


# Direct Measurement Findings of Pneumatics and Compressor Seal Vents in Western Canada

US EPA GAS STAR 2015 - Pittsburgh

# Agenda

- GreenPath Overview
  - BC Reporting Regulation
  - Pneumatics Overview
  - Compressor Vent Measurement
  - Other Measurement Applications
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# About GreenPath Energy Ltd.

**Since 2007** GreenPath Energy Ltd. has provided emission solutions and field services for Canadian & US oil and gas producers.

**Our People** have the field experience to understand the forces behind emissions and the solutions to track, manage and eliminate.

## **USA Office Location**

Denver, CO

## **Canadian Office Locations**

Calgary, AB (Head Office)

Grande Prairie, AB

Woodstock, ON

Fort St. John, BC



# British Columbia GHG Reporting Regulation

- Very Similar to reporting requirements under Subpart W / CCAC Reporting
- Linear Facilities Operation:
  - You own/ control it you have to report on it.
  - Well level vents and leaks are reported.
- Over 10,000 tCO<sub>2</sub>e/year reports
- Over 25,000 tCO<sub>2</sub>e/year reports and requires 3<sup>rd</sup> part verification.
- Key Issues:
  - Pneumatics Inventory
    - GreenPath Energy completed data collection for 2013 study on pneumatic emissions.
      - Data used to revised 2013 emissions
    - Lack of a pneumatic inventory or census.
  - Direct measurement of compressor vents (rod packing and wet-seals)

# BC GHG Reporting Regulation 2012

- Default Emission Factors by device category.
- Required pneumatic inventory or census, could use Process and Instrumentation Diagram (P&ID) as proxy.
- Requirement for all High bleed devices and pumps to be metered by 2016

Category	Common Devices	Emission Factor (scf/h)
High Bleed	Fischer 546 Fisher 4150 Fisher 2500	38.5
Low Bleed	Fischer C1 Fisher i2P? Norriseal 1001? Fisher L2?	1.4
Intermittent?	Norriseal 1001? Fisher L2?	14
Pumps	Texsteam 5100 Morgan HD312 Williams P250 Williams P125	10.7

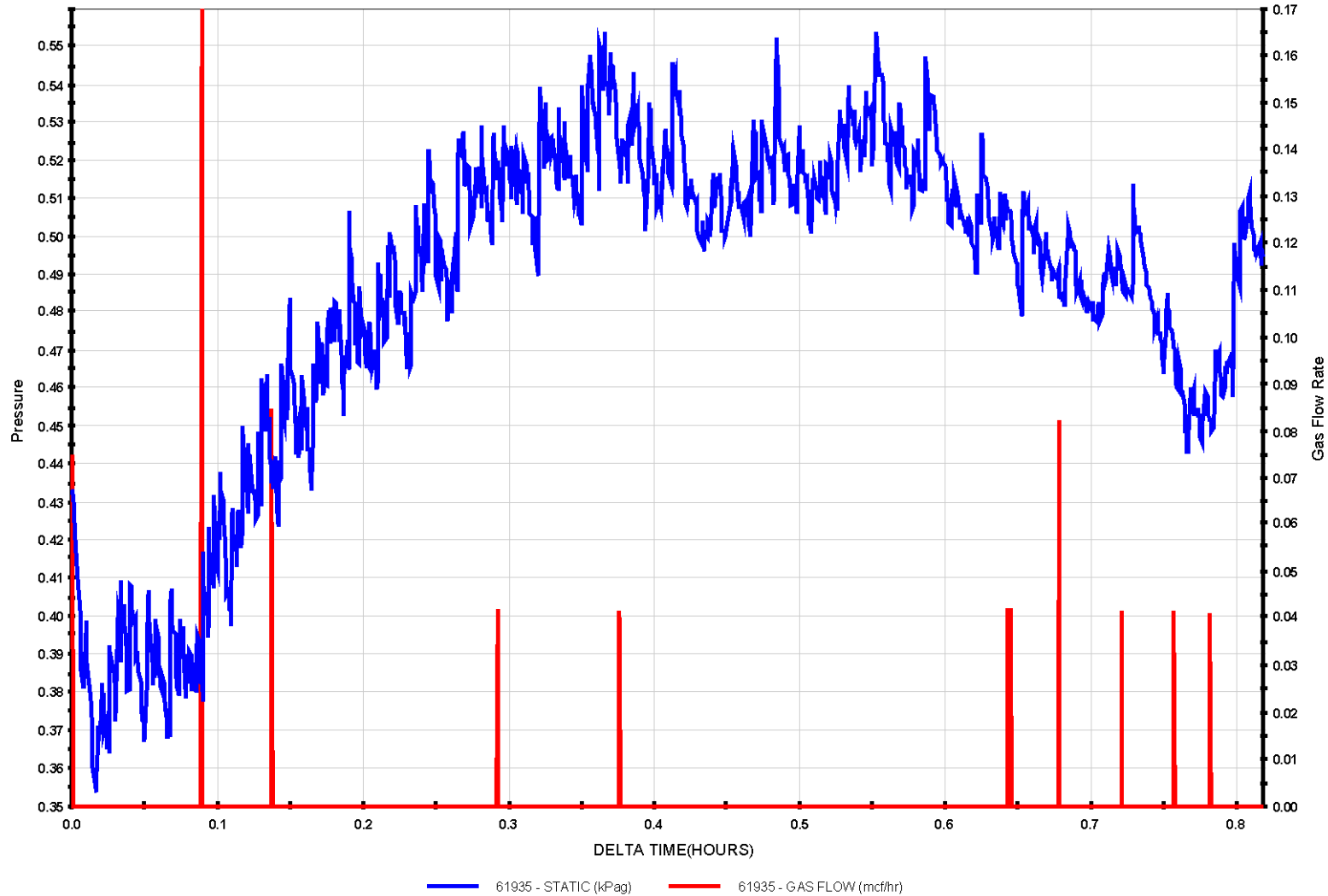
# GreenPath Direct Measurement Equipment

- GreenPath selected equipment for use In Prasino Study
- Able to evaluate full emissions from control loop of level controllers
- Greater accuracy on pump emissions
- Ability to measure rates above 10 cubic feet per minute (cfm).
- PD Meter w/ Digital Meter Specs
  - Lithium Ion Battery Up to 1 year Power
  - +/-2% fuel gas accuracy
  - Class I Div I Certified
  - Digital logged values
  - Sample rates as fast as once per second



PRESSURE And GAS FLOW RATE vs TIME

Company: GreenPath Energy  
Location: K105 1st Stage Level Controller Norrisal 1001A  
Date: October 25,2013  
Serial# 61935



- Norrisal 1001A level controller
- Comp 1<sup>st</sup> Stage Scrubber Level Controller
- Infrequent actuations and variable vent rates
- Demonstrates need for time based measurements for level controllers

# Prasino Study Key Findings

Device Make / Model	Post Average (scf/h)	Pre Average (scf/h)	Delta (%)
Fisher 4150	12	38	-69
Fisher C1	1.8	1.4	27
Fisher 546	10.0	38	-74
Fisher i2p-100(h)	6.1	1.4? Or 38 ?	323 or -84
Fisher 2500	11	38	-71
<b>Fisher L2</b>	<b>7.5</b>	<b>1.4?</b>	<b>418?</b>
<b>Norriseal 1001a</b>	<b>5.2</b>	<b>1.4?</b>	<b>266</b>
Texsteam 5100	27	10.7	157
Williams P250	22	10.7	113
Average HB	7.5	38	-81
Average LB	1.4	4.1	192

- Use of positive displacement meter which graphed emissions over time
- Significant downward revision of “high bleed” emissions
- Low Bleed, not necessarily below 6 scfh
- Large Revision on Pumps
- Need for more data on “low bleed” level Controllers
- Results of study used to justify removing requirement for metering pumps and high bleed devices



# Key Changes in BC Reporting Regulation Data

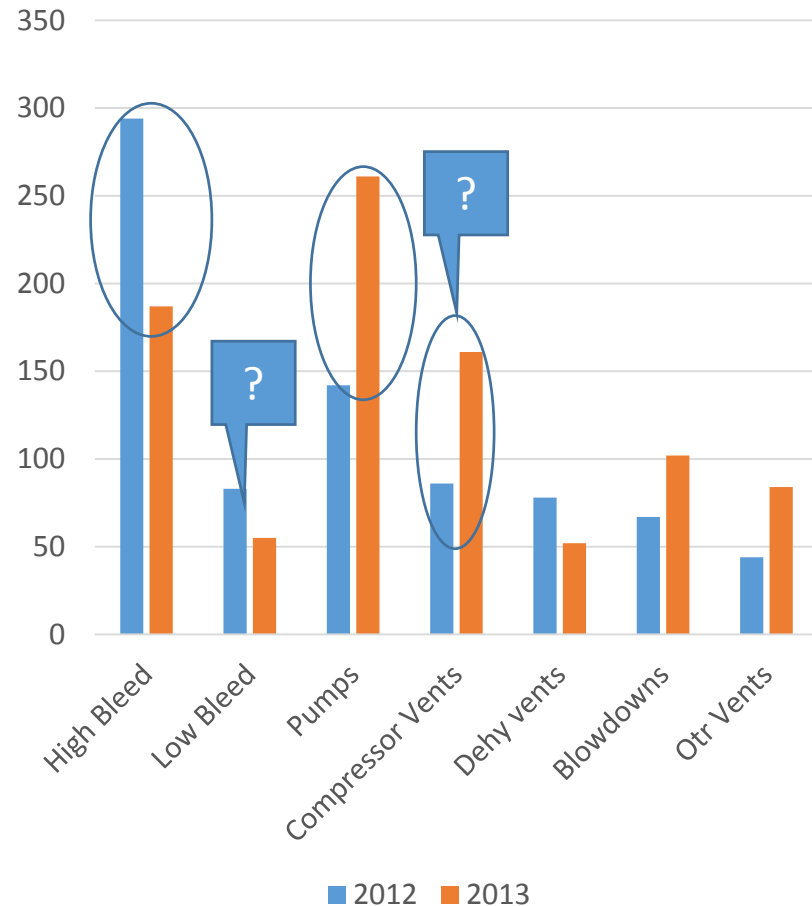
## 2012 Methods

- Generic Emission Factors for:
  - Pumps
  - High Bleed Controllers
  - Low Bleed Controllers
- Compressor Venting
  - Engineering Estimates

## 2013 & Current Methods

- Make / Model Emission Factors:
  - Piston vs Diaphragm pumps
  - High Bleed Controllers
  - Low Bleed Controllers?
- Compressor Venting
  - Direct measurement if hp >250

# Key Change In Venting = Better Data




- The Prasino Study Revised emission factors for all major makes and models of controllers (not just high bleed) and pumps.
  - GreenPath executed the field component of the “Prasino Study” using positive displacement meter.
  - But... volumes didn’t move the way you would have expected
- Requirement for direct measurement of compressor venting unless a “safety risk that could not reasonably be mitigated” was present.

Source: BC Industrial Facility GHG Reports

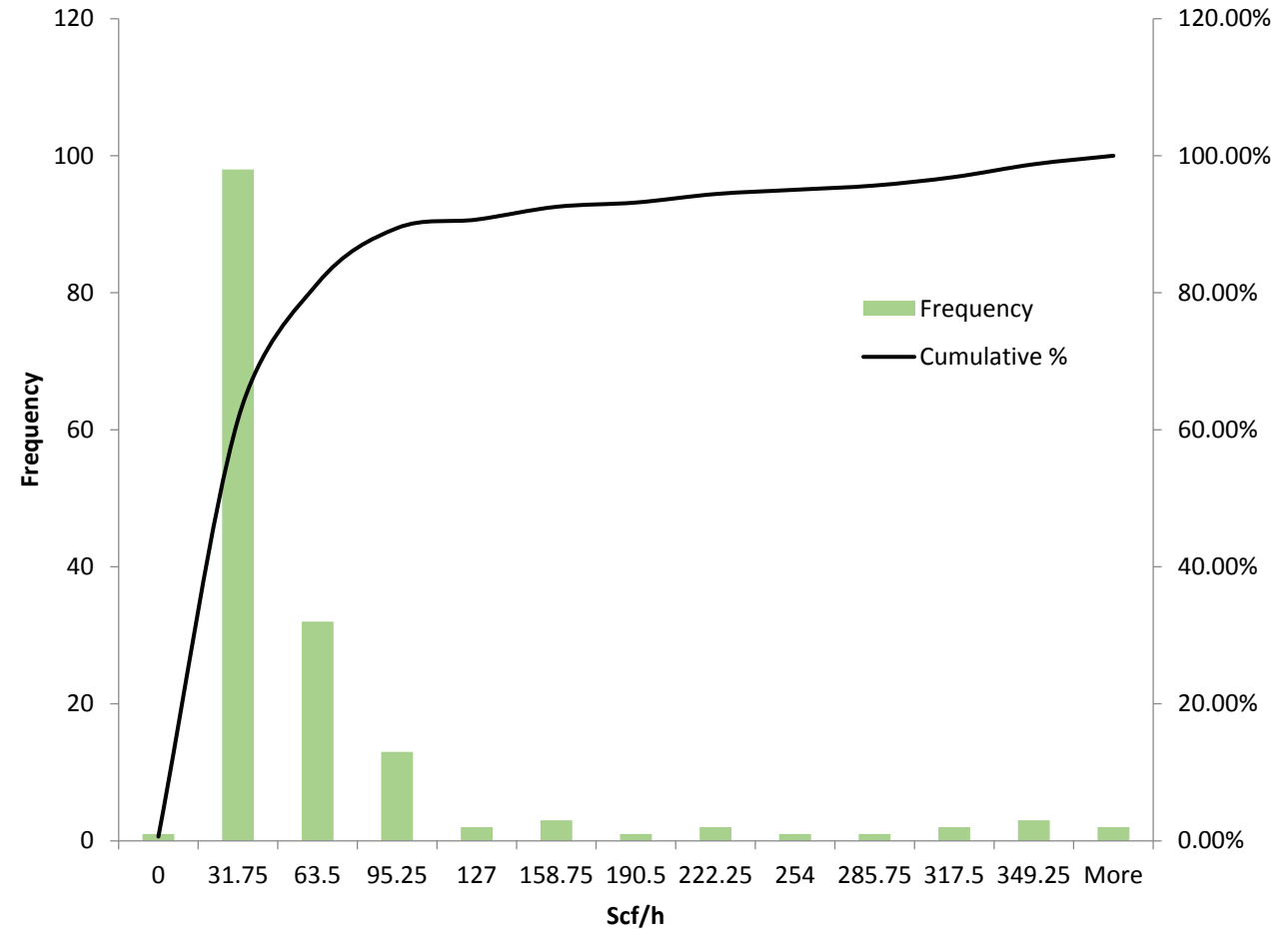
<http://www2.gov.bc.ca/gov/content/environment/climate-change/reports-data/industrial-facility-ghgs>

# How Reliable is The Aggregate Data ?

- Unsure if other firms are directly measuring compressor vents (would suggest greater change in data).
  - How are different devices being categorized?
  - GreenPath observed errors in pneumatic inventories (misclassifications or missing devices) range from 25% to infinity.
  - Greater clarity required from regulator on how to classify devices not listed by make/model
  - Greater due diligence from 3<sup>rd</sup> party verifiers on pneumatic inventories required.
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# Reciprocating Compressor Vent Measurement

- Under regulation direct measurement is required unless an exemption (due to safety concerns) is granted.
- Direct measurement accomplished via Hi-Flow or positive displacement meter.
- All GreenPath clients in BC have direct measurement.
- Results show significant variability from engineering estimates
- Average low, but several large outliers



# Reciprocating Compressor Vent Measurement

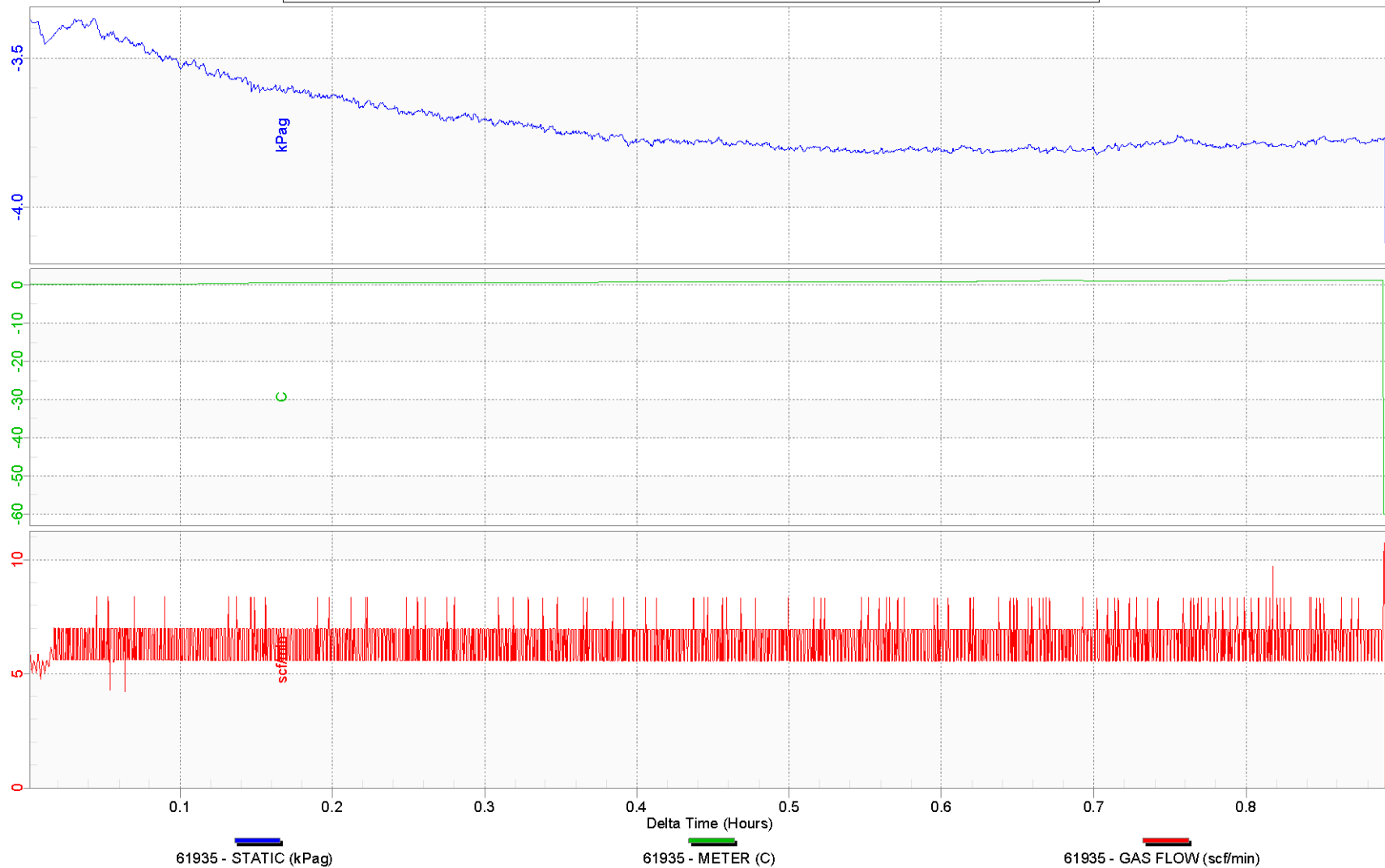


# Extrapolated Flow Test

Company: GreenPath Energy Comp #A750:

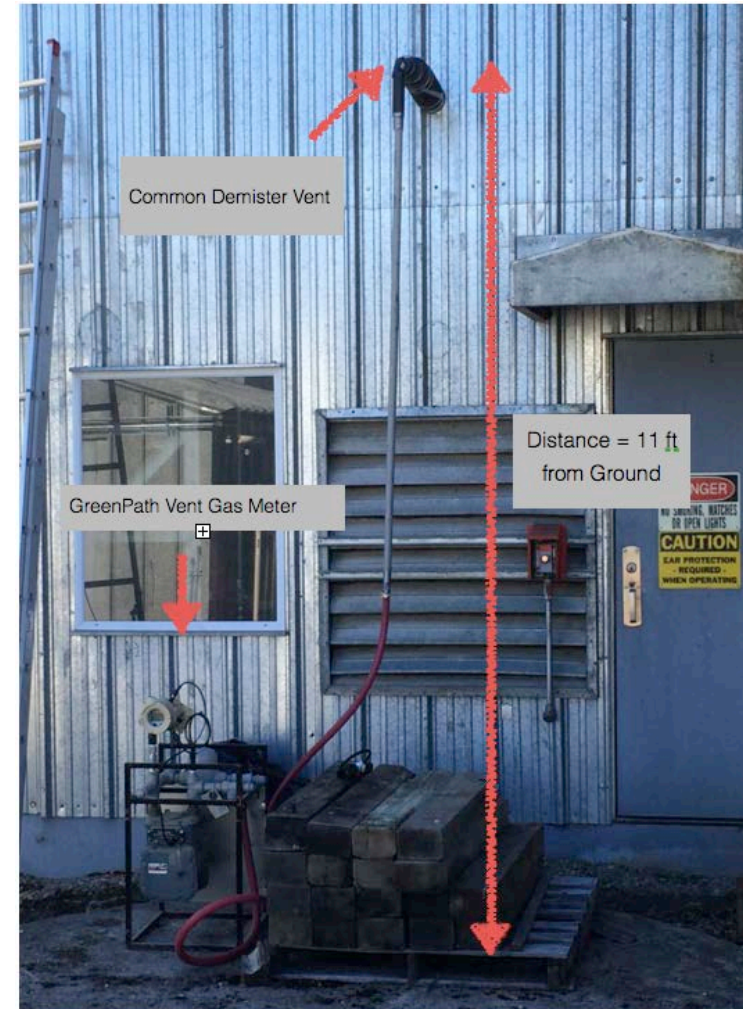
Start Time: 10-29-2014 13:17:00 Stop Time: 10-29-2014 14:10:47 Total Hours: 00:53:42

Extrapolated 24 Hour Gas Flow	Average Pressure	Average Temperature	Total Production Gas	Total Production Time Gas
9215.711 SCF	-3.716 kPag	0.598 °C	343.669 SCF	0.911 HRS



# Wet Seal Centrifugal Vent Measurement

- Extreme variability in source observed vs engineering estimates.
- Case:
  - Client Engineering estimates of 40-200 cfm from Compressor vent
  - GreenPath Direct measurement showed ~10 Cubic Feet Per minute
  - Results lowered clients reported GHG emissions
  - No need for hot wire tap installations. Height of vent within ladder reach
  - Did not observe back pressure on process



Emission Description	GPE Test Method	# Samples	Test Time	Test Time Units	Rate (cfm)	Accuracy
Compressor Wet Seal Vent Rate Test #1	Calibrated Volume Bag	3	16	Seconds	11	+/- 10%
			13		14	
			15		12	
		Average	15		12	
	Hi-Flow Sampler	Vent Rate Out of Meter Range > 10 cfm				n/a
GreenPath Vent Flow Meter	883	0.5	Hr	9.99	+/- 2%	
Compressor Wet Seal Vent Rate Test #2	Calibrated Volume Bag	3	14	Seconds	13	+/- 10%
			12		15	
			14		13	
		Average	13		14	
	Hi-Flow Sampler	Vent Rate Out of Meter Range > 10 cfm				n/a
GreenPath Vent Flow Meter	883	0.5	Hr	10.62	+/- 2%	




# Other Direct Measurement Applications:

- Measurement for vent mitigation technologies:
  - Sizing zero emission well packages
  - Pre/post audit for vent gas capture systems (Slipstream™)
- Cold Heavy Oil Production with Sand (CHOPS)
  - Use of PD meter shows extreme variance in vent rates, that would not be captured via other means (e.g Gas Oil Ratio Test).
  - Accuracy in measurement allows for accuracy in sizing reduction techniques.

# CHOPS / Blow Down Direct Measurement



# CHOPS / Blow Downs Direct Measurement

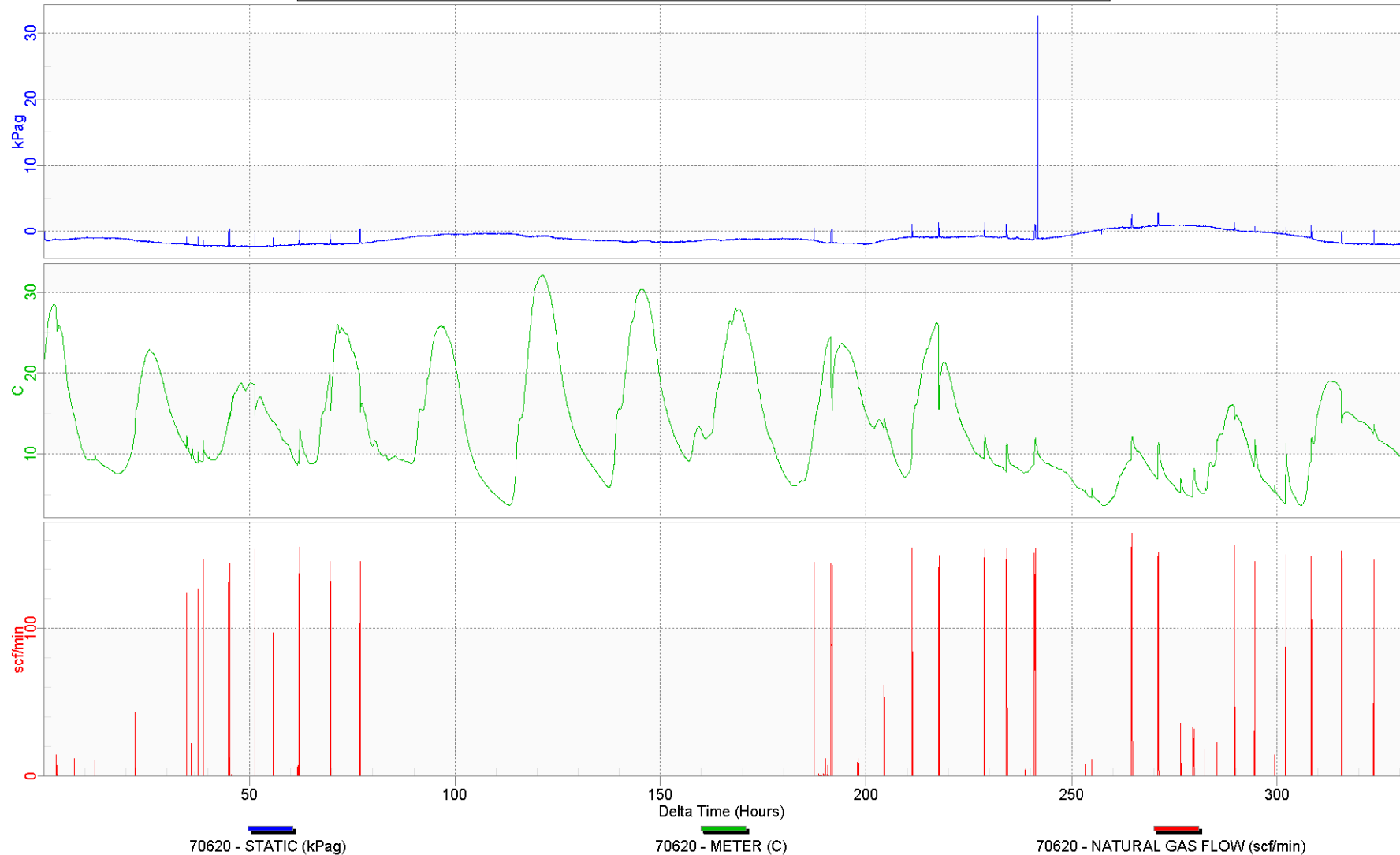
- Increased data accuracies over traditional CHOPS metering i/e orifice meters
  - In-depth insight into casing gas vent behavior and long term vent capacities
  - Reduced project costs due to simple installation, no external power requirements,
  - No disruption to well servicing activities
  - Simple liquid & oil drop out keeping turbine meter and flow run dry and liquid free
  - Excellent operation in extreme cold weather when heat traced
  - No evidence of back pressure on casing gas flow. Did not disrupt oil production
  - Minimal installation foot print and highly flexible to wellsite design and process engineering
  - Excellent turn down ratio response with proper turbine pitch installed
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# Extrapolated Flow Test

Company: GreenPath Energy Location: Canada CHOPS Well

Start Time: 09-16-2014 13:21:00 Stop Time: 09-30-2014 08:02:40 Total Hours: 330:41:29

Average 24 Hour Gas Flow	Average Pressure	Average Temperature	Total Production Gas	Total Production Time Gas
1938.818 SCF	-0.435 kPag	13.222 °C	26714.621 SCF	7.028 HRS





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