April 25, 2019

Claudia Smith
Environmental Scientist
US EPA Region 8 Air Program
1595 Wynkoop Street
Mail Code 8P-AR
Denver, CO 80202

Via email: smith.claudia@epa.gov

Re: South Ignacio Central Delivery Point, #SMNSR-SU-000013-2016.003
Synthetic Minor New Source Review Permit Revision
Red Cedar Gathering Company

Red Cedar Gathering Company requests revision of South Ignacio Central Delivery Point's federal minor NSR permit #SMNSR-SU-000031-2016.003. The changes requested herein are intended to better align compliance-related activities across Red Cedar's facilities and do not otherwise affect the physical or operational state of the facility.

Red Cedar requests removal of the facility-wide HAP and HCHO emission limits. A previous owner of the facility voluntarily requested these limits to avoid major HAP requirements and they are not necessary. This request will not change the facility's emissions as all engines will continue to operate with the same emission controls currently installed in order to comply with the major RICE MACT requirements triggered by this change.

Red Cedar requests removal of the benzene emission limit for the dehydration units. A previous owner of the facility voluntarily requested this limitation and it is not necessary. The attached GRI_GLYCalc 4.0 calculations demonstrate uncontrolled actual benzene emissions from the dehydration units are less than 0.9 megagrams per year. Therefore, per §63.764(e)(1)(ii), these units are inherently exempt from 40 CFR part 63, subpart HH, regardless of any federally enforceable emission limits.

Red Cedar requests removal of the CO and formaldehyde emission limits for each of the seven lean-burn engines and the formaldehyde emission limit for the rich-burn engine. A previous owner of the facility voluntarily requested these limits and they are no longer necessary. This request will not change the facility's emissions as all the engines will continue to operate with the same emission controls currently installed in order to comply with the major RICE MACT requirements triggered by this change.

The requested changes above would not cause any change to the facility equipment, operations, or emissions but would cause the facility to be considered a major PSD source. The attached facility construction history demonstrates that the requested permit changes do not constitute PSD avoidance. Red Cedar does not have any plans to change equipment at the facility but understands future modifications would be subject to a lower PSD permitting threshold.

Red Cedar also requests the following permit changes for the rich-burn engine to better align its current compliance requirements with those in 40 CFR part 63, subpart ZZZZ, for new >500 HP 4SRB RICE located at a major source of HAP, to which the engine will be subject. These requested changes will streamline compliance activities but will not affect equipment, operations, or emissions.

- Remove quarterly NOx and CO monitoring requirements and replace with semiannual NOx and CO performance test requirements. If the results of any two consecutive subsequent semiannual

performance tests demonstrate compliance with the emission limits the required frequency for NOx and CO testing may change from semiannually to annually.

- Change monitoring frequency of the pressure drop across the catalyst bed from once every 7 days to once every 30 days.

Certification of truth, accuracy, and completeness:

I certify under penalty of law, based on information and belief formed after reasonable inquiry, the statements and information contained in these documents are true, accurate, and complete.

Name (signed): Kourtney Hadrick

Name (typed): Kourtney Hadrick Date: 4 / 25 / 2019

Should you have any questions or need any additional information, please do not hesitate to contact me at (970)764-6921.

Sincerely,
RED CEDAR GATHERING COMPANY

Kyle Hunderman
Environmental Compliance Specialist II – Air Quality

Cc: SUIT AQP, via email: airquality@southernute-nsn.gov

Construction History

The tables below represent the relevant construction history at South Ignacio CDP assuming the enforceable emission limits for which we are requesting removal were never established

1991 Initial Construction							
Unit	Description	Rating	NOx (tpy)	CO (tpy)	VOC (tpy)	CH2O (tpy)	HAP (tpy)
E2	Waukesha 7042 GL	1,337	19.4	34.9	12.9	2.2	3.0
E3	Waukesha 7042 GL	1,337	19.4	34.9	12.9	2.2	3.0
D1	Glycol Dehydrator (as reported by SG Interests)	30 MMScfd	0.6	0.5	10	-	2.2
IEUs	Insignificant units (as reported by SG Interests)	--	0.1	0.3	0	-	-
	PTE Cumulative Total		*39.4*	*70.5*	*35.8*	*4.5*	*8.3*

December, 1997 - add one lean-burn engine							
Unit	Description	Rating	NOx (tpy)	CO (tpy)	VOC (tpy)	CH2O (tpy)	HAP (tpy)
E4-add	Waukesha 7042 GL	1,337	19.4	34.9	12.9	2.2	3.0
	Project Total Emissions Change		**+19.4**	**+34.9**	**+12.9**	**+2.2**	**+3.0**
	Cumulative Facility PTE		*58.8*	*105.4*	*48.7*	*6.7*	*11.3*

December, 2000 - add one rich-burn engine							
Unit	Description	Rating	NOx (tpy)	CO (tpy)	VOC (tpy)	CH2O (tpy)	HAP (tpy)
E1-add	Waukesha 7044 GSI	1,680	215.8	181.7	5.7	1.2	1.9
	Project Total Emissions Change		**+215.8**	**+181.7**	**+5.7**	**+1.2**	**+1.9**
	Cumulative Facility PTE		*274.6*	*287.1*	*54.4*	*7.9*	*13.2*

July 1, 2002 - Consent Agreement CAA-08-2002-09 [a]							
Unit	Description	Rating	NOx (tpy)	CO (tpy)	VOC (tpy)	CH2O (tpy)	HAP (tpy)
E1	Waukesha 7044 GSI (add enforceable NOx & CO limits)	1,680	40.3	56.5	5.7	1.2	1.9
	Project Total Emissions Change		**-175.5**	**-125.2**	**--**	**--**	**--**
	Cumulative Facility PTE		*99.1*	*161.9*	*54.4*	*7.9*	*13.2*

[a] Compliance with the consent agreement allowed the facility to continue operation as a minor PSD source.

August, 2003 - add one lean-burn engine							
Unit	Description	Rating	NOx (tpy)	CO (tpy)	VOC (tpy)	CH2O (tpy)	HAP (tpy)
E5-add	Waukesha L5794LT	1401	28.1	24.9	2.3	2.5	3.3
	Project Total Emissions Change		**+28.1**	**+24.9**	**+2.3**	**+2.5**	**+3.3**
	Cumulative Facility PTE		*127.2*	*186.8*	*56.7*	*10.4*	*16.5*

November 30, 2005 - add three lean-burn engines [b]							
Unit	Description	Rating	NOx (tpy)	CO (tpy)	VOC (tpy)	CH2O (tpy)	HAP (tpy)
E6-add	Waukesha L5794LT	1401	28.1	24.9	2.3	2.5	3.3
E7-add	Waukesha L5794LT	1401	28.1	24.9	2.3	2.5	3.3
E8-add	Waukesha L5794LT	1401	28.1	24.9	2.3	2.5	3.3
	Project Total Emissions Change		**+84.4**	**+74.7**	**+6.9**	**+7.4**	**+10.0**
	Cumulative Facility PTE		*211.7*	*261.5*	*63.6*	*17.8*	*26.6*

[b] The facility PTE of CO is now above the PSD threshold. Future modifications will trigger PSD requirements if CO PTE would increase by ≥100 tpy.

Waukesha L7044GSI Emission Calculations
South Ignacio Central Delivery Point
Red Cedar Gathering Company

Waukesha L7044GSI - Internal Combustion Engine (4SRB)

Unit E1

Manufacturer Unit Rating:	1,680	hp @ 1200rpm
Site Specific Unit Rating [a]:	1,680	hp @ 6,320 ft
BSFC:	7,881	btu/hp-hr
Maximum Heat Input:	13.2	MMBtu/hr
Operating Schedule:	8,760	hr/yr
Maximum Fuel Use [b]:	128.5	mmscf/yr

[a] Based on manufacturer's site derate of 2% for every 1,000 ft above 8,000 ft elevation.

[b] Based on LHV of: 900 btu/scf

Potential Criteria Pollutant Emissions

Pollutant	Uncontrolled Emissions			
	Emission Factors	Data Source	(lb/hr)	(ton/yr)
NO_X	13.3 g/bhp-hr	Engine Manufacturer	49.26	215.76
CO	11.20 g/bhp-hr	Engine Manufacturer	41.48	181.69
VOC	0.4 g/bhp-hr	Engine Manufacturer	1.30	5.68
PM_{10}	9.91E-03 lb/MMBtu	AP-42, Table 3.2-3	0.13	0.57
SO_2	5.88E-04 lb/MMBtu	AP-42, Table 3.2-3	0.01	0.03
CO_2	110.00 lb/MMBtu	AP-42; Table 3.2-3	1,452.00	6,359.76
Methane	2.30E-01 lb/MMBtu	AP-42; Table 3.2-3	3.04	13.30
CO_2e	--	--	--	6,692.2 MT/yr

Federally Enforceable Emissions

Pollutant	Controlled Emissions			
	Emission Factors	Data Source	(lb/hr)	(ton/yr)
NO_X	9.2 lb/hr	SMNSR	9.20	40.30
CO	12.9 lb/hr	SMNSR	12.90	56.50

Hazardous Air Pollutant (HAP) Emissions

Pollutant	Emission Factors [c]	Data Source	Uncontrolled Emissions	
			(lb/hr)	(ton/yr)
1,3-Butadiene	6.63E-04 lb/MMBtu	AP-42, Table 3.2-3	8.75E-03	3.83E-02
Acetaldehyde	2.79E-03 lb/MMBtu	AP-42, Table 3.2-3	3.68E-02	0.16
Acrolein	2.63E-03 lb/MMBtu	AP-42, Table 3.2-3	3.47E-02	0.15
Benzene	1.58E-03 lb/MMBtu	AP-42, Table 3.2-3	2.09E-02	9.13E-02
Ethylbenzene	2.48E-05 lb/MMBtu	AP-42, Table 3.2-3	3.27E-04	1.43E-03
Formaldehyde	2.05E-02 lb/MMBtu	AP-42, Table 3.2-3	2.71E-01	1.19
Methanol	3.06E-03 lb/MMBtu	AP-42, Table 3.2-3	4.04E-02	0.18
Toluene	5.58E-04 lb/MMBtu	AP-42, Table 3.2-3	7.37E-03	3.23E-02
Xylene	1.95E-04 lb/MMBtu	AP-42, Table 3.2-3	2.57E-03	1.13E-02
Total	--		< 0.42	< 1.85

[c] Uncontrolled emission factors for 4-stroke, lean-burn (4SLB) engines from GRI-HAPCalc 3.01, based on the highest emission factor between EPA's AP-42, GRI field data and GRI literature data sets.

STANDARD EQUIPMENT

AIR CLEANER - Two, dry type with rain shield and service indicator.

BARRING DEVICE - Manual.

BEARINGS - Heavy duty, replaceable, precision type.

BREATHER - Closed system.

CONNECTING RODS - Drop forged steel, rifle drilled.

CONTROL SYSTEM - Pneumatic. Includes pilot operated valves for air start and prelube. Engine mounted control panel with two push button valves. Pilot operated air start valves omitted when starter is not furnished by Waukesha. Includes engine On/Off push button. One mounted on either side of the engine.

CRANKCASE - Integral crankcase and cylinder frame. Main bearing caps drilled and tapped for temperature sensors. Does not include sensors.

CRANKSHAFT - Forged steel, seven main bearings, counterweighted and dynamically balanced.

CYLINDERS - Removable wet type cylinder liners, chrome plated on outer diameter.

CYLINDER HEADS - Twelve interchangeable. Four valves per cylinder, with water cooled exhaust valve seats. Roller valve lifters and hydraulic push rods. Flange mounted ignition coils.

ENGINE MONITOR DEVICES - Thermocouples, K-type, are wired to a bulk head connector for jacket water temperature, lube oil temperature and intake manifold temperature. 25 foot (7.6 m) customer interface and standard thermocouple harnesses are provided for making connections to a customer supplied panel. Magnetic pickup wired for customer supplied tachometer. Lube oil pressure and intake manifold pressure sensing lines are terminated in a common bulk head.

ENGINE ROTATION - Counterclockwise when facing flywheel.

FLYWHEEL - Approx. WR^2 = 155000 lb-in^2; with ring gear (208 teeth), machined to accept two drive adapters: 31.88″ (810 mm) pilot bore, 30.25″ (768 mm) bolt circle, (12) 0.75″ 10 tapped holes; or 28.88″ (734 mm) pilot bore, 27.25″ (692 mm) bolt circle, (12) 0.625″-11 tapped holes and (12) 0.75″-10 tapped holes.

FLYWHEEL HOUSING - No. 00 SAE.

FUEL SYSTEM - Two natural gas, 4″ (102 mm) updraft carburetors and two Fisher Model 99, 2″ (51 mm) gas regulators, mounted. 25 psi (172 kPa) fuel inlet pressure required.

GOVERNOR - Woodward UG-8 LD hydraulic lever type, with friction type speed control. Mounted on right hand side.

IGNITION SYSTEM - Waukesha Custom Engine Control Ignition Module. Electronic digital ignition system. 24V DC power required.

INTERCOOLER - Air-to-water.

LEVELING BOLTS

LIFTING EYES - Requires 9.5 ton Working Load Limit (W.L.L.) anchor shackles.

LUBRICATION - Full pressure, gear type pump. Full flow lube oil filter with replaceable depth-type elements and flexible connections, shipped loose. MICROSPIN® bypass filter, engine mounted. Lube oil strainer, mounted. Air/gas motor driven prelube pump, requires final piping.

MANIFOLDS - Exhaust, (2) water cooled.

OIL COOLER - Shell and tube type, with thermostatic temperature controller and pressure regulating valve. Factory mounted.

OIL PAN - Base type. 90 gallon (340 L) capacity, including filter and cooler.

PAINT - Oilfield orange primer.

PISTONS - Aluminum with floating pin. Oil cooled. 8:1 compression ratio.

SHIPPING SKID - Steel for domestic truck or rail.

TURBOCHARGERS - (2) with water-cooled bearing housing and adjustable wastegates. Single vertical exhaust outlet at rear. Flexible stainless steel exhaust connection with 8″ (203 mm) pipe flange.

VIBRATION DAMPER - Viscous type.

WATER CIRCULATING SYSTEM

Auxiliary Circuit - Belt driven water circulating pump for intercooler and lube oil cooler.

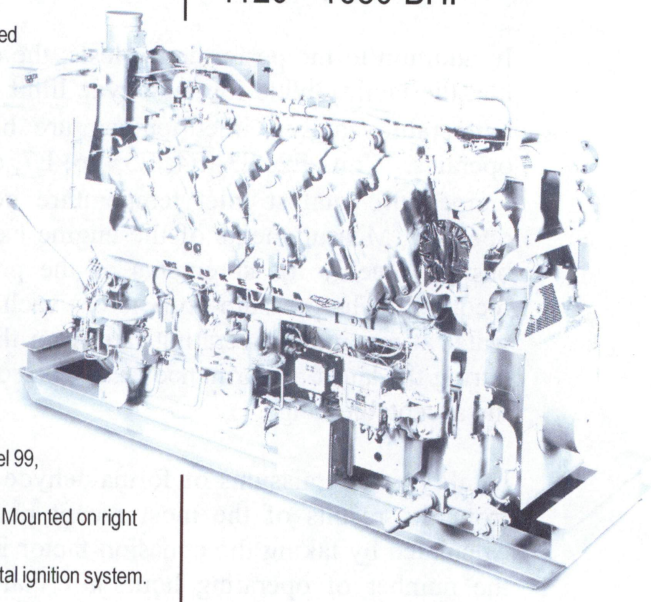
Engine Jacket - Belt driven water circulating pump. Cluster type thermostatic temperature regulating valve, full flow bypass type with 165° - 170° F (74° - 77° C) start to open thermostats. Flange connections and mating flanges for (2) 4″ (102 mm) inlets and (1) 5″ (127 mm) outlet.

WAUKESHA CUSTOM ENGINE CONTROL, DETONATION SENSING MODULE (DSM) – Includes individual cylinder sensors, Detonation Sensing Module, filter and cables. Compatible with Waukesha CEC Ignition Module only. Detonation Sensing Module and filter are mounted and wired. Packager is responsible for 24V DC power supply and ground to the DSM. The DSM meets Canadian Standards Association Class I, Division 2, Group D hazardous location requirements.

Waukesha® SERIES FOUR® VHP

L7044GSI

VHP™ Series Four
1120 - 1680 BHP



Model L7044GSI Turbocharged and Intercooled, Twelve Cylinder, Four-Cycle Gas Engine

SPECIFICATIONS

Cylinders
V 12

Piston Displacement
7040 cu. in.
(115 L)

Bore & Stroke
9.375″ x 8.5″
(238 x 216 mm)

Compression Ratio
8:1

Jacket Water System Capacity
107 gal.
(405 L)

Lube Oil Capacity
90 gal.
(340 L)

Starting System
125 - 150 psi air/gas
24/32 V electric

Dry Weight
22,750 lb.
(10,320 kg)

Waukesha Engine ISO 9001 CERTIFIED

CONTINUOUS POWER RATINGS: L7044GSI VHP SERIES FOUR

Model	I.C. Water Inlet Temp. °F (°C) (Tcra)	C.R.	Brake Horsepower (kWb Output) 800 rpm	900 rpm	1000 rpm	1100 rpm	1200 rpm
L7044GSI	130° (54°)	8:1	1120 (836)	1260 (940)	1400 (1044)	1540 (1149)	1680 (1253)

Rating Standard: All models: Ratings are based on ISO 3046/1-1995 with mechanical efficiency of 90% and auxiliary water temperature Tcra (clause 10.1) as specified above limited to ± 10° F (± 5° C). Ratings are also valid for SAE J1349, BS5514, DIN6271 and AP17B-11C standard atmospheric conditions.

ISO Standard Power/Continuous Power Rating: The highest load and speed which can be applied 24 hours a day, seven days a week, 365 days per year except for normal maintenance. It is permissible to operate the engine at up to 10% overload, or maximum load indicated by the intermittent rating, whichever is lower, for two hours in each 24 hour period.

All natural gas engine ratings are based on a fuel of 900 Btu/ft³ (35.3 MJ/nm³) SLHV value, with a 91 Waukesha Knock Index®.

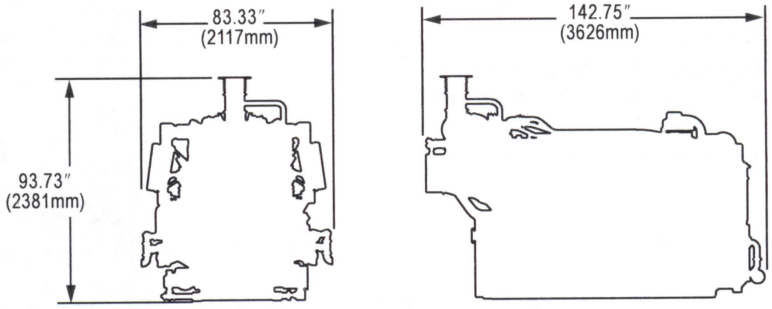
For conditions or fuels other than standard, the Waukesha Engine Sales Engineering Department.

PERFORMANCE: L7044GSI VHP SERIES FOUR

	English 130° F I.C. Water Temperature			Metric 54° C I.C. Water Temperature		
	RPM	**1200**	**1000**	**RPM**	**1200**	**1000**
Pre-Catalyst Settings	Power (Bhp)	1680	1400	Power (kWb)	1253	1044
	BSFC (Btu/bhp-hr)	7780	7685	BSFC (kJ/kW-hr)	11009	10874
	NOx (grams/bhp-hr)	12.6	12.1	NOx (g/nm³)	4.7	4.5
	CO (grams/bhp-hr)	13.8	12.2	CO (g/nm³)	5.1	4.5
	NMHC (grams/bhp--hr)	0.36	0.36	NMHC (g/nm³)	0.13	0.13
Low Fuel Consumption Settings	BSFC (Btu/bhp-hr)	7595	7535	BSFC (g/nm³)	10747	10662
	NOx (grams/bhp-hr)	21.3	20.7	NOx (g/nm³)	7.9	7.7
	CO (grams/bhp-hr)	1.6	1.6	CO (g/nm³)	0.6	0.6
	NMHC (grams/bhp--hr)	0.30	0.30	NMHC (g/nm³)	0.11	0.11

NOTES:

1) Fuel consumption and exhaust emissions are based on ISO 3046/1-1995 standard reference conditions and commercial quality natural gas of 900 Btu/ft³ (35.38 MJ/m³ [25, V(0; 101.325)]) saturated lower heat value, Waukesha Knock Index® of 91 and 93% methane content by volume. ISO 3046/1-1995 standard reference conditions are 77°F (25°C) ambient temperature, 29.54 inches Hg (100 kPa) barometric pressure, 30% relative humidity (1kPa/0.3 inches Hg water vapor pressure).
2) S.I. exhaust emissions are corrected to 5% O_2 (0°C and 101.325 kPa).
3) Data will vary due to variations in site conditions. For conditions and/or fuels other than standard, consult the Waukesha Engine Sales Engineering Department.



DRESSER
Waukesha

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Consult your local Waukesha Distributor for system application assistance. The manufacturer reserves the right to change or modify without notice, the design or equipment specifications as herein set forth without incurring any obligation either with respect to equipment previously sold or in the process of construction except where otherwise specifically guaranteed by the manufacturer.

Bulletin 7045 0102

Waukesha L7042GL Emission Calculations
South Ignacio Central Delivery Point
Red Cedar Gathering Company

Waukesha L7042 GL - Internal Combustion Engine (4SLB)

Units E2 - E4

Manufacturer Unit Rating:	1,480	hp @ 1200rpm
Site Specific Unit Rating [a]:	1,337	hp @ 6,320 ft
BSFC:	7,284	btu/hp-hr
Maximum Heat Input:	9.7	MMBtu/hr
Operating Schedule:	8,760	hr/yr
Maximum Fuel Use [b]:	94.4	mmscf/yr

[a] Based on manufacturer's site derate of 2% for every 1,000 ft above 1,500 ft elevation.

[b] Based on LHV of: 900 btu/scf

Potential Criteria Pollutant Emissions

Pollutant	Uncontrolled Emissions			
	Emission Factors	Data Source	(lb/hr)	(ton/yr)
NO_X	1.5 g/bhp-hr	Engine Manufacturer	4.42	19.37
CO	2.70 g/bhp-hr	Engine Manufacturer	7.96	34.87
VOC	1.0 g/bhp-hr	Engine Manufacturer	2.95	12.91
PM_{10}	9.91E-03 lb/MMBtu	AP-42; Table 3.2-2	0.10	0.42
SO_2	5.88E-04 lb/MMBtu	AP-42; Table 3.2-2	0.01	0.02
CO_2	110.00 lb/MMBtu	AP-42; Table 3.2-2	1,067.00	4,673.46
Methane	1.25 lb/MMBtu	AP-42; Table 3.2-2	12.13	53.11
CO_2e	--	--	--	5,444.15 MT/yr

Hazardous Air Pollutant (HAP) Emissions

Pollutant	Emission Factors [c]	Data Source	Uncontrolled Emissions	
			(lb/hr)	(ton/yr)
1,3-Butadiene	2.67E-04 lb/MMBtu	AP-42; Table 3.2-2	2.59E-03	1.13E-02
2,2,4-Trimethylpentane	2.50E-04 lb/MMBtu	AP-42; Table 3.2-2	2.43E-03	1.06E-02
Acetaldehyde	8.36E-03 lb/MMBtu	AP-42; Table 3.2-2	8.11E-02	0.36
Acrolein	5.14E-03 lb/MMBtu	AP-42; Table 3.2-2	4.99E-02	0.22
Benzene	4.40E-04 lb/MMBtu	AP-42; Table 3.2-2	4.27E-03	1.87E-02
Biphenyl	2.12E-04 lb/MMBtu	AP-42; Table 3.2-2	2.06E-03	9.01E-03
Formaldehyde	5.28E-02 lb/MMBtu	AP-42; Table 3.2-2	5.12E-01	2.24
Methanol	2.50E-03 lb/MMBtu	AP-42; Table 3.2-2	2.43E-02	0.11
n-Hexane	1.11E-03 lb/MMBtu	AP-42; Table 3.2-2	1.08E-02	4.72E-02
Toluene	4.08E-04 lb/MMBtu	AP-42; Table 3.2-2	3.96E-03	1.73E-02
Xylene	1.84E-04 lb/MMBtu	AP-42; Table 3.2-2	1.78E-03	7.82E-03
Total	--		< 0.70	< 3.05

[c] Uncontrolled emission factors for 4-stroke, lean-burn (4SLB) engines from GRI-HAPCalc 3.01, based on the highest emission factor between EPA's AP-42, GRI field data and GRI literature data sets.

STANDARD EQUIPMENT

AIR CLEANER – Two, dry type with rain shield and service indicator.

BARRING DEVICE – Manual.

BEARINGS – Heavy duty, replaceable, precision type.

BREATHER – Closed system.

CONNECTING RODS – Drop forged steel, rifle drilled.

CONTROL SYSTEM – Pneumatic. Includes pilot operated valves for air start and prelube. Engine mounted control panel with two push button valves. Pilot operated air start valves omitted when starter is not furnished by Waukesha. Includes engine On/Off push button. One mounted on either side of the engine.

CRANKCASE – Integral crankcase and cylinder frame. Main bearing caps drilled and tapped for temperature sensors. Does not include sensors.

CRANKSHAFT – Counterweighted, forged steel, seven main bearings, and dynamically balanced.

CYLINDERS – Removable wet type cylinder liners, chrome plated on outer diameter. Induction hardened.

CYLINDER HEADS – Twelve interchangeable. Two hard faced intake and two hard faced exhaust valves per cylinder. Hard faced intake and exhaust valve seat inserts. Roller valve lifters and hydraulic push rods. Includes prechamber and related fuel control valves.

ENGINE ROTATION – Counterclockwise when facing flywheel.

ENGINE MONITORING DEVICES – Engine thermocouples, K-type, for jacket water temperature, lube oil temperature, intake manifold temperature, individual cylinder exhaust temperature and a common pre turbine temperatures, one on each bank. Magnetic pickup wired for customer supplied tachometer. Lube oil pressure and intake manifold pressure sensing lines are terminated in a common bulk head.

EXHAUST OUTLET – Single vertical at rear. Flexible stainless steel connection with 8″ (203 mm) pipe flange.

FLYWHEEL – Approx. WR^2 = 155000 lb-in^2; with ring gear (208 teeth), machined to accept two drive adapters: 31.88″ (810 mm) pilot bore, 30.25″ (768 mm) bolt circle, (12) 0.75″–10 tapped holes; or 28.88″ (734 mm) pilot bore, 27.25″ (692 mm) bolt circle, (12) 0.625″–11 tapped holes and (12) 0.75″–10 tapped holes.

FLYWHEEL HOUSING – No. 00 SAE.

FUEL SYSTEM – Dual natural gas, 4″ (102 mm) duplex updraft carburetors. Two Fisher Model 99, 2″ (51 mm) gas regulators, 30 – 50 psi (241 – 345 kPa) gas inlet pressure required. Prechamber fuel system and control logic.

GOVERNOR – Woodward UG–8 LD hydraulic lever type, with friction type speed control. Mounted on right hand side.

IGNITION – Waukesha Custom Engine Control Ignition Module. Electronic digital ignition system. 24V DC power required.

INTERCOOLER – Air–to–water.

LEVELING BOLTS

LIFTING EYES

LUBRICATION – Full pressure. Gear type pump. Full flow filter, 36 gallon (136 litres) capacity, not mounted. Includes flexible connections. Includes lube oil strainer, mounted on engine. Air/gas motor driven prelube pump. Requires final piping.

MANIFOLDS – Exhaust, (2) water cooled.

OIL COOLER – With thermostatic temperature controller and pressure regulating valve. Not mounted.

OIL PAN – Base type. 90 gallon (340 litres) capacity including filter and cooler.

PAINT – Oilfield orange primer.

PISTONS – Aluminum with floating pin. 10.5:1 compression ratio. Oil cooled.

SHIPPING SKID – Steel for domestic truck or rail.

TURBOCHARGERS – Two, dry type. Wastegate controlled.

VIBRATION DAMPER – Two, viscous type. Guard included with remote mounted radiator or no radiator.

WATER CIRCULATING SYSTEM

Auxiliary Circuit – For oil cooler and intercooler. Pump is belt driven from crankshaft pulley. Includes thermostatic valve.

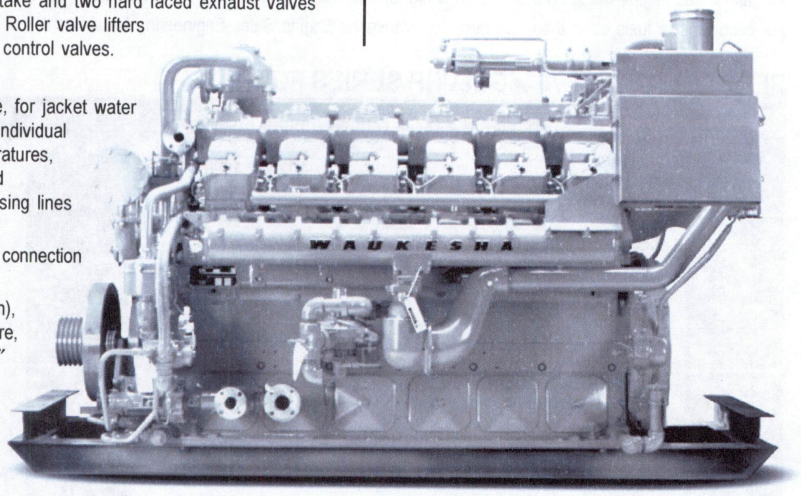
Engine Jacket – Belt driven water circulating pump, cluster type thermostatic temperature regulating valve, full flow bypass type. Flange connections and mating flanges for (2) 4″ (102 mm) inlets and (1) 5″ (127 mm) outlet.

WAUKESHA CUSTOM ENGINE CONTROL, DETONATION SENSING MODULE (DSM) – Includes individual cylinder sensors, Detonation Sensing Module, filter and cables. Device is compatible with Waukesha CEC Ignition Module only. Sensors are mounted and wired to engine junction box. Detonation Sensing Module and filter are shipped loose. One 11 ft. cable provided for connection between engine junction box and filter. One each 15 ft. cable provided for connection between filter and DSM and Ignition Module and DSM. One 20 ft. cable provided for power and ground for filter. All cables are shipped loose. Packager is responsible for power supply and ground to the DSM. 24V DC power is required. The DSM meets Canadian Standards Association Class 1, Group D, Division 2, hazardous location requirements.

Waukesha® VHP

L7042GL

VHP™ Series Gas Engine
886 - 1547 BHP



Model L7042GL Turbocharged and Intercooled, Twelve Cylinder, Lean Combustion, Four-Cycle Gas Engine

SPECIFICATIONS

Cylinders
V 12

Piston Displacement
7040 cu. in.
(115 L)

Bore & Stroke
9.375″ x 8.5″
(238 x 216 mm)

Compression Ratio
10.5:1

Jacket Water System Capacity
107 gal.
(405 L)

Lube Oil Capacity
90 gal.
(340 L)

Starting System
125 - 150 psi air/gas
24/32V electric

Dry Weight
21,000 lb.
(9525 kg)

Full Load Exhaust Emissions
Nox - 1.50 g/bhp-hr
CO - 2.65 g/bhp-hr
HC - 1.00 g/bhp-hr
(non-methane)

Waukesha Engine ISO 9001 CERTIFIED

POWER RATINGS: L7042GL VHP SERIES GAS ENGINES

Model	I.C. Water Inlet Temp. °F (°C) (Tcra)	C.R.	Brake Horsepower (kWb Output) 800 rpm	900 rpm	1000 rpm	1100 rpm	1200 rpm
High Speed Turbo[1]	85° (29°)	10.5:1	928 (692)	1160 (865)	1289 (961)	1418 (1057)	1547 (1154)
High Speed Turbo[1]	130° (54°)	10.5:1	886 (661)	1108 (826)	1232 (919)	1355 (1010)	1478 (1102)
Low Speed Turbo[2]	85° (29°)	10.5:1	1031 (769)	1160 (865)	1289 (961)	— —	— —
Low Speed Turbo[2]	130° (54°)	10.5:1	985 (735)	1108 (826)	1232 (919)	— —	— —

[1]High speed turbocharger match – 1001-1200 rpm

[2]Low speed turbocharger match – 700-1000 rpm

Rating Standard: All models: Ratings are based on ISO 3046/1-1995 with mechanical efficiency of 90% and auxiliary water temperature Tcra (clause 10.1) as specified above limited to ± 10° F (± 5° C). Ratings are also valid for SAE J1349, BS5514, DIN6271 and AP17B-11C standard atmospheric conditions.

ISO Standard Power/Continuous Power Rating: The highest load and speed which can be applied 24 hours a day, seven days a week, 365 days per year except for normal maintenance. It is permissible to operate the engine at up to 10% overload, or maximum load indicated by the intermittent rating, whichever is lower, for two hours in each 24 hour period.

All natural gas engine ratings are based on a fuel of 900 Btu/ft³ (35.3 MJ/nm³) SLHV value, with a 91 Waukesha Knock Index®.

For conditions or fuels other than standard, the Waukesha Engine Sales Engineering Department.

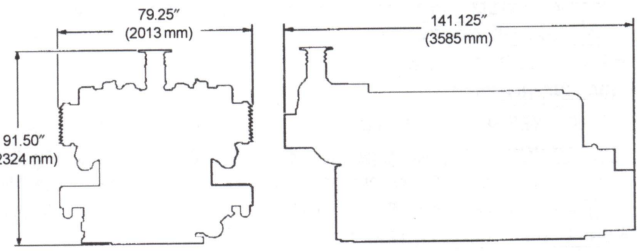
PERFORMANCE: L7042GL VHP SERIES GAS ENGINES

	English	130° F ICW		85° F ICW	
	RPM	1200	1000	1200	1000
Low NO_x Settings	Power (Bhp)	1478	1232	1547	1289
	BSFC (Btu/bhp-hr)	7155	6815	7180	6840
	NOx (grams/bhp-hr)	0.90	0.90	0.70	0.70
	CO (grams/bhp-hr)	2.75	2.65	2.65	2.55
	NMHC (grams/bhp--hr)	1.00	1.00	1.10	1.10
Low Fuel Consumption Settings	BSFC (Btu/bhp-hr)	6910	6615	6935	6640
	NOx (grams/bhp-hr)	1.50	1.60	1.30	1.40
	CO (grams/bhp-hr)	3.00	2.75	2.90	2.65
	NMHC (grams/bhp--hr)	0.70	1.00	0.80	1.10

	Metric	54° C ICW		29° C ICW	
	RPM	1200	1000	1200	1000
Low NO_x Settings	Power (kWb)	1103	919	1154	962
	BSFC (kJ/kW-hr)	10124	9643	10160	9679
	NOx (g/nm³)	0.37	0.37	0.29	0.29
	CO (g/nm³)	1.14	1.10	1.10	1.05
	NMHC (g/nm³)	0.41	0.41	0.45	0.45
Low Fuel Consumption Settings	BSFC (kJ/kW-hr)	9778	9360	9813	9396
	NOx (g/nm³)	0.62	0.66	0.54	0.58
	CO (g/nm³)	1.24	1.14	1.20	1.10
	NMHC (g/nm³)	0.29	0.41	0.33	0.45

NOTES:

1) Performance ratings are based on ISO 3046/1-1995 with mechanical efficiency of 90% and Tcra limited to ± 10° F.
2) Fuel consumptions based on ISO 3046/1-1995 with a +5% tolerance for commercial quality natural gas having a 900 Btu/ft³ saturated low heat value.
3) Data based on standard conditions of 77° F (25° C) ambient temperature, 29.53 inches Hg (100kPa) barometric pressure, 30% relative humidity (0.3 inches Hg / 1 kPa water vapor pressure).
4) Data will vary due to variations in site conditions. For conditions and/or fuels other than standard, consult the Waukesha Engine Sales Engineering Department.



DRESSER
Waukesha

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Consult your local Waukesha Distributor for system application assistance. The manufacturer reserves the right to change or modify without notice, the design or equipment specifications as herein set forth without incurring any obligation either with respect to equipment previously sold or in the process of construction except where otherwise specifically guaranteed by the manufacturer.

Bulletin 7005 0102

Waukesha L5794LT Emission Calculations
South Ignacio Central Delivery Point
Red Cedar Gathering Company

Waukesha L5794LT - Internal Combustion Engine (4SLB)

Units E5 - E8

Manufacturer Unit Rating:	1,447	hp @ 1200rpm
Site Specific Unit Rating [a]:	1,401	hp @ 6,320 ft
BSFC:	7,600	btu/hp-hr
Maximum Heat Input:	10.6	MMBtu/hr
Operating Schedule:	8,760	hr/yr
Maximum Fuel Use [b]:	103.6	mmscf/yr

[a] Based on manufacturer's site derate of 2.4% for every 1,000 ft above 5,000 ft elevation.

[b] Based on LHV of: 900 btu/scf

Potential Criteria Pollutant Emissions

Pollutant	Uncontrolled Emissions			
	Emission Factors	Data Source	(lb/hr)	(ton/yr)
NO_X	2.08 g/bhp-hr	Engine Manufacturer	6.43	28.14
CO	1.84 g/bhp-hr	Engine Manufacturer	5.68	24.90
VOC	0.17 g/bhp-hr	Engine Manufacturer	0.53	2.30
PM_{10}	9.91E-03 lb/MMBtu	AP-42; Table 3.2-2	0.11	0.46
SO_2	5.88E-04 lb/MMBtu	AP-42; Table 3.2-2	0.01	0.03
CO_2	110.00 lb/MMBtu	AP-42; Table 3.2-2	1,171.37	5,130.60
Methane	1.25 lb/MMBtu	AP-42; Table 3.2-2	13.31	58.30
CO_2e	--	--	--	5,976.67 MT/yr

Hazardous Air Pollutant (HAP) Emissions

Pollutant	Emission Factors [c]	Data Source	Uncontrolled Emissions	
			(lb/hr)	(ton/yr)
1,3-Butadiene	2.67E-04 lb/MMBtu	AP-42; Table 3.2-2	2.84E-03	1.25E-02
2,2,4-Trimethylpentane	2.50E-04 lb/MMBtu	AP-42; Table 3.2-2	2.66E-03	1.17E-02
Acetaldehyde	8.36E-03 lb/MMBtu	AP-42; Table 3.2-2	8.90E-02	0.39
Acrolein	5.14E-03 lb/MMBtu	AP-42; Table 3.2-2	5.47E-02	0.24
Benzene	4.40E-04 lb/MMBtu	AP-42; Table 3.2-2	4.69E-03	2.05E-02
Biphenyl	2.12E-04 lb/MMBtu	AP-42; Table 3.2-2	2.26E-03	9.89E-03
Formaldehyde	5.28E-02 lb/MMBtu	AP-42; Table 3.2-2	5.62E-01	2.46
Methanol	2.50E-03 lb/MMBtu	AP-42; Table 3.2-2	2.66E-02	0.12
n-Hexane	1.11E-03 lb/MMBtu	AP-42; Table 3.2-2	1.18E-02	5.18E-02
Toluene	4.08E-04 lb/MMBtu	AP-42; Table 3.2-2	4.34E-03	1.90E-02
Xylene	1.84E-04 lb/MMBtu	AP-42; Table 3.2-2	1.96E-03	8.58E-03
Total	--		< 0.76	< 3.34

[c] Uncontrolled emission factors for 4-stroke, lean-burn (4SLB) engines from GRI-HAPCalc 3.01, based on the highest emission factor between EPA's AP-42, GRI field data and GRI literature data sets.

Hunderman, Kyle

From: Aaron Countryman <aaron.countryman@wpi.com>
Sent: Friday, March 22, 2019 8:55 AM
To: Hunderman, Kyle
Subject: [EXTERNAL] RE: L5794LT Specs - A few more engines

Yes they do. I am very familiar with your entire engine fleet, and all of your 5794LT's are the same vintage 5794LT w/ESM.

Aaron Countryman
Regional Sales Representative
PH: 505.632.3602
Cell: 505.258.9536
WPI – A Pearce Industries Company
www.wpi.com

SAFETY THROUGH TEAMWORK

Join our new LinkedIn page **Oil & Gas Solutions** to receive updates on your mobile device.

From: Hunderman, Kyle [mailto:khunderman@redcedargathering.com]
Sent: Friday, March 22, 2019 6:53 AM
To: Aaron Countryman <aaron.countryman@wpi.com>
Subject: L5794LT Specs - A few more engines

Aaron,

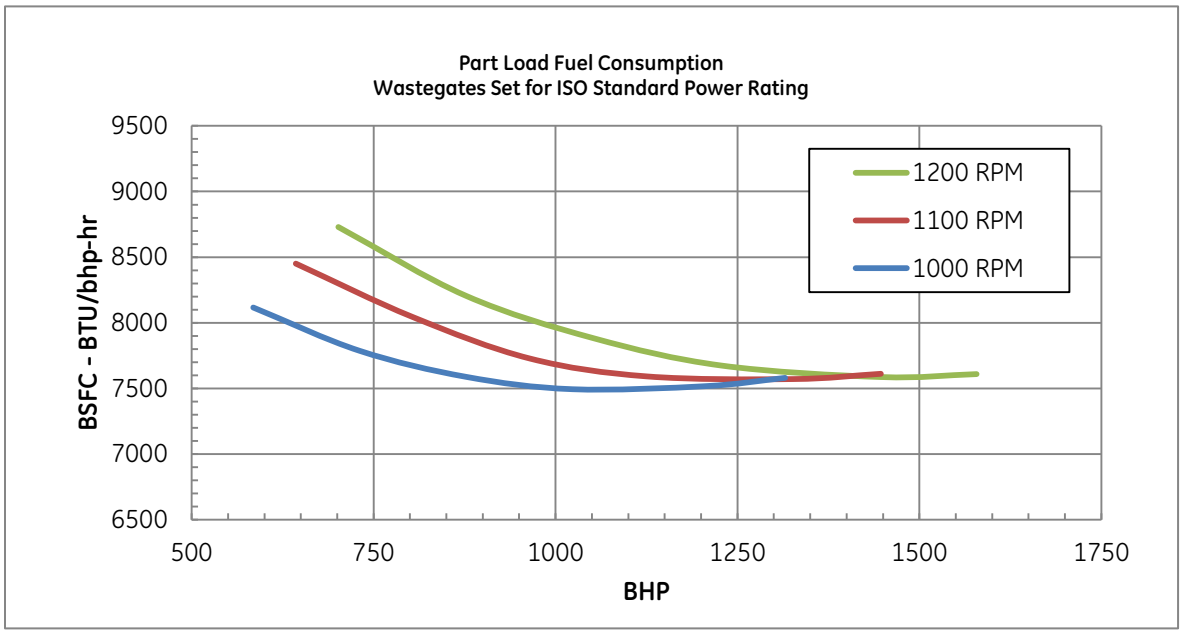
Do the attached L5794LT specs you sent me also apply to the following serial numbers?

C-15026/1
C-15809/1
C-15963/1
C-17235/1

Thanks,

Kyle Hunderman
RED CEDAR GATHERING COMPANY
NATURAL GAS GATHERING AND TREATING
Environmental Compliance Specialist II – Air Quality
970•764•6921 | office
970•749•9468 | mobile

Engine Ratings and Fuel Consumption
ISO Standard (Continuous) Ratings for Model L5794LT with ESM*
130°F (54°C) Auxiliary Water Temperature



RPM	800	900	1000	1000[4]	1100	1200
CONTINUOUS BHP	614	954	1206	1272	1326	1447
OVERLOAD BHP	None	None	1315	None	1447	1579

OVERLOAD	Allowed 2 Hours per 24 Hours	
STANDARD CONDITIONS	Barometer 29.54 in. Hg. (100 kPa)	Ambient Temperature 77°F (25°C)
DEDUCTIONS	Altitude: 2.4% per 1000 ft. (305 m) above 5000 ft. (1524 m) Ambient Temperature: 2.4% per 10°F (5.5°C) above 100°F (38°C)	
FUEL	Dry Natural Gas – 900 Btu/ft³ (35.38 MJ/m³) SLHV; 91 WKI* Refer to S-7884-7 for Full Fuel Specification	
EQUIPMENT	Engine Equipped with Lube Oil and Cooling Water Pumps but without Radiator Fan	
ENGINE DATA	Turbocharged & Intercooled with 130°F (54°C) Intercooler Water 10.2:1 Compression Ratio	

NOTES:

1. ISO Standard (continuous) power ratings conform to ISO 3046/1, latest version, with a mechanical efficiency of 90% and auxiliary water temperature, Tcra, of 130°F (54°C) limited to ± 10°F (± 5.5°C).
2. Reference Heat Rejection and Operating Data Standard Sheet S-6124-79.
3. Engine set to an exhaust oxygen concentration of 7.8% at ESM ignition timing for 2.25 g/bhp-hr NO_x (0.91 g/nm³ @ 5% O_2).
4. Power generation continuous BHP at 1000 RPM is 1272 BHP @ 7.4% O_2 with no overload allowed.

Engine Ratings & Fuel Consumption Model L5794LT with ESM 130°F (54°C) Auxiliary Water Temperature 180°F (82°C) Jacket Water Temperature	EN: 155598 DATE: 5/13	Ref. C 977-5

HEAT REJECTION AND OPERATING DATA — MODEL L5794LT with ESM*
ESM SPARK TIMING for 2.25 g/bhp-hr NO_x (0.91 g/nm³ @ 5% O_2),
10.2:1 CR, 7.8% EXHAUST O_2
130°F AUXILIARY WATER TEMP. — 180°F JACKET WATER TEMP.

	BMEP (PSI)	ENGINE SPEED – RPM		
		1000	1100	1200
POWER (BHP)	180	1315	1447	1579
	165	1206	1326	1447
	140	1023	1125	1228
	120	877	965	1052
	100	731	804	877
	80	585	643	702
BRAKE SPEC FUEL CONS. (BTU/BHP-HR)	180	7448	7478	7476
	165	7386	7439	7454
	140	7363	7459	7540
	120	7456	7593	7745
	100	7651	7903	8062
	80	7975	8304	8577
FUEL CONS. (BTU/HR x 1000)	180	9797	10821	11801
	165	8906	9867	10786
	140	7533	8395	9258
	120	6538	7325	8150
	100	5591	6353	7070
	80	4662	5340	6018
HEAT TO JACKET WATER (BTU/HR x 1000)	180	2564	2805	3017
	165	2274	2511	2721
	140	1860	2092	2316
	120	1590	1818	2056
	100	1356	1601	1822
	80	1148	1383	1617
HEAT TO LUBE OIL (BTU/HR x 1000)	180	413	464	512
	165	387	438	485
	140	349	400	448
	120	325	376	425
	100	306	358	408
	80	294	347	400

	BMEP (PSI)	ENGINE SPEED – RPM		
		1000	1100	1200
HEAT TO INTERCOOLER (BTU/HR x 1000)	180	341	429	514
	165	315	389	461
	140	275	329	386
	120	245	286	333
	100	213	247	277
	80	173	195	216
HEAT TO RADIATION (BTU/HR x 1000)	180	441	452	459
	165	419	431	440
	140	387	402	414
	120	366	382	399
	100	347	369	386
	80	329	353	374
TOTAL ENERGY IN EXHAUST (BTU/HR x 1000)	180	2864	3181	3491
	165	2600	2897	3187
	140	2192	2457	2733
	120	1896	2137	2403
	100	1607	1844	2070
	80	1313	1520	1733
EXHAUST TEMP AFTER TURBINE (± 50°F)	180	880	886	893
	165	875	882	889
	140	866	874	883
	120	858	866	878
	100	845	857	867
	80	821	835	848
INDUCTION AIR FLOW (SCFM)	180	2787	3079	3357
	165	2534	2807	3069
	140	2143	2388	2634
	120	1860	2084	2319
	100	1591	1807	2011
	80	1326	1519	1712

Continued

HEAT REJECTION AND OPERATING DATA MODEL – L5794LT with ESM 130°F AUX. WATER TEMPERATURE 180°F JACKET WATER TEMPERATURE	EN: 128025 DATE: 7/03	Ref. S 6124-79

HEAT REJECTION AND OPERATING DATA — MODEL L5794LT with ESM*
ESM SPARK TIMING for 2.25 g/bhp-hr NO_x (0.91 g/nm³ @ 5% O_2),
10.2:1 CR, 7.8% EXHAUST O_2
130°F AUXILIARY WATER TEMP. — 180°F JACKET WATER TEMP.

	BMEP (PSI)	ENGINE SPEED – RPM		
		1000	1100	1200
EXHAUST GAS FLOW (LBS/HR)	180	12517	13825	15077
	165	11378	12606	13780
	140	9624	10725	11827
	120	8353	9357	10412
	100	7143	8117	9033
	80	5956	6822	7688
NO_x EMISSION (G/BHP-HR)	180	2.06	2.06	2.07
	165	2.08	2.08	2.08
	140	2.11	2.11	2.04
	120	2.13	2.13	2.00
	100	2.28	2.14	2.07
	80	2.70	2.46	2.23
CO EMISSION (G/BHP-HR)	180	1.61	1.69	1.77
	165	1.68	1.76	1.84
	140	1.82	1.90	1.96
	120	1.95	2.03	2.07
	100	2.15	2.19	2.24
	80	2.50	2.52	2.53

	BMEP (PSI)	ENGINE SPEED – RPM		
		1000	1100	1200
NMHC EMISSION (G/BHP-HR)	180	0.18	0.17	0.16
	165	0.19	0.18	0.17
	140	0.22	0.21	0.20
	120	0.25	0.24	0.23
	100	0.28	0.27	0.26
	80	0.33	0.32	0.31
THC EMISSION (G/BHP-HR)	180	2.41	2.25	2.10
	165	2.59	2.44	2.29
	140	2.97	2.82	2.66
	120	3.35	3.20	3.04
	100	3.84	3.68	3.52
	80	4.50	4.34	4.18

NOTES:

1. All data are based on ISO standard conditions of 29.54 inches Hg. barometric pressure, 77°F ambient and induction air temperature, 30% relative humidity (0.3 inches Hg. water vapor pressure), 182°F engine jacket water outlet temperature, and ignition timing as provided by the Engine System Manager (ESM).
2. All data are average values at the standard conditions and will vary for individual engines and with operating and ambient conditions and with changes to ignition timing or air/fuel ratio. An adequate reserve should be used for cooling system or heat recovery calculations. See also Cooling System Guidelines, S-6699-7, latest version.
3. ISO Standard (continuous) power ratings conform to ISO 3046/1, latest version, with a mechanical efficiency of 90% and auxiliary water temperature, Tcra, of 130°F limited to ± 10°F.
4. Fuel standard: dry natural gas, 900 BTU/scf saturated lower heating value (SLHV), with a minimum Waukesha Knock Index* of 91. Refer to S-7884-7, latest version, for the full fuel specification.
5. 10.2:1 compression ratio.
6. For heat rejection changes due to engine jacket water outlet temperature higher than standard (Note 1), refer to S-7613-3, latest version.
7. Total Exhaust Energy includes both recoverable and non-recoverable heat. For a procedure to calculate recoverable heat refer to S-8117-2, latest version.
8. Exhaust oxygen (O_2) concentration set to 7.8% at ESM spark timing for 2.25 g/bhp-hr NO_x (0.91 g/nm³ @ 5% O_2). This O_2 level is measured at the port located in the exhaust manifold upstream of the turbocharger.
9. Reference Engine Ratings and Fuel Consumption Curve Sheet C-977-5, latest version.
10. Exhaust flow at nominal 29.54 inches Hg. atmospheric pressure:

$$\text{Flow rate: ACFM} = \frac{(\text{Exh. Flow, lb/hr}) \times (\text{Exh. Temp. } ^\circ\text{F} + 460^\circ)}{2250}$$

— METRIC —
HEAT REJECTION AND OPERATING DATA — MODEL L5794LT with ESM*
ESM SPARK TIMING for 0.91 g/nm³ @ 5% O_2 (2.25 g/bhp-hr),
10.2:1 CR, 7.8% EXHAUST O_2
54°C AUXILIARY WATER TEMP. — 82°C JACKET WATER TEMP.

	BMEP (bar)	ENGINE SPEED – RPM 1000	1100	1200
POWER (KW)	12.42	981	1079	1177
	11.39	899	989	1079
	9.66	763	839	916
	8.28	654	719	785
	6.9	545	599	654
	5.52	436	480	523
BRAKE SPEC FUEL CONS. (KJ/KWH)	12.42	10537	10580	10577
	11.39	10449	10525	10546
	9.66	10417	10553	10668
	8.28	10548	10742	10957
	6.9	10824	11182	11407
	5.52	11283	11748	12135
FUEL CONS. (KW)	12.42	2872	3172	3459
	11.39	2610	2892	3161
	9.66	2208	2460	2713
	8.28	1916	2147	2389
	6.9	1639	1862	2072
	5.52	1367	1565	1764
HEAT TO JACKET WATER (KW)	12.42	751	822	884
	11.39	666	736	798
	9.66	545	613	679
	8.28	466	533	603
	6.9	398	469	534
	5.52	337	405	474
HEAT TO LUBE OIL (KW)	12.42	121	136	150
	11.39	113	128	142
	9.66	102	117	131
	8.28	95	110	125
	6.9	90	105	120
	5.52	86	102	117

	BMEP (bar)	ENGINE SPEED – RPM 1000	1100	1200
HEAT TO INTERCOOLER (KW)	12.42	100	126	151
	11.39	92	114	135
	9.66	80	96	113
	8.28	72	84	97
	6.9	63	73	81
	5.52	51	57	63
HEAT TO RADIATION (KW)	12.42	129	132	135
	11.39	123	126	129
	9.66	113	118	121
	8.28	107	112	117
	6.9	102	108	113
	5.52	97	103	110
TOTAL ENERGY IN EXHAUST (KW)	12.42	840	932	1023
	11.39	762	849	934
	9.66	642	720	801
	8.28	556	626	704
	6.9	471	541	607
	5.52	385	445	508
EXHAUST TEMP AFTER TURBINE (± 30°C)	12.42	471	475	478
	11.39	468	472	476
	9.66	464	468	473
	8.28	459	463	470
	6.9	452	458	464
	5.52	438	446	453
INDUCTION AIR FLOW (NM³/HR)	12.42	4284	4732	5160
	11.39	3894	4315	4716
	9.66	3294	3671	4048
	8.28	2859	3203	3564
	6.9	2445	2778	3092
	5.52	2039	2335	2631

Continued

– Metric – HEAT REJECTION AND OPERATING DATA MODEL – L5794LT with ESM 54°C AUX. WATER TEMPERATURE 82°C JACKET WATER TEMPERATURE	EN: 128025 DATE: 7/03	Ref. S 6124-79

— METRIC —
HEAT REJECTION AND OPERATING DATA — MODEL L5794LT with ESM*
ESM SPARK TIMING for 0.91 g/nm³ @ 5% O_2 (2.25 g/bhp-hr),
10.2:1 CR, 7.8% EXHAUST O_2
54°C AUXILIARY WATER TEMP. — 82°C JACKET WATER TEMP.

	BMEP (bar)	ENGINE SPEED – RPM		
		1000	1100	1200
EXHAUST GAS FLOW (KG/HR)	12.42	5678	6271	6839
	11.39	5161	5718	6251
	9.66	4366	4865	5365
	8.28	3789	4245	4723
	6.9	3240	3682	4097
	5.52	2702	3095	3487
NO_x EMISSION (G/NM³ AT 5% O_2)	12.42	0.83	0.83	0.83
	11.39	0.84	0.84	0.84
	9.66	0.85	0.85	0.82
	8.28	0.86	0.86	0.81
	6.9	0.92	0.86	0.83
	5.52	1.09	0.99	0.90
CO EMISSION (G/NM³ AT 5% O_2)	12.42	0.65	0.68	0.71
	11.39	0.68	0.71	0.74
	9.66	0.73	0.77	0.79
	8.28	0.79	0.82	0.83
	6.9	0.87	0.88	0.90
	5.52	1.01	1.01	1.02

	BMEP (bar)	ENGINE SPEED – RPM		
		1000	1100	1200
NMHC EMISSION (G/NM³ AT 5% O_2)	12.42	0.07	0.07	0.06
	11.39	0.08	0.07	0.07
	9.66	0.09	0.08	0.08
	8.28	0.10	0.10	0.09
	6.9	0.11	0.11	0.11
	5.52	0.13	0.13	0.12
THC EMISSION (G/NM³ AT 5% O_2)	12.42	0.97	0.91	0.85
	11.39	1.04	0.98	0.92
	9.66	1.20	1.13	1.07
	8.28	1.35	1.29	1.22
	6.9	1.54	1.48	1.42
	5.52	1.81	1.75	1.68

NOTES:

1. All data are based on ISO standard conditions of 100 kPa barometric pressure, 25°C ambient and induction air temperature, 30% relative humidity (1 kPa water vapor pressure), 82°C engine jacket water outlet temperature, and ignition timing as provided by the Engine System Manager (ESM).
2. All data are average values at the standard conditions and will vary for individual engines and with operating and ambient conditions and with changes to ignition timing or air/fuel ratio. An adequate reserve should be used for cooling system or heat recovery calculations. See also Cooling System Guidelines, S-6699-7, latest version.
3. ISO Standard (continuous) power ratings conform to ISO 3046/1, latest version, with a mechanical efficiency of 90% and auxiliary water temperature, Tcra, of 54°C limited to ± 5.5°C.
4. Fuel standard: dry natural gas, 35.38 MJ/m³ [25, V (0; 101.325)] saturated lower heating value (SLHV), with a minimum Waukesha Knock Index* of 91. Refer to S-7884-7, latest version, for the full fuel specification.
5. 10.2:1 compression ratio.
6. For heat rejection changes due to engine jacket water outlet temperature higher than standard (Note 1), refer to S-7613-3, latest version.
7. Total Exhaust Energy includes both recoverable and non-recoverable heat. For a procedure to calculate recoverable heat refer to S-8117-2, latest version.
8. Exhaust oxygen (O_2) concentration set to 7.8% at ESM spark timing for 2.25 g/bhp-hr NO_x (0.91 g/nm³ @ 5% O_2). This O_2 level is measured at the port located in the exhaust manifold upstream of the turbocharger.
9. Reference Engine Ratings and Fuel Consumption Curve Sheet C-977-5, latest version.
10. Exhaust flow at nominal 100 kPa atmospheric pressure:

$$\text{Flow rate: } m^3/hr = \frac{(\text{Exh. Flow, kg/hr}) \times (\text{Exh. Temp. } ^\circ C + 273^\circ)}{332.96}$$

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Analytical Laboratory

Analysis Certificate

Analysis Requested: **GPA 2286_14**

Client:	Red Cedar Gathering	Project #:	95031-0055
Site Name:	South Ignacio	Compensations:	Air & Helium Free
Laboratory ID:	P903003-01	Date Reported:	03-21-19
Sampled by:	K Hunderman	Date Sampled:	02-26-19
Analyzed by:	Irene Yazzie	Date Received:	03-01-19
Sample Pressure:	395.7 psig	Date Analyzed:	03-15-19
Sample Temperature:	86.8 F	Analysis Time:	Std

GPA 2286_14 report

Components	Mol %	Wt %	L.V. %
Helium	BRL	BRL	BRL
Oxygen	BRL	BRL	BRL
Nitrogen	BRL	BRL	BRL
Carbon Dioxide	5.9368	14.7106	5.9590
Methane	93.6937	84.6267	93.4510
Ethane	0.3392	0.5743	0.5310
Propane	0.0215	0.0535	0.0590
Iso-Butane	0.0034	0.0113	BRL
N-Butane	0.0027	0.0090	BRL
Iso-Pentane	BRL	BRL	BRL
N-Pentane	BRL	BRL	BRL
iso-Hexanes	0.0013	0.0064	BRL
Benzene	0.0001	0.0005	BRL
n-Hexane	BRL	BRL	BRL
iso-Heptanes	0.0011	0.0064	BRL
Toluene	BRL	BRL	BRL
n-Heptane	BRL	BRL	BRL
iso-Octanes	0.0002	0.0013	BRL
n-Octane	BRL	BRL	BRL
n-Nonane	BRL	BRL	BRL
iso-Decanes	BRL	BRL	BRL
n-Decane	BRL	BRL	BRL
Totals	**100.0000**	**100.0000**	**100.0000**

BRL = Value below the method reportable limit = 0.0001% **N/R = Parameter not recorded**

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Analysis Certificate

Analysis Requested: **GPA 2286_14**

Client:	Red Cedar Gathering	Project #:	95031-0055
Site Name:	South Ignacio	Compensations:	Air & Helium Free
Laboratory ID:	P903003-01	Date Reported:	03-21-19
Sampled by:	K Hunderman	Date Sampled:	02-26-19
Analyzed by:	Irene Yazzie	Date Received:	03-01-19
Sample Pressure:	395.7 psig	Date Analyzed:	03-15-19
Sample Temperature:	86.8 F	Analysis Time:	Std

GPA 2261_13 Report

Components	Mol %	Wt %	L.V. %
Carbon Dioxide	5.9368	14.7106	5.9590
Hydrogen Sulfide	BRL	BRL	BRL
Nitrogen	BRL	BRL	BRL
Methane	93.6937	84.6267	93.4510
Ethane	0.3392	0.5743	0.5310
Propane	0.0215	0.0535	0.0590
Iso-Butane	0.0034	0.0113	BRL
N-Butane	0.0027	0.0090	BRL
Iso-Pentane	BRL	BRL	BRL
N-Pentane	BRL	BRL	BRL
C6+	0.0027	0.0146	BRL
Helium	BRL	BRL	BRL
Oxygen	BRL	BRL	BRL
Totals	**100.0000**	**100.0000**	**100.0000**

BRL = Value below the method reportable limit = 0.0001% **N/R = Parameter not recorded**

Group Reports

Components	Mol %	Wt %	L.V. %
Hexanes	0.0014	0.0069	BRL
Heptanes	0.0011	0.0064	BRL
Octanes	0.0002	0.0013	BRL
Nonanes	BRL	BRL	BRL
Heaviers	BRL	BRL	BRL
Totals	**0.0027**	**0.0146**	**0.0000**

C6+	0.0027	0.0146	BRL
C7+	0.0013	0.0077	BRL
C8+	0.0002	0.0013	BRL
C9+	BRL	BRL	BRL

BRL = Value below the method reportable limit = 0.0001% **N/R = Parameter not recorded**

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Analytical Laboratory

Analysis Certificate

Analysis Requested: **GPA 2286_14**

Client:	Red Cedar Gathering	Project #:	95031-0055
Site Name:	South Ignacio	Compensations:	Air & Helium Free
Laboratory ID:	P903003-01	Date Reported:	03-21-19
Sampled by:	K Hunderman	Date Sampled:	02-26-19
Analyzed by:	Irene Yazzie	Date Received:	03-01-19
Sample Pressure:	395.7 psig	Date Analyzed:	03-15-19
Sample Temperature:	86.8 F	Analysis Time:	Std

Glycal Report

Components	Mol %	Wt %	L.V. %
Carbon Dioxide	5.9368	14.7106	5.9590
Hydrogen Sulfide	BRL	BRL	BRL
Nitrogen	BRL	BRL	BRL
Methane	93.6937	84.6267	93.4510
Ethane	0.3392	0.5743	0.5310
Propane	0.0215	0.0535	0.0590
Iso-Butane	0.0034	0.0113	BRL
N-Butane	0.0027	0.0090	BRL
Iso-Pentane	BRL	BRL	BRL
N-Pentane	BRL	BRL	BRL
Cyclopentane	BRL	BRL	BRL
n-Hexane	BRL	BRL	BRL
Cyclohexane	BRL	BRL	BRL
Other Hexanes	0.0013	0.0064	BRL
n-Heptane	BRL	BRL	BRL
Methylcyclohexane	0.0001	0.0006	BRL
2,2,4 Trimethylpentane	BRL	BRL	BRL
Benzene	0.0001	0.0005	BRL
Toluene	BRL	BRL	BRL
EthylBenzene	BRL	BRL	BRL
Xylenes	BRL	BRL	BRL
Heaviers	BRL	BRL	BRL

BRL = Value below the method reportable limit = 0.0001% **N/R = Parameter not recorded**

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Analytical Laboratory

Analysis Certificate

Analysis Requested: **GPA 2286_14**

Client:	Red Cedar Gathering	Project #:	95031-0055
Site Name:	South Ignacio	Compensations:	Air & Helium Free
Laboratory ID:	P903003-01	Date Reported:	03-21-19
Sampled by:	K Hunderman	Date Sampled:	02-26-19
Analyzed by:	Irene Yazzie	Date Received:	03-01-19
Sample Pressure:	395.7 psig	Date Analyzed:	03-15-19
Sample Temperature:	86.8 F	Analysis Time:	Std

GPA 2172_09 Report Calculations @ 14.696 psia and 60 degrees F

Compressibility Factor Dry Gas	0.9978	Compressibility Factor Sat Gas	0.9975
GPM C2+	0.099	GPM C3+	0.009
GPM C4+	0.003	GPM C5+	0.001
Ideal Dry Gas Relative Density:	0.613	Ideal Sat Gas Relative Density:	0.603
Real Dry Gas Relative Density:	0.614	Real Sat Gas Relative Density:	0.604
Dry Molecular Weight:	17.761	Sat Molecular Weight:	17.451
Gross HV per Ideal Dry ft3:	953.19	Gross HV per Ideal Sat ft3:	936.56
Gross HV per Real Dry ft3:	955.29	Gross HV per Real Sat ft3:	938.91

C6+ Calculations

Ideal C6+ Dry Relative Density	3.288	C6+ Dry Molecular Weight	95.218
C6+ Compressibility Factor	0.883	C6+ Gross HV per Ideal Dry ft3	5215.5

BRL = Value below the method reportable limit = 0.0001% **N/R = Parameter not recorded**

Irene Yazzie — 3/21/2019

Analyst — Date

Irene Yazzie

Printed

Comments: 03-21-19 revised per Khunderman.

Note: The above analyses are performed in compliance with GPA 2286_14 quality assurance procedures.

References: GPA 2286_14, TP-17, GPA Standard 2145-09 and GPA Standard 2172-09

GRI-GLYCalc VERSION 4.0 - AGGREGATE CALCULATIONS REPORT

Case Name: South Ignacio - D1 PTE - Feb '19
File Name: \\durnetapp101\Shared\Durango Shared\EHS\Air Permits\GLYCalc files\South Ignacio\SOU D1 2019 02 PTE (uncontrolled).ddf
Date: March 27, 2019

DESCRIPTION:

Description: 30 MMscfd dehy unit; Feb '19 gas analysis, max design gas flow, temp, and pressure; max glycol rate (1 Kimray 50015)

Annual Hours of Operation: 8760.0 hours/yr

EMISSIONS REPORTS:

UNCONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.5159	12.382	2.2596
Ethane	0.0390	0.935	0.1707
Propane	0.0116	0.279	0.0509
Isobutane	0.0046	0.110	0.0200
n-Butane	0.0055	0.132	0.0241
Other Hexanes	0.0089	0.213	0.0388
Methylcyclohexane	0.0066	0.159	0.0289
Benzene	0.0348	0.835	0.1523
Total Emissions	0.6268	15.044	2.7455
Total Hydrocarbon Emissions	0.6268	15.044	2.7455
Total VOC Emissions	0.0719	1.727	0.3151
Total HAP Emissions	0.0348	0.835	0.1523
Total BTEX Emissions	0.0348	0.835	0.1523

FLASH GAS EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.5157	12.377	2.2589
Ethane	0.0100	0.241	0.0440
Propane	0.0013	0.030	0.0055
Isobutane	0.0003	0.007	0.0013
n-Butane	0.0003	0.006	0.0012
Other Hexanes	0.0002	0.005	0.0008
Methylcyclohexane	<0.0001	<0.001	0.0001
Benzene	<0.0001	<0.001	0.0001
Total Emissions	0.5278	12.668	2.3119
Total Hydrocarbon Emissions	0.5278	12.668	2.3119
Total VOC Emissions	0.0021	0.049	0.0090
Total HAP Emissions	<0.0001	<0.001	0.0001
Total BTEX Emissions	<0.0001	<0.001	0.0001

FLASH TANK OFF GAS

Component	lbs/hr	lbs/day	tons/yr
Methane	10.3146	247.549	45.1778
Ethane	0.2010	4.823	0.8802
Propane	0.0251	0.603	0.1100
Isobutane	0.0060	0.145	0.0265
n-Butane	0.0054	0.129	0.0235
Other Hexanes	0.0038	0.092	0.0169
Methylcyclohexane	0.0004	0.009	0.0017
Benzene	0.0003	0.008	0.0014
Total Emissions	10.5566	253.359	46.2379
Total Hydrocarbon Emissions	10.5566	253.359	46.2379
Total VOC Emissions	0.0411	0.986	0.1800
Total HAP Emissions	0.0003	0.008	0.0014
Total BTEX Emissions	0.0003	0.008	0.0014

COMBINED REGENERATOR VENT/FLASH GAS EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	1.0316	24.759	4.5185
Ethane	0.0490	1.177	0.2147
Propane	0.0129	0.309	0.0564
Isobutane	0.0049	0.117	0.0213
n-Butane	0.0058	0.139	0.0253
Other Hexanes	0.0091	0.217	0.0397
Methylcyclohexane	0.0066	0.159	0.0290
Benzene	0.0348	0.835	0.1524
Total Emissions	1.1546	27.712	5.0574
Total Hydrocarbon Emissions	1.1546	27.712	5.0574
Total VOC Emissions	0.0740	1.776	0.3241
Total HAP Emissions	0.0348	0.835	0.1524
Total BTEX Emissions	0.0348	0.835	0.1524

COMBINED REGENERATOR VENT/FLASH GAS EMISSION CONTROL REPORT:

Component	Uncontrolled tons/yr	Controlled tons/yr	% Reduction
Methane	47.4374	4.5185	90.47
Ethane	1.0509	0.2147	79.57
Propane	0.1609	0.0564	64.93
Isobutane	0.0465	0.0213	54.12
n-Butane	0.0476	0.0253	46.94
Other Hexanes	0.0557	0.0397	28.76
Methylcyclohexane	0.0306	0.0290	5.27
Benzene	0.1538	0.1524	0.89
Total Emissions	48.9834	5.0574	89.68
Total Hydrocarbon Emissions	48.9834	5.0574	89.68
Total VOC Emissions	0.4951	0.3241	34.54
Total HAP Emissions	0.1538	0.1524	0.89
Total BTEX Emissions	0.1538	0.1524	0.89

EQUIPMENT REPORTS:

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:	6.52 lbs. H2O/MMSCF
Temperature:	120.0 deg. F
Pressure:	720.0 psig
Dry Gas Flow Rate:	30.0000 MMSCF/day
Glycol Losses with Dry Gas:	0.6375 lb/hr
Wet Gas Water Content:	Saturated
Calculated Wet Gas Water Content:	131.06 lbs. H2O/MMSCF
Calculated Lean Glycol Recirc. Ratio:	3.20 gal/lb H2O

Component	Remaining in Dry Gas	Absorbed in Glycol
Water	4.96%	95.04%
Carbon Dioxide	99.74%	0.26%
Methane	99.98%	0.02%
Ethane	99.93%	0.07%
Propane	99.88%	0.12%
Isobutane	99.84%	0.16%
n-Butane	99.79%	0.21%
Other Hexanes	99.66%	0.34%
Methylcyclohexane	97.84%	2.16%
Benzene	86.36%	13.64%

FLASH TANK

Flash Control:	Combustion device
Flash Control Efficiency:	95.00 %
Flash Temperature:	100.0 deg. F
Flash Pressure:	30.0 psig

Component	Left in Glycol	Removed in Flash Gas
Water	99.98%	0.02%
Carbon Dioxide	42.67%	57.33%
Methane	4.76%	95.24%
Ethane	16.25%	83.75%
Propane	31.66%	68.34%
Isobutane	43.04%	56.96%
n-Butane	50.59%	49.41%
Other Hexanes	70.02%	29.98%
Methylcyclohexane	94.68%	5.32%
Benzene	99.11%	0.89%

REGENERATOR

No Stripping Gas used in regenerator.

Component	Remaining in Glycol	Distilled Overhead
Water	13.03%	86.97%
Carbon Dioxide	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%
Other Hexanes	1.43%	98.57%
Methylcyclohexane	4.22%	95.78%
Benzene	5.04%	94.96%

STREAM REPORTS:

WET GAS STREAM

Temperature: 120.00 deg. F
Pressure: 734.70 psia
Flow Rate: 1.25e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	2.76e-001	1.64e+002
Carbon Dioxide	5.92e+000	8.61e+003
Methane	9.34e+001	4.95e+004
Ethane	3.38e-001	3.36e+002
Propane	2.14e-002	3.12e+001
Isobutane	3.39e-003	6.51e+000
n-Butane	2.69e-003	5.17e+000
Other Hexanes	1.30e-003	3.69e+000
Methylcyclohexane	9.97e-005	3.24e-001
Benzene	9.97e-005	2.57e-001
Total Components	100.00	5.87e+004

DRY GAS STREAM

Temperature: 120.00 deg. F
Pressure: 734.70 psia
Flow Rate: 1.25e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.37e-002	8.15e+000
Carbon Dioxide	5.92e+000	8.59e+003
Methane	9.37e+001	4.95e+004
Ethane	3.39e-001	3.36e+002
Propane	2.15e-002	3.12e+001
Isobutane	3.40e-003	6.50e+000
n-Butane	2.69e-003	5.16e+000
Other Hexanes	1.30e-003	3.68e+000
Methylcyclohexane	9.79e-005	3.17e-001
Benzene	8.64e-005	2.22e-001

Component	Conc. (wt%)	Loading (lb/hr)
Total Components	100.00	5.85e+004

LEAN GLYCOL STREAM

Temperature: 120.00 deg. F
Flow Rate: 8.30e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.95e+001	4.66e+003
Water	5.00e-001	2.34e+001
Carbon Dioxide	4.82e-011	2.26e-009
Methane	7.78e-018	3.64e-016
Ethane	2.42e-009	1.13e-007
Propane	3.19e-011	1.49e-009
Isobutane	6.80e-012	3.18e-010
n-Butane	5.76e-012	2.70e-010
Other Hexanes	2.74e-006	1.28e-004
Methylcyclohexane	6.23e-006	2.91e-004
Benzene	3.94e-005	1.84e-003
Total Components	100.00	4.68e+003

RICH GLYCOL STREAM

Temperature: 120.00 deg. F
Pressure: 734.70 psia
Flow Rate: 8.68e+000 gpm
NOTE: Stream has more than one phase.

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.56e+001	4.65e+003
Water	3.69e+000	1.80e+002
Carbon Dioxide	4.64e-001	2.26e+001
Methane	2.23e-001	1.08e+001
Ethane	4.93e-003	2.40e-001
Propane	7.55e-004	3.67e-002
Isobutane	2.18e-004	1.06e-002
n-Butane	2.24e-004	1.09e-002
Other Hexanes	2.64e-004	1.28e-002
Methylcyclohexane	1.50e-004	7.28e-003
Benzene	7.60e-004	3.70e-002
Total Components	100.00	4.86e+003

FLASH TANK OFF GAS STREAM

Temperature: 100.00 deg. F
Pressure: 44.70 psia
Flow Rate: 3.59e+002 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.81e-001	3.09e-002
Carbon Dioxide	3.11e+001	1.29e+001

Methane	6.79e+001	1.03e+001
Ethane	7.06e-001	2.01e-001
Propane	6.02e-002	2.51e-002
Isobutane	1.10e-002	6.04e-003
n-Butane	9.77e-003	5.38e-003
Other Hexanes	4.72e-003	3.85e-003
Methylcyclohexane	4.17e-004	3.88e-004
Benzene	4.46e-004	3.29e-004
Total Components	100.00	2.35e+001

FLASH TANK GLYCOL STREAM

Temperature: 100.00 deg. F
Flow Rate: 8.62e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.61e+001	4.65e+003
Water	3.71e+000	1.80e+002
Carbon Dioxide	1.99e-001	9.63e+000
Methane	1.07e-002	5.16e-001
Ethane	8.05e-004	3.90e-002
Propane	2.40e-004	1.16e-002
Isobutane	9.43e-005	4.56e-003
n-Butane	1.14e-004	5.50e-003
Other Hexanes	1.86e-004	8.99e-003
Methylcyclohexane	1.42e-004	6.90e-003
Benzene	7.56e-004	3.66e-002
Total Components	100.00	4.84e+003

FLASH GAS EMISSIONS

Flow Rate: 8.34e+002 scfh
Control Method: Combustion Device
Control Efficiency: 95.00

Component	Conc. (vol%)	Loading (lb/hr)
Water	5.67e+001	2.24e+001
Carbon Dioxide	4.19e+001	4.05e+001
Methane	1.46e+000	5.16e-001
Ethane	1.52e-002	1.00e-002
Propane	1.29e-003	1.26e-003
Isobutane	2.36e-004	3.02e-004
n-Butane	2.10e-004	2.69e-004
Other Hexanes	1.02e-004	1.92e-004
Methylcyclohexane	8.97e-006	1.94e-005
Benzene	9.59e-006	1.65e-005
Total Components	100.00	6.35e+001

REGENERATOR OVERHEADS STREAM

Temperature: 212.00 deg. F
Pressure: 14.70 psia
Flow Rate: 3.39e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	9.72e+001	1.56e+002
Carbon Dioxide	2.45e+000	9.63e+000
Methane	3.60e-001	5.16e-001
Ethane	1.45e-002	3.90e-002
Propane	2.96e-003	1.16e-002
Isobutane	8.80e-004	4.56e-003
n-Butane	1.06e-003	5.50e-003
Other Hexanes	1.15e-003	8.87e-003
Methylcyclohexane	7.54e-004	6.60e-003
Benzene	4.99e-003	3.48e-002
Total Components	100.00	1.66e+002

GRI-GLYCalc VERSION 4.0 - SUMMARY OF INPUT VALUES

Case Name: South Ignacio - D1 PTE - Feb '19
File Name: \\durnetapp101\Shared\Durango Shared\EHS\Air Permits\GLYCalc files\South Ignacio\SOU D1 2019 02 PTE (uncontrolled).ddf
Date: March 27, 2019

DESCRIPTION:

Description: 30 MMscfd dehy unit; Feb '19 gas analysis, max design gas flow, temp, and pressure; max glycol rate (1 Kimray 50015)

Annual Hours of Operation: 8760.0 hours/yr

WET GAS:

Temperature: 120.00 deg. F
Pressure: 720.00 psig
Wet Gas Water Content: Saturated

Component	Conc. (vol %)
Carbon Dioxide	5.9368
Methane	93.6937
Ethane	0.3392
Propane	0.0215
Isobutane	0.0034
n-Butane	0.0027
Other Hexanes	0.0013
Methylcyclohexane	0.0001
Benzene	0.0001

DRY GAS:

Flow Rate: 30.0 MMSCF/day
Water Content: 7.0 lbs. H2O/MMSCF

LEAN GLYCOL:

Glycol Type: TEG
Water Content: 0.5 wt% H2O
Flow Rate: 8.3 gpm

PUMP:

Glycol Pump Type: Electric/Pneumatic

FLASH TANK:

Flash Control: Combustion device
Flash Control Efficiency: 95.00 %
Temperature: 100.0 deg. F
Pressure: 30.0 psig

KIMRAY INC.®

GLYCOL PUMPS

ELECTRIC PUMPS

APPLICATIONS:

- Circulating pump for gas glycol dehydrators, gas amine units and other pumping applications.

FEATURES:

- No Gas Emissions
- No Packing
- Hydraulically Balanced Diaphragms
- Double-ended Shaft
- Stud Extenders for easy Head Installation
- Pulse-Free flow
- Direct or Belt Driven

SPECIFICATIONS:

- Capacity @ max. pressure: rpm gpm l/min
  1500 psi (103 bar) 1200 8.3 31.4
- RPM: 1200 max.- 200 min.
- Inlet
  250 psi max
- Connections:
  Inlet: 1" NPT
  Outlet: 3/4" NPT
- Temperature:
  Max: 250° F (121.1° C)
  Min: 40° F (4.4° C)
  [contact factory for temperatures below 40° F (4.4° C)]
- Fluid End Material, Manifold : SA395 / SA479
- Elastomers: Highly Saturated Nitrile
- Oil Capacity: 2.75 quarts KIMRAY Part No. 7266
  2.60 Liters
- Weight (dry): 100 lbs (45.7 kg)
- Bi Directional Shaft Rotation

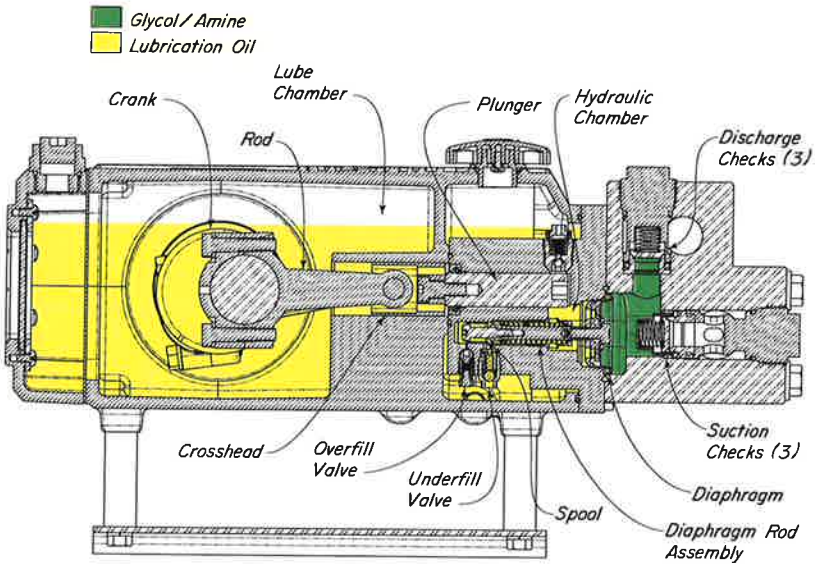
OPERATION:

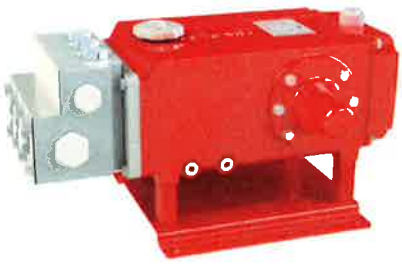
The KIMRAY ELECTRIC GLYCOL PUMP is a uniquely designed hydraulically balanced diaphragm/plunger positive displacement pump. Power to the pump is provided by a properly sized and specified electric motor either directly connected or belt driven. PLUNGERS are utilized to energize DIAPHRAGMS which in turn pressurize glycol/amine solutions used in gas processing. The Plungers operate and are lubricated in clean oil isolated from the process fluids by DIAPHRAGMS. The DIAPHRAGMS are in contact with the hydraulic oil on one side and the glycol/amine solution and on the other side. KIMZOIL EGP1 is a hydraulic/lubrication oil designed for high end pump performance designed for this application. This design allows for the protection of the reciprocating pumping internals from the process fluids.

As shown in the diagram, the PLUNGER(S) are connected to the CROSSHEAD(s) and displace the oil (YELLOW) in the HYDRAULIC CHAMBER as they reciprocate. As the Plunger moves to the right on the pressure stroke, oil is displaced in the Hydraulic Chamber and forces the DIAPHRAGM(s) to move to the right. The Diaphragm movement displaces the glycol/amine solution (GREEN) on the opposing side of the Diaphragm and forces it through the DISCHARGE CHECK VALVE(s). During the pressure stroke, a small amount of oil (YELLOW) leaks past the clearance between the Plunger and cylinder.

As the Plunger moves back on the suction stroke, the pressure drops in the Hydraulic Chamber and a small amount of oil is drawn in through the UNDER-FILL VALVE to replace the oil lost during the pressure stroke. The position of the Spool Valve regulates how much oil is drawn in. The SPOOL VALVE is positioned by the DIAPHRAGM ROD ASSEMBLY which is connected to the Diaphragm. The cycle then repeats.

When the Diaphragm moves too far forward, the Under-Fill port closes and the Over-Fill port opens. The Under-Fill Valve is a check valve that lets oil in during the suction stroke, but will not allow oil to leave. The OVER-FILL VALVE is a check valve that lets oil out during the pressure stroke, but prevents oil from coming in. The spool valve position opens the port to one of the two valves depending on the need for more or less oil.





Kimray is an ISO 9001- certified manufacturer.

GRI-GLYCalc VERSION 4.0 - AGGREGATE CALCULATIONS REPORT

Case Name: South Ignacio - D2 PTE - Feb '19
File Name: \\durnetapp101\Shared\Durango Shared\EHS\Air Permits\GLYCalc files\South Ignacio\D2\SOU D2 2019 02.ddf
Date: March 27, 2019

DESCRIPTION:

Description: 40 MMscfd dehy unit; Feb '19 gas analysis; max design gas flow, temp, and pressure; max glycol rate (3-Kimray 20015)

Annual Hours of Operation: 8760.0 hours/yr

EMISSIONS REPORTS:

UNCONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.8086	19.405	3.5415
Ethane	0.0278	0.668	0.1219
Propane	0.0070	0.167	0.0304
Isobutane	0.0027	0.066	0.0120
n-Butane	0.0033	0.080	0.0146
Other Hexanes	0.0067	0.162	0.0295
Methylcyclohexane	0.0087	0.208	0.0379
Benzene	0.0565	1.355	0.2473
Total Emissions	0.9213	22.111	4.0352
Total Hydrocarbon Emissions	0.9213	22.111	4.0352
Total VOC Emissions	0.0849	2.037	0.3718
Total HAP Emissions	0.0565	1.355	0.2473
Total BTEX Emissions	0.0565	1.355	0.2473

FLASH GAS EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	5.3786	129.086	23.5582
Ethane	0.0465	1.116	0.2036
Propane	0.0051	0.122	0.0222
Isobutane	0.0012	0.029	0.0053
n-Butane	0.0011	0.026	0.0048
Other Hexanes	0.0010	0.023	0.0043
Methylcyclohexane	0.0002	0.004	0.0007
Benzene	0.0002	0.004	0.0008
Total Emissions	5.4338	130.410	23.7999
Total Hydrocarbon Emissions	5.4338	130.410	23.7999
Total VOC Emissions	0.0087	0.209	0.0381
Total HAP Emissions	0.0002	0.004	0.0008
Total BTEX Emissions	0.0002	0.004	0.0008

FLASH TANK OFF GAS

Component	lbs/hr	lbs/day	tons/yr
Methane	107.5715	2581.716	471.1631
Ethane	0.9297	22.313	4.0721
Propane	0.1015	2.437	0.4447
Isobutane	0.0244	0.585	0.1067
n-Butane	0.0219	0.525	0.0958
Other Hexanes	0.0195	0.469	0.0856
Methylcyclohexane	0.0033	0.078	0.0143
Benzene	0.0036	0.085	0.0156
Total Emissions	108.6753	2608.207	475.9977
Total Hydrocarbon Emissions	108.6753	2608.207	475.9977
Total VOC Emissions	0.1741	4.178	0.7626
Total HAP Emissions	0.0036	0.085	0.0156
Total BTEX Emissions	0.0036	0.085	0.0156

COMBINED REGENERATOR VENT/FLASH GAS EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	6.1871	148.491	27.0996
Ethane	0.0743	1.784	0.3255
Propane	0.0120	0.289	0.0527
Isobutane	0.0040	0.095	0.0174
n-Butane	0.0044	0.106	0.0194
Other Hexanes	0.0077	0.185	0.0338
Methylcyclohexane	0.0088	0.212	0.0386
Benzene	0.0566	1.359	0.2481
Total Emissions	6.3550	152.521	27.8351
Total Hydrocarbon Emissions	6.3550	152.521	27.8351
Total VOC Emissions	0.0936	2.246	0.4099
Total HAP Emissions	0.0566	1.359	0.2481
Total BTEX Emissions	0.0566	1.359	0.2481

COMBINED REGENERATOR VENT/FLASH GAS EMISSION CONTROL REPORT:

Component	Uncontrolled tons/yr	Controlled tons/yr	% Reduction
Methane	474.7045	27.0996	94.29
Ethane	4.1940	0.3255	92.24
Propane	0.4751	0.0527	88.91
Isobutane	0.1187	0.0174	85.38
n-Butane	0.1104	0.0194	82.42
Other Hexanes	0.1151	0.0338	70.64
Methylcyclohexane	0.0522	0.0386	26.00
Benzene	0.2629	0.2481	5.63
Total Emissions	480.0329	27.8351	94.20
Total Hydrocarbon Emissions	480.0329	27.8351	94.20
Total VOC Emissions	1.1344	0.4099	63.86
Total HAP Emissions	0.2629	0.2481	5.63
Total BTEX Emissions	0.2629	0.2481	5.63

EQUIPMENT REPORTS:

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:	2.49 lbs. H2O/MMSCF
Temperature:	100.0 deg. F
Pressure:	720.0 psig
Dry Gas Flow Rate:	42.0000 MMSCF/day
Glycol Losses with Dry Gas:	0.3733 lb/hr
Wet Gas Water Content:	Saturated
Calculated Wet Gas Water Content:	74.99 lbs. H2O/MMSCF
Calculated Lean Glycol Recirc. Ratio:	4.72 gal/lb H2O

Component	Remaining in Dry Gas	Absorbed in Glycol
Water	3.31%	96.69%
Carbon Dioxide	99.74%	0.26%
Methane	99.98%	0.02%
Ethane	99.93%	0.07%
Propane	99.89%	0.11%
Isobutane	99.84%	0.16%
n-Butane	99.79%	0.21%
Other Hexanes	99.63%	0.37%
Methylcyclohexane	97.51%	2.49%
Benzene	83.48%	16.52%

FLASH TANK

Flash Control:	Combustion device
Flash Control Efficiency:	95.00 %
Flash Temperature:	100.0 deg. F
Flash Pressure:	30.0 psig

Component	Left in Glycol	Removed in Flash Gas
Water	99.88%	0.12%
Carbon Dioxide	10.00%	90.00%
Methane	0.75%	99.25%
Ethane	2.91%	97.09%
Propane	6.41%	93.59%
Isobutane	10.13%	89.87%
n-Butane	13.24%	86.76%
Other Hexanes	26.19%	73.81%
Methylcyclohexane	73.67%	26.33%
Benzene	94.37%	5.63%

REGENERATOR

No Stripping Gas used in regenerator.

Component	Remaining in Glycol	Distilled Overhead
Water	18.13%	81.87%
Carbon Dioxide	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%
Other Hexanes	2.80%	97.20%
Methylcyclohexane	5.16%	94.84%
Benzene	5.25%	94.75%

STREAM REPORTS:

WET GAS STREAM

Temperature: 100.00 deg. F
Pressure: 734.70 psia
Flow Rate: 1.75e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.58e-001	1.31e+002
Carbon Dioxide	5.93e+000	1.21e+004
Methane	9.35e+001	6.93e+004
Ethane	3.39e-001	4.71e+002
Propane	2.15e-002	4.37e+001
Isobutane	3.39e-003	9.12e+000
n-Butane	2.70e-003	7.24e+000
Other Hexanes	1.30e-003	5.17e+000
Methylcyclohexane	9.98e-005	4.53e-001
Benzene	9.98e-005	3.60e-001
Total Components	100.00	8.21e+004

DRY GAS STREAM

Temperature: 100.00 deg. F
Pressure: 734.70 psia
Flow Rate: 1.75e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	5.24e-003	4.36e+000
Carbon Dioxide	5.92e+000	1.20e+004
Methane	9.37e+001	6.93e+004
Ethane	3.39e-001	4.70e+002
Propane	2.15e-002	4.37e+001
Isobutane	3.40e-003	9.10e+000
n-Butane	2.70e-003	7.22e+000
Other Hexanes	1.30e-003	5.15e+000
Methylcyclohexane	9.75e-005	4.42e-001
Benzene	8.35e-005	3.01e-001

Total Components	100.00	8.19e+004

LEAN GLYCOL STREAM

Temperature: 100.00 deg. F
Flow Rate: 9.99e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.95e+001	5.60e+003
Water	5.00e-001	2.82e+001
Carbon Dioxide	5.62e-011	3.16e-009
Methane	7.95e-018	4.48e-016
Ethane	2.62e-009	1.47e-007
Propane	3.50e-011	1.97e-009
Isobutane	7.78e-012	4.38e-010
n-Butane	6.73e-012	3.79e-010
Other Hexanes	3.44e-006	1.94e-004
Methylcyclohexane	8.35e-006	4.70e-004
Benzene	5.56e-005	3.13e-003
Total Components	100.00	5.63e+003

RICH GLYCOL AND PUMP GAS STREAM

Temperature: 100.00 deg. F
Pressure: 734.70 psia
Flow Rate: 1.06e+001 gpm
NOTE: Stream has more than one phase.

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.47e+001	5.60e+003
Water	2.63e+000	1.55e+002
Carbon Dioxide	8.15e-001	4.82e+001
Methane	1.83e+000	1.08e+002
Ethane	1.62e-002	9.58e-001
Propane	1.83e-003	1.08e-001
Isobutane	4.58e-004	2.71e-002
n-Butane	4.26e-004	2.52e-002
Other Hexanes	4.48e-004	2.65e-002
Methylcyclohexane	2.09e-004	1.24e-002
Benzene	1.07e-003	6.31e-002
Total Components	100.00	5.91e+003

FLASH TANK OFF GAS STREAM

Temperature: 100.00 deg. F
Pressure: 44.70 psia
Flow Rate: 2.94e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.29e-001	1.79e-001
Carbon Dioxide	1.27e+001	4.34e+001

Methane	8.67e+001	1.08e+002
Ethane	4.00e-001	9.30e-001
Propane	2.98e-002	1.02e-001
Isobutane	5.42e-003	2.44e-002
n-Butane	4.86e-003	2.19e-002
Other Hexanes	2.93e-003	1.95e-002
Methylcyclohexane	4.29e-004	3.26e-003
Benzene	5.88e-004	3.55e-003
Total Components	100.00	1.52e+002

FLASH TANK GLYCOL STREAM

Temperature: 100.00 deg. F
Flow Rate: 1.03e+001 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.72e+001	5.60e+003
Water	2.69e+000	1.55e+002
Carbon Dioxide	8.36e-002	4.82e+000
Methane	1.40e-002	8.09e-001
Ethane	4.83e-004	2.78e-002
Propane	1.21e-004	6.95e-003
Isobutane	4.76e-005	2.74e-003
n-Butane	5.79e-005	3.34e-003
Other Hexanes	1.20e-004	6.93e-003
Methylcyclohexane	1.58e-004	9.12e-003
Benzene	1.03e-003	5.96e-002
Total Components	100.00	5.76e+003

FLASH GAS EMISSIONS

Flow Rate: 7.82e+003 scfh
Control Method: Combustion Device
Control Efficiency: 95.00

Component	Conc. (vol%)	Loading (lb/hr)
Water	6.23e+001	2.32e+002
Carbon Dioxide	3.60e+001	3.27e+002
Methane	1.63e+000	5.38e+000
Ethane	7.50e-003	4.65e-002
Propane	5.58e-004	5.08e-003
Isobutane	1.02e-004	1.22e-003
n-Butane	9.12e-005	1.09e-003
Other Hexanes	5.50e-005	9.77e-004
Methylcyclohexane	8.05e-006	1.63e-004
Benzene	1.10e-005	1.78e-004
Total Components	100.00	5.64e+002

REGENERATOR OVERHEADS STREAM

Temperature: 212.00 deg. F
Pressure: 14.70 psia
Flow Rate: 2.74e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	9.78e+001	1.27e+002
Carbon Dioxide	1.52e+000	4.82e+000
Methane	6.98e-001	8.09e-001
Ethane	1.28e-002	2.78e-002
Propane	2.18e-003	6.95e-003
Isobutane	6.54e-004	2.74e-003
n-Butane	7.95e-004	3.34e-003
Other Hexanes	1.08e-003	6.74e-003
Methylcyclohexane	1.22e-003	8.65e-003
Benzene	1.00e-002	5.65e-002
Total Components	100.00	1.33e+002

GRI-GLYCalc VERSION 4.0 - SUMMARY OF INPUT VALUES

Case Name: South Ignacio - D2 PTE - Feb '19
File Name: \\durnetapp101\Shared\Durango Shared\EHS\Air Permits\GLYCalc files\South Ignacio\D2\SOU D2 2019 02.ddf
Date: March 27, 2019

DESCRIPTION:

Description: 40 MMscfd dehy unit; Feb '19 gas analysis; max design gas flow, temp, and pressure; max glycol rate (3-Kimray 20015)

Annual Hours of Operation: 8760.0 hours/yr

WET GAS:

Temperature: 100.00 deg. F
Pressure: 720.00 psig
Wet Gas Water Content: Saturated

Component	Conc. (vol %)
Carbon Dioxide	5.9368
Methane	93.6937
Ethane	0.3392
Propane	0.0215
Isobutane	0.0034
n-Butane	0.0027
Other Hexanes	0.0013
Methylcyclohexane	0.0001
Benzene	0.0001

DRY GAS:

Flow Rate: 42.0 MMSCF/day
Water Content: 7.0 lbs. H2O/MMSCF

LEAN GLYCOL:

Glycol Type: TEG
Water Content: 0.5 wt% H2O
Flow Rate: 10.0 gpm

PUMP:

Glycol Pump Type: Gas Injection
Gas Injection Pump Volume Ratio: 0.080 acfm gas/gpm glycol

FLASH TANK:

Flash Control: Combustion device
Flash Control Efficiency: 95.00 %
Temperature: 100.0 deg. F

Pressure: 30.0 psig

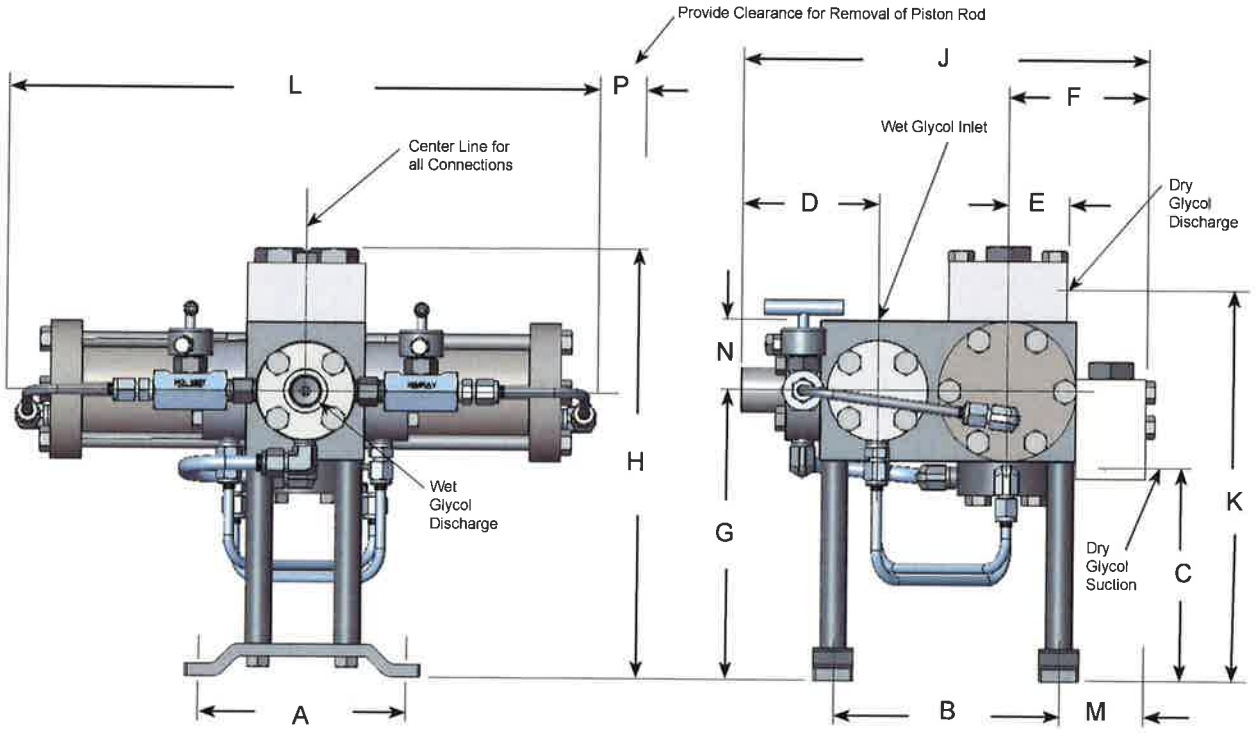


Figure 7

Table 3 - Glycol Pump Dimensions

Model PV, SC	A	B	C	D	E	F	G	H	J	K	L	M	N	P
1720 PV	5 1/4 in. (133 mm)	5 11/16 in. (144 mm)	5 3/4 in. (146 mm)	5 7/16 in. (87 mm)	1 1/2 in. (38 mm)	3 1/2 in. (88 mm)	7 1/4 in. (184 mm)	10 7/8 in. (276 mm)	10 3/16 in. (258 mm)	9 5/8 in. (244 mm)	15 in. (381 mm)	2 1/8 in. (53 mm)	1 3/4 in. (44 mm)	3 in. (76 mm)
4020 PV & 2015 SC	5 1/4 in. (133 mm)	5 11/16 in. (144 mm)	5 3/4 in. (146 mm)	5 7/16 in. (87 mm)	1 1/2 in. (38 mm)	3 1/2 in. (88 mm)	7 1/4 in. (184 mm)	10 7/8 in. (276 mm)	10 3/16 in. (258 mm)	9 5/8 in. (244 mm)	15 in. (381 mm)	2 1/8 in. (53 mm)	1 3/4 in. (44 mm)	3 in. (76 mm)
9020 PV & 5015 SC	6 1/4 in. (158 mm)	5 11/16 in. (144 mm)	6 3/8 in. (161 mm)	5 in. (127 mm)	1 3/4 in. (44 mm)	4 1/4 in. (107 mm)	8 3/4 in. (222 mm)	13 1/4 in. (336 mm)	13 7/8 in. (352 mm)	11 3/4 in. (289 mm)	20 in. (508 mm)	2 1/2 in. (63 mm)	2 in. (50 mm)	3 in. (76 mm)
21020 PV & 10015 SC	7 5/8 in. (193 mm)	10 1/8 ± 1/8 (257 mm)	7 in. (177 mm)	5 3/8 in. (136 mm)	2 1/4 in. (57 mm)	5 3/4 in. (146 mm)	9 1/4 in. (234 mm)	14 3/4 in. (374 mm)	16 5/8 in. (422 mm)	13 in. (330 mm)	24 in. (508 mm)	3 3/16 in. (80 mm)	2 1/2 in. (63 mm)	4 in. (101 mm)
45020 PV & 20015 SC	10 3/4 in. (273 mm)	14 ± 1/8 (355 mm)	9 in. (228 mm)	6 5/8 in. (168 mm)	2 5/8 in. (66 mm)	6 1/2 in. (165 mm)	11 3/8 in. (288 mm)	19 in. (482 mm)	21 1/8 in. (536 mm)	16 3/8 in. (415 mm)	34 in. (863 mm)	3 3/4 in. (95 mm)	3 1/2 in. (88 mm)	6 in. (152 mm)

Table 4 - Glycol Pump Specifications

Model Number	Max. Cap		Size of Pipe Connections	Mounting Bolts	Approx. Weight	Max. Strokes Per Minute	Glycol Output Strokes / Gal.	Glycol Output Gal. / Strokes
	G.P.M	G.P.H						
1720 PV	.67	40	1/2 in NPT (12 mm)	3/8 in. dia (9.42 mm)	66 lbs (29.93 kg)	40	59	0.017
4020 PV	.67	40	1/2 in NPT (12 mm)	3/8 in. dia (9.42 mm)	66 lbs (29.93 kg)	40	59	0.017
9020 PV	1.5	90	3/4 in NPT (19 mm)	1/2 in. dia (12 mm)	119 lbs (53.97 kg)	40	26.3	0.038
21020 PV	3.5	210	1 in NPT (25 mm)	1/2 in. dia (12 mm)	215 lbs (97.52 kg)	32	9	0.111
45020 PV	7.5	450	1 1/2 in NPT (38 mm)	1/2 in. dia (12 mm)	500 lbs (22.68 kg)	28	3.5	0.283
2015 SC	.33	20	1/2 in NPT (12 mm)	3/8 in. dia (9.52 mm)	66 lbs (29.93 kg)	55	147	0.0068
5015 SC	.83	50	3/4 in NPT (19 mm)	1/2 in. dia (12 mm)	119 lbs (53.97 kg)	50	52	0.019
10015 SC	1.67	100	1 in NPT (25 mm)	1/2 in. dia (12 mm)	215 lbs (97.52 kg)	48	25	0.040
20015 SC	3.33	200	1 1/2 in NPT (38 mm)	1/2 in. dia (12 mm)	500 lbs (22.68 kg)	40	8.8	0.114