Utah Gas Corp. – Pumpjack Engine Emission Measurement Inspections – Uinta Basin, Utah Wellpads – On-Site Partial Compliance Evaluations (PCE)

Inspection Dates:	9/9/21
Inspection Report Date:	11/15/2021
Inspection Report Prepared By:	Cindy Beeler
Inspection Report Reviewed By:	Scott Patefield, Branch Chief SCOTT PATEFIELD Digitally signed by SCOTT PATEFIELD Date: 2021.11.15 12:19:06 -07'00'
EPA Inspectors:	Cindy Beeler Scott Patefield
Company Representatives:	Andy Shaffer, Operations Supervisor - Utah Derrick Timothy, Field Operations Cuyler Walker, Field Operations Ken Secrest, EHS
Tribal Representatives:	Mike Natchees, Director, Air Quality Program, Ute Indian Tribe (UITAQ) Marie Kaufusi, UITAQ
State Representatives:	None
Parent Company Address:	1125 Escalante Dr. Rangely, CO 81648
Facilities County/State Location:	Uintah/Utah
EPA Region:	Region 8
Specific Facility Information:	See Table 1

Inspection Information

As part of a regional effort to better characterize emissions from pumpjack engines, United States Environmental Protection Agency (EPA) and Ute Tribal Air Program inspectors visited several Utah Gas wellpads in the Uinta Basin in Utah. The objective of the testing is to verify point source pollutant levels used for air quality modeling and emission inventories, assess the effectiveness of engine emission regulatory limits, and evaluate the emissions maintenance practices of individual operations. The engine emission tests were conducted by a third-party contractor, Alliance Source Testing (AST).

In the aggregate over three weeks, the EPA and its contractor conducted testing at 61 engines with seven operators. The sample population was created to reflect the universe of almost 3,400 pumping spark-ignition engines as provided in the 2017 Uinta Basin Emission Inventory – by operator, by engine make and model, by age of engine, and by jurisdiction. The aggregate results are shown below:

# Engines Tested:	61			
	AST g/hp-hr (11/1/21)			
	CO	NOx	CH4	NMHC
Average:	92.9	1.8	1.5	34.0
Median:	72.5	0.29	0.0013	30.4

Table 1 lists the Utah Gas sites inspected, their location, the date of inspection, and the start time of each test run.

Table 1 – Sites Inspected

facility_name	facility_latitude	facility_longitude	facility_county	Date_insp	Run_start Time
LITTLE CANYON UNIT 09-36F W	39.90183	-109.6061	Uintah	9/9/2021	10:05
RBU 11-2F	39.974842	-109.6365	Uintah	9/9/2021	11:55
HILL CREEK UNIT 06-30F WSMV	39.92007	-109.70906	Uintah	9/9/2021	14:10
HILL CREEK UNIT 12-29	39.91577	-109.69511	Uintah	9/9/2021	15:42

The inspection team adhered to the following approach for the engine measurements:

1) On 9/9/21, EPA inspectors Cindy Beeler and Scott Patefield met Utah Gas, AST, and Ute Indian Tribe Air Quality (UITAQ) personnel at Jensen's Hitchin Post - 6451 S Highway 88, Randlett, and shared a list of geographically clustered Utah Gas wellpads with engines. From Utah Gas, Andy Shaffer, Derrick Timothy, Cuyler Walker, and Ken Secrest accompanied EPA the entire day.

   With input from Utah Gas, we proceeded to a subset of sites on the list where engines were gas-powered and operating, testing as many engines as possible in the day.

2) AST positioned their testing trailer to be a safe distance from the process equipment.

3) AST began set up and conducted the calibration of the analyzers at the first site each day. The analyzers were kept running between sites with (1) a generator in the bed of the truck; and (2) power conditioned/battery back-up - so they could hold a calibration for the remainder of the day. Following the calibration, and at succeeding sites, AST ran the pre-bias check, a 21-minute measurement with pollutants recorded each minute, and the post-bias check.

4) EPA photographed the site sign.

5) EPA asked questions to describe the operating parameters of the engine, the associated equipment around each engine, and the maintenance schedules as well as taking numerous photographs. Table 3 summarizes the information collected.

Testing Information

Testing was conducted to determine the emission rates of nitrogen oxides (NOx), carbon monoxide (CO) and non-methane hydrocarbons (NMHC) from the engine exhausts.

Emission rates were calculated using the Wyoming Analyzer Protocol, Page 25, Section 10.1.2. Where manufacturer-specified Brake Specific Fuel Consumption (BSFC) in BTU/HP-hr and nameplate horsepower were available, those were used in calculations for emission mass rates. For site-rated hp, nameplate was adjusted to 5,000 elevation. Where they were not available, the Wyoming Analyzer Protocol default value of 9,400 BTU/hp-hr was used. Where manufacture year or horsepower were not available on the engine nameplate, or there was no nameplate, the year and horsepower noted were identified by the EPA relying on emission inventory data submitted by Utah Gas (or its predecessor, XTO).

The emission testing program was conducted in accordance with the test methods listed in Table 2. Method descriptions are provided in Attachment A - AST Test Report.

Table 2 - Source Testing Methodology

Parameter	U.S. EPA Reference Test Methods	Notes/Remarks
Oxygen / Carbon Dioxide	3A	Instrumental Analysis
Nitrogen Oxides	7E	Instrumental Analysis
Carbon Monoxide	10	Instrumental Analysis
Volumetric Flow Rate	19	Fuel Factors / Heat Inputs
Non-Methane Hydrocarbons	25A	Instrumental Analysis
Gas Dilution System Certification	205	--

Other Field Notes

Maintenance practices – Derrick Timothy described that every 55-60 days they adjust the valves (under the head cover) checking for proper tolerances; check bolts; replace seals if leaking; and change oil and oil filter. He also provided a copy of the Arrow C-Series operations and maintenance manual and a one-page template of a work order with their routine maintenance listed, provided in Attachment B.

All sites had pressure gauges on the engine fuel gas supply line, between the Little Joe pound regulator and the ounce regulator, that were operating. Three of the four sites had pressure gauges installed on the fuel gas line between the ounce regulator and the engine, thereby allowing observation of the fuel gas pressure entering the engine.

At Little Canyon Unit 9-36F, Utah Gas operates an Arrow C-101 engine. Utah Gas described that the Arrow C-106 (39 HP) is configured to constrain fuel flow to limit the horsepower of the C-101 to 24.5 HP. That configuration is an orifice plate in between the carburetor and the intake manifold. The inspector was unable to verify whether an appropriately sized orifice plate was installed. The pressure of the fuel gas going into the engine was 5 ounces/inch^2; 200 mm water column (w.c.) [1 oz/in^2 = 44 mm w.c. = 1.73 inches w.c.].

At HILL CREEK UNIT 06-30F WSMVD, the fuel gas pressure gauge on fuel gas line after the ounce regulator and entering the engine read 590 mm w.c. (13.4 oz/in^2). Derrick Timothy said gauge did not work and pressure should be 5" w.c. (2.9 oz/in2).

At HILL CREEK UNIT 12-29, the fuel gas pressure gauge following the ounce regulator on the fuel gas line entering the engine was noted as reading 5.3 in. w.c. (3.1 oz/in^2).

The engines run continuously, even if the pumpjack is not pumping, when this can be referred to as “clutched” or idled” while the engine continues to run to power a heat trace circulation pump that provides a heated medium throughout the wellpad (tank heaters, heater treater, heat trace along piping, etc.).

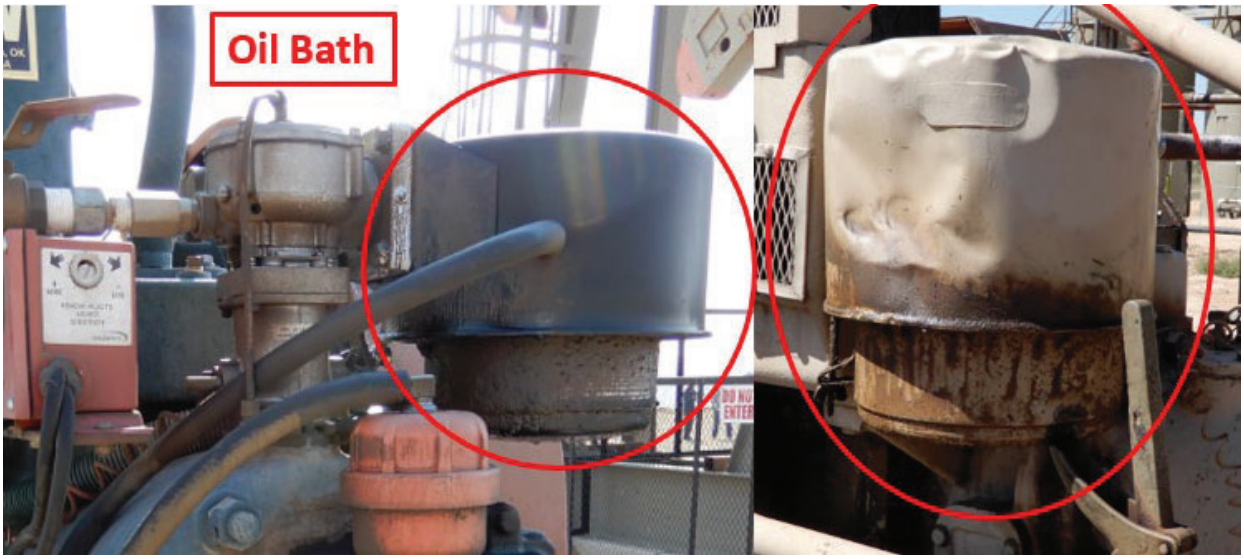
Seeking Utah Gas Review and Input

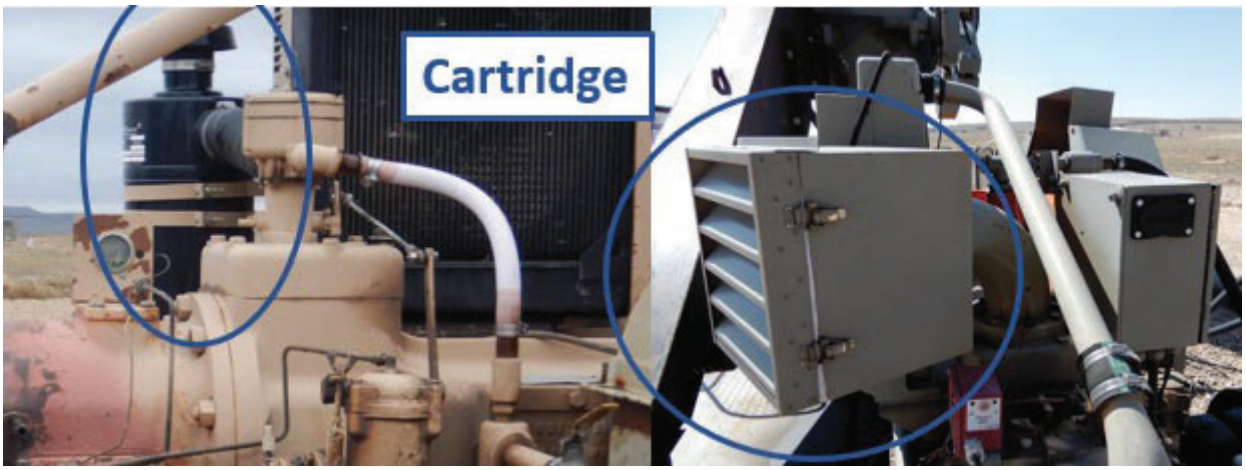
The EPA would like to better understand what could influence pumpjack engine emissions and so seeks Utah Gas’s review and input on the equipment associated with each engine. From observations and conversations with operators, engine manufacturers, and experienced engine stack testers, the EPA offers descriptions and photos of our understanding of nomenclature around equipment

associated with the engine. In addition to the following questions, the EPA requests Utah Gas's confirmation of the engine parameters and configurations listed for each engine in Table 3, below.

1) Confirm the engine Make/Model, nameplate HP, serial #, and engine category (e.g., 2-Stroke Lean Burn [2SLB], 4SRB).

2) Confirm the manufacture year of each engine with particular attention to whether, and when, the engine may have been reconstructed, remanufactured, reconditioned, rebuilt, refurbished, or modified.



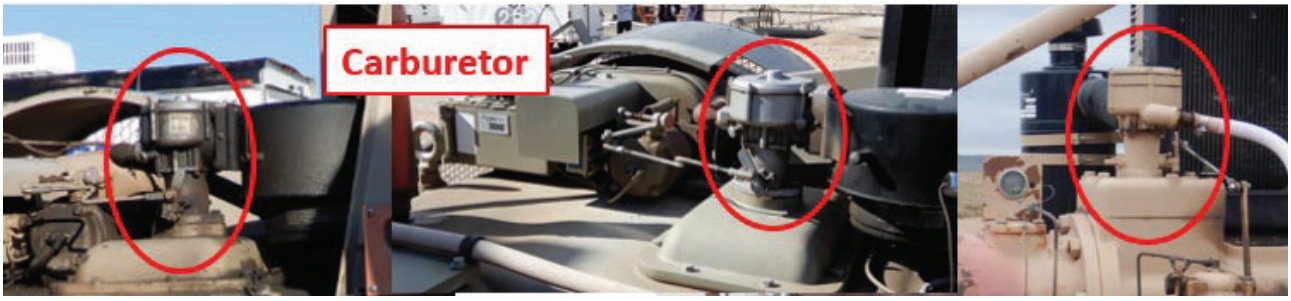


4) Knock-Out (KO) Scrubbers – Inspectors noted whether there was a single KO scrubber on the fuel gas entering the engine, or sequential dual KO scrubbers.

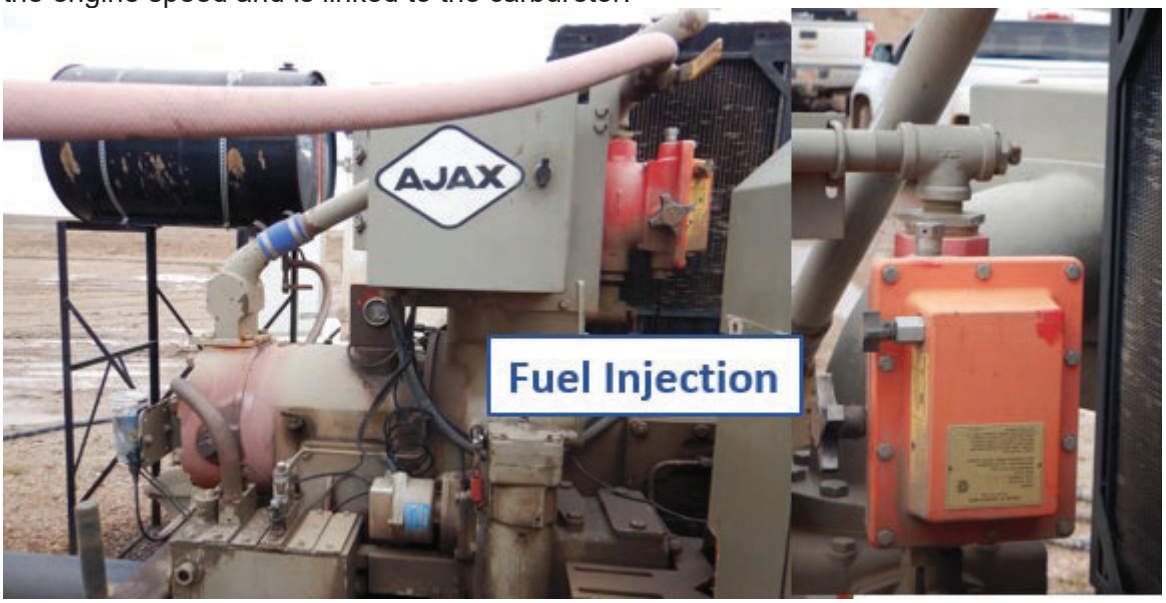
5) Fuel Gas Source – Casing free gas (gas from the annulus on the backside of the production tubing, direct from the well casing), separator gas (the associated gas with oil production that comes off the wellpad's separator or heater treater), or dry processed gas (piped in from a neighboring compressor station). Noted during inspection was EPA's understanding of the fuel gas source used by the engine during testing determined by walking the lines with the operator. EPA understands that none of the four sites had access to dry process gas (e.g., from a compressor station) but that each site could utilize either casing free gas or separator gas for fuel.

What records does Utah Gas keep regarding the source of fuel gas being used on-site?

6) Air Fuel Control – carburetor, fuel injection, mixer manifold, or Air Fuel Ratio Control (AFRC). From conversations with operators, engine manufacturers and experienced engine stack testers, EPA's understanding of various air fuel control systems present in the field are described with photos as the examples shown below:

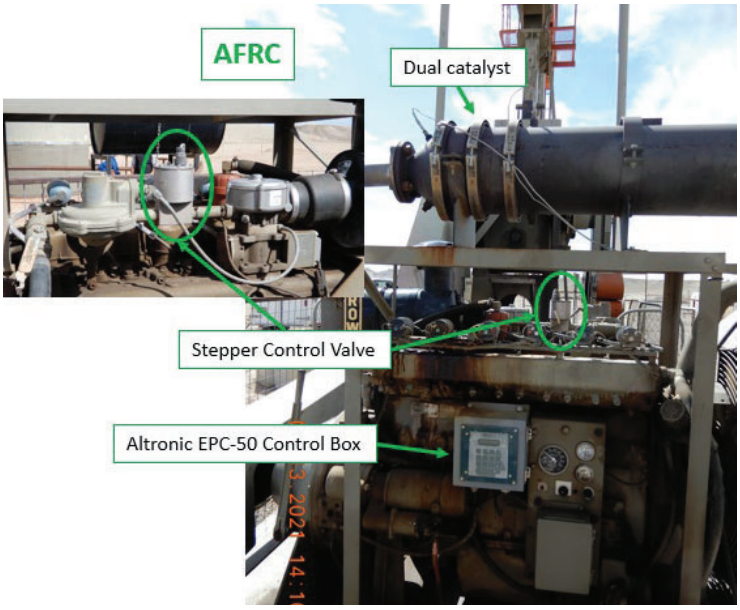


The fuel gas is routed to the carburetor where the air intake is also routed. The governor controls the engine speed and is linked to the carburetor.



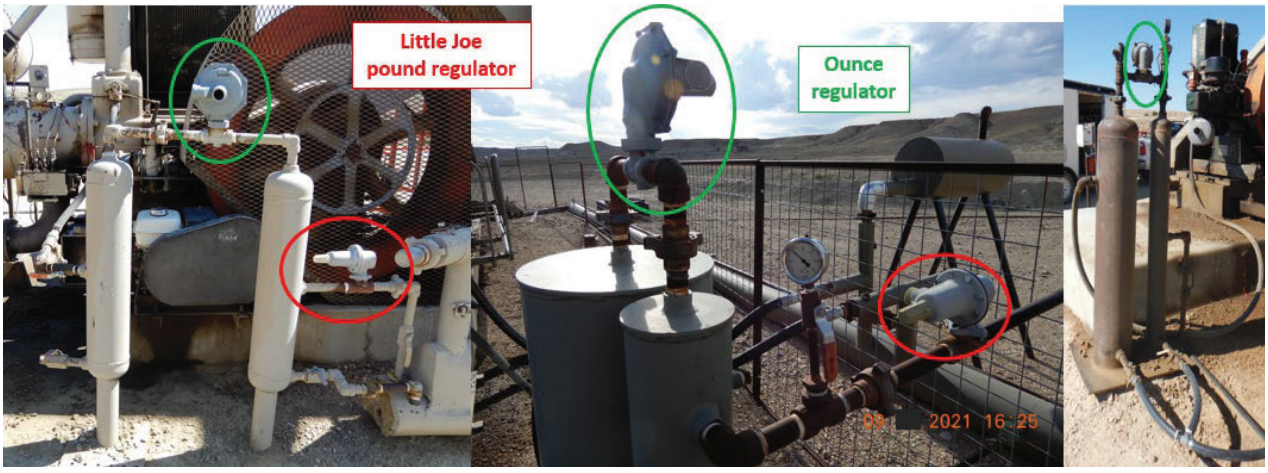
The "AJAX" control box + the red Murphy fuel control valve to the right of the AJAX box = fuel injection system.

The fuel gas is routed to the mixer manifold where the air intake is also routed. The governor controls the engine speed and is linked to the mixer manifold.

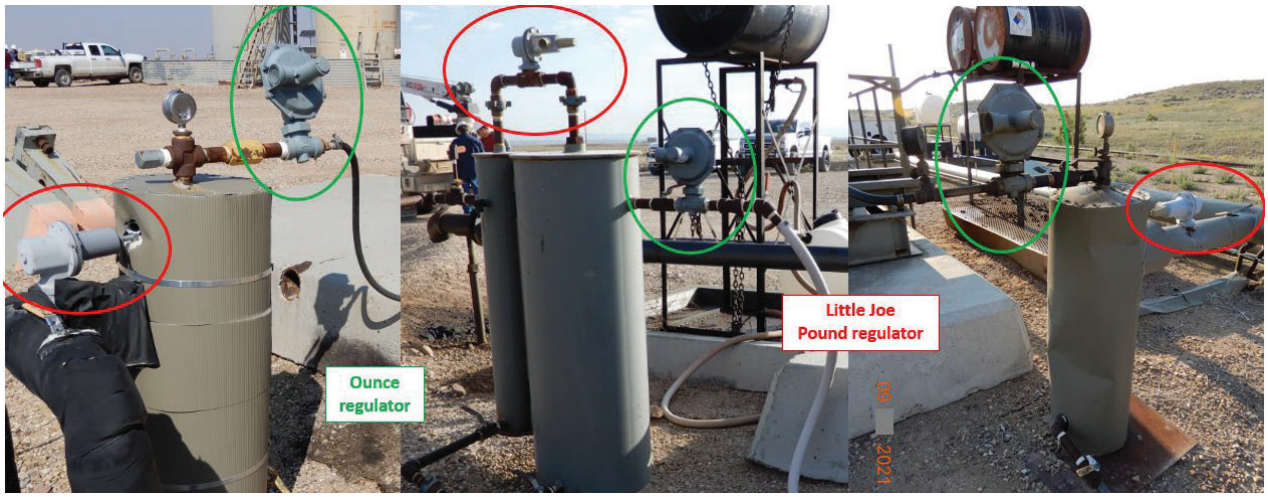


Dual catalyst chamber on the engine exhaust. The Stepper control valve is to the right of carburetor (visible in the background) and shown zoomed in from another perspective. On the bottom is an Altronic EPC-50 control panel (CD1 digital ignition, electronic governor, O2 sensors, voltage signal to Stepper valve to control fuel flow, cam/crank sensors). EPA's understanding is the combination of this equipment is an Air Fuel Ratio Control (AFRC) system.

7) Fuel Gas Volume Capacity – Yes or No. A gas volume tank provides a reservoir of pressurized fuel gas to meet engine demand. Without a gas volume vessel, the available reservoir capacity is in the piping conveying the fuel gas to the engine.



If the Ounce regulator is BEFORE the last KO scrubber and the engine, then fuel gas volume capacity IS available to the engine, equal to the volume of the 2nd KO scrubber (Y). The pressure of the fuel gas is adjusted by springs within the regulator - if spring is all the way out → discharge pressure is the minimum pressure of range of the regulator. If spring is all the way in → discharge pressure is the maximum pressure of range of the regulator.



If the Ounce regulator is between the KO scrubber and the engine, then there is NO fuel gas volume capacity available for the engine (N). The pressure of the fuel gas is adjusted by springs within the regulator - if spring is all the way out → discharge pressure is the minimum pressure of range of the regulator. If spring is all the way in → discharge pressure is the maximum pressure of range of the regulator.

8) EPA requests the most recent fuel gas analyses available for each fuel gas source available for use on each site – casing gas, separator gas and dry processed gas.

9) Maintenance Practices – EPA received a copy of the Arrow C-Series engine operation and maintenance manual from Derrick Timothy and all engines tested were Arrow C-Series engines. He also provided an example Work Order (Attachment B), listing Utah Gas engine maintenance activities. EPA requests a table showing the maintenance performed by Utah Gas on each engine in Table 3 from 1/1/2019 to now.

make	model	manufacturer_ye	horsepower	engine_category	Serial #	facility_name	AST_CO_g_hphr	AST_NOx_g_hphr	AST_CH4_g_hphr	AST_NMHC_g_hphr	AST_02_%dry	BSFC_BTU/hphr	air_filter_type	KO_Scrubbers	fuel-source	air_fuel_control	fuel_gas_volume_capacit
Arrow	C-101	2010	24.5	4SRB	310083	LITTLE CANYON UNIT 09-36F W	75.4	4.5	0.0015	6.9	13.28	13050	Oil bath	Single	Separator gas	carburetor	N
Arrow	C-96	2009	19	4SRB	210121C	RBU 11-2F	148.4	0.79	0.0015	1.1	13.56	13000	Oil bath	Dual	Casing gas	carburetor	N
Arrow	C-106	2008	39	4SRB	303706	HILL CREEK UNIT 06-30F WSMV	91.5	4.1	0.0031	16.1	16.87	13050	Oil bath	Single	Separator gas	carburetor	N
Arrow	C-106	2007	39	4SRB	303660	HILL CREEK UNIT 12-29	5.1	3.5	0.0025	2.3	16.07	13050	Oil bath	Single	Separator gas	carburetor	N

Areas of Concern

Test data has identified certain engine emissions in exceedance of the limitations found in the New Source Performance Standards, Subpart JJJJ - Standards of Performance for Stationary Spark Ignition Internal Combustion Engines:

> §60.4233(d) Owners and operators of stationary SI ICE with a maximum engine power greater than 19 KW [25 HP] and less than 75 KW [100 HP] . . . must comply with the emission standards for field testing in 40 CFR 1048.101(c)
>
> §1048.101(c) Standards for field testing. Starting in 2007, exhaust emissions may not exceed field-testing standards, as follows:
> (2) The HC + NOX standard is 3.8 g/kW-hr [2.83 g/hp-hr] . . . For natural gas-fueled engines, you are not required to measure nonmethane hydrocarbon emissions or total hydrocarbon emissions for testing to show that the engine meets the emission standards of this paragraph (c); that is, you may assume HC emissions are equal to zero
>
> §1048.101(c)(2) ... and the CO standard is 6.5 g/kW-hr [4.85 g/hp-hr].
>
> §60.4230(a)(4)(iii) ... the requirements of subpart JJJJ apply to engines manufactured on or after July 1, 2008, if they are <500 HP.

The RBU 11-2F facility was not listed in the triennial Uinta Basin Emission Inventory for 2017 reporting year (UBEI2017). The well (API well ID 4304730760) associated with the wellpad has been producing since 1984 and so this facility should have been reported in the UBEI2017.

Attachment A - AST Test Report

File: 21-2251-001 ERG Utah Gas PJ Engine Testing_DraftR2.pdf

Attachment B – Utah Gas Work Order for Engine Maintenance

Work Order

WO No.:	15697
Insp. Round WO#:	
WO Date:	09/07/2021
Asset ID:	210086-C
Facility Name:	ROOSEVELT
Asset Description:	ARROW C-96 ENGINE
Parent Asset ID:	HCU08-30F
Serial #:	
Assign To:	CUYLER_WAL CUYLER WALKER
Perform For:	DERRICK_TI DERRICK TIMOTHY
Supervisor:	DANNYFAR99 DANNY FARNSWORTH
Team Leader:	
Comments:	
Task No.:	1440HRPM
Task Desc.:	1440 HR ENGINE PM
Brief Description:	1440 HR ENGINE PM
WO Type:	PM

Additional Information:

Unit #	Yes/No/NA	Comments
Date Completed		
Mechanic		
Rated Horsepower		
Serial #		
Model #		
Rated RPM		
Manufacturer:		
Manufact Date:		
All Belts Checked		
All Hoses & Clamps		
Blowby		
Change Oil & Filter		
Airbreather		
Belt Guard		
Cleanliness of Unit		
Coolant		
Engine Bolts		
Fuel Gas Scrubber		
Kills		
Oil Pressure		
Spark Plug Gap & Clean		
Tension on Power Bands		
Valve Lash on Head		
Oil Level Cont		
Compression Test		
Grease Clutch		
Six Month Bullet		

Additional Information pg 2:

All Work Completed by:

Mechanic Print Name_____ Signature_____ Date_____

Supervisor Print Name_____Signature_____ Date_____