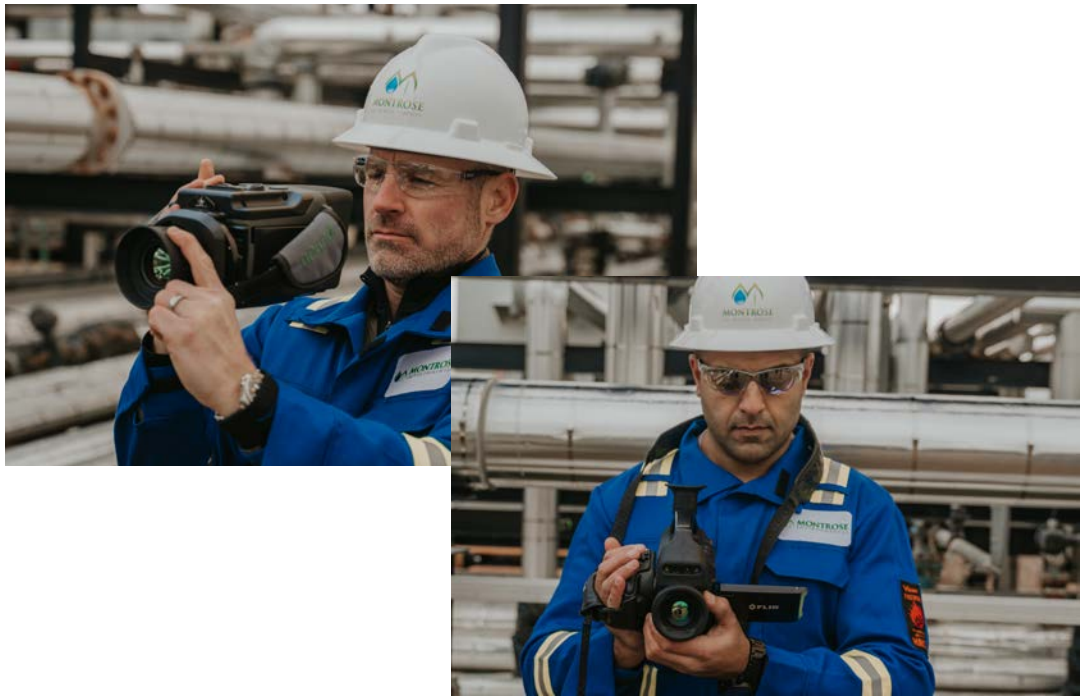

Alternative Work Practice (AWP) Strategies

MONTROSE ENVIRONMENTAL

Terence Trefiak

Andrew Sheffler

November 2020

Overview

- Procedures
  - Technology
  - Program Set-up
  - Survey Planning
  - Best Practices
- Recordkeeping and Reporting
  - Onsite Data Capture
  - Online Data Management

Terence Trefiak, PE

Terence Trefiak brings over 19 years of industry experience to the Montrose team where he currently serves as Vice President of LDAR, Canada. Prior to joining the Montrose team, Terence worked in various engineering positions for companies such as ConocoPhillips and BJ Services. He is an expert in fugitive emission management and specializes in OGI for GHG and LDAR compliance. Terence is a Registered Professional Engineer in Alberta, Canada and is a member of the Association of Professional Engineers and Geoscientists of Alberta. Terence holds a BS in Chemical Engineering from the University of Calgary.

Andrew Sheffler, EIT

Andrew Sheffler currently serves as a Senior Project Manager, OGI USA. Andrew has over 5 years of experience in conducting and managing Optical Gas Imaging fugitive emission surveys. Andrew currently oversees the largest AWP project in the USA (Freeport LNG, Texas). Andrew holds a BS in Petroleum and Natural Gas Engineering from Penn State.

About Us

Montrose is an environmental services provider offering solutions to clients across a wide array of sectors. Headquartered in Orange County, California, Montrose has over 70 offices and over 1,700 employees

- **EXPERIENCE**
  - providing OGI LDAR since 2007 (over 30,000 surveys)
  - currently perform OGI LDAR and GHG services for over 1,200 sites in USA & over 7,600 sites in Canada
  - 7,820,630 Method 21 monitored components per year on over 1,100 sites
  - only company in USA offering AWP to meet or exceed EPA requirements (**22 Gas Processing Plants, 2 LNG Export**)

Technology

OGI CAMERA

PPM MEASUREMENT
Bascom Turner Gas Rover

BUBBLE TEST
Snoop

FLOW RATE QUANTIFICATION
Bacharach Hi Flow Sampler

Technicians

- significant impact on leak detection rates and efficiently of survey
- comprehensive training program with testing and field auditing is recommended
- OGI is an effective tool but its only as effective as the Equipment Operator
- Technicians needs to have experience/knowledge of processes and equipment to determine scanning pathways and make effective leak/repair descriptions
- A written protocol for training and monitoring procedures is essential for consistent and compliant surveys

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On-site Protocols

- Pre-Planning
  - Regulatory/Client Requirements/Monitoring Program and Plan
  - Equipment Selection
- Arriving Onsite
  - Completing permitting process
  - Answering any questions operations may have
- Walkthrough of Facility
  - Gather information on what areas are operational and safe to access
  - Plan out workflow to efficiently survey the facility, route plan
- Follow Target protocols to safely and efficiently survey the facility
  - OGI performance test, PPM Monitor calibration/drift tests, Hi Flow Sampler calibration and other calibration/bump tests
  - Scanning protocol
- QA/QC
  - All data entered during that day is reviewed, including verification of picture and video quality
  - Data is synced at the end of the day and reports are accessible immediately

Quantification

- Measurement of leaks helps to categorize severity and prioritize repairs, significant impact to total emissions/recovery
- Direct measurement (Hi - Flow Sampler) is most accurate method for leak flow rates
- PPM Concentration (Method 21) is very poor indication of actual leak rate
- OGI leak rate estimation can be nearly as accurate as quantification when done by an EXPERIENCED Technician
- QOGI – software to estimate leak rates can be effective in prime conditions but less so in field settings and takes considerable time to get readings

“A leak is not a leak”

PPM Reading	EPA Emission Factor (EF) Calc (Table 2-10) lbs/hour	Emission Factor ft^3/min	Actual ft^3/min	% Error	Leak Weight	Severity
500	0.0003	0.0001	0.0001	18%	1	Minute
10,000	0.0029	0.0011	0.0010	9%	10	Very Small
50,000	0.0096	0.0036	0.01	-180%	100	Small
100,000	0.0160	0.0060	0.25	-4098%	2,500	Medium
500,000	0.0521	0.0194	1	-5045%	10,000	Large
1,000,000	0.0867	0.0323	2 to 200+	-5,653% to -575,187%+	20,000 to 200,000+	Very Large

- There is not a direct correlation between concentration and rate, but all LDAR programs use ppm as basis for size
- PPM is a poor tool to calculate a leak rate, and the fact that most instruments max out at 100,000 ppm is very limiting
- Changing mindset from finding all leaks equally to focusing on the largest leaks first will reduce over 99% of emissions.
- This can only be done with technologies like OGI

OGI

Method 21

OGI Pitfalls

OGI Pitfalls	Corrections
Inexperienced with camera use and the concepts of OGI	Technicians follow a detailed and prescriptive inspection protocols Maintain a high degree of Quality Control Contains technical procedures, training requirements, and individual and team performance audits Ensure that all processes and equipment are scanned Continuously performing a qualitative analysis of the thermal properties of the background to ensure that adequate thermal background is present (multiple performance tests) Ensure that all source data is consistently recorded - Database Management Systems
Not using multiple camera angles	
Constantly moving the camera from scene to scene without pausing in each view to look for gas images	
Area where questionable thermal background is present that may reduce the detection capabilities of the camera	
Scanning too fast and missing components/areas	
Poor data management	

Safety

- Having a standard leak hazard assessment protocol is important
- The protocol should provide clear instructions for hazard communication

Severity	Consequences					Probability			
	People	Assets	Environment	Reputation	LEL/Toxic Gas Level	A	B	C	D
						Low	Slight	Mod.	High
0	No injury or health effect	No Damage	No effect (<0.01 cfm)	No impact	0% LEL and 0ppm Toxics within 0.5 m of source				
1	Slight inhalation/odor risk	Slight wear	Slight effect (0.01 – 0.05 cfm)	Slight impact	0% LEL and 0ppm Toxics within 0.5 m of source				
3	Minor fire/explosion injury risk or exposure risk	Minor Damage	Minor effect (0.05 – 1.0 cfm)	Minor impact	1-5% LEL and below alarm level Toxics within 0.5 m of source				
4	Moderate fire/explosion injury risk or exposure risk	Moderate Damage	Moderate Effect (1.0 – 10 cfm)	Moderate impact (Regulator involvement)	Cause of LEL of 1-5% and alarm level Toxics in building				
5	Extreme fire/explosion or toxic exposure fatality risk	Major Damage	Major Effect (>10.0 cfm)	Major impact (Regulator enforcement)	Cause of LEL 10% and over and above alarm level Toxics in building				

	LOW RISK	The risk is not serious. It does not require immediate action, but should be periodically revisited to ensure that risks remains acceptably low.
	MODERATE RISK	The risk is moderate. It requires further review of controlled responses to determine the potential for escalation and to ensure risk is within acceptable limits.
	HIGH RISK	The risk is high. It requires immediate action and prompt review of control and mitigation measures.

AWP Best Practices

PERFORMANCE TEST

- Normal practice to use 100% Methane at 30 grams/hour
- Range finder is used while scanning

LEAK MEASUREMENT

- Leak rate is estimated based off camera estimation and tested with Method 21 Devise
- Some clients also request quantitate flow rate measurement (Hi Flow Sampler)

DATA RECORDING

- Inspections recorded in segments (approx. 30 min.) based on process blocks and backed up onsite
- Picture of leak with leak point ID and 10 second video is captured

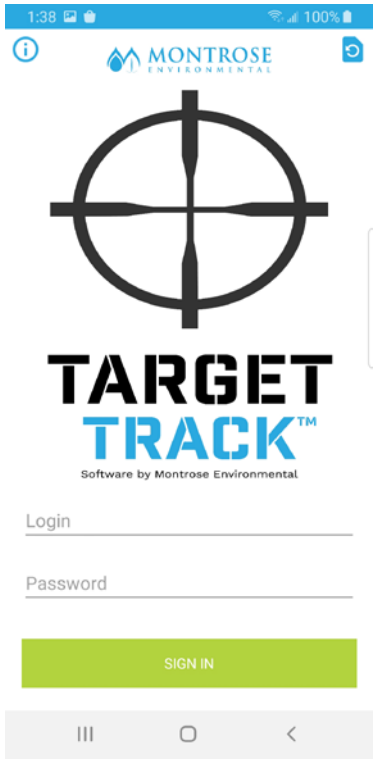
REPAIR CONFIRMATION

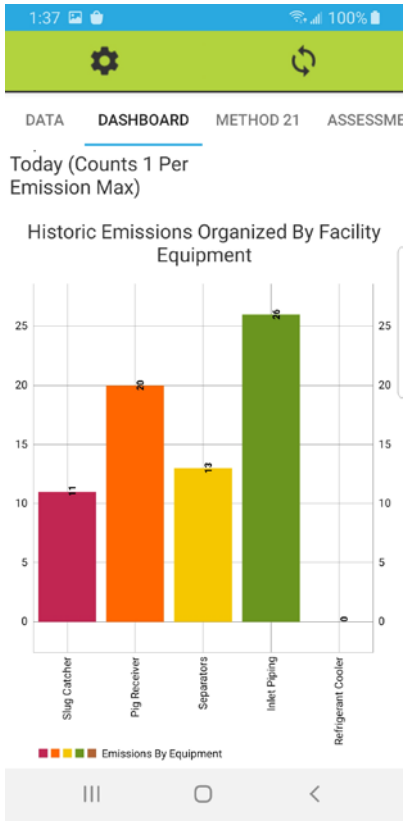
- Bubble test all leaks to enable facility staff to perform own confirmations
- M21, Snoop, or OGI can be used for confirmation

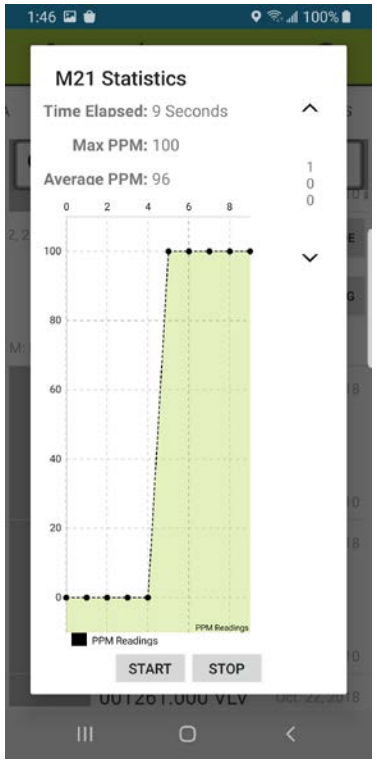
ANNUAL M21

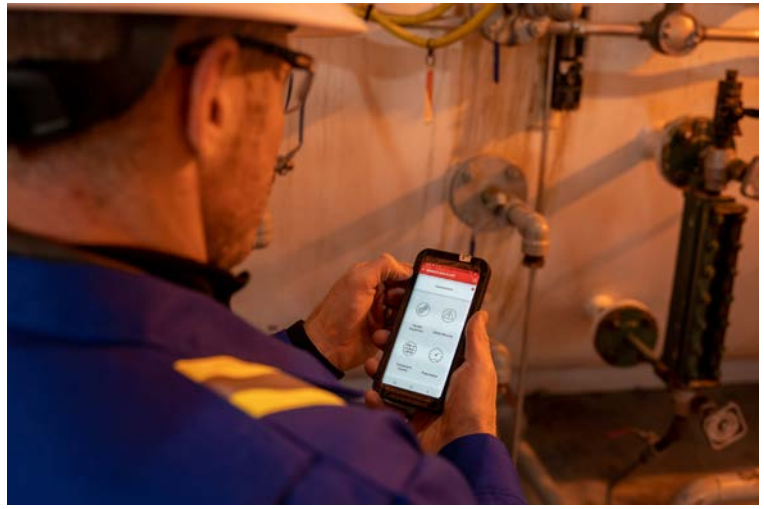
- Either done in place of one bi-monthly OGI or spaced out in 6 separate events

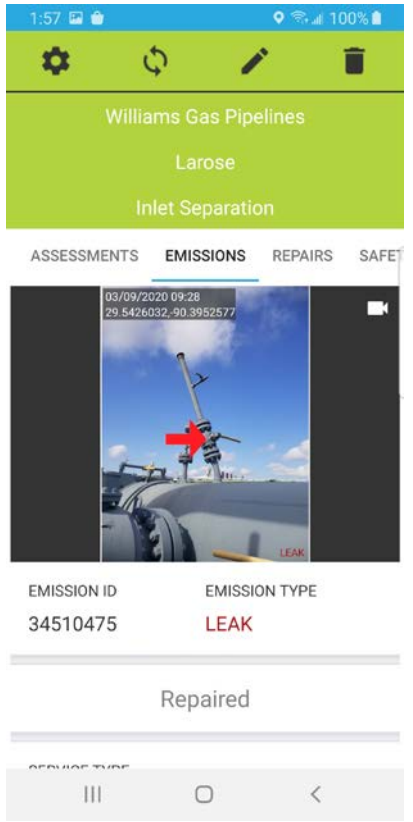
Field Data Management

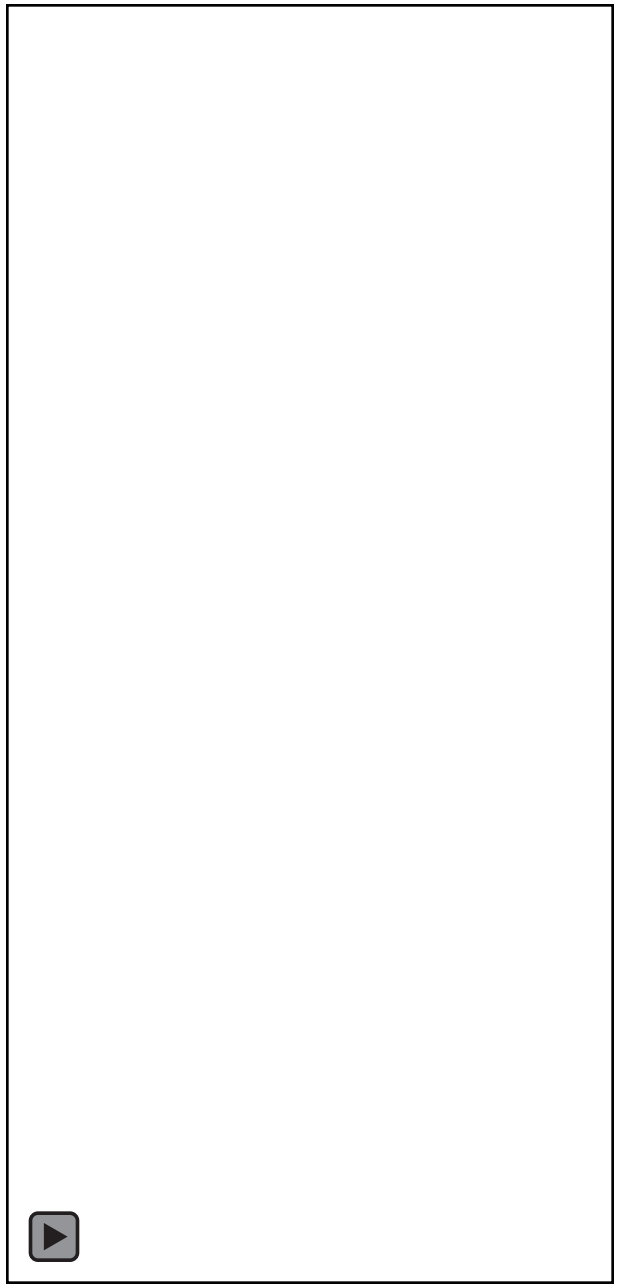




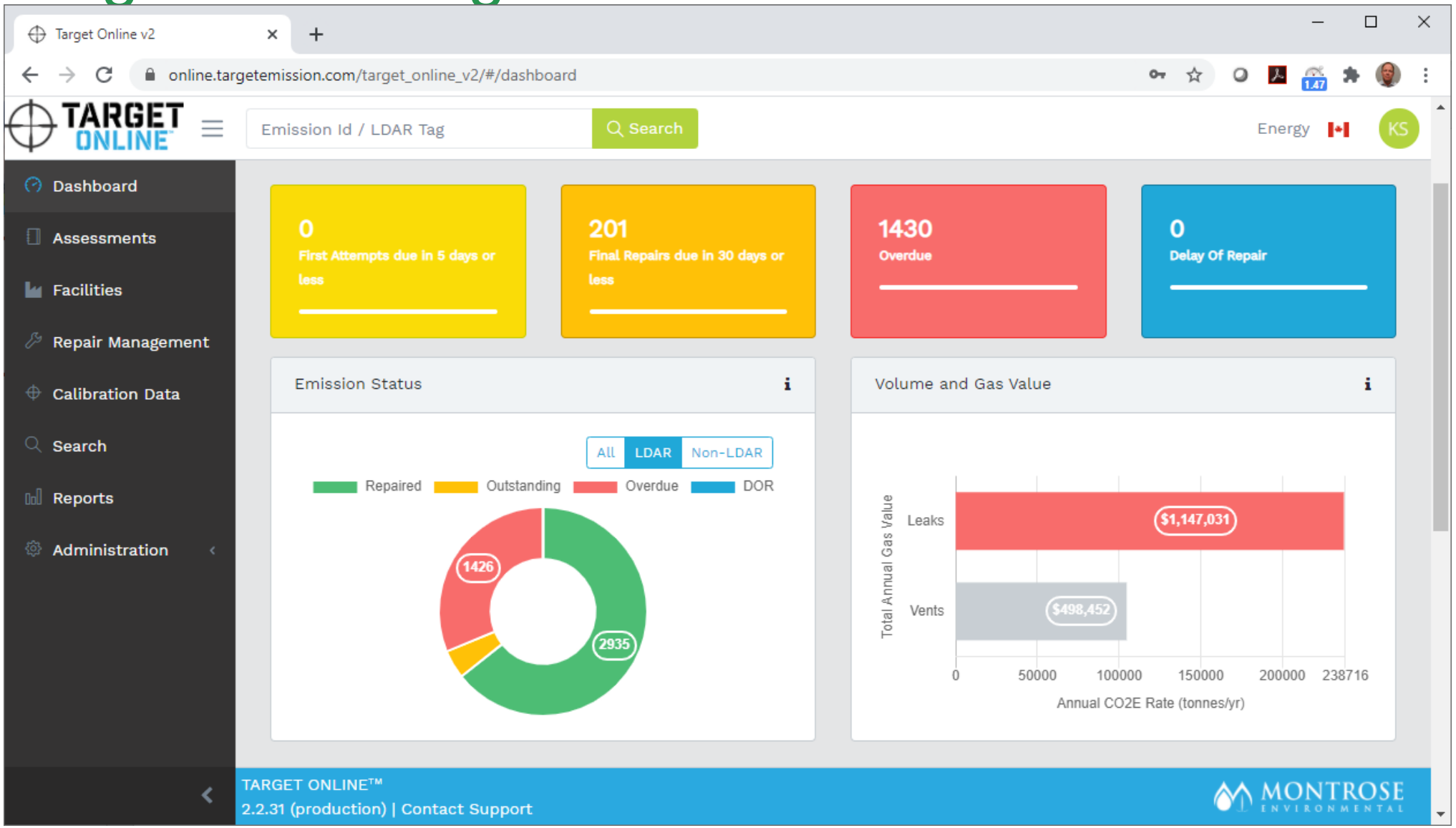






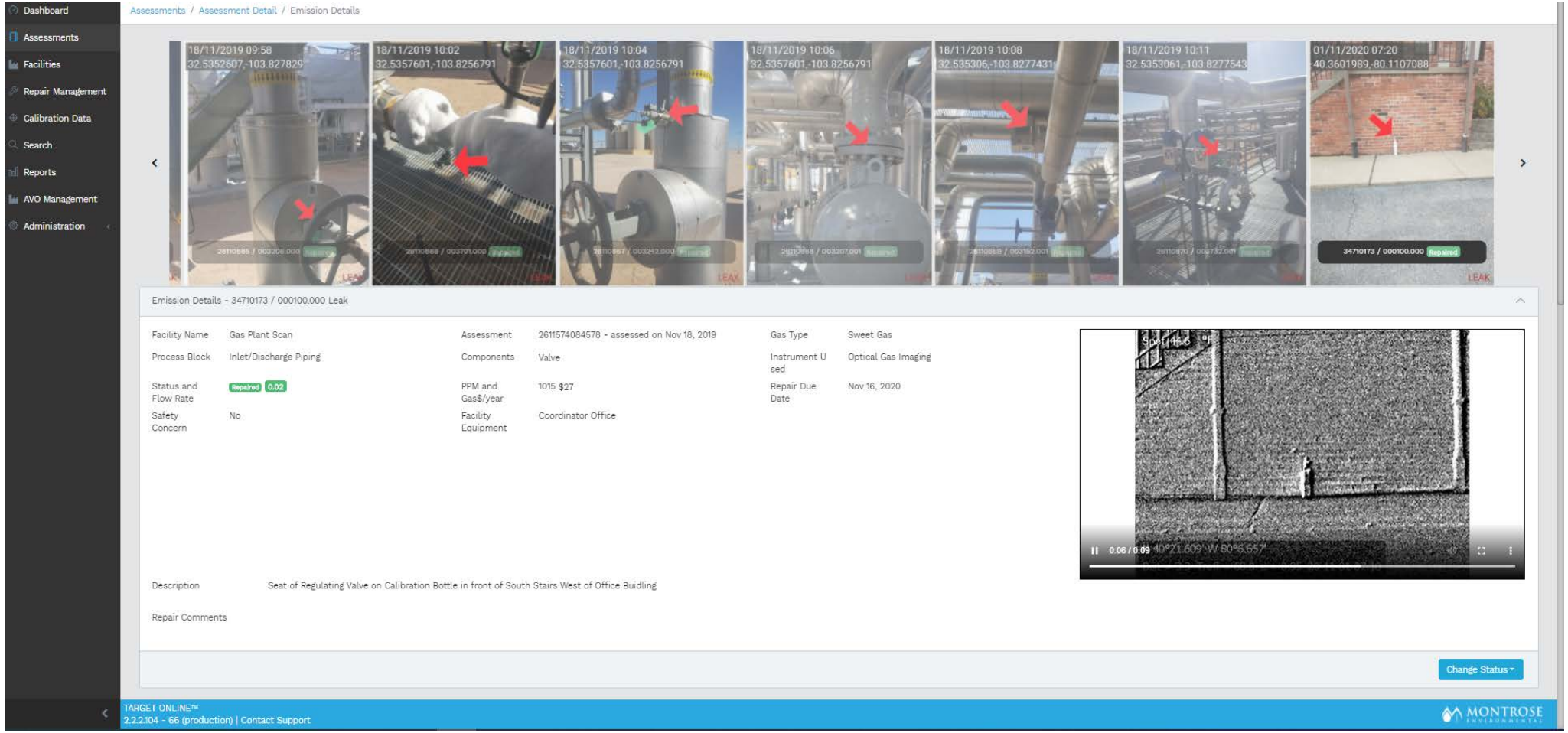


Program Management



Program Management Cont.

Target Online Repair



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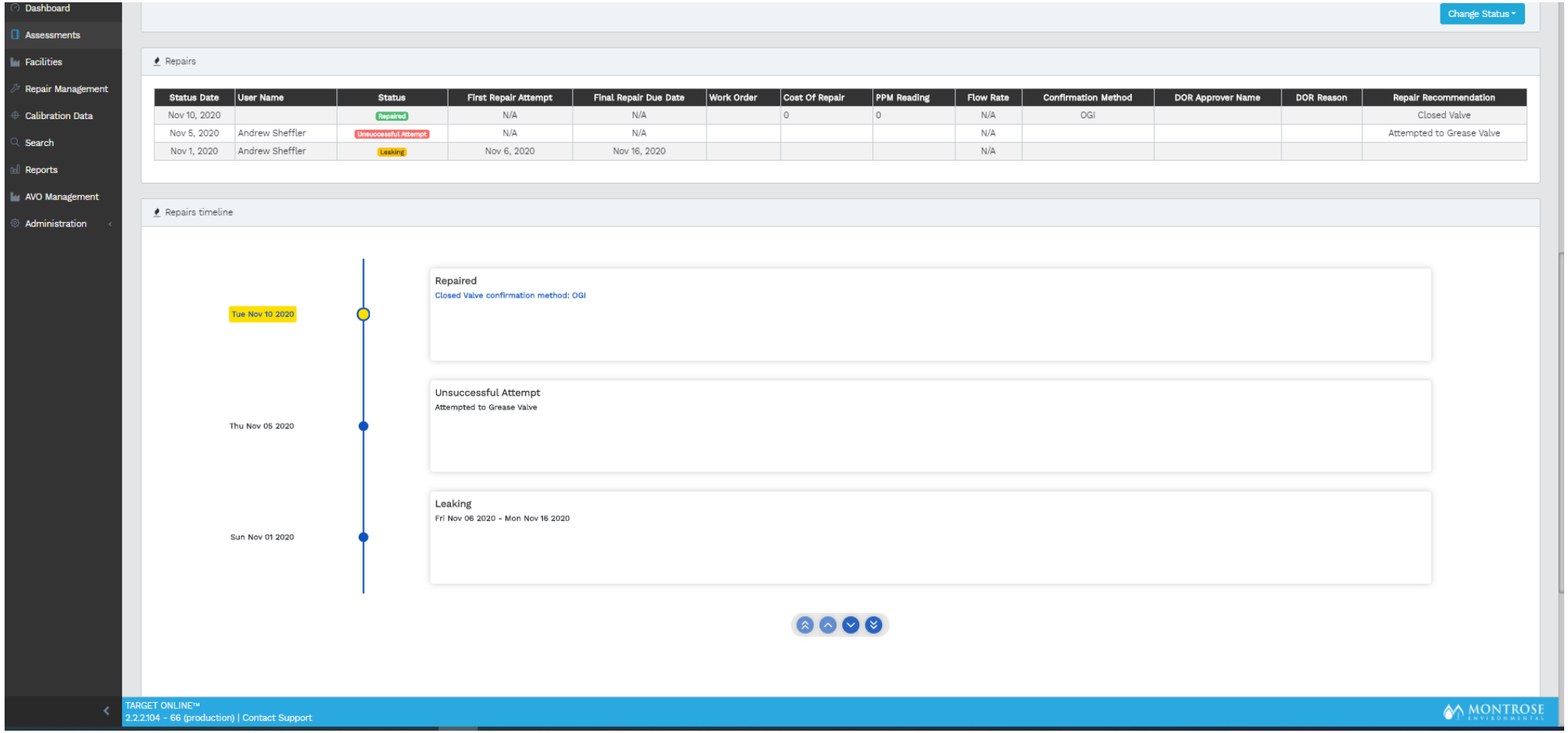


Emission Detail Report

EMISSION DETAIL REPORT

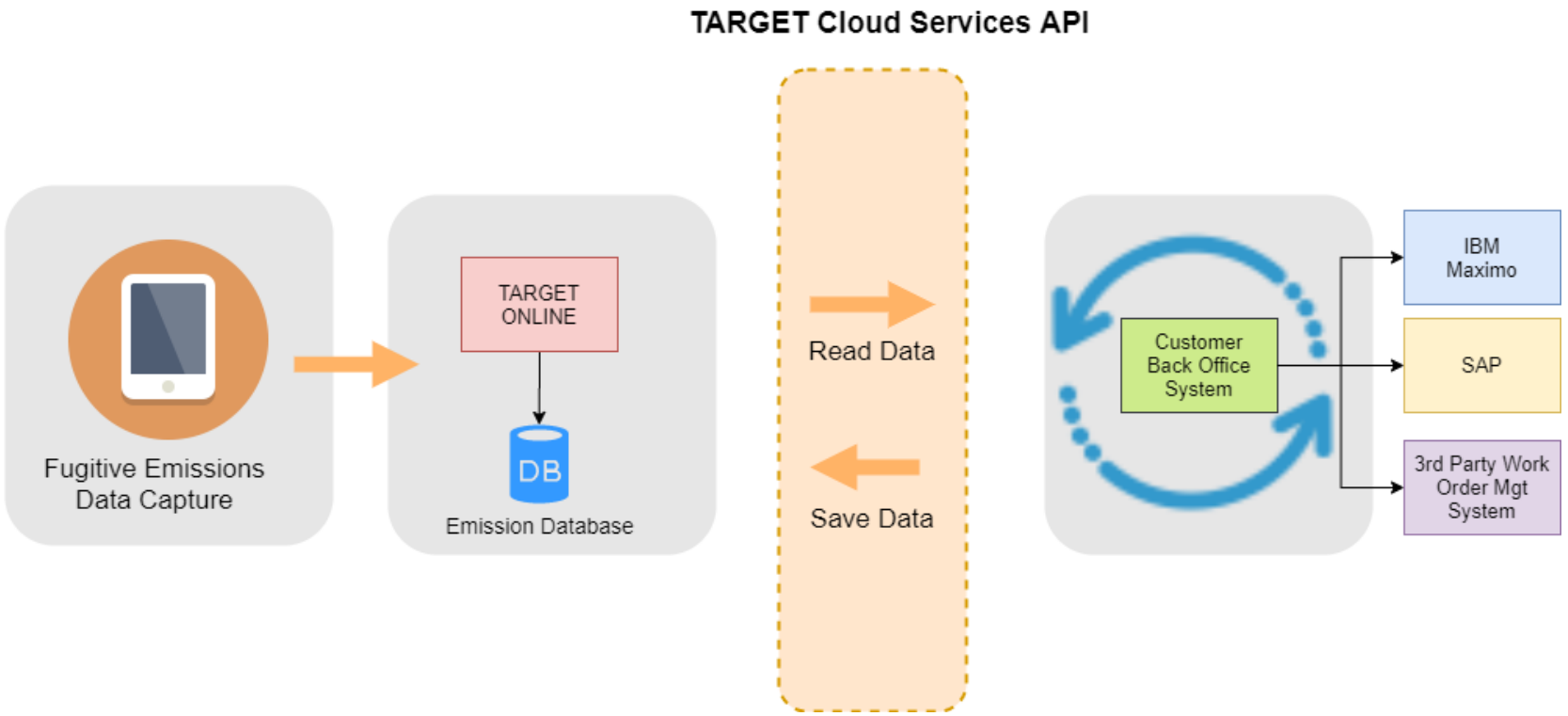
Company:	Test Company USA	Facility:	Gas Plant Scan	Start Date:	11/18/2019	Technician:	Andrew Sheffler
District:	Plant A	Location:	32.536451 / -103.828000	End Date:	11/18/2019	Technician:	Andrew Sheffler
Assessment Comments:	AWP OGI Scan. Scanned operating and pressurized cryo skid. Calibration Gas Emission Added on 11.1.20. 11-18-2019-0830-Flir Loaner 2 Gas Plant Cryo Skid						

Leaks		Vents	
LDAR Leak Count:	14	Repair Required:	0
Non-LDAR Leak Count:	0	Total:	0
Total Leak Count:	14	Mandatory Emission Tests	Leak Tests: 0
			Vent Tests: 0
			No Emission Tests: 0
			Total Tests: 0

REPAIR STATUS	
Repaired:	Delay of Repair:
12	1

Emission ID #	Emission Type	Detection Date	Process Block	Field Equipment Designation	Component	Sub Source	Operating Mode	Emission Description	LEL-H2S Safety Hazard	Emission Severity	Gas Type	Previous Leak (emission id)	Rate (cfm)	Detection Method / Quantification Method	Yearly Gas Value	Repair Recommendation	Initial PPM Reading	LDAR Tag ID	Bubble Test	Repair Status	Repair Status Date	First Attempt Due Date	Final Attempt Due Date	DOR Start Date	DOR End Date	DOR Reason	DOR Approver Name
26110858	Leak	11/18/2019	Process Building	Cryo Skid	Connector - 0000		N/A	North Flange Seal of Control Valve F001239976 at South East Corner of Cryo Skid	No	LOW	Custom Gas		0.09	Optical Gas Imaging/ Method 21	$74	Replace gasket/seal and tighten connection	50,000	003174.004	Yes	Repaired	11/21/2019	11/23/2019	12/03/2019	-	-	-	-
26110859	Leak	11/18/2019	Process Building	Cryo Skid	Connector - 0000		N/A	South Flange Seal of Control Valve F001239976 at South East Corner of Cryo Skid	No	LOW	Custom Gas		0.05	Optical Gas Imaging/ Method 21	$41	Replace gasket/seal and tighten connection	350,000	003174.002	Yes	Repaired	11/21/2019	11/23/2019	12/03/2019	-	-	-	-
26110860	Leak	11/18/2019	Process Building	Cryo Skid	Connector - 0000		N/A	Top Flange of Gate Valve upstream of Control Valve TCV-201A at South East Corner of Cryo Skid	No	LOW	Custom Gas		0.03	Optical Gas Imaging/ Method 21	$27	Reseal connection and tighten	16,000	003179.001	Yes	Repaired	11/21/2019	11/23/2019	12/03/2019	-	-	-	-
26110861	Leak	11/18/2019	Process Building	Cryo Skid	Connector - 0000		N/A	Flange Upstream of Control Valve TCV-201A at South East Corner of Cryo Skid	No	LOW	Custom Gas		0.03	Optical Gas Imaging/ Method 21	$25	Reseal connection and tighten	8,970	003182.003	Yes	Repaired	11/21/2019	11/23/2019	12/03/2019	-	-	-	-
26110862	Leak	11/18/2019	Process Building	Cryo Skid	Connector - 0000		N/A	East Flange of Overhead Gate Valve above North End of Heat Exchanger E-202, East of Cryo Skid	No	MEDIUM	Custom Gas		0.15	Optical Gas Imaging/ Method 21	$123	Reseal connection and tighten	450,000	003193.001	Yes	Repaired	11/21/2019	11/23/2019	12/03/2019	-	-	-	-
26110863	Leak	11/18/2019	Process Building	Cryo Skid	Connector - 0000		N/A	Plug of Overhead Drain Valve above North End of Heat Exchanger E-202, East Side of Cryo Skid	No	LOW	Custom Gas		0.09	Optical Gas Imaging/ Method 21	$74	Tighten connection	80,000	003192.001	Yes	Repaired	11/21/2019	11/23/2019	12/03/2019	-	-	-	-
26110864	Leak	11/18/2019	Process Building	Cryo Skid	Connector - 0000		N/A	Unknown Source under Insulation South of Gate Valve above Control Valve PCV-501B, North of Heat Exchanger E-202, East Side of Cryo Skid	No	MEDIUM	Custom Gas		0.11	Optical Gas Imaging/ Method 21	$90	Reseal connection and tighten	5,000	003200.001	Yes	Delay of Repair	11/22/2019	11/23/2019	12/03/2019	11/22/2019	12/31/2020	Shutdown required	Andrew Sheffler
26110865	Leak	11/18/2019	Process Building	Cryo Skid	Valve - 0000		N/A	Packing of Gate Valve South of Control Valve PCV-501B, North of Heat Exchanger E-202, East Side of Cryo Skid	No	LOW	Custom Gas		0.03	Optical Gas Imaging/ Optical Gas Imaging	$25	Tighten valve packing	-	003206.000	Yes	Repaired	11/21/2019	11/23/2019	12/03/2019	-	-	-	-
26110866	Leak	11/18/2019	Process Building	Cryo Skid	Valve - 0000		N/A	Seat of Drain Valve North of of Control Valve PCV-402B, North of Heat Exhanger E-202 on East Side of Cryo Skid	No	LOW	Custom Gas		0.07	Optical Gas Imaging/ Method 21	$57	Replace seal(s)	80,000	003701.000	Yes	Repaired	11/21/2019	11/23/2019	12/03/2019	-	-	-	-
26110867	Leak	11/18/2019	Process Building	Cryo Skid	Valve - 0000		N/A	Packing of Ball Valve to Tubing Line above Gate Valve, North of Control Valve PCV-402B, North of Heat Exchanger E-202 on East Side of Cryo Skid	No	MEDIUM	Custom Gas		0.15	Optical Gas Imaging/ Optical Gas Imaging	$123	Tighten valve packing	-	003242.000	Yes	Repaired	11/21/2019	11/23/2019	12/03/2019	-	-	-	-
26110868	Leak	11/18/2019	Process Building	Cryo Skid	Connector - 0000		N/A	Top Flange at North End of Heat Exchanger E-207 on West Side of Cryo Skid	No	LOW	Butane		0.05	Optical Gas Imaging/ Optical Gas Imaging	$475	Reseal connection and tighten	-	003207.001	Yes	Repaired	11/21/2019	11/23/2019	12/03/2019	-	-	-	-
26110869	Leak	11/18/2019	Process Building	Cryo Skid	Connector - 0000		N/A	Top Threaded Connection of North Ball Valve on Overhead Orifice Flow Meter FT-402A above Heat Exchanger E-202 on West Side of CR10 Skid	No	LOW	Custom Gas		0.04	Optical Gas Imaging/ Optical Gas Imaging	$33	Reseal connection and tighten	-	003152.001	Yes	Repaired	11/21/2019	11/23/2019	12/03/2019	-	-	-	-
26110870	Leak	11/18/2019	Process Building	Cryo Skid	Connector - 0000		N/A	Plug on West Side of Needle Valve Manifold to Flow Transmitter FT-402 on Second Level of Cryo Skid	No	MEDIUM	Custom Gas		0.11	Optical Gas Imaging/ Optical Gas Imaging	$90	Tighten connection	-	003732.001	Yes	Repaired	11/21/2019	11/23/2019	12/03/2019	-	-	-	-
34710173	Leak	11/01/2020	Inlet/Discharge Piping	Coordinator Office	Valve - 0000	Valve Seat	N/A	Seat of Regulating Valve on Calibration Bottle in front of South Stairs West of Office Building	No	LOW	Sweet Gas		0.02	Optical Gas Imaging/ Optical Gas Imaging	$27	Replace seal(s)	-	000100.000	Yes	Unsuccessful Attempt	11/05/2020	11/06/2020	11/16/2020	-	-	-	-
TOTAL													1.02		$1,282												

Program Communication



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QUESTIONS?