

EPA Compliance Alert: Best Practices to Reduce Venting and Flaring with Economic Benefit or How to avoid a 73 million dollar Consent Decree.

- Presented by : Jeff Voorhis, P.E. EMS-LA
- HY-BON Engineering

What Does HY-BON Do ?

We take waste gas emissions
and convert them into
revenue, while keeping you
Safe and in Compliance.

Wasting resources and most importantly additional revenue!



Actual Measurement

- 530 tons per year VOC Emissions
- $55 \text{ MSCFD} \times \$4 / \text{MSCF} \times 2000 \text{ BTU}$
= \$132,000 revenue per year
- Project Cost: \$100,000 (VRU, VRT, VCU and install estimate)
- PAYOUT 9 Months!!!!!!

Why the current focus on tank battery emissions?

- Technology advancements to see and analyze these gas streams
- Realization that industry and nationwide inventories understated
- Dramatically higher volumes of VOC's & other contaminants
- Focus on reduction of greenhouse gases
- All resulted in heightened regulations & enforcement

EPA Amends Definition of Storage Vessel Affected Facility

- A single storage vessel located in the oil and natural gas production segment, natural gas processing segment or natural gas transmission and storage segment and has the potential for VOC emissions equal to or greater than 6 tpy MUST reduce the emissions by 95% taking into account requirements under a legally and practically enforceable limit in an operating permit or by other mechanism.

6 tons per year sounds like a lot, but is it

Threshold based on potential to emit VOCs - 6 tons per year or more

Daily equivalents could be as low as:

- **33 pounds emission**
- **About 1 mcf emission**
- **1 barrel of condensate produced**
- **20 barrels of oil produced**
- **2000 barrels of water with 1% oil carryover processed**

Emission Limitations

- The 6 tpy limit is on a per tank basis. Even if the tanks are manifolded together in a series the PTE needs to be looked at on a per tank basis. So if all of the flash is occurring in the first tank of the series, and as a result it's PTE is 10 tpy and the remaining tanks are only 1 tpy each, then the first tank is an affected source under OOOO and the others are not. Since the flash is occurring in that first tank, those emissions must be accounted for for that tank's PTE and cannot be averaged out to the other tanks in the series.
-
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Compliance Alert

September 2015

EPA Observes Air Emissions from Controlled Storage Vessels at Onshore Oil and Natural Gas Production Facilities

Purpose

The U.S. Environmental Protection Agency (EPA) is publishing this Compliance Alert because EPA and state investigations have identified Clean Air Act compliance concerns regarding significant emissions from storage vessels, such as tanks or containers, at onshore oil and natural gas production facilities. The Alert discusses certain engineering and maintenance practices causing the compliance concerns and potential emissions-reducing solutions. While this Alert provides information intended to help operators and state regulators identify and address compliance concerns, the Alert's engineering and maintenance practices do not equate to or guarantee compliance with federal and state regulations.

Compliance Concerns

This Alert aims to help operators assess whether their vapor control systems are properly designed, sized, operated, and maintained such that emissions from storage vessels may be controlled in compliance with applicable federal and state regulations. For purposes of this Alert, a "vapor control system" includes a closed-top storage vessel, all vent lines leading from the storage vessel, fittings and connectors in the vent lines, any liquid knock-out vessels in the vent lines, any pressure relief devices (PRDs) on the vessel or vent lines, and the control device used to combust gas or route gas into the sales line.

EPA and state inspectors have observed emissions from storage vessel PRDs, such as closed thief hatches and pressure relief valves. Inadequately designed, sized, operated, and/or maintained vapor control systems may not effectively capture and control emissions.

and natural gas is extracted from sub-surface formations through a wellhead and then flows into a separator at varying pressures. The separator divides material from the wellhead into various constituents, such as oil, water, hydrocarbon liquids and natural gas or comingled



Storage vessels at an oil and gas production facility.

liquids and natural gas, depending on the characteristics of the well. The separator has a valve that opens to "dump" the pressurized liquid into a storage vessel.

While some storage vessels are designed to operate at pressures greater than atmospheric pressure, most storage vessels currently used for oil and natural gas production are atmospheric storage vessels, which are only designed to operate at or below atmospheric pressure.

Storage vessel emissions at onshore oil and natural gas production facilities are regulated because they contain: (1) large quantities of volatile organic compounds

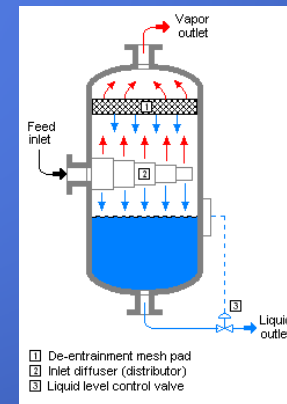
Some of the engineering solutions and maintenance considerations for storage tank discussed in the Alert include:

1. Reduce Liquid Pressure Prior to Transferring the Liquid to Atmospheric Storage Vessels
2. Adequate Diameter of Piping Used for Vent Lines to Control Device
3. Prevent Liquid Collection in Vent Lines
4. Eliminate Unintentional Natural Gas Carry-Through
5. Ensure Proper Maintenance and Set Points for Pressure Relief Valves
6. Minimize Venting from Thief Hatches
7. Adequate Sizing of Emission Control Devices

1. Crude Oil/Condensate/Produced Water Pressure Drop

To reduce flash gas volumes and peak flowrates of vent gas during separator dump of oil/produced water to storage tanks, use multiple stages of separation. This allows the system to operate with a smaller pressure drop between the last stage of separation (low pressure separator/heater treater) and an atmospheric storage vessel. Of course, to reduce air emissions, the gas liberated by the intermediate stages of separation must be collected and sent to the system (fuel, sales pipeline) and not vented to the atmosphere.

HIGH DIFFERENTIAL PRESSURE EQUALS HIGH FLASH POTENTIAL



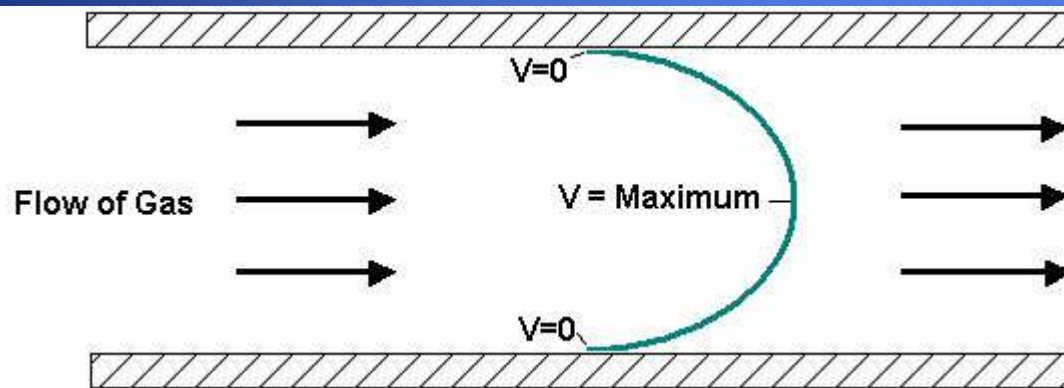
HY-BON's [IQR Emission Survey](#) includes an optional assessment of an oil and gas process to optimize pressure drops to atmospheric storage tanks and reduce flash emissions.



2. Adequate Diameter of Piping Used for Vent Lines to Control Device

Use vent piping between storage tanks and emission control devices that has a diameter designed to handle the potential instantaneous peak flow of vent gas including flash gas during separator dumps. If the piping is inadequate, then a portion of the gas will not be collected by the VRU and/or combustor. This will increase the chance of creating back pressure on the storage tank and result in venting to the atmosphere at the thief hatches and/or pressure relief valves (PRV).

INTERNAL GAS FLOW PIPE FRICTION CAUSES PROBLEMS: OVERSIZE IT



$$C_d = 0.5961 + 0.0261\beta^2 - 0.216\beta^8 + 0.000521\left(\frac{10^6\beta}{Re_D}\right)^{0.7} +$$

$$+ \left(0.0188 + 0.0063\left(\frac{19000\beta}{Re_D}\right)^{0.8}\right)\left(\frac{10^6}{Re_D}\right)^{0.3}\beta^{3.5} +$$

$$+ (0.043 + 0.08e^{-10L} - 0.123e^{-7L})\left(1 - 0.11\left(\frac{19000\beta}{Re_D}\right)^{0.8}\right)\frac{\beta^4}{1 - \beta^4} -$$

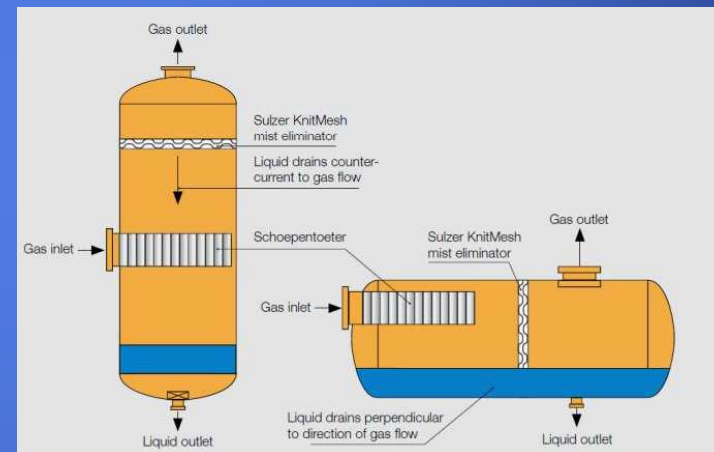
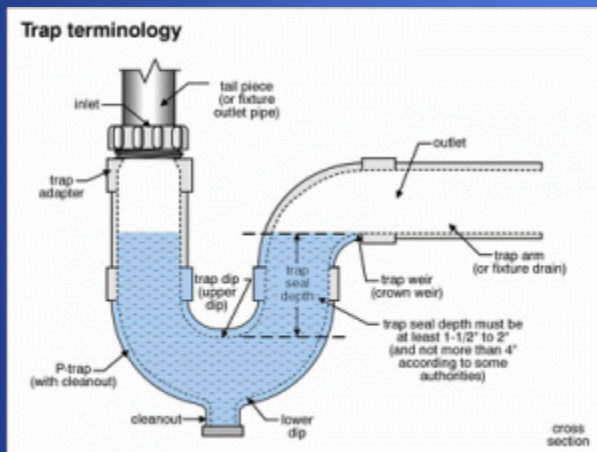
$$- 0.031\left(\frac{2L_2}{1 - \beta} - 0.8\left(\frac{2L_2}{1 - \beta}\right)^{1.1}\right)\beta^{1.3} + 0.011(0.75 - \beta)\left(2.8 - \frac{d_1}{0.0254}\right)$$

HY-BON includes this as a standard design criteria when sizing VRUs and combustors for a facility.

3. Prevent Liquid Collection in Vent Lines

The collection efficiency of vent gas control systems will be reduced if rich gas in the vent line between the storage tank and emission control device condenses and collect in vent lines – especially in low spots along the path.

NO LIQUID TRAPS TO GAS CONTROL DEVICES



In HY-BON's VRU and combustor lines, we recommend using a sloping piping of adequate inner diameter from the storage tank that is routed to a drip pot (i.e., scrubber) to ensure that liquids do not collect in the line creating a blockage. Also, the scrubber can remove liquids that can harm vapor recovery compressors and cause smoking conditions in enclosed combustors/flares.



4. Eliminate Unintentional Natural Gas Carry-Through

When storage tank pressure relief devices (PRD) are opening and venting gas on a regular basis due to pressure increase in storage vessel and this caused by unintentional natural gas carry-through, take corrective action to reduce/stop venting. This can be due to pressure increase during normal separator dump events and can also occur from separator dump valves stuck in open position (i.e., valve failed to reseal) and leaking gas into storage tanks.

If repeated PRD venting is not from unintentional natural gas carry-through, the following corrective actions are offered:

Increase the PRD pressure set points if there is sufficient margin between the set point and the rated pressure of the storage vessel to do so while continuing to safeguard storage vessel integrity-

Take steps to decrease the liquid's pressure drop experienced at the storage vessel

Replace the storage vessel with a storage vessel that is rated to a higher pressure and use higher pressure set points.

FIND THEM, DOCUMENT AND FIX THEM

HY-BON's design services will take into account production rates, operating pressures in sizing VRUs and combustors. Our IQR services include onsite inspections for carry-through of vent gas due to stuck dump valves.

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5. Ensure Proper Maintenance and Set Points for Pressure Relief Valves

By design, pressure relief valves (PRVs) are safety devices that protect vessels from over-pressurization and should remain closed during normal operations. They are not process vents that should discharge during normal operations.

The EPA alert states that PRVs should have a pressure setting that is low enough to protect vessel structural integrity and avoid over-pressurization. Also, the pressure setting should be high enough to exceed storage vessel operating pressures during normal operation.

When a PRV is found to be venting to the atmosphere actions should be taken to verify proper valve reseating after opening.

CRITICAL TO ALL OPERATIONS OF VRU AND CONTROL DEVICES. CHECK MONITOR AND MAINTAIN TO STAY IN COMPLIANCE



Division now issuing Immediate Notice of Violation for visible emissions from a flare and/or open thief hatch.

“The Division has determined that improperly secured thief hatches, visible emissions from a flare, and audible emissions from a thief hatch or PRV are violations of Regulation No. 7. The Division has determined that the minimum fine for an open thief hatch, visible emissions from a flare or audible emissions from a thief hatch or PRV will be \$15,000 per day. The duration of each such violation will be at least one day, unless evidence gathered by the Division and/or provided by the source proves otherwise.” (emphasis in original).

DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

Air Quality Control Commission; REGULATION NUMBER 7 ; CONTROL OF OZONE VIA OZONE PRECURSORS

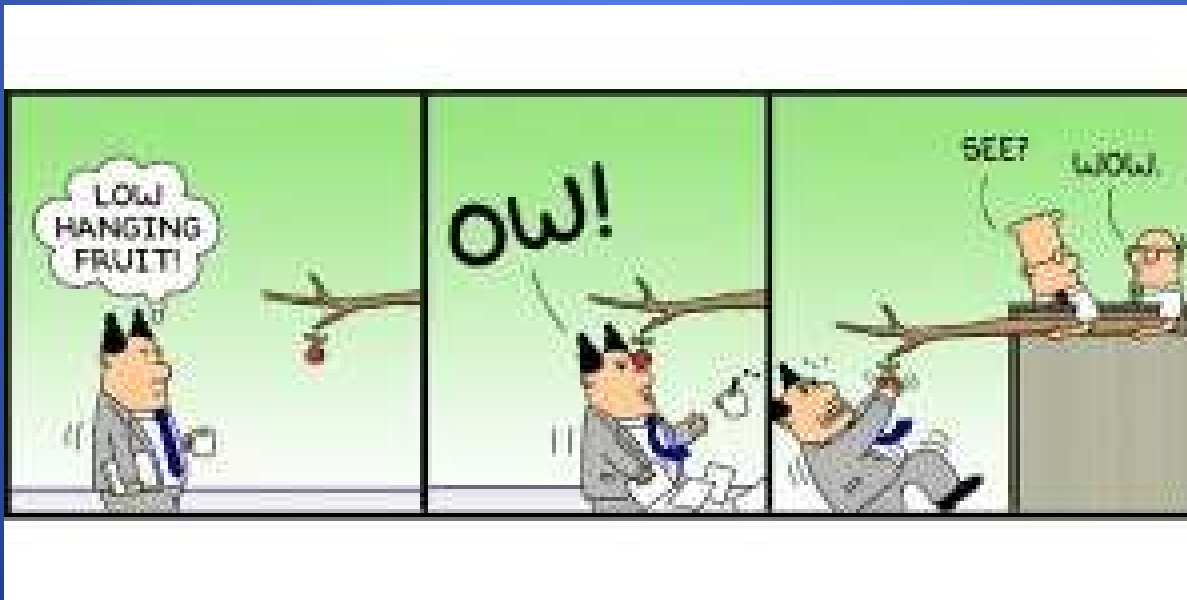
Noble Energy Reaches Agreement With Federal And State Regulators To Improve Air Emission Controls In DJ Basin Operations

The company will pay about \$13.5 million in civil penalties and \$60 Million to support environmental mitigation projects, according to the consent decree. Noble also agreed to upgrade its equipment in the DJ Basin to reduce emissions, with the work expected to be complete in 2019.

6. Minimize Venting from Thief Hatches

Inspect gauging/thief hatches and pressure relief devices regularly to ensure good seals. Install quality gaskets on thief hatches and regularly inspect those gaskets to ensure a tight seal. Implement procedures to ensure thief hatches are properly closed after vessel gauging, sampling and unloading.

INSPECTORS GO AFTER LOW HANGING FRUIT ALWAYS, PICK AND FIX IT FIRST



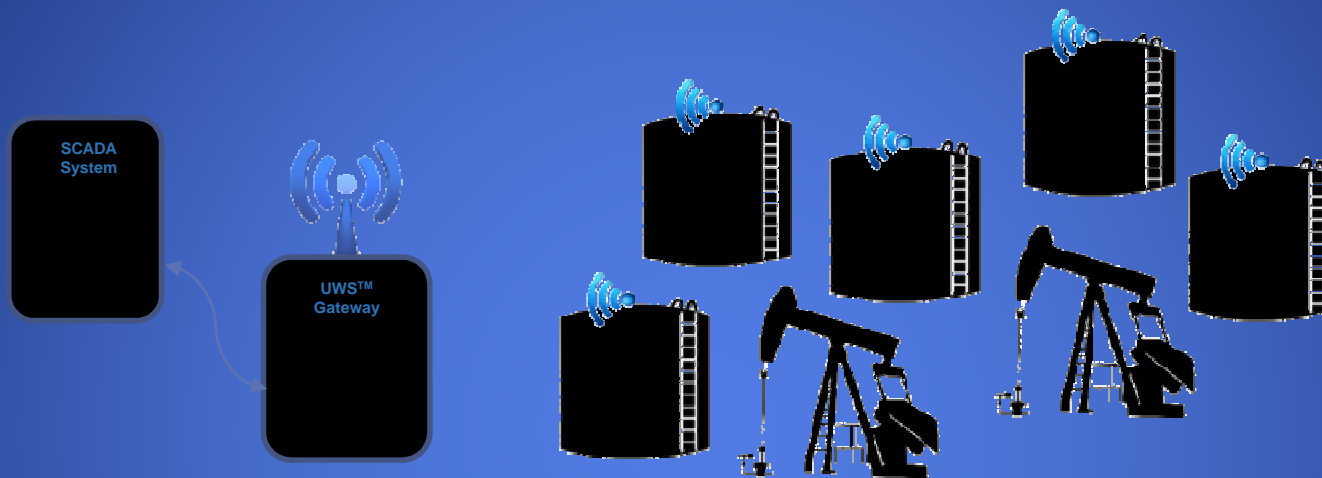
HY-BON routinely inspects and replaces gaskets for thief hatches and leaking pressure relief devices as a part of our [IQR services](#).



Hatch Sense (Pilot Testing)



Product Overview



The UWS™ Hatch Sense System is a UL listed wireless hall-effect proximity switch sensor and data gateway that provide reporting and alarming via Supervisory Control and Data Acquisition (SCADA) systems of the open or closed state of thief hatches and valves on oil and gas well sites.

The UWS™ Hatch Sense System

Solution



The Simplest Solution



- UWS™ Hatch Sense Kits with the free iOS Application
 - » One sensor per tank hatch or valve
 - » One customer supplied iPad per Operator
- Before operator leaves site the iOS App is used to verify the state of all of the hatches in the vicinity

A Better Solution

- UWS™ Hatch Sense Kits with the free iOS Application
 - » One sensor per tank hatch or valve
 - » One customer supplied iPad per Operator
- UWS™ Gateway with the free iOS Application
 - » One gateway per site
- SCADA Monitoring
 - » Data is automatically stored in the database
 - » Data can be compiled for EPA compliance reporting
 - » Email and Text messaging subscription services will alert when a hatch lid or valve is open
 - » Optional video surveillance

The UWS™ Hatch Sense System

Advantages



Certified by UL as an Intrinsically Safe Sensor for Use in Hazardous Locations

- Wireless at the hatch.
- UL File Number E482325. listed Class I, Div. 1 Intrinsically Safe.
- Evaluated to and conforms with the following list of standards:



- » UL 913, 8th Ed., Rev. 2015-10-16
- » CAN/CSA-C22.2 No. 60079-0:15 Issue Date 2015-10-01
- » CAN/CSA-C22.2 No. 60079-11:14, Issue Date 2014-02-01

Easy Non-Invasive Installation



- Wireless between the sensors and the gateway for easy quick installation.
- Universal design – Can be used to retrofit existing equipment.
- Mounting – Placement of the devices is non-destructive, therefore installation most likely will *not* require a permit or regulatory approval.

Energy Efficient

- Sensors are battery powered with an approximate life of 2 years.
- Gateway requires 25 VDC and supports the use of solar power.



Remotely view the state of all valves and hatches at all times.

Configuration, User Interface, and Alerts



On-Site Verification



Configuration



Remote Operations Center

Alert

The UWS™ iOS App

The GMC® System

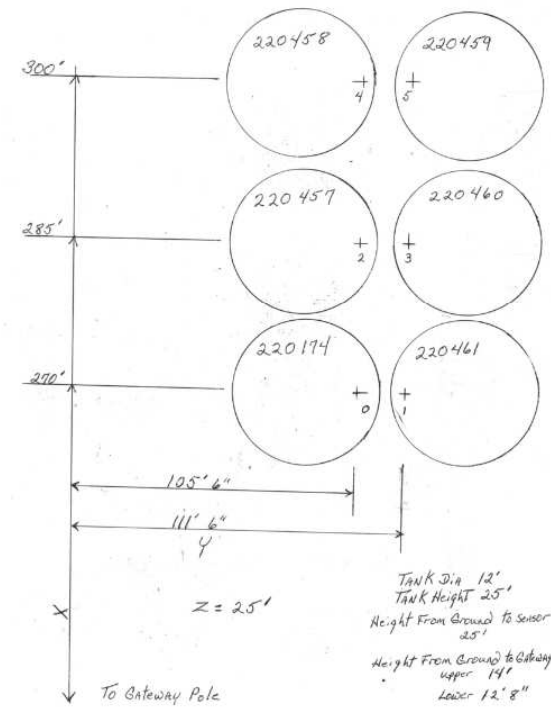


Traction



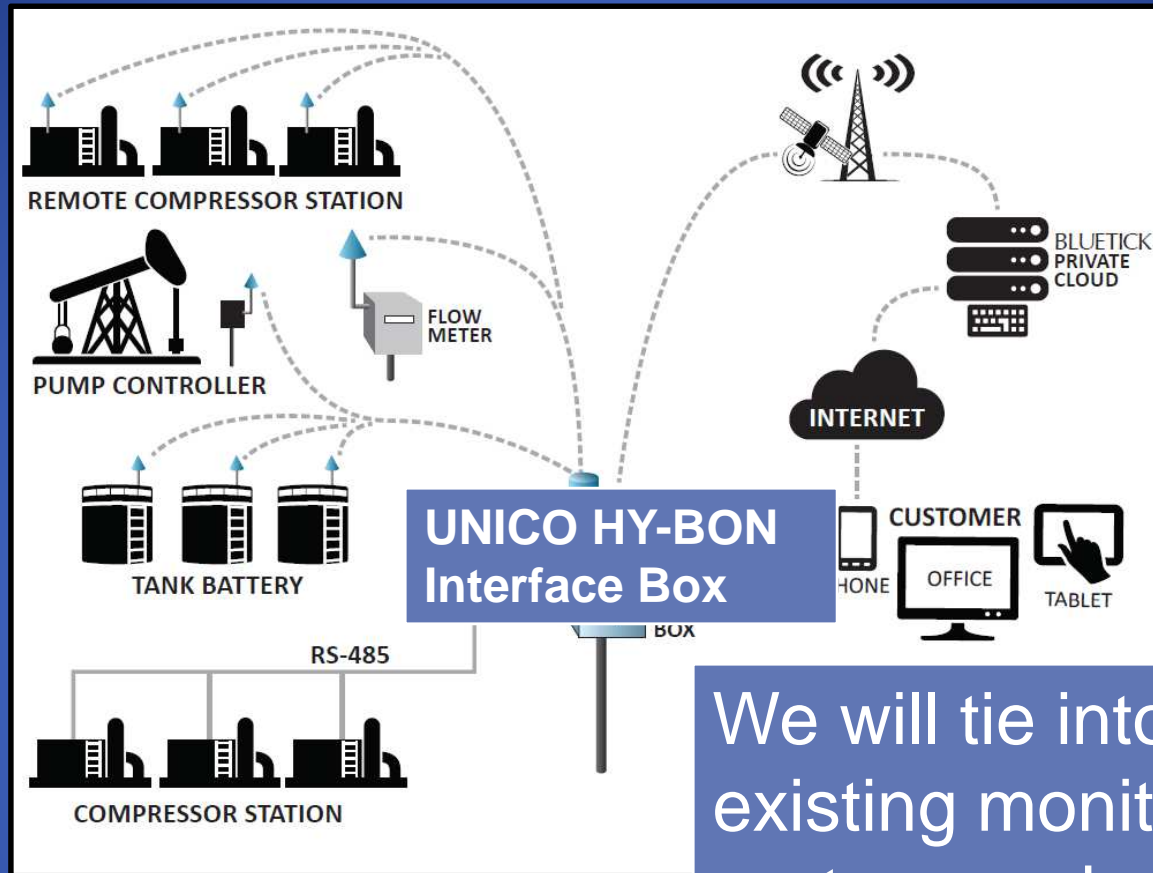
Pilot Installation at a Denver based Bonanza Creek Energy Inc

The pilot installation has six tanks, each equipped with one UWS™ Hatch Sense. There are two UWS™ Gateways installed approximately 300 feet away from the tanks and outside the hazardous area. Both gateways are solar powered during the daytime. One gateway is powered by backup batteries for over-night operation.



GMT Time	Name	Hatch Closed	Hatch Open	ΔT	Data Count	State Change	Work Ticket	Time Open
		Count	Count		Count	Count		
		4920	45		4965	10		
Value	MDT Time			Data Notes	State Change			
5/18/16 23:24	S05 Hatch State	0	5/18/16 17:24	0:05		1	RR1090988	< 5 min
5/18/16 23:29	S05 Hatch State	1	5/18/16 17:29	0:05		1		
5/19/16 0:13	S05 Hatch State	0	5/18/16 18:13	0:05		1	RR1090988	< 5 min
5/19/16 0:19	S05 Hatch State	1	5/18/16 18:19	0:06		1		
5/23/16 13:42	S05 Hatch State	0	5/23/16 7:42	0:06		1	RR0040963	~ 1hr 22 min
5/23/16 15:24	S05 Hatch State	1	5/23/16 9:24	0:06		1		
5/24/16 8:22	S05 Hatch State	0	5/24/16 2:22	0:05		1	RR0040964	~ 12 min
5/24/16 8:34	S05 Hatch State	1	5/24/16 2:34	0:06		1		
6/1/16 18:34	S05 Hatch State	0	6/1/16 12:34	0:17		1	RR0300825	~43 min
6/1/16 19:17	S05 Hatch State	1	6/1/16 13:17	0:22		1		
6/1/16 20:48	S05 Hatch State	0	6/1/16 14:48	0:11		1	RR0300825	~ 6 min
6/1/16 20:56	S05 Hatch State	1	6/1/16 14:56	0:07		1		
6/4/16 20:11	S05 Hatch State	0	6/4/16 14:11	0:05		1	RR0040983	~ 10 min
6/4/16 20:21	S05 Hatch State	1	6/4/16 14:21	0:05		1		
6/6/16 16:26	S05 Hatch State	0	6/6/16 10:26	0:05		1		~ 34 min
6/6/16 17:05	S05 Hatch State	1	6/6/16 11:05	0:07		1		
6/9/16 19:50	S05 Hatch State	0	6/9/16 13:50	0:04		1	RR1091009	< 5 min
6/9/16 19:55	S05 Hatch State	1	6/9/16 13:55	0:04		1		
6/16/16 17:00	S05 Hatch State	0	6/16/16 11:00	0:05		1		~ 1hr 8 min
6/16/16 18:08	S05 Hatch State	1	6/16/16 12:08	0:06		1		

Bonanza Creek “found the devices to be successful.”
The feedback from all levels, Operations, Automation, and Facilities is very strong .



We will tie into your existing monitoring systems or build one for you.





7. Proper Sizing of Emission Controls

Ensure that vent gas control devices are properly designed/sized for the specific facility's operations. The design should be sized and operated to control for the full range of gas flowrates that are expected.

Key to ensuring proper sizing of emission controls is appropriate sampling, measurement and/or modeling to estimate potential maximum flow of vent gas from storage tanks.

YOU DON'T KNOW, WHAT YOU DON'T KNOW. GET GOOD DATA. Allows for Management Decisions based on fact.



HY-BON's engineers can run process simulation calculations to estimate the potential range of flowrates of vent gas for various operating scenarios. The assessment will take into account production rates, storage tanks used and operating pressures in sizing VRUs and combustors.

LOW BID COST MORE

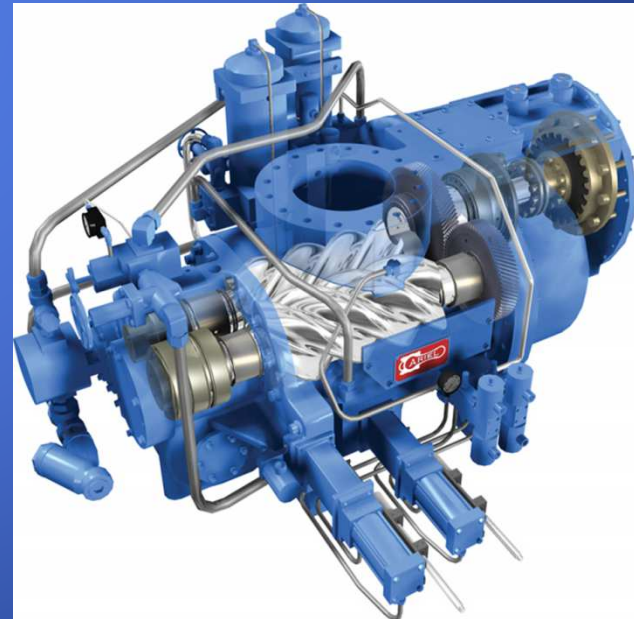
After flyover of an oil and gas production site by the TCEQ using FLIR Camera, an O&G Operator observed visible vent gas emissions. TCEQ gave the operator the opportunity to correct the emissions without monetary penalty.



LOW BID COST MORE

The operator contacted HY-BON for an IQR measurement and bid for a vapor recovery unit (VRU). HY-BON engineered a system for the application and quoted a wet, flooded screw VRU and vapor recovery tower (VRT).

PAYBACK for HY-BON system estimated at 9 MONTHS.



LOW BID COST MORE

The operator decided to go with another vendor based on cost/low bid for a reciprocating compressor VRU (which was NOT designed for the wet gas service it would encounter.)

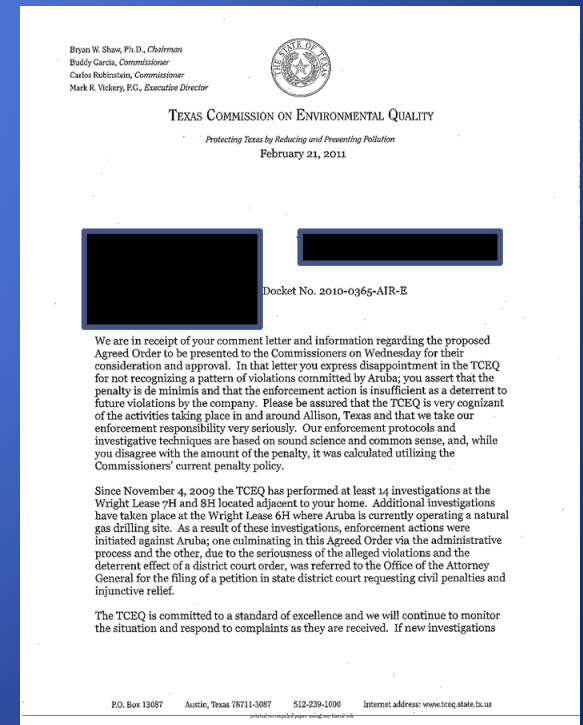
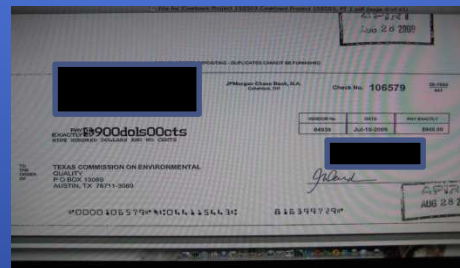
HY-BON gave a “HEADS UP” of possible failure using recip in wet gas service.



LOW BID COST MORE

TCEQ inspectors conducted a follow-up inspection for the production facility and found the site venting natural gas due to failure of the reciprocating VRU compressor.

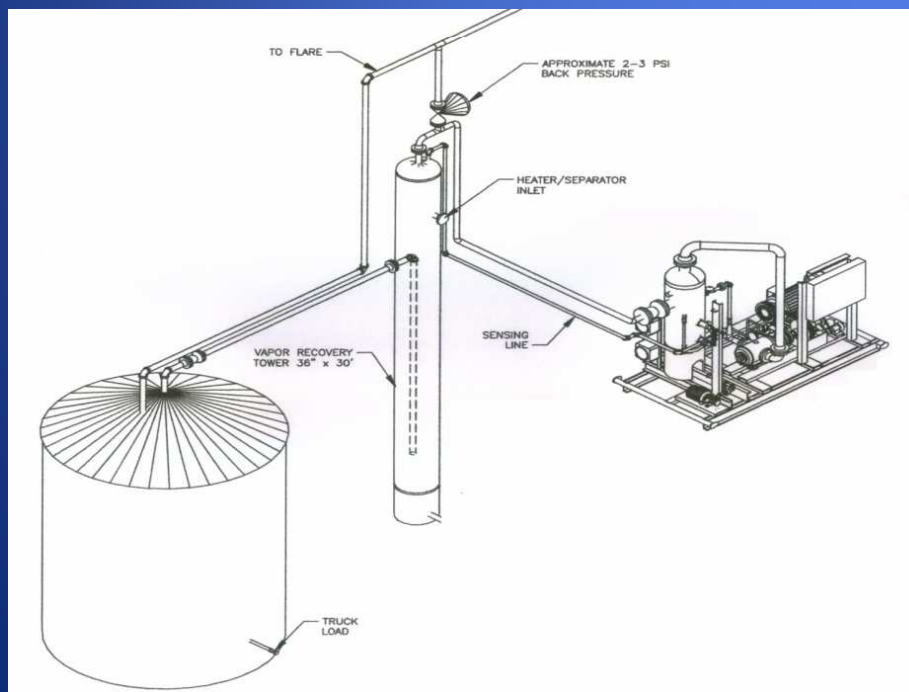
TCEQ issued a notice of violation and the company was fined \$300,000.



LOW BID COST MORE

The operator contact HY-BON to correct the low bid system that did not function properly.

HY-BON supplied the proper VRU design for the application. The production site is NOW producing and operating in compliance with TCEQ air quality regulations.



LOW BID COST MORE

HY-BON's engineered designs have the lowest downtime and operating costs in the oil and gas industry.

DOING IT RIGHT THE FIRST TIME WILL MAKE YOUR COMPANY MONEY AND KEEP YOU IN COMPLIANCE.



Non-compliance **Costs**



Non-compliant
Organization



The Law



COMPLIANCE
HAS NEVER BEEN
SO EASY!

YOU DON'T KNOW . WHAT YOU DON'T KNOW

HEADS UP: SECTION 114 LETTERS

- If you do receive a Section 114 Request, remember the key is a good faith response to EPA. Act quickly and develop a plan of action to ensure your response is forthright and timely. First, don't panic; a planned approach is the best defense.





GasFindIR Camera

The invention of the FLIR Gas Find IR Camera's in 2004 allowed industry (and regulators) to see these gas streams for the first time



HY-BON







WHAT GETS SEEN, GETS MEASURED

**WHAT GETS MEASURED, GETS
CONTROLLED**

***WHAT GETS CONTROLLED, CAN MAKE
YOU MONEY***

PICARRO REAL TIME MEASUREMENT



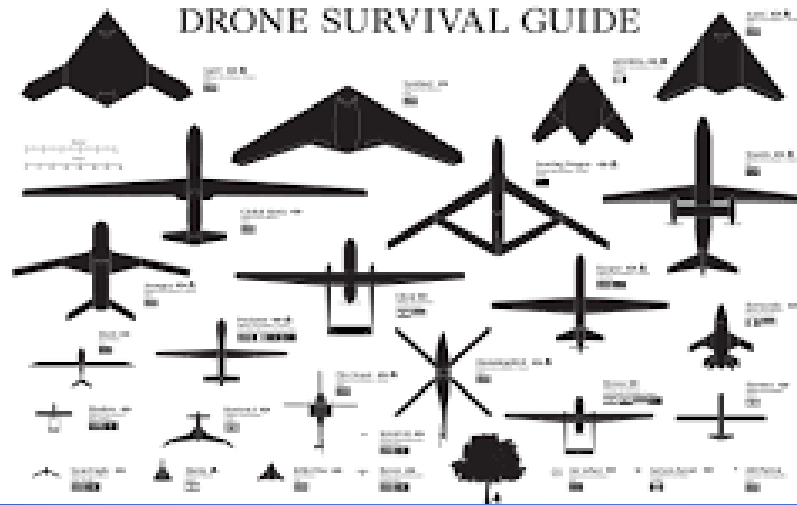
See greenhouse emissions like never before.

Now anyone can measure and map emissions with CRDS precision and cloud-based algorithms. In seconds.

Methane emissions in Rodeo, CA.



DRONE SURVIVAL GUIDE



HY-BON



Total Safety gets approval to use drone in flare stack inspections. FAA: Feb 2015

- **Company intends to make service available to Permian Basin clients**
- **Inspection by drone can be done for refineries, petrochemical plants, tank batteries, drilling rigs, completion sites or production facilities.**
- **More economical and efficient than traditional inspection methods.**

FLIR™ HI

MANUAL

WH



1/18/08 2:42:47PM



Understanding this gas stream

HY-BON

- 3 Phase separation – as pressure is reduced on the liquid, heavier hydrocarbon gases are released.
- Methane versus ethane, butane & propane
- Higher levels of contaminants & H₂S
- Some is heavier than air, so exposure to employees and community is higher
- Higher BTU, so more valuable
 - 2,000 to 3,000 BTU vs. 1,000 BTU typical pipeline gas
 - Sells for 2.5X normal NYMEX gas prices

GAS COMING OUT OF SOLUTION



“Best in Class” Solutions for Effective Capture & Control

Requires a Total Solutions Approach

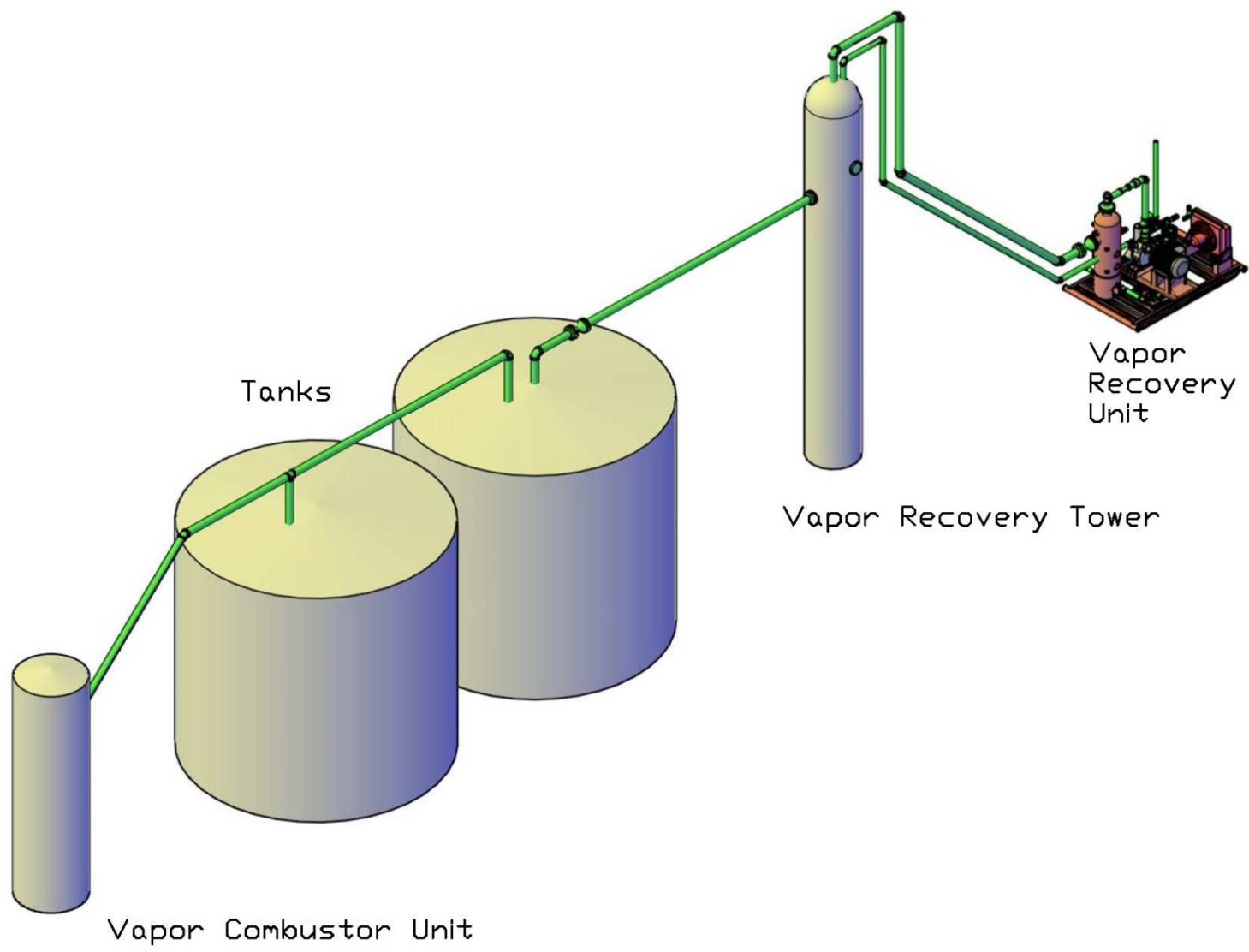
Emission Surveys to Accurately determine volumes, gas analysis & pressures

Vapor Recovery Towers

“Real” Vapor Recovery Units

Enclosed Combustors

Maintenance & Tracking program



HY-BON

1500TPY 125MSCFD



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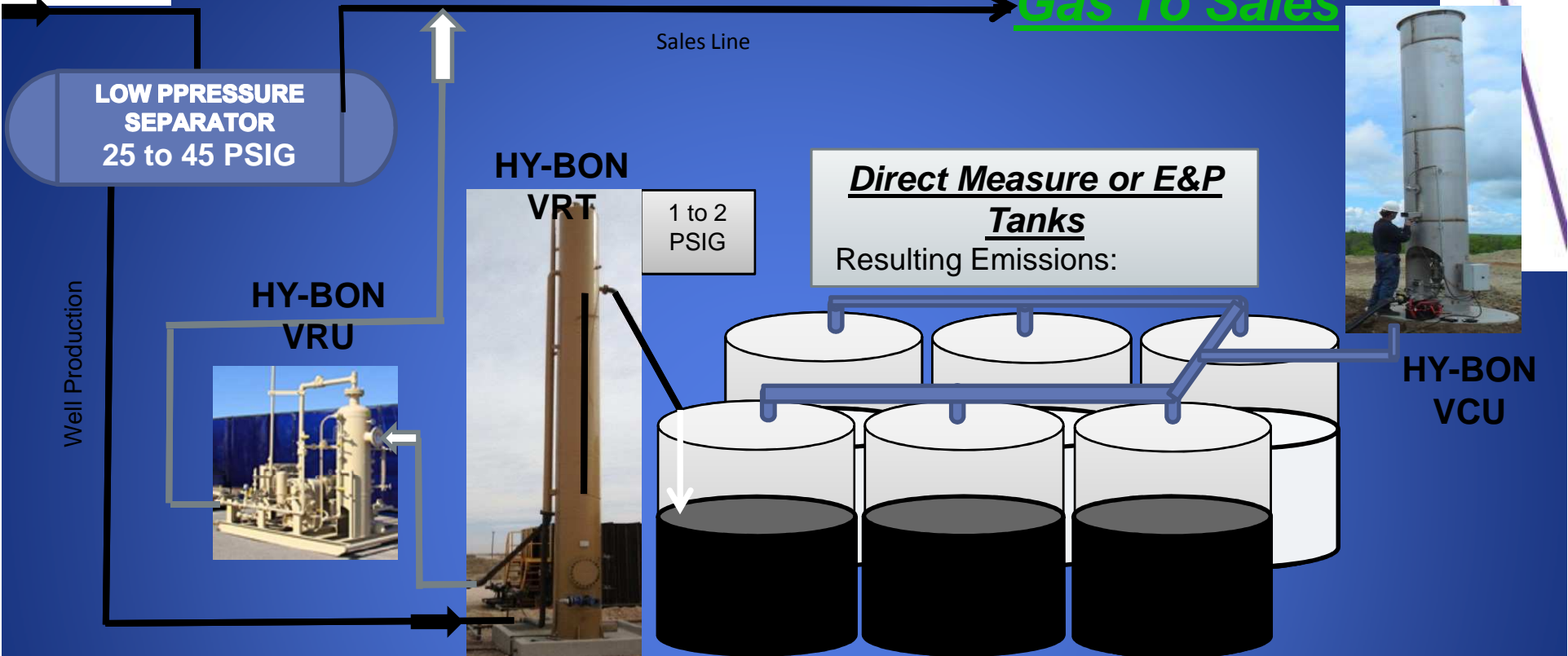




HY-BON Engineering - GOLD Standard Solution

HY-BON

Gas To Sales



Economic Payback

6.65

Months

Operational Data		Qty	Project Installed Cost			\$145,400.00		
Flow Volume MSCFD	100		IQR Field Survey Cost			\$1,600		
Operating Days	350		UNIT SELECTION					
BTU of GAS	2100	1	HB-NK100-40-36D	Op Range	60-120	PSI	200	41,900
Gas Price	\$3.57	1	HY-BON(VRT)		5 - 75	1 - 2	20,500	
		1	HY-BON Combustor (SM)		.7MTF	4 oz	9,500	
Annualized Revenue	\$262,395.00	0	NONE		0	0	0	
			Install Cost %	100%	Installation Cost		71,900	

XYZ Energy												
Vent Gas Management Recommendations												
Program Approach on 30 Sites												
									**Est	Total	Survey	Total
	# of	Total	Gas \$ per day						Instal	Installed	Cost Avg	Program
	Sites	mcf/d	@ \$4 per mcf	Gas \$ per year	Solution	Cost	Qty	Total Cost	Costs	Costs	\$1,550 ea	Cost
Tier 3 Sites	6	460	\$1,840	\$671,600	VRU - NK 100	\$41,097	6	\$246,582	\$86,304	\$332,886	\$9,300	\$342,186
Tier 4 Sites	20	469	\$1,876	\$684,740	VRU - NK 60	\$33,255	20	\$665,100	\$232,785	\$897,885	\$31,000	\$928,885
Tier 5 Sites	3	11	\$0	\$0	BioFilters *	\$6,600	3	\$19,800		\$19,800	\$4,650	\$24,450
Under 25 tons	1	1									\$1,550	\$1,550
Totals	30	929	mcf/d	\$1,356,340	per year		29	\$931,482	\$319,089	\$1,250,571	\$46,500	\$1,297,071
			(Captured Gas)	\$113,028	per month							
Tier 1 Site		Over 300	Case by Case design									
Tier 2 Site		120-300	Q225 VRU									
Tier 3 Site		60-120 m	NK100 VRU									
Tier 4 Site		5-60 mcf	NK60 VRU									
Tier 5 Site		2 - 5 mcf	BioFilter									
											Payback Analysis: < 12 months	
(Not including OPEX)												



WHAT GETS SEEN, GETS MEASURED

WHAT GETS MEASURED, GETS
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*WHAT GETS CONTROLLED, CAN MAKE
YOU MONEY*



Keys to Success

“TOTAL SOLUTIONS APPROACH”

Using Standardized VRU Designs
Engineered to cost effectively capture the
gas analysis from your field or basin with
maximum run times



Recommendation:

A Pilot Program – Evaluate 10 Sites in one Basin

*Allows for management decisions based on
fact*

HY-BON Engineering Company

Electronic Design for Industry



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Belpre, OH 45714

Phone: (740) 401-4000
Fax: (740) 401-4005

www.ediplungerlift.com

Setting a New Standard!!

HY-BON ENGINEERING COMPANY,



Any Questions ?

