ORIGIN ID:DENA (303) 572-9000
INTEROFFICE
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DENVER, CO 80202
UNITED STATES US

SHIP DATE: 28AUG18
ACTWGT: 1.0 LB
CAD: 325717/FXRS1304

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TO **CLAUDIA SMITH**

1595 WYNKOOP STREET
8P-AR
DENVER CO 80202
(303) 312-6520 REF:
INV:
PO: HUNTER GOODLOE DEPT:

FedEx Express

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OGFIP-TAT-000820-2017.002
Rcvd: 12/18/2018

eog resources

EOG Resources, Inc.
600 Seventeenth Street
Suite 1000N
Denver, CO 80202
Main: 303-572-9000
Fax: 303-824-5400

August 28, 2018

Claudia Smith
Tribal NSR and PSD Permits Lead
U.S. EPA, Region 8
1595 Wynkoop Street, 8P-AR
Denver, Colorado 80202-1129

Re: Part 2 Air Permit Registration
Clarks Creek Central Facility & Compressor Station
Fort Berthold Indian Reservation, McKenzie County, ND

EOG Resources, Inc. (EOG) is submitting an air permit Registration application for our oil and gas exploration and production (E&P) facility located on the Ft. Berthold Indian Reservation. This registration application was prepared to meet the requirements of the U.S. Environmental Protection Agency (EPA) for new and modified minor sources located in Indian country and the requirements of the Oil and Natural Gas Federal Implementation Program (FIP) for Indian Country (40 CFR Part 49) issued June 3, 2016. Additional compression equipment is in the process of being installed and a modified Part 2 Registration will be submitted soon after the installation is complete, but EOG is submitting this Part 2 within 60 days of initial startup of the new wells associated with this facility. EOG submitted an initial application for a 40 CFR Part 71 Federal Operating Permit for this facility on July 27, 2018 as emissions from the facility exceeded the Title V thresholds due to flaring of produced gas caused by lack of gas takeaway capacity. With the addition of new equipment under this Part 2 Registration, EOG will also modify the recently submitted Part 71 application.

We trust the attached permit application package will meet your expectations and that you will not hesitate to call me at (303) 262-9915 or Mark Smith at (307) 823-6208 if you have any questions or need additional information. We appreciate your prompt attention to this most important project.

Sincerely,

Mathew Oliver
Environmental Manager
EOG Environmental – Denver Division

Cc: smith.claudia@epa.gov, r8airpermitting@epa.gov, schwartz.colin@epa.gov

ED_004016P_00013183-00002

Part Two: Oil & Gas Production Facility Part 2 Registration

Clarks Creek Central Facility & Compressor Station
Add Clarks Creek 24-0706H, 72-0706H, 107-0706H, 108-0706H, and 155-0706H wells
McKenzie County, North Dakota

EOG Resources, Inc

August 28, 2018

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1. Introduction

EOG Resources, Inc (EOG) is hereby submitting an air registration for a modification to an existing oil and gas production facility known as the modification for the facility known as Clarks Creek Central Facility. The modification is being submitted to register equipment associated with the construction of five new wells and the addition of new gas engine driven compressors and glycol dehydration unit. The five new wells are the Clarks Creek 24-0706H, 72-0706H, 107-0706H, 108-0706H, and 155-0706H. The Facility is located on the Fort Berthold Indian Reservation in McKenzie County, North Dakota, and extracts oil and gas using horizontal drilling and hydraulic fracturing techniques. The latitude and longitude of the Facility locations are 47.905900 N and -102.755400 W, (NAD 83) respectively.

The Facility consists of well head(s), a heater-treater separator(s), emission control device(s), crude oil and produced water storage tanks, and truck loading station(s).

In accordance with the requirements of §49.160(c)(1)(iv) this application includes the Part 2 Registration Form, presented in Appendix A, and is being submitted within 60 days of Facility start up.

2. Process Description

Gas and liquids rise to the surface through the well head. The gas/liquid mixture enters a heater treater to separate the natural gas, crude oil, and produced water.

The crude oil and produced water will be temporarily stored in above ground storage tanks. Crude oil may be sent off-site via pipeline or hauled away by trucks. Produced water may be hauled away by truck for recycling and/or disposal. A control device may be used in the absence of a pipeline.

The Facility will produce approximately 17,330,000 standard cubic feet per day of natural gas, 8,215 barrels per day (bbl/day) of crude oil and 8,481 bbl/day of produced water, and will be operational 8,760 hours/year.

A Plot Plan and Facility Flow Diagram are provided in Figures 1 and 2 respectively.

3. Equipment Description

The Facility may consist of the equipment described below:

3.1 Separator/Heater Treater

The Facility may contain heater treater(s)/separator(s) for separation of multi-phase streams into individual components of crude oil, natural gas and produced water.

3.2 Tanks

The Facility may contain stable oil storage tanks and produced water storage tanks.

3.3 Control Device

The Facility may use a control device to control emissions from tanks. The Facility may use a control device to control emissions from treater gas and flashing if a pipeline is not installed. The control device will have a control efficiency of 98 percent.

3.4 Component Count

Component count of 1540 connectors, 384 valves, 10 pumps, 942 flanges and 20 open ended lines were used for estimating fugitive emissions.

3.5 Natural Gas Fired Compressor Engines

The Facility may include natural gas fired engine compressors to provide artificial gas lift and midstream compression for the wells on location.

3.6 TEG Dehydration Unit

The Facility may install TEG dehydration unit(s) to dry gas to meet pipeline specifications. The fuel gas dehydration unit has been disconnected and will no longer be used.

4. Emissions Calculations

Emission calculations were performed for all emission sources in the Facility. The calculated emissions are provided in Tables 3 through 13. The Facility information used for calculating emissions is presented in Table 1. The fuel usage from the Facility is presented in Table 2. The Emission Summary of all sources is provided in Table 3 and HAP Emissions Summary is provided in Table 4. The emission sources are described below.

4.1 Tank Emissions

The tank emissions include flashing, working and breathing (F/W/B) losses. F/W/B losses for tanks were estimated using ProMax. The F/W/B losses for oil tanks are provided in Table 5 and the F/W/B losses for water tanks are provided in Table 6. Emissions from the tanks are captured with a vapor recovery unit (VRU) with a flare backup.

4.2 Engineered Flare Emissions

An enclosed flare is used to control tank losses. The flare will be operated a maximum of 8,760 hr/yr.

Emissions were estimated using a mass balance approach. The flare destruction efficiency will destroy 98% of all species. Inlet flare gas consists of pilot gas, tank losses and captured truck loading losses. Flare emissions are provided in Table 7.

4.3 Heater Treater Burner Emissions

The heater treater burner emissions were calculated based on the maximum heat input rating, AP-42 emission factors for natural gas combustion, and the produced natural gas heat content. The emissions calculations are provided in Table 8.

4.4 Truck Loading Emissions

Crude oil is sent off-site either via pipeline or tanker trucks. As a worst-case scenario, this application assumes that crude oil and produced water is hauled away by trucks. Emissions from the truck loading were calculated using the AP-42 equation for truck loading losses. The truck loading emission calculations are provided in Table 9.

4.5 Fugitive Emissions

Fugitive emissions from component leaks were calculated using the Average Emission Factor Approach provided in the EPA's Protocol for Equipment Leaks Emissions Estimate (EPA 453/R-95-017 dated November 1995). This approach for estimating emissions allows use of average emission factors developed by the EPA in combination with unit-specific data that are relatively simple to obtain. The calculated fugitive emissions are based on the following:

- Number of each type of component in a unit (valve, connector, etc.)
- Service of each component (gas, light or heavy liquid)
- VOC/HAP concentration of the stream
- Gas analysis
- Liquid analysis
- EPA Average emission factors for oil and gas production operation

Fugitive emissions calculations are provided in Table 10.

The average emission factors are not intended to provide an accurate estimate of the emission rate from a single piece of equipment. According to EPA, the average factors are more appropriately applied to the estimation of emissions from populations of equipment. Since fugitive emissions from component leaks are estimated from component population, average emission factor accounts for the span of possible leak rates and considered reasonable for this analysis. Hence, screening range approaches were not used for this project.

4.6 Natural Gas Fired Compressor Engines

One 1340-hp Caterpillar G3516 natural gas fired compressor engine will be utilized to provide gas lift for the well associated with the facility. The engine was manufactured June 27, 2006 and will be controlled to 2.0 g/hp-hr NOx, 4.0 g/hp-hr CO, and 1.0 g/hp-hr VOC through lean-burn technology with an oxidation catalyst and air-fuel ratio controller. Emissions are provided in Table 9.

One 1875-hp Caterpillar G3606 natural gas fired compressor engine will be utilized to provide midstream gas compression for the wells associated with the facility. The engine was manufactured February 13, 2018 and will be controlled to 1.0 g/hp-hr NOx, 2.0 g/hp-hr CO, and 0.7 g/hp-hr VOC through lean-burn technology with an oxidation catalyst and air-fuel ratio controller. Emissions are provided in Table 9.

A second Caterpillar G3606 unit will be installed in the coming weeks and an updated registration will be prepared at that time.

4.7 TEG Dehydration Unit

The Facility may install a TEG dehydration unit to dry gas to meet pipeline specifications. Emissions were estimated using GRI-Gly-Calc and included in Table 13.

5. Air Quality Impact Analysis

EPA Region 8 requires that activities that meet certain criteria perform Air Quality Impact Analysis (AQIA). A qualitative evaluation of the applicability criteria for the Facility is provided below.

5.1 Potential to Cause Adverse Air Quality Effects/Violation of Applicable Standards

EOG performed a review of Facility emissions and the State's air quality to evaluate whether the Facility emissions exceed the applicable air quality standards.

A review of the North Dakota 2015 Annual Air Quality Report indicated that the highest criteria pollutant concentrations at state-wide monitoring stations were significantly lower than the National Ambient Air Quality Standards (NAAQS) for a majority of criteria pollutants. The table below summarizes the monitoring concentrations and their comparison with NAAQS.

Pollutant	Averaging Time (Hours)	Highest Concentration	NAAQS	Unit	Highest Concentration Location
SO2[1]	1	26	75	ppb	Lostwood
	24	6.5	140	ppb	Lostwood
	Annual	1.07	30	ppb	Beulah
NO2	1	34	100	ppb	Fargo NW
	Annual	5.37	53	ppb	Bismarck
PM2.5	24	25	35	ug/m3	Williston
	Annual	6.9	12	ug/m3	Williston
PM10	24	147	150	ug/m3	Williston
CO	1	875	35,000	ppb	Fargo NW
	8	800	9,000	ppb	Fargo NW
Ozone	8	61	70	ppb	Bismarck

[1]Monitored data for 24 hour and annual SO2 concentration was not available. Reported data is from the 2014 Air Quality Report.

Based on the table, the majority of the pollutants are less than 50 percent of the NAAQS level. This provides a wide margin before compliance could potentially be compromised. Hence, compliance with the NAAQS is expected.

The Facility is located far from the locations with highest state-wide ambient concentrations. Therefore, there is wider margin to the NAAQS limits at the Facility location.

The Facility is located in an attainment area. Based on emission rates of criteria pollutants, it is reasonable to believe that the Facility emissions does not cause or contribute to the exceedance of NAAQS.

5.2 Major Source

The Facility will not be a major source of criteria pollutants and not subject to PSD permitting requirements. Hence, this criterion is not applicable.

5.3 Stack Orientation and Heights

The stacks at the Facility will be exhausted unobstructed vertically to the atmosphere. Hence, these stacks provide adequate dispersion for the Facility emissions. The stack height for Facility emissions sources is provided below:

Source	Stack Height (ft)
Engineered Flare	10-40
Heater Treater Burner	0-15
Compressor Engines	25-30

5.4 Terrain

The Facility is located in relatively flat to gently rolling open terrain. Due to flat terrain conditions, the dispersion of the plume is not negatively impacted.

5.5 Site Location Area Designation

The Facility is located in McKenzie County, which is designated as attainment for all criteria pollutants.

5.6 Building Downwash

There are no large buildings at the Facility. Therefore, building downwash is not a concern.

5.7 Proximity to Property Line

The majority of the emission sources will be located far from property line. This will provide adequate dispersion for the emissions before the plume reaches the property boundary.

5.8 Sensitive Receptors

The Facility is expected to be located far from any sensitive receptors to provide adequate dispersion. Hence, the ambient impact from the Facility emissions is expected to be negligible.

5.9 Vehicular Emissions

After the Facility is constructed, the primary vehicular traffic will consist of trucks hauling crude oil and produced water off-site.

Based on low traffic volume, PM_{10} and $PM_{2.5}$ fugitive emissions are not expected to cause or contribute to an exceedance of NAAQS.

5.10 Fugitive Emissions

There will be limited process fugitive emissions. The process fugitive emissions occur due to leaks in piping components. The fugitive emissions are readily dispersed upon entering the atmosphere resulting in minimal impact on the air quality. Facility personnel use Audio-Visual-Olfactory (AVO) techniques to identify larger fugitive emissions leaks. Any fugitive emissions leaks identified will be promptly repaired to minimize emissions.

EOG utilizes the EPA protocol for Equipment Leak Emission Estimates, EPA- 453/R-95-017, November 1995 to estimate fugitive emission estimates on a monthly basis.

5.11 Summary

Based on the above AQIA, the low emissions and adequate dispersion characteristics at this Facility does not cause adverse impact on the air quality. Hence, air dispersion modeling is not required.

6. Testing, Monitoring, and Recordkeeping

6.1 Testing/Monitoring

At a minimum, the Facility will perform the following monitoring:

- Monitor oil production
- Monitor the volume of gas sent to the engineered flare.

6.2 Leak Detection Monitoring

The Facility will monitor oil/gas/water components for leaks using infrared detection techniques quarterly in compliance with NSPS Subpart OOOOa. If EOG personnel discover a leaking component, repairs will be coordinated and implemented as soon as possible in accordance with the repair timelines of OOOOa.

6.3 Recordkeeping

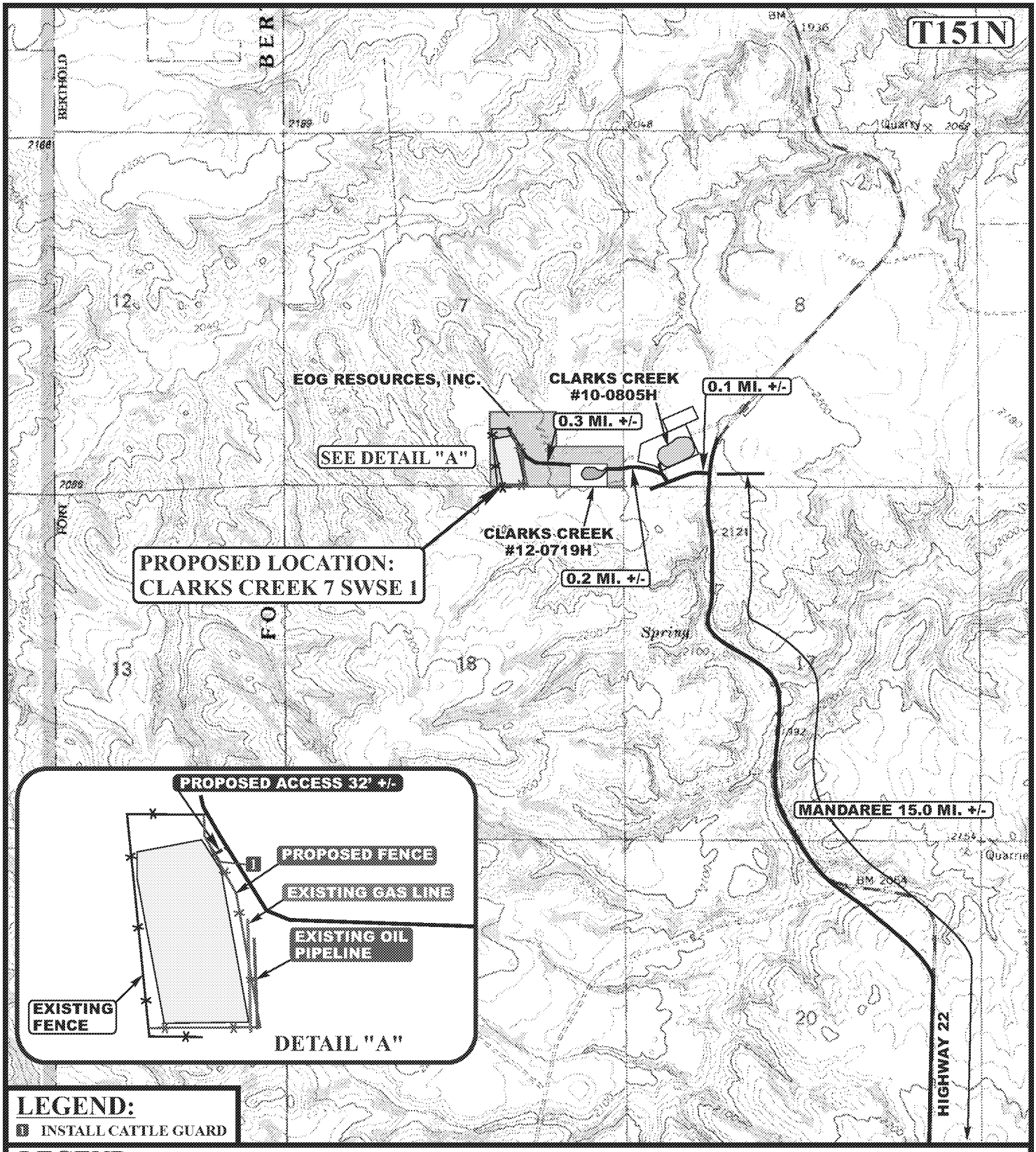
The Facility will maintain records of:

- The volume of oil produced
- The volume of natural gas produced.

7. Summary

The Facility will operate as a major source of criteria pollutants. Facility-wide emissions will not exceed 250 tpy of any criteria pollutant, and will not exceed a total of 25 tpy for all HAPs or 10 tpy of any individual HAP as demonstrated in Table 3 and Table 4. A Part 71 Title V application was submitted on July 27, 2018. EOG will update the Title V application to incorporate these enclosed changes.

Figures



LEGEND:

- EXISTING ROAD
- PROPOSED ACCESS
- EXISTING FENCE
- PROPOSED FENCE
- EXISTING OIL PIPELINE
- EXISTING GAS LINE

N

EOG RESOURCES, INC.

CLARKS CREEK 7 SWSE 1
SECTION 7, T151N, R94W, 5th P.M.
SW 1/4 SE 1/4

Uintah Engineering & Land Surveying
85 South 200 East Vernal, Utah 84078
(435) 789-1017 * FAX (435) 789-1813

ACCESS ROAD MAP	10 MONTH	23 DAY	12 YEAR	B TOPO
SCALE: 1" = 2000'	DRAWN BY: A.T.	REV:11-19-15 J.M.C.		

eog resources
Site Facility Diagram

Well Name: Clarks Creek 7 CPF
1/4 1/4: SESE **Sec:** 7 **T:** 151N **R:** 94W
County: McKenzie **State:** ND
Lat./Long.: 47.9059, -102.7554
CA#: NDM102328
Type of well:
Injection: **Oil:** X **Gas:** **Tank Battery:** X

EOG Resources, Inc. site facility diagrams & site security plans are located at the Stanley office in Stanley, North Dakota. The office is located at 6201 81st Ave NW and normal business hours are 7:00am to 4:30pm CST.

Valve	Production Phase	Sales Phase	Recycle Phase
PV	O/C	SC	O/C
SV	SC	O	SC
RV	O/C	SC	O/C
EV	O	SC	O

Revised: 7/17/18

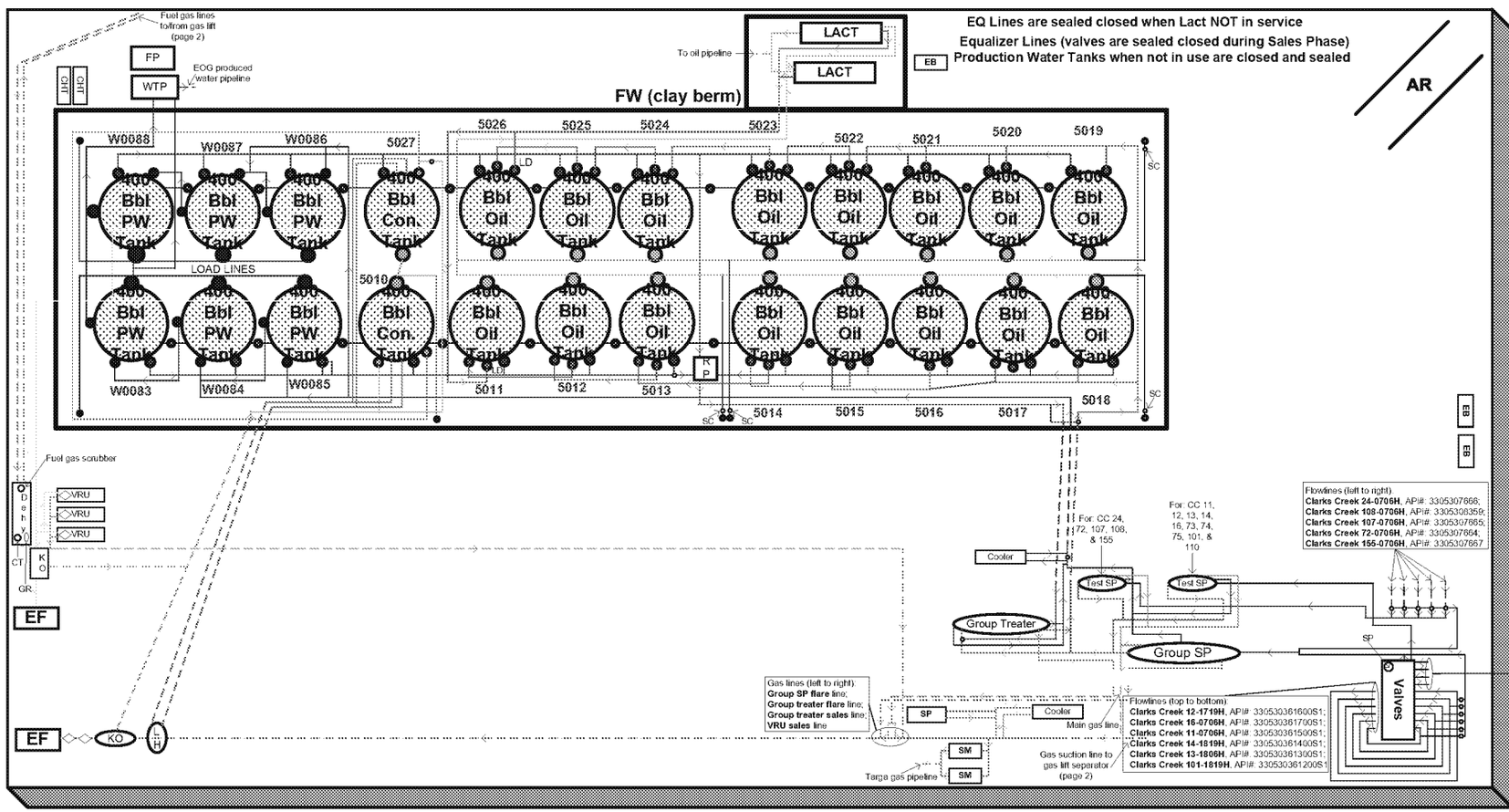
Abbreviations

AR = Access Road
CC = Clarks Creek
CT = Contactor
CHT = Chemical Tank
Con. = Condensate
EF = Engineered Flare
EV = Equalizer Valve
FP = Filter Pot
FW = Firewall
GR = Glycol Reboiler
KO = Knock Out
LACT = LACT Unit
LD = LACT Divert
LH = Line Heater
O = Open
O/C = Open/Closed
PV = Production Valve
RP = Recycle Pump
RV = Recycle Valve
SC = Sealed Closed
SM = Sales Meter
SP = Separator
SV = Sales Valve
WTP = Water Transfer Pump
VRU = Vapor Recovery Unit

◇ = Meter
∘ = Valve
---------- = Buried Line
_____ = Unburied Line

Equalizer Lines
Tank Vent Line
Water Line
Oil Lines
Recycle Line
Sales Line
Gas Line
Condensate Line
Glycol Line

Equalizer Valve
Water Valve
Oil Valve
Sales Valve
Recycle Valve
Condensate Valve



eog resources
Site Facility Diagram

Well Name: Clarks Creek 7 CPF gas lift
1/4 1/4: SESE **Sec:** 7 **T:** 151N **R:** 94W
County: McKenzie **State:** ND
Lat./Long.: 47.9065, -102.7554
CA#: NDM102328
Type of well:
Injection: **Oil:** X **Gas:** **Tank Battery:** X

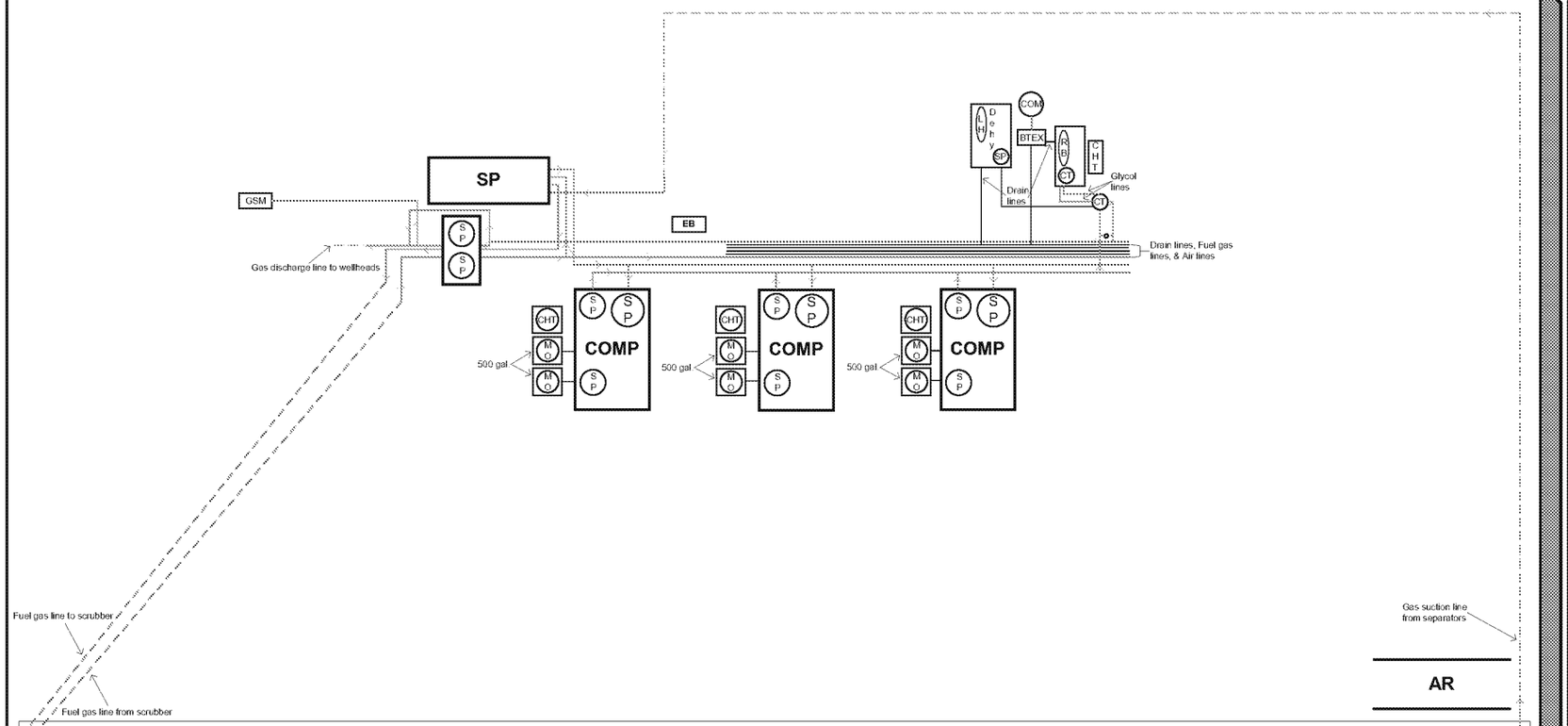
EOG Resources, Inc. site facility diagrams & site security plans are located at the Stanley office in Stanley, North Dakota. The office is located at 6201 81st Ave NW and normal business hours are 7:00am to 4:30pm CST.

Revised: 7/26/18

Abbreviations

AR = Access Road
BTEX = BTEX Unit
CHT = Chemical Tank
COM = Combustor
COMP = Compressor
CT = Contactor
EB = Electrical Building
LH = Line Heater
MO = Motor oil
RB = Reboiler
SP = Separator

∘ = Valve
---------- = Buried Line
_____ = Unburied Line



Clarks Creek 7 CPF
(see page 1)

Tables

TABLE 1
FACILITY INFORMATION SUMMARY

FACILITY INFORMATION		
Facility ID	Clarks Creek Central Facility	Name of the facility

PRODUCTION DATA		DESCRIPTION
Daily Average Oil Production Rate	8215	Average daily production in barrels of oil per day (BOPD), based on the first 30 days of production.
Produced Water Tank Throughput	8481	Average daily production in barrels of water per day (BWPD), based on the first 30 days of production.
Daily Average Gas Production Rate	17330	Average daily production of gas in Mscf per day, based on the first 30 days of production.
Decline Factor	1	Decline factor built into oil and gas production expectations, default is set to 0.6.
Adjusted Daily Average Oil Production Rate	8215	This is the average BOPD expected to be produced for the first 365 days of operation.
Adjusted Daily Average Gas Production Rate	17330	This is the average daily mcfd of gas the well is expected to produce in the first 365 days of operation.

OIL/CONDENSATE TANKS		DESCRIPTION
Molecular Weight	51.20	Molecular weight of the tank vapors in pounds per pound-mole (lb/lb-mole). Obtained from promax.
VOC%	0.88	VOC weight fraction of the tank vapor gas (C3+). Obtained from Promax.
HAP%	0.07	HAP weight fraction of the tank vapor gas. Obtained from Promax.
H_2S weight %	0.00	H_2S weight percent of the tank vapor gas. Obtained from Promax.
Flare Efficiency	98.00%	Flare destruction efficiency to control tank vapor emissions

TREATER GAS DATA		DESCRIPTION
Heating Value	1,567.7	Btu/scf of wellstream gas.
Molecular Weight	27.32	Average molecular weight of the wellstream gas in lb/lb-mole.
Specific Gravity	0.94	If necessary to convert specific gravity to molecular weight, enter the specific gravity of the wellstream gas.
Calculated Molecular Weight	27.21	Calculated molecular weight based on the specific gravity entered above.
VOC%	41.05%	VOC weight fraction of the wellstream gas (C3+).
HAP%	2.34%	HAP weight fraction of the wellstream gas.
H_2S weight %	0.000%	H_2S weight percent of the wellstream gas
H_2S mole %	0.0000%	H_2S mole percent of the wellstream gas
Control Equipment (No Gas Pipeline)	Engineered Flare	Used to combusted gas stream when pipeline is unavailable
Control Destruction Efficiency	98%	Control efficiency of any applicable controls (combustor, pit flare, utility flare, etc).

HEATER TREATER		DESCRIPTION
Firing Rate	3,300,000	Combined burner rating for the burners in Btu/hr.
Hours of Operation	8,760	The burner is assumed to operate 8,760 hours per year.

TRUCK LOADING		DESCRIPTION
Oil is hauled by truck		If sales oil pipeline is unavailable, oil will be hauled by truck
Submerged loading: dedicated normal service	0.6	Submerged loading: dedicated normal service
Molecular Weight	51.2	Molecular weight of tank vapors in lb/lb-mole (obtained from Promax)
Vapor Pressure	1.80	True vapor pressure of liquid loaded, pounds per square inch absolute (psia).
Temperature	50	Estimated average annual temperature of liquid loaded in °F
Load Rate (bbl/hr)	200	Maximum load rate of liquid loaded in barrels per hour.
Load Time (hrs)	1	The time it takes to loadout one load (hrs).

MISCELLANEOUS		DESCRIPTION
Pilot Fuel consumption	2.16	Fuel consumption in scf/min

TABLE 2
FACILITY-WIDE FUEL USE

Type of Fuel	Equipment	Quantity of Fuels			Sulfur Content
		Maximum hourly *scf/hr*	Daily *scf/day*	Annual *MMscf/yr*	*% mole*
Natural Gas	RICE1-2	5,220.17	125,284.16	45.73	0.00
	Heater Treater	2,105.01	50,520.19	18.44	0.00
	Pilot	129.60	3,110	1.14	0.00
	Flare	722,083.33	17,330,000	6,325.45	0.00

TABLE 3

EMISSIONS SUMMARY

UNCONTROLLED EMISSIONS

SOURCE	VOC	HAP	NOx	CO	H_2S	SO_2	CO_2e[a]
	(TPY)						(MT/yr)
Oil Tanks	4,283	357.88	--	--	0.00	--	
Water Tanks	31.44	2.53	--	--	--	--	
Engineered Flare	7,185	409.31	25.88	140.84	0.00	0.00	
Treater Burner	0.08	0.03	1.42	1.19	0.00	0.00	
RICE Engine	29.75	4.04	43.98	98.19	--	--	
Fugitive	13.58	0.36	--	--	--	--	
Glycol Dehydrator	1,970.60	509.67					
Totals (No Gas Pipeline)[b]	**13,514.50**	**1,283.83**	**71.29**	**240.22**	**0.00**	**0.00**	**77,878.38**
Totals (With Gas Pipeline)[c]	**4,358.41**	**360.81**	**45.40**	**99.38**	**0.00**	**0.00**	**0.02**

CONTROLLED EMISSIONS

SOURCE	VOC	HAP	NOx	CO	H_2S	SO_2	CO_2e
	(TPY)						(MT/yr)
Oil Tank Flash Gas[e]	4.22	0.35	--	--	0.00	--	
Oil Tank Working and Breathing[e]	0.07	0.00	--	--	0.00	--	
Water Tanks	0.03	0.00	--	--	0.00	--	
Engineered Flare	143.71	8.19	25.88	140.84	0.00	0.00	
Treater Burner	0.08	0.03	1.42	1.19	0.00	0.00	
RICE Engine	25.61	4.04	43.98	87.97	--	--	
Truck Loading[d]	0.00	0.00	--	--	--	--	
Fugitive	13.58	0.36	--	--	--	--	
Glycol Dehydrator	27.46	1.32					
Totals (No Gas Pipeline)[b]	**214.75**	**14.28**	**71.29**	**230.00**	**0.00**	**0.00**	**661,216.47**
Totals (With Gas Pipeline)[c]	**71.01**	**4.78**	**45.40**	**89.16**	**0.00**	**0.00**	**5,439.38**

Notes:

[a]Uncombusted GHG

[b]No Gas Pipeline - gas produced from treater will be sent to engineered flare

[c]With Gas Pipeline - gas produced from treater will be sent to the gas pipeline

[d]These emissions assume the sales oil pipeline is in place.

[e]These emissions account for 95% VRU capture with flare backup.

TABLE 4

HAZARDOUS AIR POLLUTANT (HAP) EMISSIONS SUMMARY

UNCONTROLLED HAP EMISSION SUMMARY

SOURCE	POTENTIAL TO EMIT (TPY)					
	BENZENE	TOLUENE	ETHYLBENZENE	XYLENE	2,2,4 TMP	N-HEXANE
Oil Tanks	18.10	35.22	6.20	7.92	23.56	266.88
Water Tanks	0.58	1.17	0.18	0.26	0.01	0.32
Engineered Flare	18.71	38.07	7.60	8.06	23.56	271.46
Heater Treater	0.00	0.00	0.00	0.00	0.00	0.03
RICE Engine	0.00	0.00	0.00	0.00	0.00	0.00
Truck Loading	0.00	0.01	0.00	0.00	0.00	0.01
Glycol Dehydrator	57.95	267.90	125.18	15.82	0.00	42.82
Total	**95.36**	**342.42**	**14.01**	**16.29**	**47.19**	**581.65**

CONTROLLED HAP EMISSION SUMMARY

SOURCE	POTENTIAL TO EMIT (TPY)					
	BENZENE	TOLUENE	ETHYLBENZENE	XYLENE	2,2,4 TMP	N-HEXANE
Oil Tanks	0.02	0.04	0.01	0.01	0.02	0.27
Water Tanks	0.00	0.00	0.00	0.00	0.00	0.00
Engineered Flare	0.37	0.76	0.15	0.16	0.47	5.43
Heater Treater	0.00	0.00	0.00	0.00	0.00	0.03
RICE Engine	0.00	0.00	0.00	0.00	0.00	0.00
Truck Loading	0.00	0.01	0.00	0.00	0.00	0.01
Glycol Dehydrator	0.26	0.44	0.07	0.01	0.00	0.55
Total	**0.66**	**1.31**	**0.19**	**0.23**	**0.55**	**6.41**

Notes:

[a]No Gas Pipeline - gas produced from treater will be sent to engineered flare

[b]With Gas Pipeline - gas produced from treater will be sent to the gas pipeline

TABLE 5
WORKING, BREATHING & FLASHING EMISSIONS-OIL TANKS

Flashing Emissions

VRU (95%) & Flare Control Efficiency % 98

Component	Uncontrolled Emissions		Controlled Emissions	
	TPY	lb/hr	TPY	lb/hr
Water	33.150	1.492	0.033	0.001
Hydrogen Sulfide	0.000	0.000	0.000	0.000
Oxygen	0.000	0.000	0.000	0.000
Carbon Dioxide	8.378	1.749	0.008	0.002
Nitrogen	0.817	0.360	0.001	0.000
Methane	67.419	10.552	0.067	0.011
Ethane	480.321	7.227	0.480	0.007
Propane	1251.392	4.001	1.251	0.004
iso-Butane	307.343	0.291	0.307	0.000
n-Butane	1101.188	1.700	1.101	0.002
iso-Pentane	333.562	0.232	0.334	0.000
n-Pentane	428.196	0.213	0.428	0.000
Heptanes	382.321	0.156	0.382	0.000
Octanes	39.820	0.004	0.040	0.000
Nonanes	15.212	0.001	0.015	0.000
Decanes+	2.061	0.471	0.002	0.000
Benzene	17.984	4.106	0.018	0.004
Toluene	35.029	7.998	0.035	0.008
Ethylbenzene	6.172	1.409	0.006	0.001
Xylenes	7.882	1.799	0.008	0.002
n-Hexane	264.503	60.389	0.265	0.060
2,2,4-Trimethylpentane	23.382	5.338	0.023	0.005
Total	4806.131	109.487	4.806	0.109

Flashing Emissions Summary

Component	Uncontrolled Emissions		Controlled Emissions	
	TPY	lb/yr	TPY	lb/yr
VOC	4216.045	88.107	4.216	0.088
H2S	0.000	0.000	0.000	0.000
HAPs	354.951	81.039	0.355	0.081

Working & Breathing Emissions

VRU (95%) & Flare Control Efficiency % 98

Component	Uncontrolled Emissions		Controlled Emissions	
	TPY	lb/hr	TPY	lb/hr
Water	0.000	0.000	0.000	0.000
Hydrogen Sulfide	0.000	0.000	0.000	0.000
Oxygen	0.000	0.000	0.000	0.000
Carbon Dioxide	0.200	0.046	0.000	0.000
Nitrogen	0.002	0.001	0.000	0.000
Methane	0.670	0.153	0.001	0.000
Ethane	15.638	3.570	0.016	0.004
Propane	27.213	6.213	0.027	0.006
iso-Butane	5.381	1.229	0.005	0.001
n-Butane	17.952	4.099	0.018	0.004
iso-Pentane	4.508	1.029	0.005	0.001
n-Pentane	5.359	1.223	0.005	0.001
Heptanes	3.168	0.723	0.003	0.001
Octanes	0.216	0.049	0.000	0.000
Nonanes	0.063	0.014	0.000	0.000
Decanes+	0.002	0.000	0.000	0.000
Benzene	0.116	0.027	0.000	0.000
Toluene	0.192	0.044	0.000	0.000
Ethylbenzene	0.029	0.007	0.000	0.000
Xylenes	0.036	0.008	0.000	0.000
n-Hexane	2.380	0.543	0.002	0.001
2,2,4-Trimethylpentane	0.178	0.041	0.000	0.000
Total	83.305	19.019	0.083	0.019

Working & Breathing Emissions Summary

Component	Uncontrolled Emissions		Controlled Emissions	
	TPY	lb/hr	TPY	lb/hr
VOC	66.794	15.250	0.067	0.015
H2S	0.000	0.000	0.000	0.000
HAPs	2.932	0.669	0.003	0.001

Notes:
Oil is flashed in the tanks and is captured a VRU with flare backup
Working, Breathing & Flashing emissions obtained from Proma›

TABLE 6
WORKING, BREATHING & FLASHING EMISSIONS-WATER TANKS

Flashing Emissions

VRU (95%) & Flare Control Efficiency % 98

Component	Uncontrolled Emissions		Controlled Emissions	
	TPY	lb/hr	TPY	lb/hr
Water	6.537	1.492	0.007	0.001
Hydrogen Sulfide	0.000	0.000	0.000	0.000
Oxygen	0.000	0.000	0.000	0.000
Carbon Dioxide	7.661	1.749	0.008	0.002
Nitrogen	1.575	0.360	0.002	0.000
Methane	46.219	10.552	0.046	0.011
Ethane	31.653	7.227	0.032	0.007
Propane	17.525	4.001	0.018	0.004
iso-Butane	1.273	0.291	0.001	0.000
n-Butane	7.445	1.700	0.007	0.002
iso-Pentane	1.016	0.232	0.001	0.000
n-Pentane	0.934	0.213	0.001	0.000
Heptanes	0.683	0.156	0.001	0.000
Octanes	0.017	0.004	0.000	0.000
Nonanes	0.003	0.001	0.000	0.000
Decanes+	0.015	0.003	0.000	0.000
Benzene	0.576	0.132	0.001	0.000
Toluene	1.168	0.267	0.001	0.000
Ethylbenzene	0.184	0.042	0.000	0.000
Xylenes	0.260	0.059	0.000	0.000
n-Hexane	0.324	0.074	0.000	0.000
2,2,4-Trimethylpentane	0.014	0.003	0.000	0.000
Total	125.082	28.558	0.125	0.029

Flashing Emissions Summary

Component	Uncontrolled Emissions		Controlled Emissions	
	TPY	lb/yr	TPY	lb/yr
VOC	31.437	7.177	0.031	0.007
H2S	0.000	0.000	0.000	0.000
HAPs	2.526	0.577	0.003	0.001

Working & Breathing Emissions

VRU (95%) & Flare Control Efficiency % 98

Component	Uncontrolled Emissions		Controlled Emissions	
	TPY	lb/hr	TPY	lb/hr
Water	1.092	0.249	0.001	0.000
Hydrogen Sulfide	0.000	0.000	0.000	0.000
Oxygen	0.000	0.000	0.000	0.000
Carbon Dioxide	0.109	0.025	0.000	0.000
Nitrogen	0.000	0.000	0.000	0.000
Methane	0.036	0.008	0.000	0.000
Ethane	0.023	0.005	0.000	0.000
Propane	0.002	0.000	0.000	0.000
iso-Butane	0.000	0.000	0.000	0.000
n-Butane	0.000	0.000	0.000	0.000
iso-Pentane	0.000	0.000	0.000	0.000
n-Pentane	0.000	0.000	0.000	0.000
Heptanes	0.000	0.000	0.000	0.000
Octanes	0.000	0.000	0.000	0.000
Nonanes	0.000	0.000	0.000	0.000
Decanes+	0.000	0.000	0.000	0.000
Benzene	0.000	0.000	0.000	0.000
Toluene	0.000	0.000	0.000	0.000
Ethylbenzene	0.000	0.000	0.000	0.000
Xylenes	0.000	0.000	0.000	0.000
n-Hexane	0.000	0.000	0.000	0.000
2,2,4-Trimethylpentane	0.000	0.000	0.000	0.000
Total	1.263	0.288	0.001	0.000

Working & Breathing Emissions Summary

Component	Uncontrolled Emissions		Controlled Emissions	
	TPY	lb/hr	TPY	lb/hr
VOC	0.002	0.000	0.000	0.000
H2S	0.000	0.000	0.000	0.000
HAPs	0.000	0.000	0.000	0.000

Notes:
Water is flashed in the tanks and is captured by the flare.
Working, Breathing & Flashing emissions obtained fromPromax

TABLE 7
ENGINEERED FLARE EMISSIONS

Volume of Gas sent to Flare	1,330,500	scf/day
Lower Heating Value	1,568	Btu/scf
Average Molecular Weight	27.32	lb/lb-mole
Standard Molar Volume		
VOC Weight %	41.05%	
HAP Weight %	2.34%	
H_2S Weight %	0.00%	
H_2S Mole %	0.00%	
Flare Destruction Efficiency	98.00%	

EMISSION RATE CALCULATION

							No Gas Pipeline[2]				With Gas Pipeline[3]	
							Flare Inlet (Uncontrolled) Emissions		Flare Outlet (Controlled) Emissions		Flare Outlet (Controlled) Emissions	
Pollutant	Volume of Gas		Std Mol Vol	MW	Wt%	Usage	Hourly	Annual	Hourly	Annual	Hourly	Annual
	scf/day	*scf/hr*	*scf/lb-mol*	*lb/lb-mole*	*wt%*	*hrs/yr*	*lbs/hr*	*tpy*	*lbs/hr*	*tpy*	*lbs/hr*	*tpy*
VOC	1,330,500	55437.50	379	27.32	41.05%	8760	1640.52	7185.49	32.81	143.71	0.00	0.00
HAP	1,330,500	55,438	379	27.32	2.34%	8760	93.45	409.31	1.87	8.19	0.00	0.00
H_2S	1,330,500	55,438	379	27.32	0.00%	8760	0.00	0.00	0.00	0.00	0.00	0.00
	Volume of Gas		Std Mol Vol	MW	E.F.[1]	Usage	Hourly	Annual	Hourly	Annual	Hourly	Annual
	scf/day	*scf/hr*	*scf/lb-mol*	*lb/lb-mole*	*lb/ MMBtu*	*hr/yr*	*lbs/hr*	*tpy*	*lb/hr*	*tpy*	*lb/hr*	*tpy*
NO_X	1,330,500	55,438			0.068	8760	0.00	0.00	5.91	25.88	0.00	0.00
CO	1,330,500	55,438			0.37	8760	0.00	0.00	32.16	140.84	0.00	0.00
SO_2	1,330,500	55,438	379	64		8760	0.00	0.00	0.00	0.00	0.00	0.00

HAP SPECIATED EMISSIONS

		Emissions					
		Uncontrolled				Controlled	
HAP	Weight	Treater Gas	F/W/B (Oil Tanks)	F/W/B (Water Tanks)	Total	No Gas Pipeline[2]	With Gas Pipeline[3]
	%	*tpy*				*tpy*	*tpy*
Benzene	0.15	0.6135	18.0999	0.5763	18.7134	0.3743	0.000
Toluene	0.70	2.8447	35.2212	1.1677	38.0660	0.7613	0.000
Ethylbenzene	0.34	1.3945	6.2012	0.1836	7.5957	0.1519	0.000
Xylenes	0.03	0.1390	7.9180	0.2601	8.0570	0.1611	0.000
2,2,4-Trimethylpentane	0.00	0.0034	23.5595	0.0143	23.5629	0.4713	0.000
n-hexane	1.12	4.5767	266.8834	0.3241	271.4601	5.4292	0.000

Sample Calculations

Uncontrolled Emissions (VOC, HAP. and H_2S) = (volume of gas, scf/hr) * (weight, %) * (MW, lb/lbmol) * (conversion factor, scf/lbmol)
Controlled Emissions (VOC, HAP, and H_2S) = (emission rate, lbs/hr) * (1-destruction efficiency, %)
Emissions from NO_x and CO = (volume of gas, scf/hr) * (Lower heating value, Btu/scf) * (Emission factor, lb/MMBtu) * (Btu/MMBtu)

[1]NOx & CO emission factors are from AP-42 Table 13.5-1 ((Emission Factors for Flare Operations).)
HAP Speciation based on Extended Gas Analysis for Tank Vapo
[2]No Gas Pipeline - gas produced from treater will be sent to engineered flar
[3]With Gas Pipeline - gas produced from treater will be sent to the gas pipelin

TABLE 8
HEATER TREATER BURNER EMISSIONS

Burner Rating: 3,300,000 Btu/hr
Burner Fuel: Natural Gas

Pollutant	Burner Rating	E.F.	Conv.	Usage	Emissions	
	MMBtu/hr	*lb/MMBtu*	*lb/ton*	*hr/yr*	*lb/hr*	*tpy*
VOC	3.3	0.0054	2000	8760	0.0178	0.0779
HAP	3.3	1.77E-03	2000	8760	0.0058	0.0256
NO_X	3.3	0.0980	2000	8760	0.3235	1.4171
CO	3.3	0.0824	2000	8760	0.2718	1.1903

HAP SPECIATED EMISSIONS

HAP	Burner Rating	HAP Emission Factor	Conv.	Usage	Emissions	
	MMBtu/hr	*lb/MMBtu*	*lb/ton*	*hr/yr*	*lbs/hr*	*tpy*
Benzene	3.3	2.06E-06	2000	8760	6.79E-06	2.98E-05
Toluene	3.3	3.33E-06	2000	8760	1.10E-05	4.82E-05
Ethylbenzene	3.3	0.00	2000	8760	0.00	0.00
Xylenes	3.3	0.00	2000	8760	0.00	0.00
2,2,4-Trimethylpentane	3.3	0.00	2000	8760	0.00	0.00
n-hexane	3.3	1.76E-03	2000	8760	5.82E-03	2.55E-02

NOx, CO & VOC Emission Factors are based on AP-42 Table 1.4-1 and 1.4-2

Emission factors were calculated using AP-42 Emissions for Natural Gas Combustion (Tables 1.4-1 and 1.4-2).

Natural gas heat content 1,020 Btu/scf

Propane Heat Content 91.5×10^6 Btu/1000 gallons

Sample Calculations- Benzene from Treater Burner

Benzene Emissions 3300000 (Btu/hr) x 8760 hrs/year x 0.00000206 lbs/MMBtu x 1/ 1000000 (MMBtu/Btu) (1/2000) (tons/lb) 2.98E-05

TABLE 9
RICE EMISSIONS

Engine 1 :Caterpillar G3516TALE Gas Lift Compressor
Maximum Horsepower 1340 hp

Pollutant	Maximum horsepower	Emission Factors		Conversion Factor			Emissions			
		Uncontrolled[1]	Controlled				Uncontrolled		Controlled	
		g/hp-hr	*g/hp-hr*	*g/lb*	*hrs/yr*	*lb/ton*	*lb/hr*	*tpy*	*lb/hr*	*tpy*
NO_X	1340	2.00	2	453.6	8760	2000	5.91	25.88	5.91	25.88
CO	1340	4.79	4	453.6	8760	2000	14.15	61.98	11.82	51.76
VOC	1340	1.32	1	453.6	8760	2000	3.90	17.08	2.95	12.94
Formaldehyde	1340	0.20	0.2	453.6	8760	2000	0.59	2.59	0.59	2.59

Engine 2: Caterpillar G3606LE Gas Compressor
Maximum Horsepower 1875 hp

Pollutant	Maximum horsepower	Emission Factor		Conversion Factor			Emissions			
							Uncontrolled		Controlled	
			g/hp-hr	*g/lb*	*hrs/yr*	*lb/ton*	*lb/hr*	*tpy*	*lb/hr*	*tpy*
NO_X	1875	1.00	1	453.6	8760	2000	4.13	18.11	4.13	18.11
CO	1875	2.00	2	453.6	8760	2000	8.27	36.21	8.27	36.21
VOC	1875	0.70	0.7	453.6	8760	2000	2.89	12.67	2.89	12.67
Formaldehyde	1875	0.08	0.08	453.6	8760	2000	0.33	1.45	0.33	1.45

Aggregated Emissions

Pollutant	Uncontrolled	Controlled
	tpy	*tpy*
NO_X	43.98	43.98
CO	98.19	87.97
VOC	29.75	25.61
Formaldehyde	4.04	4.04

Notes:
[1] Uncontrolled Emission Factors from AP-42 Chapter 3: Stationary Internal Combustion Sources, Table 3.2-3

Sample Calculations
NO_X Uncontrolled Emissions (hp) x 8760 hrs/year x 2.0 g/hp-hr x (1/453.6)(lb/g) (1/2000) (tons/lb)
NO_X Controlled Emissions (hp) x 8760 hrs/year x 2.0(g/hp-hr) x (1/453.6)(lb/g) x (1/2000) x (tons/lb) x1(%)

TABLE 10
TRUCK LOADING EMISSIONS

Formula: $L_L = 12.46 \frac{SPM}{T}$ — AP-42, Chap. 5-2, Eq. 1: Loading Loss (lb/10^3 gallon of liquid loaded)

Where:	S =	0.6	Submerged loading: dedicated normal service *Source AP-42, Table 5.2-1*
	P =	1.80	True vapor pressure of liquid loaded
	M =	50.00	Molecular weight of tank vapors (lb/lb-mol)
	T =	510.00	Temperature of bulk liquid loaded (^{o}R = ^{o}F+460)
	L_L =	1.32	lb/10^3 gallons of Loading loss

Truck Loading Emissions

Pollutant	Truck load rate	Annual Production	Load Time	Conversion Factor	Emission Rates	
	bbl/hr	*bbl/yr*	*hrs*	*gal/bbl*	*lbs/hr*	*tpy*
VOC (C3+)	200.0	2,998,475.0	1.00	42	11.07	0.73

HAP Speciated Emissions

HAP	HAP Weight %	Emission Rates
	%	*tpy*
Benzene	0.15	1.09E-03
Toluene	0.70	5.06E-03
Ethylbenzene	0.34	2.48E-03
Xylenes	0.03	2.47E-04
2,2,4-Trimethylpentane	0.00	6.11E-06
n-Hexane	1.12	8.14E-03

(EPA AP-42 Values) Table 1 below is required to supply the saturation factor variable in the above equation.

Cargo Carrier	Mode of Operation	S Factor
Tank Trucks and Rail Tank Cars	Submerged loading of a clean cargo tank	0.50
	Submerged loading: dedicated normal service	0.60
	Submerged loading: dedicated vapor balance service	1.00

(EPA AP-42 Values) Table 2 below may be used to provide the vapor pressure and molecular weight values for the above equation.

Petroleum Liquid	Vapor MW at 60F Mv(lb/lb-mole)	Condensed Vapor Density at 60F Wvc(lb/gal	Liquid Density at 60F W1(lb/gal)	True Vapor Pressure, Pva (psi) at various temperatures in F						
				40	50	60	70	80	90	100
Crude Oil RVP 5	50	4.5	7.1	1.8	2.3	2.8	3.4	4	4.8	5.7

Sample Calculations- Benzene from Truck Loading Emissions

Benzene Emissions: 0.15 (% Wt Benzene) x 0.73 (TPY VOC) = 1.09E-03 (TPY)

TABLE 11
FUGITIVE EMISSIONS

Fugitive Components	Stream Type	Number of Components (provided by EOG)	EPA Average Total Hydrocarbon Emission Factors [a] (lb/hr/source)	Fugitive VOC Emission Rates [a] (lbs/hour)	Fugitive VOC Emission Rates [a] (tons/year)	VOC EMISSIONS: Total Gas (tons/year)	VOC EMISSIONS: Total Heavy Oil (tons/year)	VOC EMISSIONS: Total Light Oil (tons/year)	VOC EMISSIONS: Total Water/ Light Oil (tons/year)
Connectors	Gas	614	4.58E-04	0.12	0.51	0.51			
	Heavy Oil	0	1.67E-05	0.00	0.00		0.00		
	Light Oil	770	4.58E-04	0.35	1.55			1.55	
	Water/Oil	156	2.42E-04	0.04	0.17				0.17
Valves	Gas	165	1.00E-02	0.68	2.97	2.97			
	Heavy Oil	0	1.83E-05	0.00	0.00		0.00		
	Light Oil	145	5.42E-03	0.79	3.44			3.44	
	Water/Oil	74	2.17E-04	0.02	0.07				0.07
Pumps	Gas	0	5.42E-03	0.00	0.00	0.00			
	Light Oil	5	2.88E-02	0.00	0.01	0.01	0.00	0.01	
	Water/Oil	5	5.42E-05	0.00	0.00				0.00
Flanges	Gas	355	8.75E-04	0.13	0.56	0.56			
	Heavy Oil	0	8.75E-07	0.00	0.00		0.00		
	Light Oil	370	2.42E-04	0.09	0.39			0.39	
	Water/Oil	217	6.25E-06	0.00	0.01				0.01
Open Ended Lines	Gas	10	4.58E-03	0.02	0.08	0.08			
	Heavy Oil	0	3.08E-04	0.00	0.00		0.00		
	Light Oil	5	3.08E-03	0.02	0.07			0.07	
	Water/Oil	5	5.42E-04	0.00	0.01				0.01
Others	Gas	47	1.96E-02	0.38	1.66	1.66			
	Heavy Oil	0	7.08E-05	0.00	0.00		0.00		
	Light Oil	10	1.67E-02	0.17	0.73			0.73	
	Water/Oil	10	3.08E-02	0.31	1.35				1.35
			Total Fugitive Emission Rates	**3.10**	**13.56**	**5.78**	**0.00**	**6.19**	**1.60**

Speciated HAP Weight Fraction

	Tank Vapor composition[b]				Heavy oil composition[b]				light oil and water/oil composition[b]			
Component	*mol%*	*MW of component*	*MW of W&S Stream*	*wt. fraction*	*mol%*	*MW of component*	*MW of Heavy Oil Stream*	*wt. fraction*	*mol%*	*MW of component*	*MW of LP Oil*	*wt. fraction*
	%	lb/lb-mol	lb/lb-mol		%	lb/lb-mol	lb/lb-mol		%	lb/lb-mol	lb/lb-mol	
Benzene	-	78.11	-	3.74E-05	-	78.11	-	1.77E-03	-	78.11	-	1.77E-03
Toluene	-	92.13	-	7.29E-05	-	92.13	-	8.87E-03	-	92.13	-	8.87E-03
Ethylbenzene	-	106.17	-	1.28E-05	-	106.17	-	3.75E-03	-	106.17	-	3.75E-03
Xylenes	-	106.17	-	1.64E-05	-	106.17	-	7.53E-03	-	106.17	-	7.53E-03
n-hexane	-	86.18	-	5.50E-04	-	86.18	-	1.67E-02	-	86.18	-	1.67E-02
2,2,4-trimethylpentane	-	114.24	-	4.86E-05	-	114.24	-	6.53E-03	-	114.24	-	6.53E-03

TABLE 11

Fugitive HAP Emissions

	Fugitive VOC Emission Rates (tons/yr)	*Speciated Fugitive HAP (weight fraction)* [b]						*Speciated Fugitive Emissions*						
		Benzene	*Toluene*	*Ethyl-Benzene*	*Xylenes*	*n-hexane*	*2,2,4 TMP*	*Benzene (tons/yr)*	*Toluene (tons/yr)*	*Ethyl-Benzene (tons/yr)*	*Xylenes (tons/yr)*	*n-hexane (tons/yr)*	*2,2,4 TMP (tons/yr)*	*Total HAP (tons/yr)*
Gas	5.78	3.74E-05	7.29E-05	1.28E-05	1.64E-05	5.50E-04	4.86E-05	0.0002	0.0004	0.0001	0.0001	0.0032	0.0003	
Heavy Oil	0.00	1.77E-03	8.87E-03	3.75E-03	7.53E-03	1.67E-02	6.53E-03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Light Oil	6.19	1.77E-03	8.87E-03	3.75E-03	7.53E-03	1.67E-02	6.53E-03	0.0110	0.0549	0.0232	0.0466	0.1031	0.0404	
Water/Light Oil	1.60	1.77E-03	8.87E-03	3.75E-03	7.53E-03	1.67E-02	6.53E-03	0.0028	0.0142	0.0060	0.0121	0.0267	0.0105	
Total	**13.58**							**0.0140**	**0.070**	**0.0293**	**0.0588**	**0.1330**	**0.0512**	**0.3559**

Notes:

[a] EPA Protocol for Equipment Leak Emission Estimates, November 1995, Table 2-4, Pages 2-15.

[b] HAP weight fractionsfor Tank Vapors obtained from Promaxs. HAP weight for Heavy Oil and Light Oil obtained from Liquid Analysi:

Sample Calculations- Fugitive VOC and HAP (Benene) Emissions from Gas

VOC Emissions (connectors)	614 (# of components) x 0.000458 lbs/hr/source x 41.05% NMVOC from Summary -Extended Gas Analysis	=	0.12	lbs/hr	
Benzene Emissions (Gas)	5.78 tons/year AggregateFugitive VOC Emissions from Gas x 0.0000374 Fugitive Emission Factor =			0.0002	tons/year

TABLE 12
GREENHOUSE GAS EMISSIONS

Flare CO_2 and CH_4 Emissions

Components	Mole fraction of treater gas constituents[a]	Volume of treater gas sent to flare *scf/year*	Mole fraction of tank vapor constituents[b]	Volume of flash gas *scf/year*	Volume of W/B sent to Flare *scf/year*	Component volume of gas sent to Flare *scf/year*	Component volume of gas for destruction *scf/year*	Number of carbon atoms	Flare Efficiency	No Gas Pipeline[i]: Flared CO_2 Volume[c] *scf/year*	No Gas Pipeline[i]: Unflared CO_2 and CH_4 Volume[c] *scf/year*	No Gas Pipeline[i]: Volume GHGs Emitted *scf/year*	With Gas Pipeline[j]: Flared CO_2 Volume[c] *scf/year*	With Gas Pipeline[j]: Unflared CO_2 and CH_4 Volume[c] *scf/year*	With Gas Pipeline[j]: Volume GHGs Emitted *scf/year*
CO_2	0.007	6,325,450,000	0.000	10,989,654	1,272,678	214	42,893,090	1	0	--	42,893,090	11,024,125,204	--	214	490,229
Methane	0.567	6,325,450,000	0.000	10,989,654	1,272,678	1,720	3,584,014,341	1	0.98	3,512,334,054	71,680,287	71,680,287	1,686	34	34
Ethane	0.203	6,325,450,000	0.001	10,989,654	1,272,678	12,255	1,281,858,372	2	0.98	2,512,442,409	--		24,020	--	
Propane	0.112	6,325,450,000	0.003	10,989,654	1,272,678	31,928	710,670,934	3	0.98	2,089,372,545	--		93,868	--	
i-Butane	0.013	6,325,450,000	0.001	10,989,654	1,272,678	7,842	81,498,614	4	0.98	319,474,566	--		30,739	--	
n-Butane	0.041	6,325,450,000	0.002	10,989,654	1,272,678	28,096	259,308,291	4	0.98	1,016,488,501	--		110,135	--	
Pentane	0.022	6,325,450,000	0.002	10,989,654	1,272,678	19,435	136,870,546	5	0.98	670,665,676	--		95,234	--	
Hexane	0.009	6,325,450,000	0.001	10,989,654	1,272,678	6,749	58,529,812	6	0.98	344,155,294	--		39,681	--	
Benzene	0.001	6,325,450,000	0.000	10,989,654	1,272,678	459	3,302,344	6	0.98	19,417,781	--		2,698	--	
Heptanes	0.006	6,325,450,000	0.001	10,989,654	1,272,678	9,755	36,438,021	7	0.98	249,964,824	--		66,916	--	
Toluene	0.002	6,325,450,000	0.000	10,989,654	1,272,678	894	12,980,717	7	0.98	89,047,720	--		6,131	--	
Octane plus	0.002	6,325,450,000	0.000	10,989,654	1,272,678	2,053	14,063,529	8	0.98	110,258,064	--		16,097	--	
Ethyl benzene	0.001	6,325,450,000	0.000	10,989,654	1,272,678	157	5,522,275	8	0.98	43,294,639	--		1,235	--	
Xylenes	0.000	6,325,450,000	0.000	10,989,654	1,272,678	201	550,515	8	0.98	4,316,040	--		1,577	--	
Subtotal										**10,981,232,113**	--		**490,015**	--	

Flare CO_2 and CH_4 Emissions

Pollutant	Volume Emitted: No Gas Pipeline[i] *scf/year*	Volume Emitted: With Gas Pipeline[j] *scf/year*	Density of GHG[d] *lb/scf*	Operating Time *hrs/yr*	Conversion Factor *lb/ton*	Emissions[d]: No Gas Pipeline[i] *lbs/hr*	Emissions[d]: No Gas Pipeline[i] *(tons/yr)*	Emissions[d]: With GasPipeline[j] *lbs/hr*	Emissions[d]: With GasPipeline[j] *(tons/yr)*	GWF	CO_2e Emissions: No Gas Pipeline[i] *MT/yr*	CO_2e Emissions: With Gas Pipeline[j] *MT/yr*
CO_2	11,024,125,204	490,229	0.12	8760	2000	145935.02	639,195.38	6.49	28.42	1	579,865.27	5.89
CH_4	71,680,287	34	0.09	8760	2000	761.28	3334.39	0.00	0.00	25	75,622.22	0.01
Subtotal											655,487.48	5.90

Flare N_2O Emissions

N_2O Source	Volume of gas combusted: No Gas Pipeline[i] *scf/year*	Volume of gas combusted: With Gas Pipeline[j] *scf/year*	HHV *Btu/scf*	Emission Factor *lbs/MMBtu*	Operating Time *hrs/yr*	Conversion Factor *lb/ton*	Emissions[e]: No Gas Pipeline[i] *lbs/hr*	Emissions[e]: No Gas Pipeline[i] *tons/yr*	Emissions[e]: With GasPipeline[j] *lbs/hr*	Emissions[e]: With GasPipeline[j] *tons/yr*	GWF	CO_2e Emissions: No Gas Pipeline[i] *MT/yr*	CO_2e Emissions: With Gas Pipeline[j] *MT/yr*
Flare	6,325,450,000	0	1,567.7	2.20E-04	8760	2000	2.50E-01	1.09E+00	0.00E+00	0.00E+00	298	295.51	0.00E+00
Subtotal												295.51	0.00E+00

TABLE 12
GREENHOUSE GAS EMISSIONS

Engine, Heater Treater, and Pilot Emissions

Emission Source	Firing Rate *MMBtu/hr*	Operating Time *hrs/yr*	Fuel Type	CO_2 Emissions			CH_4 Emissions			N_2O Emissions			**CO_{2e} Emissions**	
				Emission Factor[f] *kg/MMBtu*	GWF	Emissions *MT/yr*	Emission Factor[f] *kg/MMBtu*	GWF	Emissions *MT/yr*	Emission Factor[f] *kg/MMBtu*	GWF	Emissions *MT/yr*	No Gas Pipeline[i] *(MT/yr)*	With Gas Pipeline[j] *(MT/yr)*
Engine-1	3.41	8760	Natural Gas	53.02	1	1584.20	0.001	25	0.030	0.0001	298	0.0030	1585.84	1585.84
Engine-2	4.77	8760	Natural Gas	53.02	1	2216.72	0.001	21	0.042	0.0001	310	0.0042	2218.90	2218.90
Heater Treater	3.30	8760	Natural Gas	53.02	1	1532.70	0.001	25	0.029	0.0001	298	0.0029	1534.29	1534.29
Pilot Gas[g]	0.20	8760	Natural Gas	53.02	1	94.36	0.001	25	0.002	0.0001	298	0.0002	94.46	94.46
Subtotal													**5,433.48**	**5,433.48**

GHG Emissions Summary

Emission Sources	CO_2e emissions	
	No Gas Pipeline[i]	With Gas Pipeline[j]
Flare (MT/yr)	655,782.99	5.90
Engine, Treater Heater, Pilot (MT/yr)	5,433.48	5,433.48
Total Emissions (MT/yr)	661,216.47	5,439.38

Notes
a Mole Fraction from laboratory reports for Treater Gas
b Mole fraction from promax for Oil tanks
c 40 CFR 98.233 (n)(4): Eqns: W-19, W-20 and W-21
d 40 CFR 98.233(v) Eqn W-36 - density at 60F and 14.7 psia
e 40 CFR 98.233(z)(6) Eqn W-40
[f] 40 CFR 98.37 Table C-1
[g] MMBtu/hr based on fuel consumption and heating value of treater gas
[i] No Gas Pipeline - gas produced from treater will be sent to engineered flare
[j] With Gas Pipeline - gas produced from treater will be sent to the gas pipeline

Sample Calculations

Methane Volume for Destruction

(6,325,450,000 (scf/year-Volume of Treater Gas sent to flare) x 0.57 (mole fraction of methane in treater gas)) + (0.00 (mole fraction of methane in tank vapor) x 10,989,654 scf/year- Volume of flash sent to flare)) + (0.00 (methane mole fraction in tank vapors) x 1,272,678 scf/year- volume of flash sent to flare)) — 3,584,014,341 scf/year

Methane Combusted Volume

3,584,014,341 (scf/year- methane volume for destruction) x 1 (# of carbon atoms in methane) x0.98 (default fraction of methane combsted) — 3,512,334,054 scf/year

Methane Uncombusted Volume

3,584,014,341 scf/year- total volume of gas for destruction x(1-0.98)default fraction of gas combusted — 71,680,287 scf/year
71,680,287 (scf/year- Uncombusted Volume) x 0.093034964(lbs/scf- methane density)/ 8760 hrs/year - operating time — 761.28 lbs/hr
761.28 (lbs/hr) x 8760 (hrs/year) x 25 (global warming potential for methane) x 0.9072 (MT/ton) x / 2000 (lb/ton) — 75,623.88 MT/year

Table 13
CONTROLLED FLASH TANK AND REGENERATOR VENT EMISSION CONTROL REPORT:

Component	*Emissions* *Uncontrolled (tpy)*	*Controlled (tpy)*	*% Reduction (%)*
Methane	1085.1412	21.7022	98
Ethane	802.9242	16.0457	98
Propane	658.1789	13.05	98
Isobutane	100.0669	1.9468	98
n-Butane	332.4433	6.3222	98
Isopentane	81.4154	1.4337	98
n-Pentane	129.8508	2.2175	98
n-Hexane	42.82	0.5451	98
Cyclohexane	27.7908	0.1972	98
Other Hexanes	51.3873	0.77	98
Heptanes	8.3573	0.0615	98
Methylcyclohexane	16.8278	0.0786	98
2,2,4-Trimethylpentane	0.0028	0.0002	98
Benzene	57.9548	0.2551	98
Toluene	267.895	0.4396	98
Ethylbenzene	125.1821	0.0715	98
Xylenes	15.8156	0.007	98
C8+ Heavies	54.6101	0.0656	98
Total Emissions	3858.6643	65.210	98
Total Hydrocarbon Emissions	3858.6643	65.210	98
Total VOC Emissions	1970.599	27.462	98
Total HAP Emissions	509.670	1.319	98
Total BTEX Emissions	466.848	0.773	98

Appendix A
EPA Application Forms

EPA Form No. 5900-391
EPA ICR No. 1230.27
OMB Control No. 2060-0003
Approval expires 4/30/2017

United States Environmental Protection Agency
https://www.epa.gov/tribal-air/tribal-minor-new-source-review
January 4, 2017

Part 2: Submit Within 60 Days After Startup of Production -- Emission and Production Information

FEDERAL IMPLEMENTATION PLAN FOR TRUE MINOR SOURCES IN INDIAN COUNTRY IN THE OIL AND NATURAL GAS PRODUCTION AND NATURAL GAS PROCESSING SEGMENTS OF THE OIL AND NATURAL GAS SECTOR

Registration for New True Minor Oil and Natural Gas Sources and Minor Modifications at Existing True Minor Oil and Natural Gas Sources

Please submit information to:

[Reviewing Authority Address Phone]	Federal Minor NSR Permit Coordinator U.S. EPA, Region 8 1595 Wynkoop Street, 8P-AR Denver, CO 80202-1129 R8airpermitting@epa.gov

A. GENERAL SOURCE INFORMATION (See Instructions Below)

1. Company Name EOG Resources, Inc.		**2. Source Name** Clarks Creek Central Facility & Compressor Station	
3. Type of Oil and Natural Gas Operation Oil & Gas Well Site		**4. New Minor Source?** ☐ Yes ■ No **5. True Source Modification?** ☐ Yes ■ No	
6. NAICS Code 211111		**7. SIC Code** 1311	
8. U.S. Well ID(s) or API Number(s) [if applicable] See Attached List			
9. Area of Indian Country Fort Berthold Indian Reservation	**10. County** McKenzie	**11a. Latitude** 47.905900 (NAD 83)	**11b. Longitude** -102.755400 (NAD 83)

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Clarks Creek Central Facility Well List with API numbers

Well Name	API	New/Existing
Clarks Creek 11-0706H	3305303615	Existing
Clarks Creek 12-0719H	3305303616	Existing
Clarks Creek 13-1806H	3305303613	Existing
Clarks Creek 14-1819H	3305303614	Existing
Clarks Creek 16-0706H	3305303617	Existing
Clarks Creek 73-0719H	3305307663	Existing
Clarks Creek 74-0719H	3305307661	Existing
Clarks Creek 75-0719HX	3305307809	Existing
Clarks Creek 101-1819H	3305303612	Existing
Clarks Creek 110-0719H	3305307662	Existing
Clarks Creek 24-0706H	3305307666	New
Clarks Creek 72-0706H	3305307665	New
Clarks Creek 107-0706H	3305307665	New
Clarks Creek 108-0706H	3305308359	New
Clarks Creek 155-0706H	3305307667	New

B. CONTACT INFORMATION (See Instructions Below)

1. Owner Name Mathew Oliver	Title Environmental Manager
Mailing Address 600 17th Street, Suite 1000N, Denver, CO 80202	
Email Address mathew_oliver@eogresources.com	
Telephone Number 303-262-9915	Facsimile Number
2. Operator Name (if different from owner)	Title
Mailing Address	
Email Address	
Telephone Number	Facsimile Number
3. Source Contact Mathew Oliver (see above)	Title
Mailing Address	
Email Address	
Telephone Number	Facsimile Number

4. Compliance Contact	Title
Mathew Oliver	Environmental Manager
Mailing Address	
600 17th Street, Suite 1000N, Denver, CO 80202	
Email Address	
mathew_oliver@eogresources.com	
Telephone Number	Facsimile Number
303-262-9915	

C. EMISSIONS AND OTHER SOURCE INFORMATION

Include all of the following information in the table below and as attachments to this form:

Note: The emission estimates can be based upon actual test data or, in the absence of such data, upon procedures acceptable to the Reviewing Authority. The following procedures are generally acceptable for estimating emissions from air pollution sources: (1) unit-specific emission tests; (2) mass balance calculations; (3) published, verifiable emission factors that are applicable to the unit (i.e., manufacturer specifications); (4) other engineering calculations; or (5) other procedures to estimate emissions specifically approved by the Reviewing Authority. Guidance for estimating emissions can be found at https://www.epa.gov/chief

- ■ Narrative description of the operations.
- ■ Identification and description of any air pollution control equipment and compliance monitoring devices or activities.
- ■ Type and actual amount (annually) of each fuel that will be used.
- ■ Type of raw materials used (e.g., water for hydraulic fracturing).
- ■ Actual, annual production rates.
- ■ Actual operating schedules.
- ■ Any existing limitations on source operations affecting emissions or any work practice standards, where applicable, for all regulated New Source Review (NSR) pollutants at your source. Indicate all requirements referenced in the Federal Implementation Plan (FIP) for True Minor Sources in Indian Country in the Oil and Natural Gas Production and Natural Gas Processing Segments of the Oil and Natural Gas Sector that apply to emissions units and air pollution generating activities at the source or proposed. Include statements indicating each emissions unit that is an emissions unit potentially subject to the requirements referenced in the FIP, but does not meet the definition of an affected facility under the referenced requirement, and therefore, is not subject to those requirements.
- ■ For each emissions unit comprising the new source or modification, estimates of the total allowable (potential to emit) annual emissions at startup of production from the air pollution source for the following air pollutants: particulate matter, PM_{10}, $PM_{2.5}$, sulfur oxides ( ), nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compound (VOC), lead (Pb) and lead compounds, fluorides (gaseous and particulate), sulfuric acid mist (H_2SO_4), hydrogen sulfide (H_2S), total reduced sulfur (TRS) and reduced sulfur compounds, including all calculations for the estimates. Allowable annual emissions are defined as: emissions rate of an emissions unit calculated using the maximum capacity of a stationary source to emit a pollutant under its physical and operational design. Any physical

or operational limitation on the capacity of the source to emit a pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation, or the effect it would have on emissions, is legally and practically enforceable. You must determine the potential for emissions within 30 days from the startup of production.

☒ For each emissions unit comprising the new source or modification, estimates of the total actual annual emissions during the upcoming, consecutive 12 months from the air pollution source for the following air pollutants: particulate matter (PM, PM_{10}, $PM_{2.5}$), sulfur oxides (SO_x), nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compound (VOC), lead (Pb) and lead compounds, ammonia (NH_3), fluorides (gaseous and particulate), sulfuric acid mist (H_2SO_4), hydrogen sulfide (H_2S), total reduced sulfur (TRS) and reduced sulfur compounds, including all calculations for the estimates. Estimates of actual emissions must take into account equipment, operating conditions, and air pollution control measures. You should calculate an estimate of the actual annual emissions using estimated operating hours, production rates, in-place control equipment, and types of materials processed, stored, or combusted.

D. TABLE OF ESTIMATED EMISSIONS

Provide in the table below estimates of the total allowable annual emissions in tons per year (tpy) and total actual annual emissions (tpy) for the following pollutants for all emissions units comprising the new source or modification.

POLLUTANT	TOTAL ALLOWABLE ANNUAL EMISSIONS (TPY)	TOTAL ACTUAL ANNUAL EMISSIONS (TPY)
PM		
PM_{10}		
$PM_{2.5}$		
SO_x	0.00	0.00
NO_x	71.29	41.45 (taken from recent Part 71 application)
CO	230.00	144.54 (taken from recent Part 71 application)
VOC	214.75	129.16 (taken from recent Part 71 application)
Pb		

POLLUTANT	TOTAL ALLOWABLE ANNUAL EMISSIONS (TPY)	TOTAL ACTUAL ANNUAL EMISSIONS (TPY)
NH3		
Fluorides		
H_2SO_4		
H_2S	0.00	0.00
TRS		

Instructions for Part 2

Please answer all questions. If the item does not apply to the source and its operations write "n/a". If the answer is not known write "unknown".

A. General Source Information

1. Company Name: Provide the complete company name. For corporations, include divisions or subsidiary name, if any.
2. Source Name: Provide the source name. Please note that a source is a site, place, or location that may contain one or more air pollution emitting units.
3. Type of Operation: Indicate the generally accepted name for the oil and natural gas production or natural gas processing segment operation (e.g., oil and gas well site, tank battery, compressor station, natural gas processing plant).
4. New True Minor Source: [Per Federal Indian Country Minor New Source Review Rule, 40 CFR 49.153].
5. True Minor Source Modification: [Per Federal Indian Country Minor New Source Review Rule, 40 CFR 49.153].
6. North American Industry Classification System (NAICS): The NAICS Code for your oil and natural gas source can be found at the following link for North American Industry Classification System: http://www.census.gov/eos/www/naics/.
7. Standard Industrial Classification Code (SIC Code): Although the new NAICS code has replaced the SIC codes, much of the Clean Air Act permitting processes continue to use these codes. The SIC Code for your oil and natural gas source can be found at the following link for Standard Industrial Classification Codes: http://www.osha.gov/pls/imis/sic_manual.html.
8. U.S. Well ID or API Number: Unique well identifier as assigned by the Federal or State oil and gas regulatory agency with primacy, using the American Petroleum Institute (API) Standard for number format (pre-2014) or the Professional Petroleum Data Management (PPDM) Association US Well Number Standard (2014-present). Provide IDs for all oil and natural gas production wells associated with the facility, if applicable. May not be applicable for downstream production sources, such as compressor stations.
9. Area of Indian Country: Provide the name of the Indian reservation within which the source is operating.
10. County: Provide the County within which the source is operating.
11. Latitude & Longitude (11a. and 11b.): Provide latitude and longitude location(s) in decimal degrees, indicating the datum used in parentheses. These are GPS (global positioning system) coordinates. This information should be provided in decimal degrees with 6 digits to the right of the decimal point, indicating the datum used in parentheses (i.e., NAD 27, NAD 83, WGS 84 – WGS 84 is preferred over NAD 27).

B. Contact Information

Please provide the information requested in full.

1. Owners: List the full name (last, middle initial, first) of all owners of the source.
2. Operator: Provide the name of the operator of the source if it is different from the owner(s).
3. Source Contact: The source contact must be the local contact authorized to receive requests for data and information.
4. Compliance Contact: The compliance contact must be the local contact responsible for the source's compliance with this rule. If this is the same as the Source Contact please note this on the form.

C. Attachments

The information requested in the attachments will enable the U.S. Environmental Protection Agency (EPA) to understand the type of oil and natural gas source being registered and the nature and extent of the air pollutants to be emitted.

Disclaimers:

The public reporting and recordkeeping burden for this collection of information is estimated to average 6 hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

Information in these forms submitted in compliance with the final Federal Indian Country Minor NSR rule may be claimed as confidential. A company may assert a claim of confidentiality for information submitted by clearly marking that information as confidential. Such information shall be treated in accordance with EPA's procedures for information claimed as confidential at 40 CFR part 2, subpart B, and will only be disclosed by the means set forth in the subpart. If no claim of confidentiality accompanies the report when it is received by EPA, it may be made public without further notice to the company (40 CFR 2.203).

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Appendix B
Gas and Liquid Analysis

zedi

Realize Production Potential

Run File:	CLARKS CREEK 75-0719HX 7-11-2017 1-25-15 PM.dat		
Method:	PrecisionExtBTEX.met		
Operator:	EOG		
Client:	EOG	**Analysis Date:**	7/11/2017
Well No:	CLARKS CREEK 75-0719HX	**Date Sampled:**	7/11/2017
Field:	MCKENZIE	**Interval:**	REQUESTED
County, State:	MCKENZIE	**Pressure (PSI):**	165
Location:	SESW S20 T153N R96W	**Temperature (DEG F):**	168
Formation:	0	**Sample Source:**	TEST TREATER

Components	Mole %	BTU	GPM	Specific Gravity	Weight %
Carbon Dioxide (CO2)	0.6781	0.0000	0.0000	0.0103	1.0970
Hydrogen Sulfide (H2S)	0.0000	0.0000	0.0000	0.0000	0.0000
Nitrogen (N2)	1.9838	0.0000	0.0000	0.0192	2.0428
Methane (CH4)	56.6602	572.2680	0.0000	0.3138	33.4126
Ethane (C2)	20.2649	358.6279	5.4057	0.2104	22.3987
Propane (C3)	11.2346	282.6738	3.0872	0.1710	18.2101
iso-Butane (i-C4)	1.2883	41.8942	0.4205	0.0259	2.7524
n-Butane (C4)	4.0990	133.7217	1.2890	0.0823	8.7575
iso-Pentane (i-C5)	0.8512	34.0557	0.3105	0.0212	2.2575
n-Pentane (C5)	1.3106	52.5380	0.4739	0.0326	3.4758
Cyclopentane	0.0017	0.0598	0.0005	0.0000	0.0044
n-Hexane (n-C6)	0.3530	16.7883	0.1448	0.0105	1.1182
Cyclohexane	0.1230	5.1413	0.0417	0.0036	0.3805
Other Hexanes	0.4492	19.7440	0.1827	0.0134	1.4229
Heptanes (C7)	0.0550	3.0264	0.0253	0.0019	0.2026
Methylcyclohexane	0.0717	3.4874	0.0287	0.0024	0.2588
2,2,4-Trimethylpentane	0.0002	0.0116	0.0001	0.0000	0.0008
Benzene	0.0522	1.8746	0.0146	0.0014	0.1499
Toluene	0.2052	8.7696	0.0685	0.0065	0.6950
Ethylbenzene	0.0873	4.3394	0.0336	0.0032	0.3407
Xylenes	0.0087	0.4313	0.0034	0.0003	0.0340
Octanes (C8)	0.1211	7.5675	0.0619	0.0048	0.5085
Nonanes (C9)	0.0951	6.6535	0.0534	0.0042	0.4483
Decanes+ (C10+)	0.0059	0.4568	0.0036	0.0003	0.0309
Totals	100.0000				

ADDITIONAL BTEX DATA

Components	Mole %	BTU	GPM	Specific Gravity
Cyclopentane	0.0017	0.0598	0.0005	0.0000
Cyclohexane	0.1230	5.1413	0.0417	0.0036
2-Methylpentane	0.2827	12.4269	0.1150	0.0084
3-Methylpentane	0.1665	7.3171	0.0677	0.0050
n-Hexane	0.3530	16.7883	0.1448	0.0105
Methylcyclohexane	0.0717	3.4874	0.0287	0.0024
2,2,4-Trimethylpentane	0.0002	0.0116	0.0001	0.0000
Benzene	0.0522	1.8746	0.0146	0.0014
Toluene	0.2052	8.7696	0.0685	0.0065
Ethylbenzene	0.0873	4.3394	0.0336	0.0032
m-Xylene	0.0014	0.0685	0.0005	0.0001
p-Xylene	0.0059	0.2920	0.0023	0.0002
o-Xylene	0.0014	0.0708	0.0006	0.0001

BTU 14.73 PSIA and 60F	
Real BTU Dry	1567.6910
Real BTU Wet	1541.1364

Propane Plus GPM:	6.2438
I-Pentane Plus GPM:	1.4472
Specific Gravity from Composition:	0.9393
Total Gross Real BTU Content:	1567.6910
Total Acid Gas Mole %:	0.6781
Compressibility Factor:	0.9936
VOC Weight Fraction:	0.4057
H2S Mole Fraction:	0.0000
H2S Weight Fraction:	0.0000
HAP Weight %	2.3386
Average Molecular Weight g/mol	37.3327

Note: Onsite H2S (draeger)= 0 ppm

Distribution:

Date Received: 7/11/2017

NOTATION: ALL CALCULATIONS PERFORMED USING PHYSICAL CONSTANTS FROM GPA 2145-09, THE TABLES OF PHYSICAL CONSTANTS FOR HYDROCARBONS AND OTHER COMPOUNDS OF INTEREST TO THE NATURAL GAS INDUSTRY.

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Realize Production Potential

Zedi US Inc
29 Country Acres Road
Riverton, WY 82501
307-856-0866

EXTENDED HYDROCARBON LIQUID STUDY
CERTIFICATE OF ANALYSIS

Company:	**EOG Resources**	Sample Name:	**Clarks Creek 74-0719H**
Date Sampled:	7/10/2017	Sample Number:	17071717-07
Sample Location:	North Dakota	Date Tested:	7/19/2017
Sample Pressure:	151PSI	Test Method:	GPA 2186M
Sample Temperature:	155 DEG F		
County:	Mckenzie	Date Reported:	7/21/2017
Sampling Method:	GPA 2174	Note: Due to the nature of H2S, the values of H2S reported may be lower than actual.	
Type Sample:	SPOT		

Components	Mole %	Weight %	Liq. Vol. %
Carbon Dioxide	0.0396	0.012	0.011
Nitrogen	0.1123	0.021	0.020
Methane	2.2988	0.249	0.616
Ethane	3.3487	0.679	1.415
Propane	4.5845	1.364	1.995
iso-Butane	1.0965	0.430	0.567
n-Butane	4.6622	1.828	2.322
iso-Pentane	2.0971	1.021	1.211
n-Pentane	3.9273	1.911	2.249
Hexanes	2.4721	1.437	1.606
Heptanes	6.9751	4.715	5.083
Octanes	3.3686	2.596	2.726
Nonanes	3.0203	2.613	2.684
Decanes+	54.9466	76.613	73.074
Benzene	0.3362	0.177	0.148
Toluene	1.4278	0.887	0.755
Ethylbenzene	0.5232	0.375	0.319
Xylenes	1.0509	0.753	0.645
n-Hexane	2.8650	1.666	1.861
2,2,4-Trimethylpentane	0.8475	0.653	0.696
Totals	100.000	100.000	100.000

ADDITIONAL BTEX DATA

Components	Mole %	Weight %	Liq. Vol. %
2-Methylpentane	1.768	1.028	1.148
3-Methylpentane	0.705	0.410	0.458
n-Hexane	2.865	1.666	1.861
2,2,4-Trimethylpentane	0.848	0.653	0.696
Benzene	0.336	0.177	0.148
Toluene	1.428	0.887	0.755
Ethylbenzene	0.523	0.375	0.319
m-Xylene	0.121	0.087	0.074
p-Xylene	0.751	0.538	0.461
o-Xylene	0.179	0.128	0.110

RELATIVE SPECIFIC GRAVITY OF DECANES+ (C10+) FRACTION, calculated	**0.77787**
AVERAGE MOLECULAR WEIGHT	**148.233**
AVERAGE MOLECULAR WEIGHT OF DECANES+ (C10+) FRACTION, calculated	**206.685**
TRUE VAPOR PRESSURE AT 100 F, PSIA, calculated	**155.097**
AVERAGE BOILING POINT, F, calculated	**317.389**
CUBIC FEET OF GAS / GALLON OF LIQUID, as Ideal Gas, calculated	**19.070**
BTU / GALLON OF LIQUID AT 14.73 PSIA, calculated	**122,367.54**
LBS / GALLON OF LIQUID, calculated	**6.186**

NOTATION: ALL CALCULATIONS PERFORMED USING PHYSICAL CONSTANTS FROM GPA 2145-09, THE TABLES OF PHYSICAL CONSTANTS FOR HYDROCARBONS AND OTHER COMPOUNDS OF INTEREST TO THE NATURAL GAS INDUSTRY.

FLASHED CRUDE OIL LIQUID STUDIES
CERTIFICATE OF ANALYSIS

Sample Name: **Clarks Creek 74-0719H**
Sample Number: 17071717-06
Sampling Method: ASTM D4057

TEST PERFORMED	RESULTS	DATE TESTED
API GRAVITY AT 60/60 F, (ASTM D-7777), calculated from SG	41.2	7/20/2017
SPECIFIC GRAVITY AT 60/60 F, (ASTM D-7777), calculated from SG	0.8193	7/20/2017
REID VAPOR PRESSURE (ASTM D5191), PSI AT 100 F, measured	4.14	7/20/2017
CLOUD POINT (ASTM D-97), deg F, measured	-40.0	7/25/2017
POUR POINT (ASTM D-97), deg F, measured	<-67.0	7/25/2017
PARAFFIN CONTENT (UOP-46), weight %, measured	4.033	7/27/2017
EOG GRINDOUT (EOG METHOD), volume %, measured	0.375	7/25/2017
KINEMATIC VISCOSITY AT 100 F (ASTM D-445), measured, SUS	34.500	7/25/2017
KINEMATIC VISCOSITY AT 120 F (ASTM D-445), measured, SUS	33.233	7/25/2017
ASPHALTENES (ASTM D-3279), weight %, measured	<1.000	7/27/2017

ASTM D86 Distillation
Certificate of Analysis

Date Tested:	**7/28/2017**	**Qualifiers:**
	% Recovery	DEG C
	Intial Boiling Point	37
	5	68
	10	80
	20	105
	30	160
	40	193
	50	220
	60	248
	70	285
	72	300
	Final Boiling Point	N/A
	Volume % Recovery	72
	Volume % Residue	20
	Volume % Loss	8

Comments: Residue and loss observed
Temperatures are uncorrected for barometric pressure

Appendix C
Modeling

ED_004016P_00013183-00048

G3606

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1000	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	7.6	RATING LEVEL:	CONTINUOUS
AFTERCOOLER TYPE:	SCAC	FUEL SYSTEM:	GAV WITH AIR FUEL RATIO CONTROL
AFTERCOOLER - STAGE 2 INLET (°F):	130		
AFTERCOOLER - STAGE 1 INLET (°F):	174	**SITE CONDITIONS:**	
JACKET WATER OUTLET (°F):	190	FUEL:	Gas Analysis
ASPIRATION:	TA	FUEL PRESSURE RANGE(psig): (See note 1)	58.0-70.3
COOLING SYSTEM:	JW+1AC, OC+2AC	FUEL METHANE NUMBER:	36.1
CONTROL SYSTEM:	ADEM4	FUEL LHV (Btu/scf):	1312
EXHAUST MANIFOLD:	DRY	ALTITUDE(ft):	6000
COMBUSTION:	LOW EMISSION	MAXIMUM INLET AIR TEMPERATURE(°F):	100
NOx EMISSION LEVEL (g/bhp-hr NOx):	0.5	STANDARD RATED POWER:	1875 bhp@1000rpm
SET POINT TIMING:	16		

				MAXIMUM RATING	SITE RATING AT MAXIMUM INLET AIR TEMPERATURE		
RATING		**NOTES**	**LOAD**	**100%**	**100%**	**75%**	**50%**
ENGINE POWER	(WITHOUT FAN)	(2)	bhp	1875	1875	1406	938
INLET AIR TEMPERATURE			°F	100	100	100	100
ENGINE DATA							
FUEL CONSUMPTION (LHV)		(3)	Btu/bhp-hr	6839	6839	7117	7899
FUEL CONSUMPTION (HHV)		(3)	Btu/bhp-hr	7506	7506	7812	8456
AIR FLOW (@inlet air temp, 14.7 psia)	(WET)	(4)(5)	ft3/min	5013	5013	3797	2611
AIR FLOW	(WET)	(4)(5)	lb/hr	21313	21313	16145	11103
FUEL FLOW (60°F, 14.7 psia)			scfm	163	163	127	92
INLET MANIFOLD PRESSURE		(6)	in Hg(abs)	102.4	102.4	78.5	56.2
EXHAUST TEMPERATURE - ENGINE OUTLET		(7)	°F	797	797	867	947
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(8)(5)	ft3/min	11926	11926	9549	6979
EXHAUST GAS MASS FLOW	(WET)	(8)(5)	lb/hr	21969	21969	16657	11473
EMISSIONS DATA - ENGINE OUT							
NOx (as NO2)		(9)(10)	g/bhp-hr	0.50	0.50	0.50	0.50
CO		(9)(10)	g/bhp-hr	2.82	2.82	2.82	2.82
THC (mol. wt. of 15.84)		(9)(10)	g/bhp-hr	3.42	3.42	3.58	3.78
NMHC (mol. wt. of 15.84)		(9)(10)	g/bhp-hr	2.01	2.01	2.10	2.22
NMNEHC (VOCs) (mol. wt. of 15.84)		(9)(10)(11)	g/bhp-hr	1.51	1.51	1.58	1.67
HCHO (Formaldehyde)		(9)(10)	g/bhp-hr	0.21	0.21	0.22	0.25
CO2		(9)(10)	g/bhp-hr	492	492	508	551
EXHAUST OXYGEN		(9)(12)	% DRY	11.5	11.5	11.3	10.9
HEAT REJECTION							
HEAT REJ. TO JACKET WATER (JW)		(13)	Btu/min	23280	23280	18948	15426
HEAT REJ. TO ATMOSPHERE		(13)	Btu/min	5534	5534	5674	5502
HEAT REJ. TO LUBE OIL (OC)		(13)	Btu/min	11756	11756	10844	8385
HEAT REJ. TO A/C - STAGE 1 (1AC)		(13)(14)	Btu/min	21105	21105	10658	3444
HEAT REJ. TO A/C - STAGE 2 (2AC)		(13)(14)	Btu/min	8661	8661	5208	2539
COOLING SYSTEM SIZING CRITERIA							
TOTAL JACKET WATER CIRCUIT (JW+1AC)		(14)(15)	Btu/min	47768			
TOTAL STAGE 2 AFTERCOOLER CIRCUIT (OC+2AC)		(14)(15)	Btu/min	23201			
A cooling system safety factor of 0% has been added to the cooling system sizing criteria.							

CONDITIONS AND DEFINITIONS

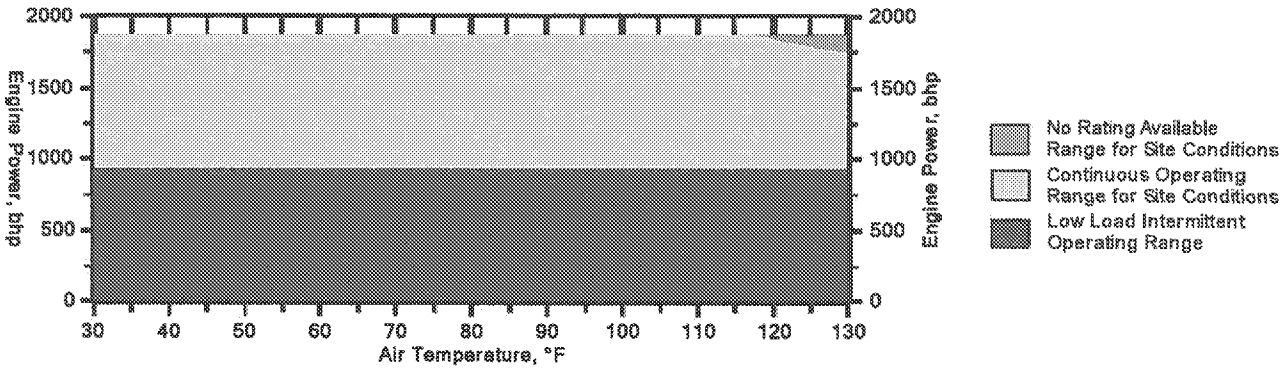
Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Maximum rating is the maximum capability at the specified aftercooler inlet temperature for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

PREPARED BY:
Data generated by Gas Engine Rating Pro Version 6.05.00
Ref. Data Set EM0555-07-001, Printed 15Jun2017

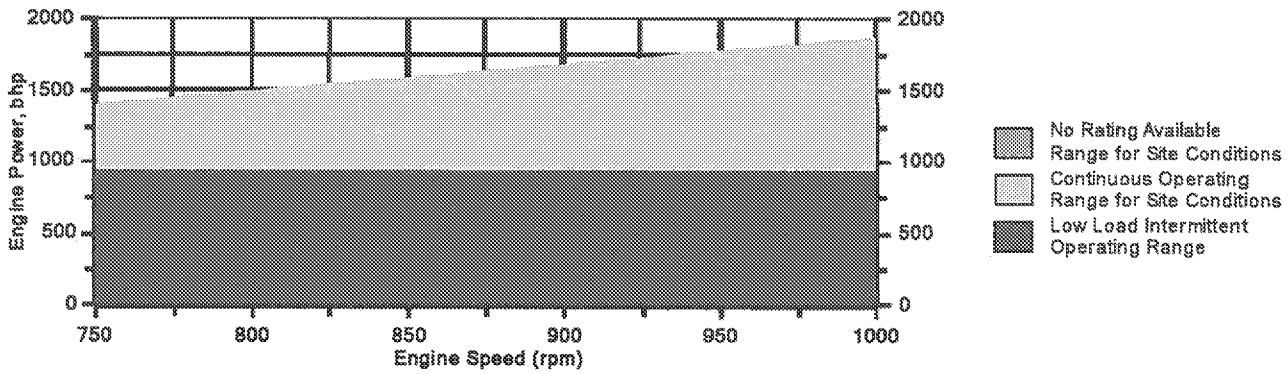
Engine Power vs. Inlet Air Temperature

Data represents temperature sweep at 6000 ft and 1000 rpm



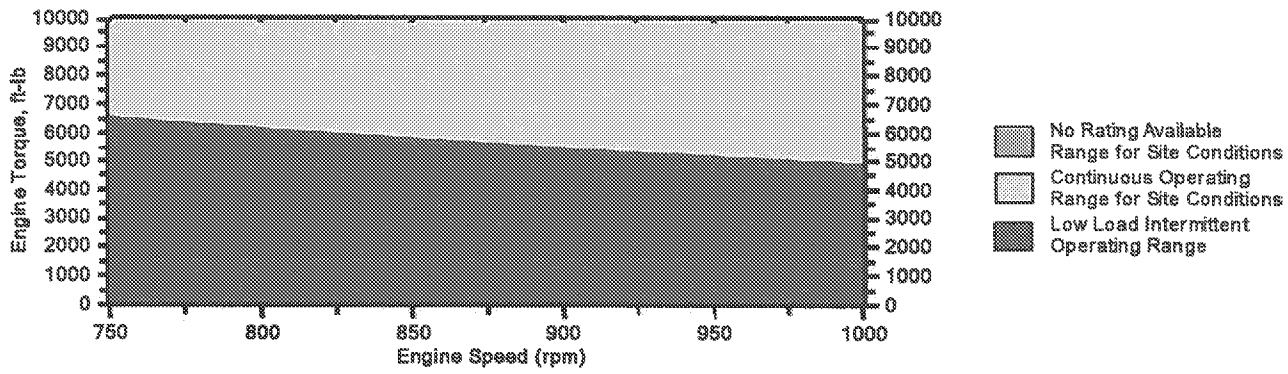
Engine Power vs. Engine Speed

Data represents speed sweep at 6000 ft and 100 °F



Engine Torque vs. Engine Speed

Data represents speed sweep at 6000 ft and 100 °F



Note: At site conditions of 6000 ft and 100°F inlet air temp., constant torque can be maintained down to 750 rpm. The minimum speed for loading at these conditions is 750 rpm.

PREPARED BY:
Data generated by Gas Engine Rating Pro Version 6.05.00
Ref. Data Set EM0555-07-001, Printed 15Jun2017

NOTES

1. Fuel pressure range specified is to the engine gas shutoff valve (GSOV). Additional fuel train components should be considered in pressure and flow calculations.

2. Engine rating is with two engine driven water pumps. Tolerance is ± 3% of full load.

3. Fuel consumption tolerance is ± 2.5% of full load data.

4. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 5 %.

5. Inlet and Exhaust Restrictions must not exceed A&I limits based on full load flow rates from the standard technical data sheet.

6. Inlet manifold pressure is a nominal value with a tolerance of ± 5 %.

7. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.

8. Exhaust flow value is on a "wet" basis. Flow is a nominal value with a tolerance of ± 6 %.

9. Emissions data is at engine exhaust flange prior to any after treatment.

10. Values listed are higher than nominal levels to allow for instrumentation, measurement, and engine-to-engine variations. They indicate the maximum values expected under steady state conditions. Fuel methane number cannot vary more than ± 3. THC, NMHC, and NMNEHC do not include aldehydes. An oxidation catalyst may be required to meet Federal, State or local CO or HC requirements.

11. VOCs - Volatile organic compounds as defined in US EPA 40 CFR 60, subpart JJJJ

12. Exhaust Oxygen level is the result of adjusting the engine to operate at the specified NOx level. Tolerance is ± 0.5.

13. Heat rejection values are nominal. Tolerances, based on treated water, are ± 10% for jacket water circuit, ± 50% for radiation, ± 20% for lube oil circuit, and ± 5% for aftercooler circuit.

14. Aftercooler heat rejection includes an aftercooler heat rejection factor for the site elevation and inlet air temperature specified. Aftercooler heat rejection values at part load are for reference only. Do not use part load data for heat exchanger sizing.

15. Cooling system sizing criteria are maximum circuit heat rejection for the site, with applied tolerances.

Constituent	Abbrev	Mole %	Norm
Water Vapor	H2O	0.0000	0.0000
Methane	CH4	64.4281	65.1616
Ethane	C2H6	11.2513	11.3794
Propane	C3H8	11.5629	11.6945
Isobutane	iso-C4H10	1.2528	1.2671
Norbutane	nor-C4H10	4.4102	4.4604
Isopentane	iso-C5H12	0.7887	0.7977
Norpentane	nor-C5H12	1.0187	1.0303
Hexane	C6H14	0.2371	0.2398
Heptane	C7H16	0.1297	0.1312
Nitrogen	N2	1.0498	1.0618
Carbon Dioxide	CO2	2.7450	2.7763
Hydrogen Sulfide	H2S	0.0000	0.0000
Carbon Monoxide	CO	0.0000	0.0000
Hydrogen	H2	0.0000	0.0000
Oxygen	O2	0.0000	0.0000
Helium	HE	0.0000	0.0000
Neopentane	neo-C5H12	0.0000	0.0000
Octane	C8H18	0.0000	0.0000
Nonane	C9H20	0.0000	0.0000
Ethylene	C2H4	0.0000	0.0000
Propylene	C3H6	0.0000	0.0000
TOTAL (Volume %)		98.8743	100.0001

Fuel Makeup:	Gas Analysis
Unit of Measure:	English

Calculated Fuel Properties

Caterpillar Methane Number:	36.1
Lower Heating Value (Btu/scf):	1312
Higher Heating Value (Btu/scf):	1440
WOBBE Index (Btu/scf):	1397
THC: Free Inert Ratio:	25.05
Total % Inerts (% N2, CO2, He):	3.84%
RPC (%) (To 905 Btu/scf Fuel):	100%
Compressibility Factor:	0.995
Stoich A/F Ratio (Vol/Vol):	13.54
Stoich A/F Ratio (Mass/Mass):	15.36
Specific Gravity (Relative to Air):	0.882
Fuel Specific Heat Ratio (K):	1.261

CONDITIONS AND DEFINITIONS

Caterpillar Methane Number represents the knock resistance of a gaseous fuel. It should be used with the Caterpillar Fuel Usage Guide for the engine and rating to determine the rating for the fuel specified. A Fuel Usage Guide for each rating is included on page 2 of its standard technical data sheet.

RPC always applies to naturally aspirated (NA) engines, and turbocharged (TA or LE) engines only when they are derated for altitude and ambient site conditions.

Project specific technical data sheets generated by the Caterpillar Gas Engine Rating Pro program take the Caterpillar Methane Number and RPC into account when generating a site rating.

Fuel properties for Btu/scf calculations are at 60F and 14.696 psia.

Caterpillar shall have no liability in law or equity, for damages, consequently or otherwise, arising from use of program and related material or any part thereof.

FUEL LIQUIDS

Field gases, well head gases, and associated gases typically contain liquid water and heavy hydrocarbons entrained in the gas. To prevent detonation and severe damage to the engine, hydrocarbon liquids must not be allowed to enter the engine fuel system. To remove liquids, a liquid separator and coalescing filter are recommended, with an automatic drain and collection tank to prevent contamination of the ground in accordance with local codes and standards.

To avoid water condensation in the engine or fuel lines, limit the relative humidity of water in the fuel to 80% at the minimum fuel operating temperature.

PREPARED BY:
Data generated by Gas Engine Rating Pro Version 6.05.00
Ref. Data Set EM0555-07-001, Printed 15Jun2017

G3516

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED (rpm):	1400	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	8	RATING LEVEL:	CONTINUOUS
AFTERCOOLER TYPE:	SCAC	FUEL SYSTEM:	HPG IMPCO
AFTERCOOLER WATER INLET (°F):	130		WITH AIR FUEL RATIO CONTROL
JACKET WATER OUTLET (°F):	210	**SITE CONDITIONS:**	
ASPIRATION:	TA	FUEL:	EOG Clarks Creek Fuel
COOLING SYSTEM:	JW+OC, AC	FUEL PRESSURE RANGE(psig): (See note 1)	35.0-40.0
CONTROL SYSTEM:	ADEM3	FUEL METHANE NUMBER:	52.5
EXHAUST MANIFOLD:	ASWC	FUEL LHV (Btu/scf):	1278
COMBUSTION:	LOW EMISSION	ALTITUDE(ft):	2200
NOx EMISSION LEVEL (g/bhp-hr NOx):	2.0	MAXIMUM INLET AIR TEMPERATURE(°F):	100
SET POINT TIMING:	25	STANDARD RATED POWER:	1340 bhp@1400rpm

				MAXIMUM RATING	SITE RATING AT MAXIMUM INLET AIR TEMPERATURE		
RATING		**NOTES**	**LOAD**	**100%**	**100%**	**75%**	**51%**
ENGINE POWER	(WITHOUT FAN)	(2)	bhp	1340	1315	987	670
INLET AIR TEMPERATURE			°F	93	100	100	100
ENGINE DATA							
FUEL CONSUMPTION (LHV)		(3)	Btu/bhp-hr	7819	7836	8085	8626
FUEL CONSUMPTION (HHV)		(3)	Btu/bhp-hr	8591	8609	8883	9477
AIR FLOW (@inlet air temp, 14.7 psia)	(WET)	(4)(5)	ft3/min	2954	2940	2220	1557
AIR FLOW	(WET)	(4)(5)	lb/hr	12726	12500	9438	6622
FUEL FLOW (60°F, 14.7 psia)			scfm	137	134	104	75
INLET MANIFOLD PRESSURE		(6)	in Hg(abs)	69.6	68.5	54.0	39.1
EXHAUST TEMPERATURE - ENGINE OUTLET		(7)	°F	926	926	926	929
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(8)(5)	ft3/min	7981	7840	5926	4178
EXHAUST GAS MASS FLOW	(WET)	(8)(5)	lb/hr	13248	13014	9835	6910
EMISSIONS DATA - ENGINE OUT							
NOx (as NO2)		(9)(10)	g/bhp-hr	2.00	2.00	2.00	2.00
CO		(9)(10)	g/bhp-hr	2.57	2.58	2.70	2.90
THC (mol. wt. of 15.84)		(9)(10)	g/bhp-hr	2.32	2.33	2.44	2.60
NMHC (mol. wt. of 15.84)		(9)(10)	g/bhp-hr	1.39	1.39	1.46	1.55
NMNEHC (VOCs) (mol. wt. of 15.84)		(9)(10)(11)	g/bhp-hr	0.73	0.73	0.77	0.81
HCHO (Formaldehyde)		(9)(10)	g/bhp-hr	0.20	0.20	0.20	0.22
CO2		(9)(10)	g/bhp-hr	533	534	544	571
EXHAUST OXYGEN		(9)(12)	% DRY	7.7	7.7	7.6	7.5
HEAT REJECTION							
HEAT REJ. TO JACKET WATER (JW)		(13)	Btu/min	44444	43994	36750	30363
HEAT REJ. TO ATMOSPHERE		(13)	Btu/min	5313	5249	4380	3543
HEAT REJ. TO LUBE OIL (OC)		(13)	Btu/min	6628	6561	5481	4528
HEAT REJ. TO AFTERCOOLER (AC)		(13)(14)	Btu/min	12112	12112	7487	2687
COOLING SYSTEM SIZING CRITERIA							
TOTAL JACKET WATER CIRCUIT (JW+OC)		(14)	Btu/min	56842			
TOTAL AFTERCOOLER CIRCUIT (AC)		(14)(15)	Btu/min	12718			
A cooling system safety factor of 0% has been added to the cooling system sizing criteria.							

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Maximum rating is the maximum capability at the specified aftercooler inlet temperature for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

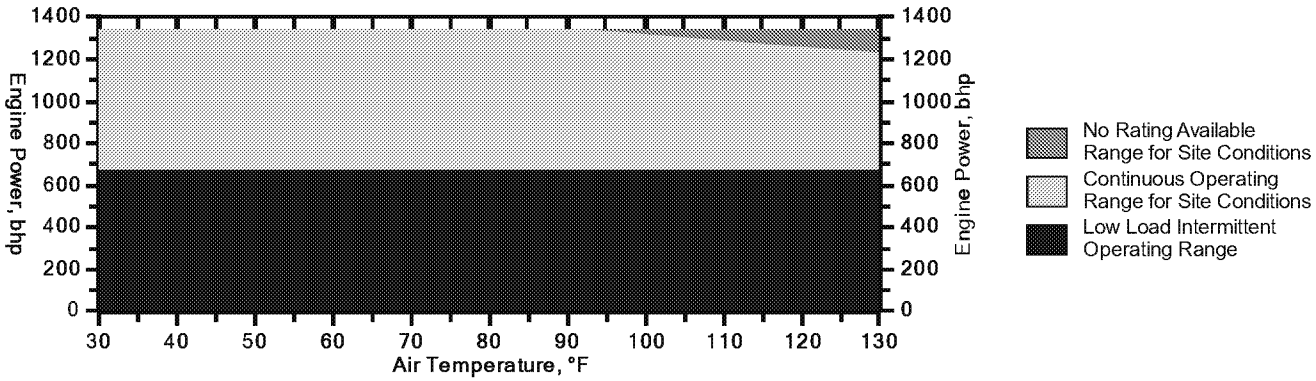
For notes information consult page three.

*****WARNINGS ISSUED FOR THIS RATING CONSULT PAGE 3*****

PREPARED BY:
Data generated by Gas Engine Rating Pro Version 6.04.00
Ref. Data Set DM8618-05-002, Printed 10Aug2017

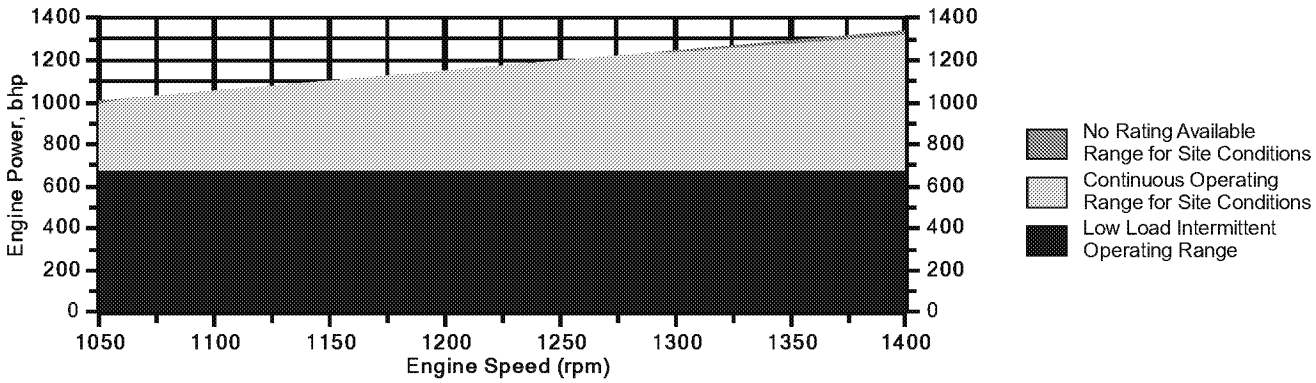
Engine Power vs. Inlet Air Temperature

Data represents temperature sweep at 2200 ft and 1400 rpm



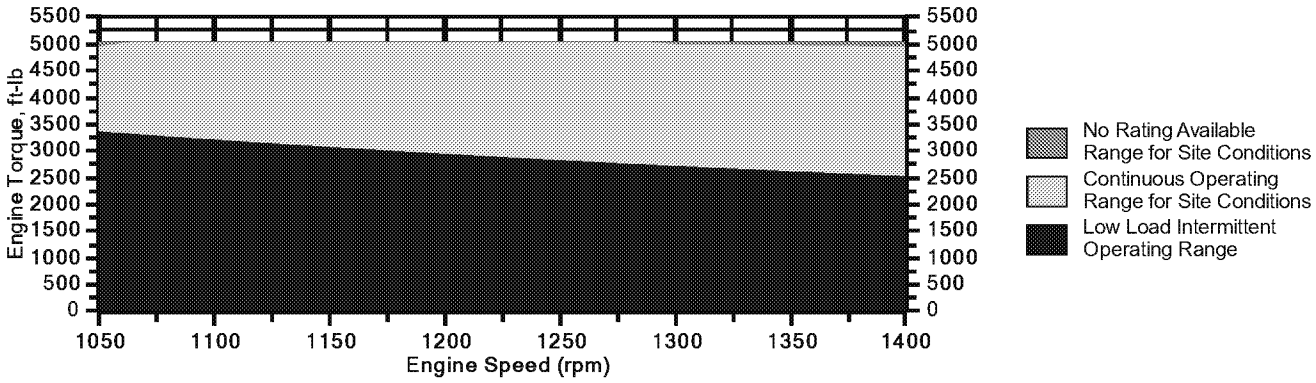
Engine Power vs. Engine Speed

Data represents speed sweep at 2200 ft and 100 °F



Engine Torque vs. Engine Speed

Data represents speed sweep at 2200 ft and 100 °F



Note: At site conditions of 2200 ft and 100°F inlet air temp., constant torque can be maintained down to 1050 rpm. The minimum speed for loading at these conditions is 1050 rpm.

NOTES

1. Fuel pressure range specified is to the engine fuel pressure regulator. Additional fuel train components should be considered in pressure and flow calculations.

2. Engine rating is with two engine driven water pumps. Tolerance is ± 3% of full load.

3. Fuel consumption tolerance is ± 3.0% of full load data.

4. Air flow value is on a 'wet' basis. Flow is a nominal value with a tolerance of ± 5 %.

5. Inlet and Exhaust Restrictions must not exceed A&I limits based on full load flow rates from the standard technical data sheet.

6. Inlet manifold pressure is a nominal value with a tolerance of ± 5 %.

7. Exhaust temperature is a nominal value with a tolerance of (+)63°F, (-)54°F.

8. Exhaust flow value is on a "wet" basis. Flow is a nominal value with a tolerance of ± 6 %.

9. Emissions data is at engine exhaust flange prior to any after treatment.

10. Values listed are higher than nominal levels to allow for instrumentation, measurement, and engine-to-engine variations. They indicate the maximum values expected under steady state conditions. Fuel methane number cannot vary more than ± 3. THC, NMHC, and NMNEHC do not include aldehydes. An oxidation catalyst may be required to meet Federal, State or local CO or HC requirements.

11. VOCs - Volatile organic compounds as defined in US EPA 40 CFR 60, subpart JJJJ

12. Exhaust Oxygen level is the result of adjusting the engine to operate at the specified NOx level. Tolerance is ± 0.5.

13. Heat rejection values are nominal. Tolerances, based on treated water, are ± 10% for jacket water circuit, ± 50% for radiation, ± 20% for lube oil circuit, and ± 5% for aftercooler circuit.

14. Aftercooler heat rejection includes an aftercooler heat rejection factor for the site elevation and inlet air temperature specified. Aftercooler heat rejection values at part load are for reference only. Do not use part load data for heat exchanger sizing.

15. Cooling system sizing criteria are maximum circuit heat rejection for the site, with applied tolerances.

WARNING(S):
1. The lower heating value of the fuel is higher than or equal to 1050 Btu/scf and lower than 1400 Btu/scf. The lower heating value of the fuel is higher than the known capabilities of the air fuel ratio control system. To achieve part load NOx emissions, manual adjustment of the air fuel ratio control settings may be required. May require on-site adjustment or tuning of the fuel system and up to two 7E-1569 valve washers per carburetor mixer to lean out part load operating points.

RECOMMENDED ACTION
For additional information please contact your Caterpillar engine dealer.

Constituent	Abbrev	Mole %	Norm
Water Vapor	H2O	0.0100	0.0100
Methane	CH4	61.3000	61.3184
Ethane	C2H6	21.6000	21.6065
Propane	C3H8	10.0100	10.0130
Isobutane	iso-C4H1O	0.9500	0.9503
Norbutane	nor-C4H1O	2.4900	2.4907
Isopentane	iso-C5H12	0.3300	0.3301
Norpentane	nor-C5H12	0.4400	0.4401
Hexane	C6H14	0.0200	0.0200
Heptane	C7H16	0.0000	0.0000
Nitrogen	N2	2.1300	2.1306
Carbon Dioxide	CO2	0.6900	0.6902
Hydrogen Sulfide	H2S	0.0000	0.0000
Carbon Monoxide	CO	0.0000	0.0000
Hydrogen	H2	0.0000	0.0000
Oxygen	O2	0.0000	0.0000
Helium	HE	0.0000	0.0000
Neopentane	neo-C5H12	0.0000	0.0000
Octane	C8H18	0.0000	0.0000
Nonane	C9H20	0.0000	0.0000
Ethylene	C2H4	0.0000	0.0000
Propylene	C3H6	0.0000	0.0000
TOTAL (Volume %)		99.9700	99.9999

Fuel Makeup:	EOG Clarks Creek Fuel
Unit of Measure:	English

Calculated Fuel Properties

Caterpillar Methane Number:	52.5
Lower Heating Value (Btu/scf):	1278
Higher Heating Value (Btu/scf):	1404
WOBBE Index (Btu/scf):	1398
THC: Free Inert Ratio:	34.45
Total % Inerts (% N2, CO2, He):	2.82%
RPC (%) (To 905 Btu/scf Fuel):	100%
Compressibility Factor:	0.995
Stoich A/F Ratio (Vol/Vol):	13.20
Stoich A/F Ratio (Mass/Mass):	15.78
Specific Gravity (Relative to Air):	0.836
Fuel Specific Heat Ratio (K):	1.260

CONDITIONS AND DEFINITIONS

Caterpillar Methane Number represents the knock resistance of a gaseous fuel. It should be used with the Caterpillar Fuel Usage Guide for the engine and rating to determine the rating for the fuel specified. A Fuel Usage Guide for each rating is included on page 2 of its standard technical data sheet.

RPC always applies to naturally aspirated (NA) engines, and turbocharged (TA or LE) engines only when they are derated for altitude and ambient site conditions.

Project specific technical data sheets generated by the Caterpillar Gas Engine Rating Pro program take the Caterpillar Methane Number and RPC into account when generating a site rating.

Fuel properties for Btu/scf calculations are at 60F and 14.696 psia.

Caterpillar shall have no liability in law or equity, for damages, consequently or otherwise, arising from use of program and related material or any part thereof.

FUEL LIQUIDS

Field gases, well head gases, and associated gases typically contain liquid water and heavy hydrocarbons entrained in the gas. To prevent detonation and severe damage to the engine, hydrocarbon liquids must not be allowed to enter the engine fuel system. To remove liquids, a liquid separator and coalescing filter are recommended, with an automatic drain and collection tank to prevent contamination of the ground in accordance with local codes and standards.

To avoid water condensation in the engine or fuel lines, limit the relative humidity of water in the fuel to 80% at the minimum fuel operating temperature.

WARNING(S)

1. The lower heating value of the fuel is higher than or equal to 1050 Btu/scf and lower than 1400 Btu/scf. The lower heating value of the fuel is higher than the known capabilities of the air fuel ratio control system. To achieve part load NOx emissions, manual adjustment of the air fuel ratio control settings may be required. May require on-site adjustment or tuning of the fuel system and up to two 7E-1569 valve washers per carburetor mixer to lean out part load operating points.

RECOMMENDED ACTION

For additional information please contact your Caterpillar engine dealer.

PREPARED BY:
Data generated by Gas Engine Rating Pro Version 6.04.00
Ref. Data Set DM8618-05-002, Printed 10Aug2017

Bryan Research & Engineering, Inc.

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ProMax® 4.0

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Simulation Report

Project: Clarks Creek Central Facility - 2018 Pt. 2.pmx

Licensed to EOG Resources, Inc. and Affiliates

Client Name: EOG
Location: Clarks Creek Central Facility 2018
Job:

ProMax Filename: C:\Users\msmith6\Documents\ProMax\EOG Promax\Clarks Creek Central Facility - 2018 Pt. 2.pmx
ProMax Version: 4.0.18221.0
Simulation Initiated: 8/28/2018 7:28:09 AM

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Report Navigator can be activated via the ProMax Navigator Toolbar.
An asterisk (*), throughout the report, denotes a user specified value.
A question mark (?) after a value, throughout the report, denotes an extrapolated or approximate value.

Names	Units	Sales Oil	Produced Water
Std Liquid Volumetric Flow	bbl/d	8215	8481

Process Streams		Heater Treater Oil Flash Emissions		Oil SWB	Sales Oil	Water Flash Emissions	Water SWB
Composition	Status:	Solved	Solved	Solved	Solved	Solved	Solved
Phase: **Total**	From Block:	VSSL-100	Oil Storage Tanks	--	Oil Storage Tanks	Produced Water Storage Tanks	--
	To Block:	--	--	--	--	--	--
Mole Fraction		%	%	%	%	%	%
Hydrogen Sulfide		0	0	0	0	0	0
Oxygen		0	0	0	0	0	0
Carbon Dioxide		0.436874	0.202413	0.253814	0.00168321	3.38852	3.74013
Nitrogen		0.287562	0.0310089	0.00467579	4.24418E-05	1.09423	0.0239556
Methane		18.4854	4.46823	2.33024	0.0156370	56.0800	3.39840
Ethane		22.6263	16.9839	29.0143	0.287667	20.4907	1.13170
Propane		24.2313	30.1733	34.4298	1.60523	7.73598	0.0631684
Isobutane		3.80692	5.62220	5.16546	0.689304	0.426230	0.000740661
n-Butane		13.2550	20.1439	17.2310	3.41324	2.49321	0.00442939
Isopentane		3.19082	4.91555	3.48558	1.95077	0.274171	0.000110586
n-Pentane		4.15606	6.31012	4.14363	3.19344	0.251850	3.60867E-05
2-Methylpentane		1.22060	1.78850	0.906340	1.80588	0.0671676	4.59603E-06
3-Methylpentane		0.526686	0.769493	0.385719	0.860574	0.0584136	8.42611E-06
Heptane		1.44895	1.85682	0.652746	6.82597	0.0247346	1.13854E-07
Octane		0.324994	0.370639	0.105639	3.92932	0.00291080	1.75135E-09
Nonane		0.124326	0.126106	0.0273479	3.62140	0.000455722	5.77540E-11
Benzene		0.172088	0.244783	0.0831557	0.394780	0.143605	0.00119307
Toluene		0.317346	0.404215	0.116338	2.00592	0.246687	0.000431419
Ethylbenzene		0.0542515	0.0618109	0.0153508	0.828381	0.0336690	1.54505E-05
m-Xylene		0.00807586	0.00913620	0.00298824	0.134642	0.00572702	2.25152E-06
p-Xylene		0.0507672	0.0578630	0.0137168	0.826001	0.0349741	1.11041E-05
o-Xylene		0.0106596	0.0119347	0.00238305	0.198051	0.00698216	3.14107E-06
n-Hexane		2.31145	3.26341	1.54108	4.40653	0.0732131	1.82512E-06
2,2,4-Trimethylpentane		0.166830	0.217634	0.0868239	0.815262	0.00243168	1.39809E-08
Water		2.76768	1.95643	0.00131622	0.0302548	7.06274	91.6357
C10+		0.0190698	0.0106016	0.000463711	62.1600	0.00142598	9.62006E-12
Molar Flow		lbmol/h	lbmol/h	lbmol/h	lbmol/h	lbmol/h	lbmol/h
Hydrogen Sulfide		0	0	0	0	0	0
Oxygen		0	0	0	0	0	0
Carbon Dioxide		0.334682	0.0434650	0.00103870	0.00976473	0.0397449	0.000565067
Nitrogen		0.220297	0.00665868	1.91351E-05	0.000246215	0.0128345	3.61927E-06
Methane		14.1614	0.959482	0.00953619	0.0907141	0.657778	0.000513437
Ethane		17.3336	3.64702	0.118737	1.66882	0.240341	0.000170979
Propane		18.5632	6.47924	0.140900	9.31234	0.0907374	9.54361E-06
Isobutane		2.91642	1.20728	0.0211390	3.99882	0.00499937	1.11901E-07
n-Butane		10.1545	4.32559	0.0705158	19.8010	0.0292436	6.69200E-07
Isopentane		2.44444	1.05554	0.0142643	11.3169	0.00321583	1.67076E-08
n-Pentane		3.18389	1.35500	0.0169573	18.5259	0.00295402	5.45205E-09
2-Methylpentane		0.935083	0.384052	0.00370908	10.4763	0.000787828	6.94378E-10
3-Methylpentane		0.403485	0.165237	0.00157850	4.99239	0.000685149	1.27303E-09
Heptane		1.11001	0.398723	0.00267128	39.5991	0.000290119	1.72012E-11
Octane		0.248973	0.0795890	0.000432316	22.7949	3.41416E-05	2.64598E-13
Nonane		0.0952444	0.0270792	0.000111918	21.0086	5.34529E-06	8.72559E-15
Benzene		0.131834	0.0525634	0.000340304	2.29021	0.00168439	1.80251E-07
Toluene		0.243114	0.0867989	0.000476100	11.6368	0.00289346	6.51796E-08
Ethylbenzene		0.0415612	0.0132729	6.28211E-05	4.80563	0.000394913	2.33429E-09
m-Xylene		0.00618678	0.00196186	1.22290E-05	0.781088	6.71738E-05	3.40165E-10
p-Xylene		0.0388919	0.0124252	5.61340E-05	4.79183	0.000410220	1.67764E-09
o-Xylene		0.00816617	0.00256278	9.75234E-06	1.14894	8.18957E-05	4.74559E-10
n-Hexane		1.77077	0.700766	0.00630669	25.5633	0.000858737	2.75743E-10
2,2,4-Trimethylpentane		0.127806	0.0467335	0.000355316	4.72953	2.85218E-05	2.11227E-12
Water		2.12027	0.420113	5.38647E-06	0.175515	0.0828409	0.0138445
C10+		0.0146090	0.00227654	1.89768E-06	360.605	1.67257E-05	1.45342E-15
Mass Fraction		%	%	%	%	%	%
Hydrogen Sulfide		0	0	0	0	0	0
Oxygen		0	0	0	0	0	0
Carbon Dioxide		0.450154	0.174327	0.240347	0.000455469	6.12500	8.62738
Nitrogen		0.188606	0.0169994	0.00281838	7.31026E-06	1.25899	0.0351738
Methane		6.94317	1.40277	0.804357	0.00154240	36.9512	2.85753
Ethane		15.9291	9.99393	18.7720	0.0531842	25.3061	1.78359
Propane		25.0167	26.0374	32.6669	0.435218	14.0107	0.145996
Isobutane		5.18053	6.39481	6.45995	0.246335	1.01750	0.00225635
n-Butane		18.0377	22.9121	21.5492	1.21978	5.95183	0.0134937
Isopentane		5.39001	6.94035	5.41105	0.865385	0.812457	0.000418191
n-Pentane		7.02050	8.90936	6.43262	1.41665	0.746313	0.000136465
2-Methylpentane		2.46272	3.01614	1.68055	0.956852	0.237735	2.07592E-05
3-Methylpentane		1.06266	1.29768	0.715207	0.455978	0.206750	3.80588E-05
Heptane		3.39928	3.64104	1.40734	4.20546	0.101796	5.97955E-07
Octane		0.869177	0.828526	0.259644	2.75972	0.0136564	1.04856E-08
Nonane		0.373333	0.316511	0.0754703	2.85577	0.00240062	3.88242E-10
Benzene		0.314720	0.374178	0.139761	0.189603	0.460720	0.00488458
Toluene		0.684592	0.728842	0.230644	1.13639	0.933546	0.00208346
Ethylbenzene		0.134850	0.128418	0.0350663	0.540735	0.146812	8.59744E-05
m-Xylene		0.0200737	0.0189813	0.00682612	0.0878888	0.0249724	1.25286E-05
p-Xylene		0.126189	0.120216	0.0313336	0.539182	0.152502	6.17891E-05
o-Xylene		0.0264961	0.0247954	0.00544369	0.129280	0.0304453	1.74785E-05
n-Hexane		4.66365	5.50345	2.85751	2.33482	0.259132	8.24366E-06
2,2,4-Trimethylpentane		0.446176	0.486498	0.213399	0.572591	0.0114085	8.37059E-08
Water		1.16739	0.689741	0.000510209	0.00335126	5.22593	86.5268
C10+		0.0922811	0.0428807	0.00206222	78.9938	0.0121052	1.04215E-10

Mass Flow	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h
Hydrogen Sulfide	0	0	0	0	0	0
Oxygen	0	0	0	0	0	0
Carbon Dioxide	14.7292	1.91287	0.0457126	0.429741	1.74915	0.0248683
Nitrogen	6.17126	0.186532	0.000536039	0.00689732	0.359538	0.000101388
Methane	227.183	15.3924	0.152984	1.45528	10.5524	0.00823680
Ethane	521.205	109.662	3.57032	50.1799	7.22682	0.00514118
Propane	818.556	285.706	6.21305	410.633	4.00112	0.000420831
Isobutane	169.509	70.1697	1.22864	232.420	0.290574	6.50390E-06
n-Butane	590.199	251.413	4.09853	1150.88	1.69970	3.88954E-05
Isopentane	176.363	76.1558	1.02915	816.501	0.232018	1.20543E-06
n-Pentane	229.713	97.7615	1.22345	1336.62	0.213129	3.93358E-07
2-Methylpentane	80.5811	33.0958	0.319631	902.802	0.0678914	5.98383E-08
3-Methylpentane	34.7705	14.2393	0.136028	430.221	0.0590429	1.09704E-07
Heptane	111.226	39.9528	0.267667	3967.90	0.0290705	1.72360E-09
Octane	28.4398	9.09133	0.0493828	2603.83	0.00389994	3.02246E-11
Nonane	12.2156	3.47304	0.0143540	2694.46	0.000685560	1.11910E-12
Benzene	10.2978	4.10582	0.0265818	178.893	0.131571	1.40797E-05
Toluene	22.4001	7.99751	0.0438671	1072.20	0.266598	6.00554E-06
Ethylbenzene	4.41234	1.40912	0.00666940	510.190	0.0419259	2.47820E-07
m-Xylene	0.656820	0.208280	0.00129829	82.9242	0.00713151	3.61136E-08
p-Xylene	4.12896	1.31912	0.00595947	508.725	0.0435510	1.78106E-07
o-Xylene	0.866961	0.272078	0.00103536	121.977	0.00869446	5.03816E-08
n-Hexane	152.596	60.3888	0.543481	2202.93	0.0740020	2.37622E-08
2,2,4-Trimethylpentane	14.5990	5.33829	0.0405872	540.247	0.00325800	2.41281E-10
Water	38.1973	7.56846	9.70388E-05	3.16196	1.49240	0.249412
C10+	3.01947	0.470526	0.000392222	74531.7	0.00345696	3.00400E-13

Process Streams		Heater Treater	Oil Flash Emissions	Oil SWB	Sales Oil	Water Flash Emissions	Water SWB
Properties	Status:	Solved	Solved	Solved	Solved	Solved	Solved
Phase: **Total**	From Block:	VSSL-100	Oil Storage Tanks	--	Oil Storage Tanks	Produced Water Storage Tanks	--
	To Block:	--	--	--	--	--	--
Property	**Units**						
Temperature	°F	170*	130*	64.4643	130	100*	64.4643
Pressure	psia	39.6959*	13.5*	9.47444	13.5	13.5*	0.327698
Mole Fraction Vapor	%	100	100	100	0	100	100
Mole Fraction Light Liquid	%	0	0	0	100	0	0
Mole Fraction Heavy Liquid	%	0	0	0	0	0	0
Molecular Weight	lb/lbmol	42.7112	51.0999	46.4753	162.640	24.3473	19.0790
Mass Density	lb/ft^3	0.257610	0.110697	0.0792699	47.4725	0.0549377	0.00111189
Molar Flow	lbmol/h	76.6083	21.4734	0.409237	580.124	1.17293	0.0151082
Mass Flow	lb/h	3272.04	1097.29	19.0194	94351.3	28.5576	0.288249
Vapor Volumetric Flow	ft^3/h	12701.5	9912.56	239.932	1987.49	519.819	259.242
Liquid Volumetric Flow	gpm	1583.57	1235.85	29.9136	247.792	64.8085	32.3211
Std Vapor Volumetric Flow	MMSCFD	0.697719	0.195572	0.00372717	5.28354	0.0106826	0.000137600
Std Liquid Volumetric Flow	sgpm	13.0992	4.05498	0.0754953	239.604	0.144950	0.000645307
Compressibility		0.973978	0.984795	0.987554	0.00730881	0.996136	0.999679
Specific Gravity		1.47471	1.76435	1.60467	0.761154	0.840649	0.658747
API Gravity					47.2460		
Enthalpy	Btu/h	-3.50005E+06	-1.07524E+06	-19397.2	-6.97181E+07	-51262.4	-1559.63
Mass Enthalpy	Btu/lb	-1069.69	-979.907	-1019.87	-738.921	-1795.05	-5410.71
Mass Cp	Btu/(lb*°F)	0.466982	0.434218	0.397644	0.502060	0.450034	0.428324
Ideal Gas CpCv Ratio		1.11209	1.09893	1.12113	1.03132	1.22226	1.32113
Dynamic Viscosity	cP	0.0100390	0.00875045	0.00802111	0.840668	0.0110086	0.0102613
Kinematic Viscosity	cSt	2.43281	4.93485	6.31692	1.10551	12.5095	576.129
Thermal Conductivity	Btu/(h*ft*°F)	0.0149710	0.0118354	0.00985302	0.0670657	0.0165332	0.0118128
Surface Tension	lbf/ft				0.00161798		
Net Ideal Gas Heating Value	Btu/ft^3	2197.56	2632.16	2424.85	8052.02	1158.36	50.9141
Net Liquid Heating Value	Btu/lb	19368.8	19385.8	19643.1	18632.7	17915.6	86.2842
Gross Ideal Gas Heating Value	Btu/ft^3	2389.77	2855.46	2633.56	8603.59	1275.45	102.284
Gross Liquid Heating Value	Btu/lb	21077.0	21044.5	21347.9	19919.7	19741.2	1108.07

Process Streams		Heater Treater	Oil Flash Emissions	Oil SWB	Sales Oil	Water Flash Emissions	Water SWB
Composition	Status:	Solved	Solved	Solved	Solved	Solved	Solved
Phase: **Vapor**	From Block:	VSSL-100	Oil Storage Tanks	--	Oil Storage Tanks	Produced Water Storage Tanks	--
	To Block:	--	--	--	--	--	--
Mole Fraction		%	%	%	%	%	%
Hydrogen Sulfide		0	0	0		0	0
Oxygen		0	0	0		0	0
Carbon Dioxide		0.436874	0.202413	0.253814		3.38852	3.74013
Nitrogen		0.287562	0.0310089	0.00467579		1.09423	0.0239556
Methane		18.4854	4.46823	2.33024		56.0800	3.39840
Ethane		22.6263	16.9839	29.0143		20.4907	1.13170
Propane		24.2313	30.1733	34.4298		7.73598	0.0631684
Isobutane		3.80692	5.62220	5.16546		0.426230	0.000740661
n-Butane		13.2550	20.1439	17.2310		2.49321	0.00442939
Isopentane		3.19082	4.91555	3.48558		0.274171	0.000110586
n-Pentane		4.15606	6.31012	4.14363		0.251850	3.60867E-05
2-Methylpentane		1.22060	1.78850	0.906340		0.0671676	4.59603E-06
3-Methylpentane		0.526686	0.769493	0.385719		0.0584136	8.42611E-06
Heptane		1.44895	1.85682	0.652746		0.0247346	1.13854E-07
Octane		0.324994	0.370639	0.105639		0.00291080	1.75135E-09
Nonane		0.124326	0.126106	0.0273479		0.000455722	5.77540E-11
Benzene		0.172088	0.244783	0.0831557		0.143605	0.00119307
Toluene		0.317346	0.404215	0.116338		0.246687	0.000431419
Ethylbenzene		0.0542515	0.0618109	0.0153508		0.0336690	1.54505E-05
m-Xylene		0.00807586	0.00913620	0.00298824		0.00572702	2.25152E-06
p-Xylene		0.0507672	0.0578630	0.0137168		0.0349741	1.11041E-05
o-Xylene		0.0106596	0.0119347	0.00238305		0.00698216	3.14107E-06
n-Hexane		2.31145	3.26341	1.54108		0.0732131	1.82512E-06
2,2,4-Trimethylpentane		0.166830	0.217634	0.0868239		0.00243168	1.39809E-08
Water		2.76768	1.95643	0.00131622		7.06274	91.6357
C10+		0.0190698	0.0106016	0.000463711		0.00142598	9.62006E-12

Molar Flow	lbmol/h	lbmol/h	lbmol/h	lbmol/h	lbmol/h	lbmol/h
Hydrogen Sulfide	0	0	0		0	0
Oxygen	0	0	0		0	0
Carbon Dioxide	0.334682	0.0434650	0.00103870		0.0397449	0.000565067
Nitrogen	0.220297	0.00665868	1.91351E-05		0.0128345	3.61927E-06
Methane	14.1614	0.959482	0.00953619		0.657778	0.000513437
Ethane	17.3336	3.64702	0.118737		0.240341	0.000170979
Propane	18.5632	6.47924	0.140900		0.0907374	9.54361E-06
Isobutane	2.91642	1.20728	0.0211390		0.00499937	1.11901E-07
n-Butane	10.1545	4.32559	0.0705158		0.0292436	6.69200E-07
Isopentane	2.44444	1.05554	0.0142643		0.00321583	1.67076E-08
n-Pentane	3.18389	1.35500	0.0169573		0.00295402	5.45205E-09
2-Methylpentane	0.935083	0.384052	0.00370908		0.000787828	6.94378E-10
3-Methylpentane	0.403485	0.165237	0.00157850		0.000685149	1.27303E-09
Heptane	1.11001	0.398723	0.00267128		0.000290119	1.72012E-11
Octane	0.248973	0.0795890	0.000432316		3.41416E-05	2.64598E-13
Nonane	0.0952444	0.0270792	0.000111918		5.34529E-06	8.72559E-15
Benzene	0.131834	0.0525634	0.000340304		0.00168439	1.80251E-07
Toluene	0.243114	0.0867989	0.000476100		0.00289346	6.51796E-08
Ethylbenzene	0.0415612	0.0132729	6.28211E-05		0.000394913	2.33429E-09
m-Xylene	0.00618678	0.00196186	1.22290E-05		6.71738E-05	3.40165E-10
p-Xylene	0.0388919	0.0124252	5.61340E-05		0.000410220	1.67764E-09
o-Xylene	0.00816617	0.00256278	9.75234E-06		8.18957E-05	4.74559E-10
n-Hexane	1.77077	0.700766	0.00630669		0.000858737	2.75743E-10
2,2,4-Trimethylpentane	0.127806	0.0467335	0.000355316		2.85218E-05	2.11227E-12
Water	2.12027	0.420113	5.38647E-06		0.0828409	0.0138445
C10+	0.0146090	0.00227654	1.89768E-06		1.67257E-05	1.45342E-15
Mass Fraction	%	%	%	%	%	%
Hydrogen Sulfide	0	0	0		0	0
Oxygen	0	0	0		0	0
Carbon Dioxide	0.450154	0.174327	0.240347		6.12500	8.62738
Nitrogen	0.188606	0.0169994	0.00281838		1.25899	0.0351738
Methane	6.94317	1.40277	0.804357		36.9512	2.85753
Ethane	15.9291	9.99393	18.7720		25.3061	1.78359
Propane	25.0167	26.0374	32.6669		14.0107	0.145996
Isobutane	5.18053	6.39481	6.45995		1.01750	0.00225635
n-Butane	18.0377	22.9121	21.5492		5.95183	0.0134937
Isopentane	5.39001	6.94035	5.41105		0.812457	0.000418191
n-Pentane	7.02050	8.90936	6.43262		0.746313	0.000136465
2-Methylpentane	2.46272	3.01614	1.68055		0.237735	2.07592E-05
3-Methylpentane	1.06266	1.29768	0.715207		0.206750	3.80588E-05
Heptane	3.39928	3.64104	1.40734		0.101796	5.97955E-07
Octane	0.869177	0.828526	0.259644		0.0136564	1.04856E-08
Nonane	0.373333	0.316511	0.0754703		0.00240062	3.88242E-10
Benzene	0.314720	0.374178	0.139761		0.460720	0.00488458
Toluene	0.684592	0.728842	0.230644		0.933546	0.00208346
Ethylbenzene	0.134850	0.128418	0.0350663		0.146812	8.59744E-05
m-Xylene	0.0200737	0.0189813	0.00682612		0.0249724	1.25286E-05
p-Xylene	0.126189	0.120216	0.0313336		0.152502	6.17891E-05
o-Xylene	0.0264961	0.0247954	0.00544369		0.0304453	1.74785E-05
n-Hexane	4.66365	5.50345	2.85751		0.259132	8.24366E-06
2,2,4-Trimethylpentane	0.446176	0.486498	0.213399		0.0114085	8.37059E-08
Water	1.16739	0.689741	0.000510209		5.22593	86.5268
C10+	0.0922811	0.0428807	0.00206222		0.0121052	1.04215E-10
Mass Flow	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h
Hydrogen Sulfide	0	0	0		0	0
Oxygen	0	0	0		0	0
Carbon Dioxide	14.7292	1.91287	0.0457126		1.74915	0.0248683
Nitrogen	6.17126	0.186532	0.000536039		0.359538	0.000101388
Methane	227.183	15.3924	0.152984		10.5524	0.00823680
Ethane	521.205	109.662	3.57032		7.22682	0.00514118
Propane	818.556	285.706	6.21305		4.00112	0.000420831
Isobutane	169.509	70.1697	1.22864		0.290574	6.50390E-06
n-Butane	590.199	251.413	4.09853		1.69970	3.88954E-05
Isopentane	176.363	76.1558	1.02915		0.232018	1.20543E-06
n-Pentane	229.713	97.7615	1.22345		0.213129	3.93358E-07
2-Methylpentane	80.5811	33.0958	0.319631		0.0678914	5.98383E-08
3-Methylpentane	34.7705	14.2393	0.136028		0.0590429	1.09704E-07
Heptane	111.226	39.9528	0.267667		0.0290705	1.72360E-09
Octane	28.4398	9.09133	0.0493828		0.00389994	3.02246E-11
Nonane	12.2156	3.47304	0.0143540		0.000685560	1.11910E-12
Benzene	10.2978	4.10582	0.0265818		0.131571	1.40797E-05
Toluene	22.4001	7.99751	0.0438671		0.266598	6.00554E-06
Ethylbenzene	4.41234	1.40912	0.00666940		0.0419259	2.47820E-07
m-Xylene	0.656820	0.208280	0.00129829		0.00713151	3.61136E-08
p-Xylene	4.12896	1.31912	0.00595947		0.0435510	1.78106E-07
o-Xylene	0.866961	0.272078	0.00103536		0.00869446	5.03816E-08
n-Hexane	152.596	60.3888	0.543481		0.0740020	2.37622E-08
2,2,4-Trimethylpentane	14.5990	5.33829	0.0405872		0.00325800	2.41281E-10
Water	38.1973	7.56846	9.70388E-05		1.49240	0.249412
C10+	3.01947	0.470526	0.000392222		0.00345696	3.00400E-13

Process Streams		Heater Treater Oil Flash Emissions		Oil SWB	Sales Oil	Water Flash Emissions	Water SWB
Properties	**Status:**	Solved	Solved	Solved	Solved	Solved	Solved
Phase: **Vapor**	**From Block:**	**VSSL-100**	**Oil Storage Tanks**	--	**Oil Storage Tanks**	**Produced Water Storage Tanks**	--
	To Block:	--	--	--	--	--	--
Property	**Units**						
Temperature	°F	170	130	64.4643		100	64.4643
Pressure	psia	39.6959	13.5	9.47444		13.5	0.327698
Mole Fraction Vapor	%	100	100	100		100	100
Mole Fraction Light Liquid	%	0	0	0		0	0
Mole Fraction Heavy Liquid	%	0	0	0		0	0
Molecular Weight	lb/lbmol	42.7112	51.0999	46.4753		24.3473	19.0790
Mass Density	lb/ft^3	0.257610	0.110697	0.0792699		0.0549377	0.00111189
Molar Flow	lbmol/h	76.6083	21.4734	0.409237		1.17293	0.0151082
Mass Flow	lb/h	3272.04	1097.29	19.0194		28.5576	0.288249
Vapor Volumetric Flow	ft^3/h	12701.5	9912.56	239.932		519.819	259.242
Liquid Volumetric Flow	gpm	1583.57	1235.85	29.9136		64.8085	32.3211
Std Vapor Volumetric Flow	MMSCFD	0.697719	0.195572	0.00372717		0.0106826	0.000137600
Std Liquid Volumetric Flow	sgpm	13.0992	4.05498	0.0754953		0.144950	0.000645307
Compressibility		0.973978	0.984795	0.987554		0.996136	0.999679
Specific Gravity		1.47471	1.76435	1.60467		0.840649	0.658747
API Gravity							
Enthalpy	Btu/h	-3.50005E+06	-1.07524E+06	-19397.2		-51262.4	-1559.63
Mass Enthalpy	Btu/lb	-1069.69	-979.907	-1019.87		-1795.05	-5410.71
Mass Cp	Btu/(lb*°F)	0.466982	0.434218	0.397644		0.450034	0.428324
Ideal Gas CpCv Ratio		1.11209	1.09893	1.12113		1.22226	1.32113
Dynamic Viscosity	cP	0.0100390	0.00875045	0.00802111		0.0110086	0.0102613
Kinematic Viscosity	cSt	2.43281	4.93485	6.31692		12.5095	576.129
Thermal Conductivity	Btu/(h*ft*°F)	0.0149710	0.0118354	0.00985302		0.0165332	0.0118128
Surface Tension	lbf/ft						
Net Ideal Gas Heating Value	Btu/ft^3	2197.56	2632.16	2424.85		1158.36	50.9141
Net Liquid Heating Value	Btu/lb	19368.8	19385.8	19643.1		17915.6	86.2842
Gross Ideal Gas Heating Value	Btu/ft^3	2389.77	2855.46	2633.56		1275.45	102.284
Gross Liquid Heating Value	Btu/lb	21077.0	21044.5	21347.9		19741.2	1108.07

Process Streams		Heater Treater Oil Flash Emissions		Oil SWB	Sales Oil	Water Flash Emissions	Water SWB
Composition	**Status:**	Solved	Solved	Solved	Solved	Solved	Solved
Phase: **Light Liquid**	**From Block:**	**VSSL-100**	**Oil Storage Tanks**	--	**Oil Storage Tanks**	**Produced Water Storage Tanks**	--
	To Block:	--	--	--	--	--	--
Mole Fraction		%	%	%	%	%	%
Hydrogen Sulfide					0		
Oxygen					0		
Carbon Dioxide					0.00168321		
Nitrogen					4.24418E-05		
Methane					0.0156370		
Ethane					0.287667		
Propane					1.60523		
Isobutane					0.689304		
n-Butane					3.41324		
Isopentane					1.95077		
n-Pentane					3.19344		
2-Methylpentane					1.80588		
3-Methylpentane					0.860574		
Heptane					6.82597		
Octane					3.92932		
Nonane					3.62140		
Benzene					0.394780		
Toluene					2.00592		
Ethylbenzene					0.828381		
m-Xylene					0.134642		
p-Xylene					0.826001		
o-Xylene					0.198051		
n-Hexane					4.40653		
2,2,4-Trimethylpentane					0.815262		
Water					0.0302548		
C10+					62.1600		
Molar Flow		lbmol/h	lbmol/h	lbmol/h	lbmol/h	lbmol/h	lbmol/h
Hydrogen Sulfide					0		
Oxygen					0		
Carbon Dioxide					0.00976473		
Nitrogen					0.000246215		
Methane					0.0907141		
Ethane					1.66882		
Propane					9.31234		
Isobutane					3.99882		
n-Butane					19.8010		
Isopentane					11.3169		
n-Pentane					18.5259		
2-Methylpentane					10.4763		
3-Methylpentane					4.99239		
Heptane					39.5991		
Octane					22.7949		
Nonane					21.0086		
Benzene					2.29021		
Toluene					11.6368		
Ethylbenzene					4.80563		
m-Xylene					0.781088		
p-Xylene					4.79183		
o-Xylene					1.14894		
n-Hexane					25.5633		
2,2,4-Trimethylpentane					4.72953		
Water					0.175515		
C10+					360.605		

Mass Fraction	%	%	%	%	%	%
Hydrogen Sulfide				0		
Oxygen				0		
Carbon Dioxide				0.000455469		
Nitrogen				7.31026E-06		
Methane				0.00154240		
Ethane				0.0531842		
Propane				0.435218		
Isobutane				0.246335		
n-Butane				1.21978		
Isopentane				0.865385		
n-Pentane				1.41665		
2-Methylpentane				0.956852		
3-Methylpentane				0.455978		
Heptane				4.20546		
Octane				2.75972		
Nonane				2.85577		
Benzene				0.189603		
Toluene				1.13639		
Ethylbenzene				0.540735		
m-Xylene				0.0878888		
p-Xylene				0.539182		
o-Xylene				0.129280		
n-Hexane				2.33482		
2,2,4-Trimethylpentane				0.572591		
Water				0.00335126		
C10+				78.9938		
Mass Flow	**lb/h**	**lb/h**	**lb/h**	**lb/h**	**lb/h**	**lb/h**
Hydrogen Sulfide				0		
Oxygen				0		
Carbon Dioxide				0.429741		
Nitrogen				0.00689732		
Methane				1.45528		
Ethane				50.1799		
Propane				410.633		
Isobutane				232.420		
n-Butane				1150.88		
Isopentane				816.501		
n-Pentane				1336.62		
2-Methylpentane				902.802		
3-Methylpentane				430.221		
Heptane				3967.90		
Octane				2603.83		
Nonane				2694.46		
Benzene				178.893		
Toluene				1072.20		
Ethylbenzene				510.190		
m-Xylene				82.9242		
p-Xylene				508.725		
o-Xylene				121.977		
n-Hexane				2202.93		
2,2,4-Trimethylpentane				540.247		
Water				3.16196		
C10+				74531.7		

Process Streams		Heater Treater Oil Flash Emissions		Oil SWB	Sales Oil	Water Flash Emissions	Water SWB
Properties	**Status:**	Solved	Solved	Solved	Solved	Solved	Solved
Phase: **Light Liquid**	**From Block:**	**VSSL-100**	**Oil Storage Tanks**	**--**	**Oil Storage Tanks**	**Produced Water Storage Tanks**	**--**
	To Block:	--	--	--	--	--	--
Property	**Units**						
Temperature	°F				130		
Pressure	psia				13.5		
Mole Fraction Vapor	%				0		
Mole Fraction Light Liquid	%				100		
Mole Fraction Heavy Liquid	%				0		
Molecular Weight	lb/lbmol				162.640		
Mass Density	lb/ft^3				47.4725		
Molar Flow	lbmol/h				580.124		
Mass Flow	lb/h				94351.3		
Vapor Volumetric Flow	ft^3/h				1987.49		
Liquid Volumetric Flow	gpm				247.792		
Std Vapor Volumetric Flow	MMSCFD				5.28354		
Std Liquid Volumetric Flow	sgpm				239.604		
Compressibility					0.00730881		
Specific Gravity					0.761154		
API Gravity					47.2460		
Enthalpy	Btu/h				-6.97181E+07		
Mass Enthalpy	Btu/lb				-738.921		
Mass Cp	Btu/(lb*°F)				0.502060		
Ideal Gas CpCv Ratio					1.03132		
Dynamic Viscosity	cP				0.840668		
Kinematic Viscosity	cSt				1.10551		
Thermal Conductivity	Btu/(h*ft*°F)				0.0670657		
Surface Tension	lbf/ft				0.00161798		
Net Ideal Gas Heating Value	Btu/ft^3				8052.02		
Net Liquid Heating Value	Btu/lb				18632.7		
Gross Ideal Gas Heating Value	Btu/ft^3				8603.59		
Gross Liquid Heating Value	Btu/lb				19919.7		

GRI-GLYCalc VERSION 4.0 - AGGREGATE CALCULATIONS REPORT

Case Name: Clarks Creek Central Facility
File Name: C:\Users\msmith6\Documents\my gly calc stuff\North Dakota\Clarks Creek Central Facility Compressor Dehy.ddf
Date: August 27, 2018

DESCRIPTION:

Description: Compressor Station Dehy

Annual Hours of Operation: 8760.0 hours/yr

EMISSIONS REPORTS:

CONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.0544	1.306	0.2383
Ethane	0.1690	4.057	0.7404
Propane	0.2831	6.793	1.2398
Isobutane	0.0635	1.523	0.2780
n-Butane	0.2577	6.185	1.1288
Isopentane	0.0554	1.330	0.2426
n-Pentane	0.1025	2.460	0.4490
Cyclopentane	0.0004	0.009	0.0016
n-Hexane	0.0267	0.641	0.1169
Cyclohexane	0.0213	0.512	0.0934
Other Hexanes	0.0371	0.890	0.1625
Heptanes	0.0029	0.070	0.0128
Methylcyclohexane	0.0072	0.174	0.0317
2,2,4-Trimethylpentane	<0.0001	<0.001	<0.0001
Benzene	0.0515	1.237	0.2258
Toluene	0.0832	1.997	0.3645
Ethylbenzene	0.0123	0.295	0.0539
Xylenes	0.0013	0.030	0.0055
C8+ Heavies	0.0001	0.002	0.0003
Total Emissions	1.2296	29.510	5.3856
Total Hydrocarbon Emissions	1.2296	29.510	5.3856
Total VOC Emissions	1.0061	24.147	4.4069
Total HAP Emissions	0.1750	4.200	0.7665
Total BTEX Emissions	0.1483	3.560	0.6496

UNCONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	2.7277	65.464	11.9472
Ethane	8.5984	206.361	37.6608
Propane	15.4494	370.785	67.6683
Isobutane	3.7960	91.103	16.6264
n-Butane	16.6149	398.757	72.7732
Isopentane	4.9909	119.781	21.8600
n-Pentane	9.4576	226.983	41.4243
Cyclopentane	0.0441	1.057	0.1929
n-Hexane	4.8882	117.318	21.4105

Cyclohexane	5.1599	123.837	22.6002
Other Hexanes	5.0262	120.629	22.0147
Heptanes	1.3526	32.461	5.9242
Methylcyclohexane	3.3071	79.371	14.4852
2,2,4-Trimethylpentane	0.0003	0.008	0.0015
Benzene	12.8970	309.528	56.4888
Toluene	60.3060	1447.345	264.1404
Ethylbenzene	28.3799	681.118	124.3040
Xylenes	3.5939	86.255	15.7415
C8+ Heavies	11.7225	281.340	51.3446
Total Emissions	198.3125	4759.500	868.6088
Total Hydrocarbon Emissions	198.3125	4759.500	868.6088
Total VOC Emissions	186.9865	4487.675	819.0008
Total HAP Emissions	110.0655	2641.571	482.0867
Total BTEX Emissions	105.1769	2524.245	460.6747

FLASH GAS EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	4.9004	117.610	21.4639
Ethane	3.4944	83.864	15.3053
Propane	2.6964	64.713	11.8102
Isobutane	0.3810	9.144	1.6688
n-Butane	1.1857	28.457	5.1934
Isopentane	0.2719	6.527	1.1911
n-Pentane	0.4038	9.691	1.7685
Cyclopentane	0.0004	0.010	0.0019
n-Hexane	0.0978	2.346	0.4282
Cyclohexane	0.0237	0.569	0.1038
Other Hexanes	0.1387	3.329	0.6075
Heptanes	0.0111	0.267	0.0487
Methylcyclohexane	0.0107	0.257	0.0469
2,2,4-Trimethylpentane	<0.0001	<0.001	<0.0001
Benzene	0.0067	0.161	0.0293
Toluene	0.0171	0.411	0.0751
Ethylbenzene	0.0040	0.096	0.0176
Xylenes	0.0003	0.008	0.0015
C8+ Heavies	0.0149	0.358	0.0653
Total Emissions	13.6591	327.818	59.8269
Total Hydrocarbon Emissions	13.6591	327.818	59.8269
Total VOC Emissions	5.2643	126.344	23.0577
Total HAP Emissions	0.1260	3.023	0.5517
Total BTEX Emissions	0.0282	0.676	0.1235

FLASH TANK OFF GAS

Component	lbs/hr	lbs/day	tons/yr
Methane	245.0213	5880.512	1073.1934
Ethane	174.7177	4193.224	765.2634
Propane	134.8198	3235.674	590.5106
Isobutane	19.0504	457.208	83.4405
n-Butane	59.2854	1422.850	259.6701
Isopentane	13.5971	326.331	59.5554
n-Pentane	20.1887	484.529	88.4265

Cyclopentane	0.0216	0.518	0.0945
n-Hexane	4.8880	117.312	21.4095
Cyclohexane	1.1851	28.442	5.1906
Other Hexanes	6.9344	166.425	30.3726
Heptanes	0.5555	13.332	2.4331
Methylcyclohexane	0.5348	12.836	2.3426
2,2,4-Trimethylpentane	0.0003	0.007	0.0013
Benzene	0.3347	8.033	1.4660
Toluene	0.8572	20.573	3.7546
Ethylbenzene	0.2005	4.811	0.8781
Xylenes	0.0169	0.406	0.0741
C8+ Heavies	0.7456	17.893	3.2655
Total Emissions	682.9549	16390.918	2991.3426
Total Hydrocarbon Emissions	682.9549	16390.918	2991.3426
Total VOC Emissions	263.2159	6317.182	1152.8857
Total HAP Emissions	6.2976	151.143	27.5836
Total BTEX Emissions	1.4093	33.823	6.1728

EQUIPMENT REPORTS:

CONDENSER AND COMBUSTION DEVICE

Condenser Outlet Temperature:	100.00 deg. F
Condenser Pressure:	14.70 psia
Condenser Duty:	2.56e-001 MM BTU/hr
Hydrocarbon Recovery:	11.03 bbls/day
Produced Water:	3.14 bbls/day
Ambient Temperature:	50.00 deg. F
Excess Oxygen:	0.00 %
Combustion Efficiency:	98.00 %
Supplemental Fuel Requirement:	2.56e-001 MM BTU/hr

Component	Emitted	Destroyed
Methane	1.99%	98.01%
Ethane	1.97%	98.03%
Propane	1.83%	98.17%
Isobutane	1.67%	98.33%
n-Butane	1.55%	98.45%
Isopentane	1.11%	98.89%
n-Pentane	1.08%	98.92%
Cyclopentane	0.85%	99.15%
n-Hexane	0.55%	99.45%
Cyclohexane	0.41%	99.59%
Other Hexanes	0.74%	99.26%
Heptanes	0.22%	99.78%
Methylcyclohexane	0.22%	99.78%
2,2,4-Trimethylpentane	0.25%	99.75%
Benzene	0.40%	99.60%
Toluene	0.14%	99.86%
Ethylbenzene	0.04%	99.96%
Xylenes	0.04%	99.96%
C8+ Heavies	0.00%	100.00%

ABSORBER

NOTE: Because the Calculated Absorber Stages was below the minimum allowed, GRI-GLYCalc has set the number of Absorber Stages to 1.25 and has calculated a revised Dry Gas Dew Point.

Calculated Absorber Stages:	1.25	
Calculated Dry Gas Dew Point:	2.55	lbs. H2O/MMSCF
Temperature:	110.0	deg. F
Pressure:	1200.0	psig
Dry Gas Flow Rate:	17.3000	MMSCF/day
Glycol Losses with Dry Gas:	6.8067	lb/hr
Wet Gas Water Content:	Saturated	
Calculated Wet Gas Water Content:	67.44	lbs. H2O/MMSCF
Calculated Lean Glycol Recirc. Ratio:	19.19	gal/lb H2O

Component	Remaining in Dry Gas	Absorbed in Glycol
Water	3.77%	96.23%
Carbon Dioxide	98.63%	1.37%
Nitrogen	99.80%	0.20%
Methane	99.86%	0.14%
Ethane	99.71%	0.29%
Propane	99.70%	0.30%
Isobutane	99.69%	0.31%
n-Butane	99.62%	0.38%
Isopentane	99.70%	0.30%
n-Pentane	99.64%	0.36%
Cyclopentane	98.40%	1.60%
n-Hexane	99.60%	0.40%
Cyclohexane	98.07%	1.93%
Other Hexanes	99.67%	0.33%
Heptanes	99.47%	0.53%
Methylcyclohexane	98.42%	1.58%
2,2,4-Trimethylpentane	99.78%	0.22%
Benzene	84.25%	15.75%
Toluene	84.31%	15.69%
Ethylbenzene	85.10%	14.90%
Xylenes	80.76%	19.24%
C8+ Heavies	99.56%	0.44%

FLASH TANK

Flash Control:	Combustion device	
Flash Control Efficiency:	98.00 %	
Flash Temperature:	70.0	deg. F
Flash Pressure:	120.0	psig

Component	Left in Glycol	Removed in Flash Gas
Water	99.97%	0.03%
Carbon Dioxide	16.49%	83.51%
Nitrogen	1.11%	98.89%
Methane	1.10%	98.90%
Ethane	4.69%	95.31%
Propane	10.28%	89.72%
Isobutane	16.62%	83.38%

n-Butane	21.89%	78.11%
Isopentane	26.92%	73.08%
n-Pentane	31.98%	68.02%
Cyclopentane	67.20%	32.80%
n-Hexane	50.06%	49.94%
Cyclohexane	81.69%	18.31%
Other Hexanes	42.14%	57.86%
Heptanes	70.93%	29.07%
Methylcyclohexane	86.39%	13.61%
2,2,4-Trimethylpentane	53.31%	46.69%
Benzene	97.59%	2.41%
Toluene	98.70%	1.30%
Ethylbenzene	99.37%	0.63%
Xylenes	99.59%	0.41%
C8+ Heavies	94.22%	5.78%

REGENERATOR

No Stripping Gas used in regenerator.

Component	Remaining in Glycol	Distilled Overhead
Water	72.66%	27.34%
Carbon Dioxide	0.00%	100.00%
Nitrogen	0.00%	100.00%
Methane	0.00%	100.00%
Ethane	0.00%	100.00%
Propane	0.00%	100.00%
Isobutane	0.00%	100.00%
n-Butane	0.00%	100.00%
Isopentane	0.35%	99.65%
n-Pentane	0.34%	99.66%
Cyclopentane	0.41%	99.59%
n-Hexane	0.24%	99.76%
Cyclohexane	2.38%	97.62%
Other Hexanes	0.49%	99.51%
Heptanes	0.21%	99.79%
Methylcyclohexane	2.59%	97.41%
2,2,4-Trimethylpentane	0.42%	99.58%
Benzene	4.75%	95.25%
Toluene	7.44%	92.56%
Ethylbenzene	9.71%	90.29%
Xylenes	12.25%	87.75%
C8+ Heavies	3.57%	96.43%

STREAM REPORTS:

WET GAS STREAM

Temperature: 110.00 deg. F
Pressure: 1214.70 psia
Flow Rate: 7.24e+005 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.42e-001	4.88e+001
Carbon Dioxide	6.77e-001	5.69e+002
Nitrogen	1.98e+000	1.06e+003
Methane	5.66e+001	1.73e+004
Ethane	2.02e+001	1.16e+004
Propane	1.12e+001	9.44e+003
Isobutane	1.29e+000	1.43e+003
n-Butane	4.09e+000	4.54e+003
Isopentane	8.50e-001	1.17e+003
n-Pentane	1.31e+000	1.80e+003
Cyclopentane	1.70e-003	2.27e+000
n-Hexane	3.52e-001	5.80e+002
Cyclohexane	1.23e-001	1.97e+002
Other Hexanes	4.49e-001	7.37e+002
Heptanes	5.49e-002	1.05e+002
Methylcyclohexane	7.16e-002	1.34e+002
2,2,4-Trimethylpentane	2.00e-005	4.35e-002
Benzene	5.21e-002	7.77e+001
Toluene	2.05e-001	3.60e+002
Ethylbenzene	8.72e-002	1.77e+002
Xylenes	8.69e-003	1.76e+001
C8+ Heavies	2.22e-001	7.21e+002
Total Components	100.00	5.21e+004

DRY GAS STREAM

Temperature: 110.00 deg. F
Pressure: 1214.70 psia
Flow Rate: 7.21e+005 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	5.38e-003	1.84e+000
Carbon Dioxide	6.71e-001	5.61e+002
Nitrogen	1.99e+000	1.06e+003
Methane	5.67e+001	1.73e+004
Ethane	2.03e+001	1.16e+004
Propane	1.12e+001	9.41e+003
Isobutane	1.29e+000	1.42e+003
n-Butane	4.09e+000	4.52e+003
Isopentane	8.51e-001	1.17e+003
n-Pentane	1.31e+000	1.79e+003
Cyclopentane	1.68e-003	2.23e+000
n-Hexane	3.53e-001	5.77e+002
Cyclohexane	1.21e-001	1.93e+002
Other Hexanes	4.49e-001	7.35e+002
Heptanes	5.49e-002	1.04e+002
Methylcyclohexane	7.08e-002	1.32e+002
2,2,4-Trimethylpentane	2.00e-005	4.34e-002
Benzene	4.41e-002	6.54e+001
Toluene	1.73e-001	3.04e+002
Ethylbenzene	7.45e-002	1.50e+002
Xylenes	7.05e-003	1.42e+001
C8+ Heavies	2.22e-001	7.18e+002

Total Components	100.00	5.18e+004

LEAN GLYCOL STREAM

Temperature: 110.00 deg. F
Flow Rate: 1.50e+001 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.84e+001	8.28e+003
Water	1.50e+000	1.26e+002
Carbon Dioxide	9.27e-012	7.81e-010
Nitrogen	2.50e-012	2.11e-010
Methane	9.91e-018	8.34e-016
Ethane	1.90e-007	1.60e-005
Propane	1.39e-008	1.17e-006
Isobutane	1.59e-009	1.34e-007
n-Butane	5.14e-009	4.33e-007
Isopentane	2.10e-004	1.77e-002
n-Pentane	3.85e-004	3.24e-002
Cyclopentane	2.17e-006	1.83e-004
n-Hexane	1.38e-004	1.16e-002
Cyclohexane	1.49e-003	1.26e-001
Other Hexanes	2.95e-004	2.49e-002
Heptanes	3.32e-005	2.79e-003
Methylcyclohexane	1.05e-003	8.80e-002
2,2,4-Trimethylpentane	1.74e-008	1.46e-006
Benzene	7.64e-003	6.43e-001
Toluene	5.76e-002	4.85e+000
Ethylbenzene	3.63e-002	3.05e+000
Xylenes	5.96e-003	5.02e-001
C8+ Heavies	5.15e-003	4.34e-001
Total Components	100.00	8.42e+003

RICH GLYCOL AND PUMP GAS STREAM

Temperature: 110.00 deg. F
Pressure: 1214.70 psia
Flow Rate: 1.71e+001 gpm
NOTE: Stream has more than one phase.

Component	Conc. (wt%)	Loading (lb/hr)
TEG	8.83e+001	8.28e+003
Water	1.86e+000	1.74e+002
Carbon Dioxide	1.61e-001	1.51e+001
Nitrogen	1.68e-001	1.58e+001
Methane	2.64e+000	2.48e+002
Ethane	1.95e+000	1.83e+002
Propane	1.60e+000	1.50e+002
Isobutane	2.44e-001	2.28e+001
n-Butane	8.09e-001	7.59e+001
Isopentane	1.98e-001	1.86e+001
n-Pentane	3.16e-001	2.97e+001
Cyclopentane	7.02e-004	6.58e-002
n-Hexane	1.04e-001	9.79e+000
Cyclohexane	6.90e-002	6.47e+000

Other Hexanes	1.28e-001	1.20e+001
Heptanes	2.04e-002	1.91e+000
Methylcyclohexane	4.19e-002	3.93e+000
2,2,4-Trimethylpentane	7.02e-006	6.58e-004
Benzene	1.48e-001	1.39e+001
Toluene	7.04e-001	6.60e+001
Ethylbenzene	3.37e-001	3.16e+001
Xylenes	4.38e-002	4.11e+000
C8+ Heavies	1.38e-001	1.29e+001
Total Components	100.00	9.38e+003

FLASH TANK OFF GAS STREAM

Temperature: 70.00 deg. F
Pressure: 134.70 psia
Flow Rate: 1.02e+004 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.21e-002	5.87e-002
Carbon Dioxide	1.06e+000	1.26e+001
Nitrogen	2.06e+000	1.56e+001
Methane	5.66e+001	2.45e+002
Ethane	2.15e+001	1.75e+002
Propane	1.13e+001	1.35e+002
Isobutane	1.21e+000	1.91e+001
n-Butane	3.78e+000	5.93e+001
Isopentane	6.98e-001	1.36e+001
n-Pentane	1.04e+000	2.02e+001
Cyclopentane	1.14e-003	2.16e-002
n-Hexane	2.10e-001	4.89e+000
Cyclohexane	5.22e-002	1.19e+000
Other Hexanes	2.98e-001	6.93e+000
Heptanes	2.05e-002	5.55e-001
Methylcyclohexane	2.02e-002	5.35e-001
2,2,4-Trimethylpentane	9.97e-006	3.07e-004
Benzene	1.59e-002	3.35e-001
Toluene	3.45e-002	8.57e-001
Ethylbenzene	7.00e-003	2.00e-001
Xylenes	5.91e-004	1.69e-002
C8+ Heavies	1.62e-002	7.46e-001
Total Components	100.00	7.11e+002

FLASH TANK GLYCOL STREAM

Temperature: 70.00 deg. F
Flow Rate: 1.55e+001 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.56e+001	8.28e+003
Water	2.01e+000	1.74e+002
Carbon Dioxide	2.88e-002	2.50e+000
Nitrogen	2.01e-003	1.74e-001
Methane	3.15e-002	2.73e+000

Ethane	9.92e-002	8.60e+000
Propane	1.78e-001	1.54e+001
Isobutane	4.38e-002	3.80e+000
n-Butane	1.92e-001	1.66e+001
Isopentane	5.78e-002	5.01e+000
n-Pentane	1.09e-001	9.49e+000
Cyclopentane	5.10e-004	4.42e-002
n-Hexane	5.65e-002	4.90e+000
Cyclohexane	6.10e-002	5.29e+000
Other Hexanes	5.83e-002	5.05e+000
Heptanes	1.56e-002	1.36e+000
Methylcyclohexane	3.92e-002	3.40e+000
2,2,4-Trimethylpentane	4.05e-006	3.51e-004
Benzene	1.56e-001	1.35e+001
Toluene	7.52e-001	6.52e+001
Ethylbenzene	3.63e-001	3.14e+001
Xylenes	4.73e-002	4.10e+000
C8+ Heavies	1.40e-001	1.22e+001
Total Components	100.00	8.67e+003

FLASH GAS EMISSIONS

Flow Rate: 4.36e+004 scfh
Control Method: Combustion Device
Control Efficiency: 98.00

Component	Conc. (vol%)	Loading (lb/hr)
Water	6.05e+001	1.25e+003
Carbon Dioxide	3.86e+001	1.95e+003
Nitrogen	4.84e-001	1.56e+001
Methane	2.66e-001	4.90e+000
Ethane	1.01e-001	3.49e+000
Propane	5.32e-002	2.70e+000
Isobutane	5.70e-003	3.81e-001
n-Butane	1.77e-002	1.19e+000
Isopentane	3.28e-003	2.72e-001
n-Pentane	4.87e-003	4.04e-001
Cyclopentane	5.35e-006	4.32e-004
n-Hexane	9.86e-004	9.78e-002
Cyclohexane	2.45e-004	2.37e-002
Other Hexanes	1.40e-003	1.39e-001
Heptanes	9.64e-005	1.11e-002
Methylcyclohexane	9.47e-005	1.07e-002
2,2,4-Trimethylpentane	4.68e-008	6.14e-006
Benzene	7.45e-005	6.69e-003
Toluene	1.62e-004	1.71e-002
Ethylbenzene	3.28e-005	4.01e-003
Xylenes	2.77e-006	3.39e-004
C8+ Heavies	7.61e-005	1.49e-002
Total Components	100.00	3.23e+003

REGENERATOR OVERHEADS STREAM

Temperature: 212.00 deg. F
Pressure: 14.70 psia

Flow Rate: 2.08e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	4.82e+001	4.75e+001
Carbon Dioxide	1.04e+000	2.50e+000
Nitrogen	1.14e-001	1.74e-001
Methane	3.11e+000	2.73e+000
Ethane	5.22e+000	8.60e+000
Propane	6.40e+000	1.54e+001
Isobutane	1.19e+000	3.80e+000
n-Butane	5.22e+000	1.66e+001
Isopentane	1.26e+000	4.99e+000
n-Pentane	2.39e+000	9.46e+000
Cyclopentane	1.15e-002	4.41e-002
n-Hexane	1.04e+000	4.89e+000
Cyclohexane	1.12e+000	5.16e+000
Other Hexanes	1.07e+000	5.03e+000
Heptanes	2.47e-001	1.35e+000
Methylcyclohexane	6.15e-001	3.31e+000
2,2,4-Trimethylpentane	5.59e-005	3.49e-004
Benzene	3.02e+000	1.29e+001
Toluene	1.20e+001	6.03e+001
Ethylbenzene	4.88e+000	2.84e+001
Xylenes	6.18e-001	3.59e+000
C8+ Heavies	1.26e+000	1.17e+001
Total Components	100.00	2.49e+002

CONDENSER PRODUCED WATER STREAM

Temperature: 100.00 deg. F
Flow Rate: 9.16e-002 gpm

Component	Conc. (wt%)	Loading (lb/hr)	(ppm)
Water	9.99e+001	4.58e+001	999388.
Carbon Dioxide	4.23e-003	1.94e-003	42.
Nitrogen	6.77e-006	3.10e-006	0.
Methane	2.15e-004	9.83e-005	2.
Ethane	8.01e-004	3.67e-004	8.
Propane	1.17e-003	5.34e-004	12.
Isobutane	1.46e-004	6.67e-005	1.
n-Butane	8.03e-004	3.68e-004	8.
Isopentane	1.25e-004	5.74e-005	1.
n-Pentane	2.52e-004	1.16e-004	3.
Cyclopentane	6.94e-006	3.18e-006	0.
n-Hexane	5.66e-005	2.59e-005	1.
Cyclohexane	2.74e-004	1.25e-004	3.
Other Hexanes	6.25e-005	2.86e-005	1.
Heptanes	3.52e-006	1.61e-006	0.
Methylcyclohexane	4.50e-005	2.06e-005	0.
2,2,4-Trimethylpentane	6.85e-010	3.14e-010	0.
Benzene	2.08e-002	9.51e-003	208.
Toluene	2.85e-002	1.31e-002	285.
Ethylbenzene	3.28e-003	1.50e-003	33.
Xylenes	4.79e-004	2.19e-004	5.
C8+ Heavies	4.82e-008	2.21e-008	0.

Total Components	100.00	4.58e+001	1000000.

CONDENSER RECOVERED OIL STREAM

Temperature: 100.00 deg. F
Flow Rate: 3.22e-001 gpm

Component	Conc. (wt%)	Loading (lb/hr)
Water	4.34e-002	5.94e-002
Carbon Dioxide	1.73e-002	2.37e-002
Nitrogen	6.22e-004	8.51e-004
Methane	5.64e-003	7.72e-003
Ethane	1.06e-001	1.46e-001
Propane	9.47e-001	1.30e+000
Isobutane	4.55e-001	6.23e-001
n-Butane	2.72e+000	3.73e+000
Isopentane	1.62e+000	2.22e+000
n-Pentane	3.16e+000	4.33e+000
Cyclopentane	1.85e-002	2.54e-002
n-Hexane	2.60e+000	3.55e+000
Cyclohexane	2.99e+000	4.09e+000
Other Hexanes	2.32e+000	3.17e+000
Heptanes	8.82e-001	1.21e+000
Methylcyclohexane	2.15e+000	2.95e+000
2,2,4-Trimethylpentane	2.24e-004	3.06e-004
Benzene	7.53e+000	1.03e+001
Toluene	4.10e+001	5.61e+001
Ethylbenzene	2.03e+001	2.78e+001
Xylenes	2.58e+000	3.53e+000
C8+ Heavies	8.56e+000	1.17e+001
Total Components	100.00	1.37e+002

CONDENSER VENT STREAM

Temperature: 100.00 deg. F
Pressure: 14.70 psia
Flow Rate: 5.52e+002 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	6.51e+000	1.70e+000
Carbon Dioxide	3.86e+000	2.47e+000
Nitrogen	4.26e-001	1.73e-001
Methane	1.17e+001	2.72e+000
Ethane	1.93e+001	8.45e+000
Propane	2.21e+001	1.42e+001
Isobutane	3.75e+000	3.17e+000
n-Butane	1.52e+001	1.29e+001
Isopentane	2.64e+000	2.77e+000
n-Pentane	4.89e+000	5.13e+000
Cyclopentane	1.83e-002	1.87e-002
n-Hexane	1.07e+000	1.33e+000
Cyclohexane	8.71e-001	1.07e+000
Other Hexanes	1.48e+000	1.86e+000
Heptanes	1.00e-001	1.46e-001

Methylcyclohexane	2.53e-001	3.61e-001
2,2,4-Trimethylpentane	2.60e-005	4.32e-005
Benzene	2.27e+000	2.58e+000
Toluene	3.11e+000	4.16e+000
Ethylbenzene	3.98e-001	6.15e-001
Xylenes	4.10e-002	6.32e-002
C8+ Heavies	1.46e-003	3.61e-003
Total Components	100.00	6.58e+001

COMBUSTION DEVICE OFF GAS STREAM

Temperature: 1000.00 deg. F
Pressure: 14.70 psia
Flow Rate: 9.84e+000 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Methane	1.31e+001	5.44e-002
Ethane	2.17e+001	1.69e-001
Propane	2.47e+001	2.83e-001
Isobutane	4.21e+000	6.35e-002
n-Butane	1.71e+001	2.58e-001
Isopentane	2.96e+000	5.54e-002
n-Pentane	5.48e+000	1.03e-001
Cyclopentane	2.05e-002	3.73e-004
n-Hexane	1.19e+000	2.67e-002
Cyclohexane	9.77e-001	2.13e-002
Other Hexanes	1.66e+000	3.71e-002
Heptanes	1.12e-001	2.91e-003
Methylcyclohexane	2.84e-001	7.23e-003
2,2,4-Trimethylpentane	2.91e-005	8.64e-007
Benzene	2.54e+000	5.15e-002
Toluene	3.48e+000	8.32e-002
Ethylbenzene	4.46e-001	1.23e-002
Xylenes	4.59e-002	1.26e-003
C8+ Heavies	1.63e-003	7.22e-005
Total Components	100.00	1.23e+000

CONDENSER CONTROL CURVE DATA REPORT:

CONDENSER CONTROL EFFICIENCY CURVES

Note: Condenser curves computed for the range 40.0 F <= T <= 170.0 F. DO NOT EXTRAPOLATE BEYOND THIS RANGE!

Temp(F)	BTEX	Total HAP	VOC
40.0	99.27	99.14	87.54
45.0	99.10	98.94	86.60
50.0	98.89	98.71	85.62
55.0	98.65	98.42	84.60
60.0	98.35	98.09	83.54
65.0	98.01	97.69	82.43
70.0	97.59	97.22	81.29
75.0	97.10	96.66	80.10
80.0	96.53	96.01	78.86

85.0	95.85	95.25	77.57
90.0	95.06	94.37	76.20
95.0	94.13	93.34	74.76
100.0	93.04	92.15	73.23
105.0	91.76	90.76	71.59
110.0	90.26	89.14	69.82
115.0	88.51	87.27	67.90
120.0	86.28	84.92	65.63
125.0	83.79	82.31	63.26
130.0	80.83	79.25	60.62
135.0	77.29	75.63	57.64
140.0	73.06	71.34	54.25
145.0	67.97	66.23	50.37
150.0	61.82	60.10	45.87
155.0	54.41	52.80	40.67
160.0	46.17	44.71	35.06
165.0	20.63	19.89	18.22
170.0	15.95	15.38	14.93

ANNUAL AIR-COOLED CONDENSER PERFORMANCE:

ANNUAL AIR-COOLED CONDENSER PERFORMANCE

Nearest Site for Air Temperature Data: Fargo, ND

Ambient Air Dry Bulb Temperature (deg. F)	Frequency (%)	Condenser Outlet Temperature (deg. F)
<=50	58.44	<=70
51-55	6.08	71-75
56-60	7.12	76-80
61-65	7.35	81-85
66-70	6.94	86-90
71-75	5.69	91-95
76-80	4.12	96-100
81-85	2.54	101-105
86-90	1.23	106-110
91-95	0.39	111-115
96-100	0.07	116-120
>100	0.02	>120

Condenser outlet temperature approach to ambient: 20.00 deg. F

Annual air-cooled condenser emissions and control efficiency:

	Uncontrolled emissions tons/year	Controlled emissions tons/year	% Control
Benzene	56.489	5.992	89.39
BTEX	460.675	16.063	96.51
Total HAP	482.087	19.227	96.01
VOC	819.001	169.856	79.26