- Control is difficult at atmospheric pressures
TYPICAL COMPRESSOR TYPES
USED IN LOW PRESSURE

Dry Screw Compressors
- Similar in design to flooded screw
- Lubricating oil never comes in contact with process gas
- Extremely high rpm / very sophisticated seal systems
- Noise suppression systems req’d
Dry Screw Compressor Typical Operating Parameters

- Not recommended for volumes less than 2 MMSCFD.
- Discharge pressure up to 600 psi
- Volumes in excess of 25 MMSCFD
TYPICAL COMPRESSOR TYPES USED IN LOW PRESSURE

Vapor Jet
- Utilizes pressurized water to affect gas gathering
- No moving internal parts
- Uses produced water in a closed system
- Separation of gas and water required
VAPOR JET VAPOR RECOVERY TECHNOLOGY
Vapor Jet Typical Operating Parameters

- Differential pressure equal to or less than 40 psig (for single-stage models).
- Volume from approximately 5 MSCFD to 75 MSCFD (for single-compressor units).
- Suction Temperature is not an issue.
- Gas composition and saturation level is not an issue.
- Gas can be sent down the pipeline, or re-injected into the formation.
<table>
<thead>
<tr>
<th>Jet Pump Size ( in. )</th>
<th>1 1/2</th>
<th>2</th>
<th>2 1/2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Medium Pressure ( psig )</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Operating Medium Rate ( gpm )</td>
<td>45</td>
<td>82</td>
<td>143</td>
</tr>
<tr>
<td>Gas Volume Recovered ( Mcfpd )</td>
<td>25</td>
<td>45</td>
<td>77</td>
</tr>
<tr>
<td>Centrifugal Pump Eff. ( % )</td>
<td>26</td>
<td>42</td>
<td>53</td>
</tr>
<tr>
<td>Motor Eff. ( % )</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>KW-HR/day</td>
<td>401</td>
<td>453</td>
<td>625</td>
</tr>
<tr>
<td>Power Cost ( $/KW-HR )</td>
<td>0.045</td>
<td>0.045</td>
<td>0.045</td>
</tr>
<tr>
<td>Electrical Cost ( $/Mcf )</td>
<td>0.74</td>
<td>0.45</td>
<td>0.36</td>
</tr>
</tbody>
</table>
Technological Advancements

Low Pressure Gas Management Systems
Sensing Technology

Pressure sensing achieved with diaphragm actuated mechanical device / set pressures achieved by manually setting counter weights in conjunction with proximity switch.
Sensing Technology

High sensitivity electronic transmitters are now commercially viable for low pressure applications.
Sensing Technology

These transmitters are highly accurate to extremely minute pressures – and do not require a highly trained technician to calibrate.
Advancements in lubrication systems monitoring and control have dramatically increased bearing life.
Lubrication Systems

Lubrication requirements are precisely monitored and detailed reporting capabilities are easily downloaded into handheld “palm” devices or directly into Excel format.
Control Systems

PLC driven auto ignition for natural gas drive engines reduce compressor downtime and pumper requirements.
Technology Advancements

Control systems can range from almost completely manual to incredibly sophisticated.
Technology Advancements

Programmable Logics Controllers have dramatically expanded the capability of these packages.

Automated restart is now possible on BOTH electric and engine drive units.
Technology Advancements

Typical Shutdown indicators include:
- High Discharge Temperature
- High Discharge Pressure
- High Liquid Level
- Low Suction Pressure
- Lube Oil No-Flow
- Excessive Vibration
Even the most basic PLC can be configured to automatically call the cell phone number of the correct field personnel based on the specific cause of the shutdown.
Technology Advancements

Remote Monitoring

- Now commercially available on this size equipment
- Ability to remotely monitor all variables captured by the PLC from an internet link for a couple hundred dollars a month
- Ability to view actual real time video footage of the unit if required
HY-BON ENGINEERING COMPANY, INC.

Setting a New Standard!!