

Best Practices to Reduce Venting and Flaring with Economic Benefit.

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What does a Vapor Recovery Units do?



Takes waste gas emissions and convert them into revenue, while keeping you safe and in compliance.

Wasting resources and, most importantly, revenue!



Actual Measurement

➔ 530 tons per year of VOC Emissions

➔ $55 \text{ MSCFD} \times \frac{\$4}{\text{MSCF}} \times 2000 \text{ BTU} = \frac{\$132,000 \text{ Revenue}}{\text{Year}}$

➔ Project Cost: \$100,000 (VRU, VRT, VCU and Install Estimate)

➔ Payout: 9 Months!

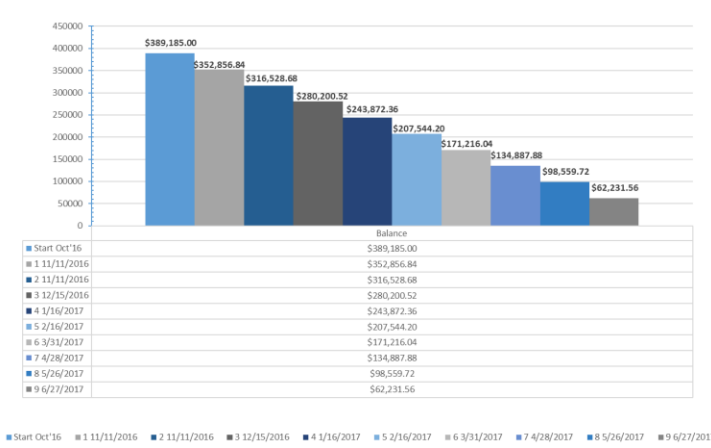
Vent Gas Revenue Share – A Permian Basin Success Story

A TOTAL SOLUTIONS APPROACH

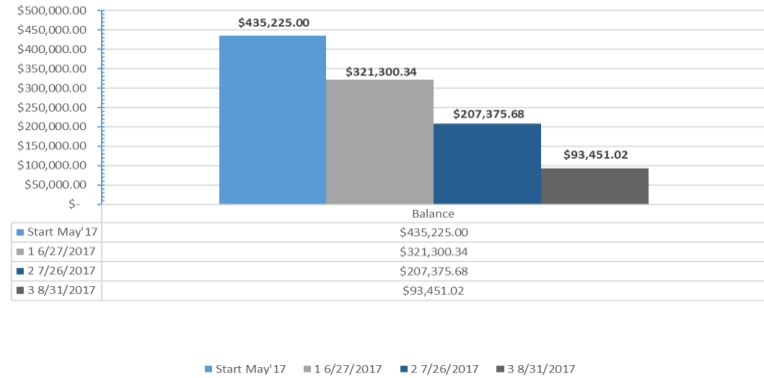
Actual Revenue Sharing Payback



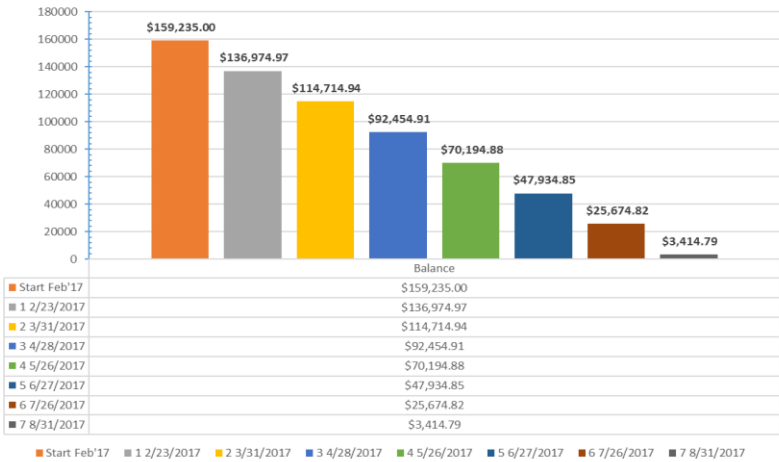
Actual Revenue Sharing Payback
12-months Payback



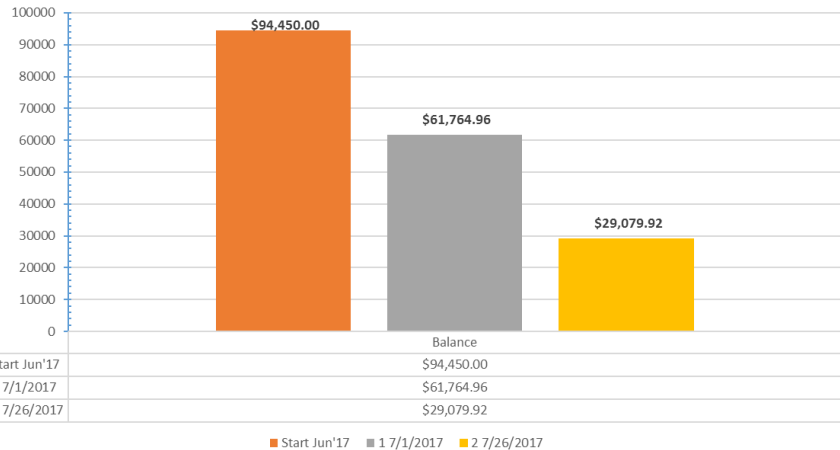
Actual Revenue Sharing Payback
4-Months Payback



Actual Revenue Payback
8-months Payback



Actual Revenue Payback
3-months Payback



HEADS UP: WHAT THEY ARE LOOKING FOR

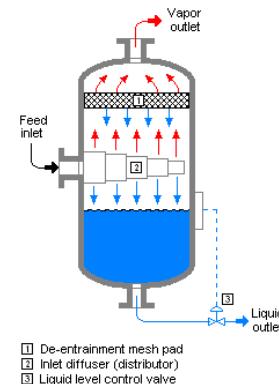


1. Crude Oil/Condensate/Produced Water Pressure Drop

To reduce flash gas volumes and peak flowrates of vent gas during separator dumps 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

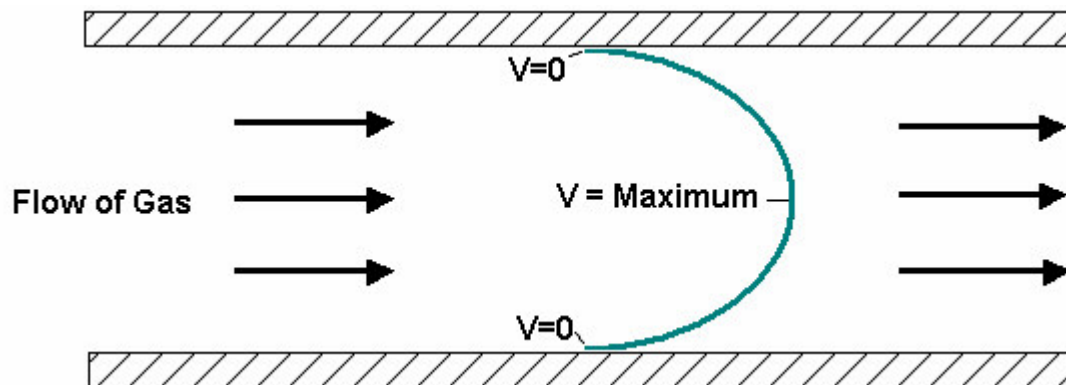


Optimize pressure drops to atmospheric storage tanks and reduce flash emissions.

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 increase flash gas during separator dumps. If the piping is inadequate, then a portion of the 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



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

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

$$+ (0.043 + 0.08e^{-10L_2} - 0.123e^{-7L_2})\left(1 - 0.11\left(\frac{19000\beta}{Re_D}\right)^{0.8}\right)\frac{\beta^4}{1 - \beta^4} -$$

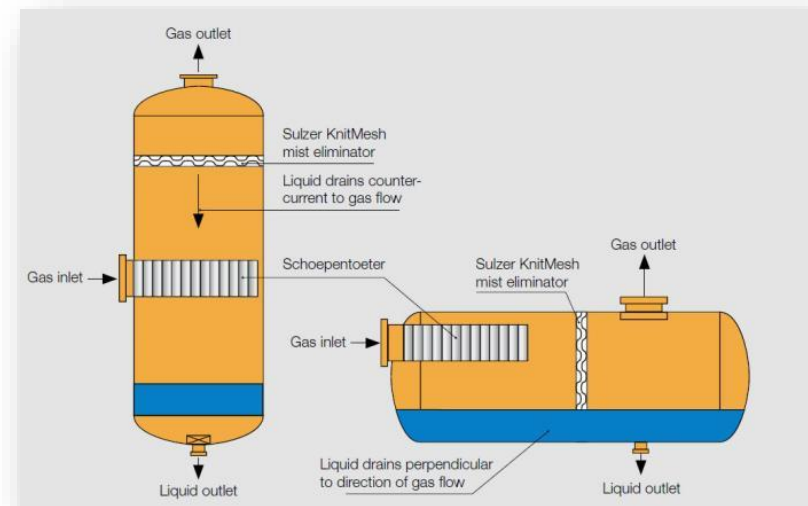
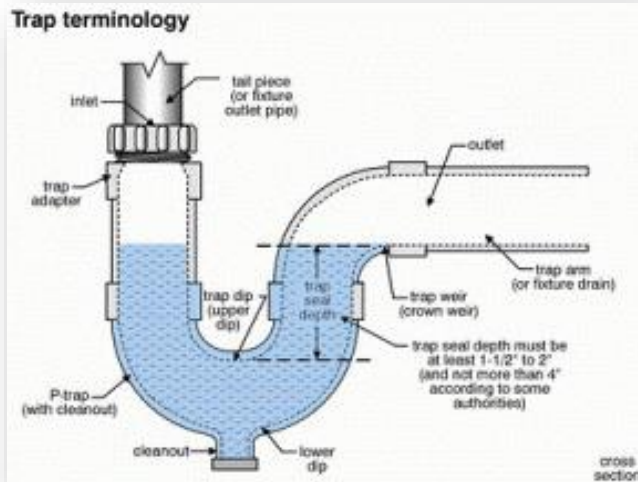
$$- 0.031\left(\frac{2L_2}{1 - \beta} - 0.8\left(\frac{2L_2}{1 - \beta}\right)^{1.1}\right)\beta^{1.3} + 0.011(0.75 - \beta)\left(2.8 - \frac{d_1}{0.0254}\right)$$

Use 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 to vent line between the storage tank and emission control device condenses and collects in vent lines – especially in low spots along the path.

No Liquid Traps to Gas Control Devices



VRU and combustor lines, 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 reseat) 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 Them and Fix Them

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.



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

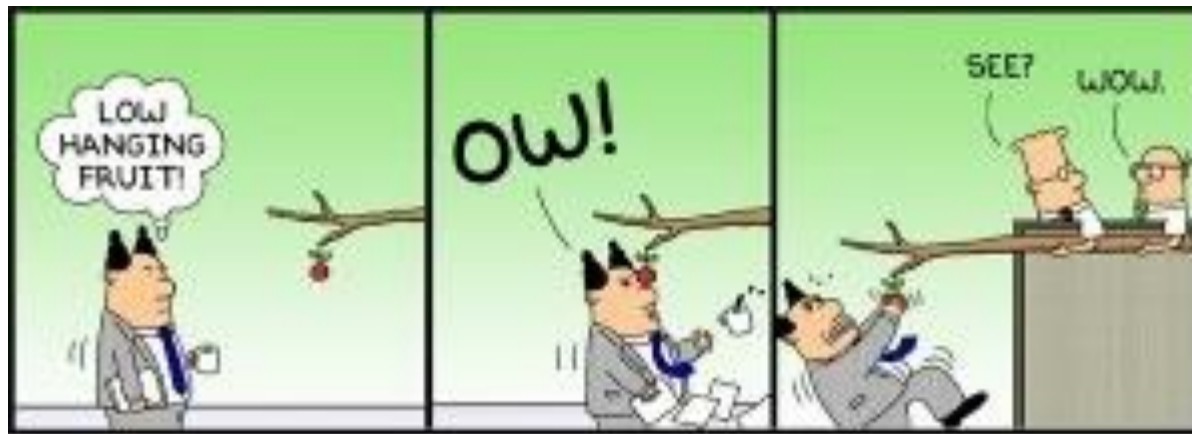
“The Division has determined that improperly secured thief hatches, visible emissions from a flare, and audible emissions from a thief hatch or PRV are violations of Regulation No. 7. **The Division has determined that the minimum fine for an open thief hatch, visible emissions from a flare or audible 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*

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.

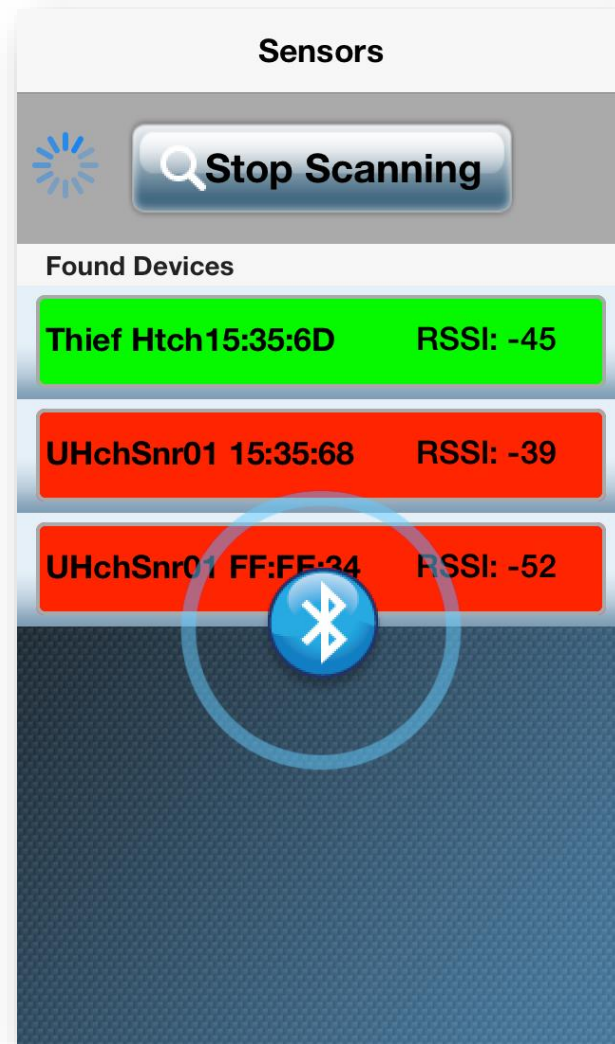
Inspectors Go After Low Hanging Fruit. Always Pick and Fix It First.



Routinely inspects and replaces gaskets for thief hatches and leaking pressure relief devices.



Hatch Sense

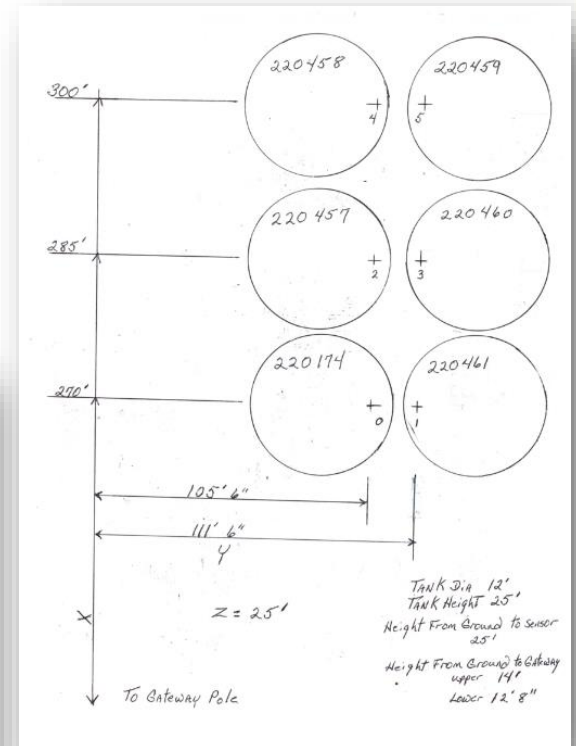


Configuration, User Interface and Alerts

Pilot Installation at a Denver Based Producer



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.



		Hatch Closed	Hatch Open			Data Count	State Change		
		Count	Count				Count		
		4920	45			4965	10		
GMT Time	Name	Value	MDT Time	ΔT	Data Notes	State Change	Work Ticket	Time Open	
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			

Producer “found the devices to be successful.”

The feedback from all levels, Operations, Automation, and Facilities is very strong .

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

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

PAYBACK for HY-BON/EDI 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 the wet gas service it would encounter.)

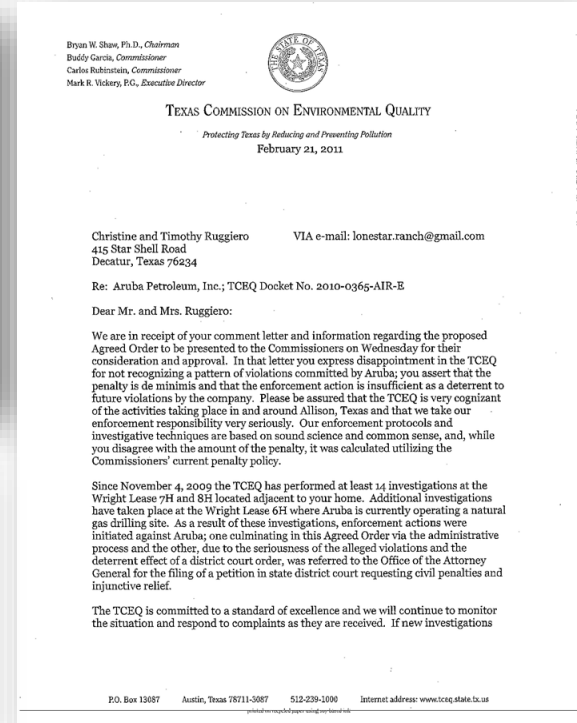
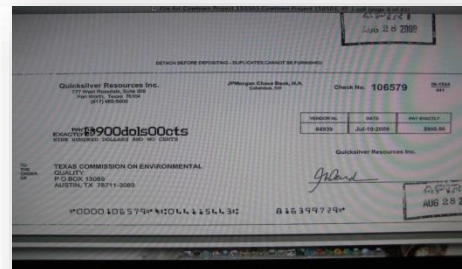
HY-BON/EDI gave a “HEADS UP” of possible failure using reciprocating compressors in wet gas service.



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.



YOU DON'T KNOW WHAT YOU DON'T KNOW



WHAT GETS SEEN, GETS
MEASURED

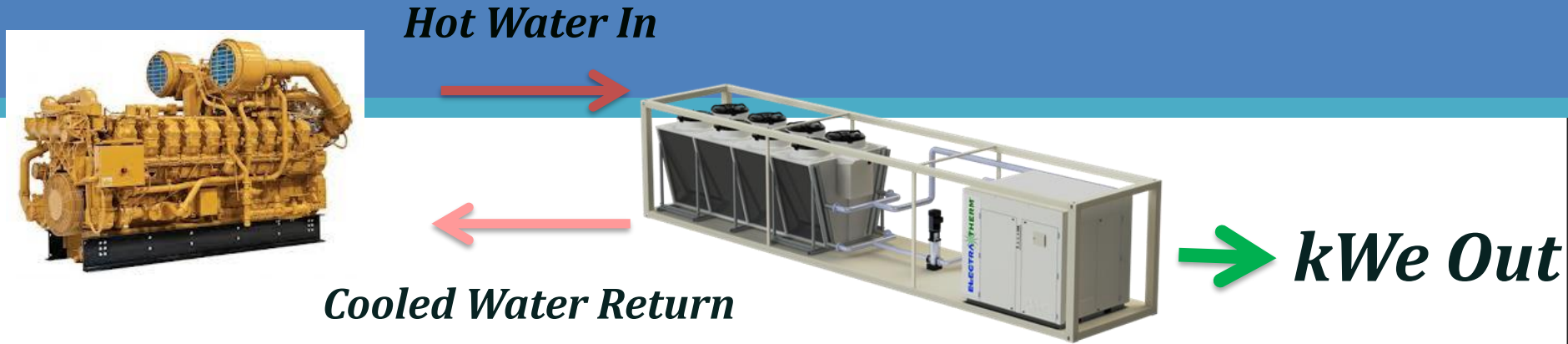
WHAT GETS MEASURED, GETS
CONTROLLED

WHAT GETS CONTROLLED, CAN
MAKE YOU MONEY

Opportunity to Learn Something New



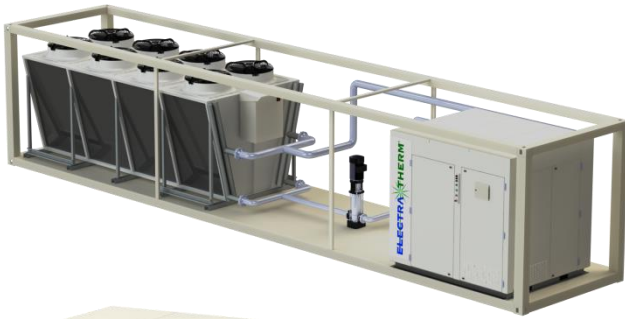
Waste Heat to Energy: Stationary Engines



Produce More Power & Reduce Cooling Fan Load

Waste heat from engine jacket water or combination
exhaust & jacket water

Requirements



Power+ 4200
Up to 35kW



Power+ 4400
Up to 65kW

Power+ 6500
Up to 110kW

Range of need:

- 15 - 110kW output
- Up to 250°F
- Plug & Play
- Robust & Reliable





The Crude Oil Stabilization and Recovery (COSR) process



Six Bakken crude oil wells, each producing 400 barrels of oil per day of oil, with an uncontrolled Reid vapor pressure of 17, are gathered to feed a single heater treater at 50 psig. The Reid vapor pressure is reduced to 7.6 psi. Concurrently, the tank vent is completely recovered without the need for a flare.

	COSR	Uncontrolled
Vent recovery	100%	0%
Crude oil Reid vapor pressure, psia	7.6	17.2
Max storage temp., °F	113	44
Recovered vent value, \$/month	\$ 161,241	\$0

Not Always the answer!

