



EHS Department

December 8, 2016

To: Texas Commission on Environmental Quality

Re: Chesapeake Operating, LLC
CN600514004
APD-Cert Submittal
Rogers J Pad

Chesapeake Operating, LLC (COLLC) is registering the Rogers J Pad in Dimmit County, Texas, under Texas Commission on Environmental Quality (TCEQ) Permit by Rule (PBR) §106.352, §106.359, and §106.512. COLLC has prepared an APD-Cert submittal to register and certify the site-wide emissions.

Please add the following technical contact for this site:

Technical Contact: Keri Lohse, EHS Technician
Company: Chesapeake Energy Corporation
Address: P. O. Box 18496, Oklahoma City, OK 73154
Phone: (405) 935-1268
Fax: (405) 849-1268
Email: keri.lohse@chk.com

Chesapeake Energy Corporation

P.O. Box 18496 | Oklahoma City, OK 73154-0496 | 6100 N. Western Avenue | Oklahoma City, OK 73118
405-848-8000

Texas Commission on Environmental Quality
Form APD – CERT
Certification of Emission Limits
(Page 1)

I. Company and Site Information		
A. Company Name: Chesapeake Operating, LLC		
B. Responsible Official Name: Brian Wasinger		
Responsible Official's Title: Production Manager		
Mailing Address: P.O. Box 18496		
City: Oklahoma City	County: Oklahoma	
State: Oklahoma	ZIP Code: 73154-0496	
Telephone: (405) 935-9528	Fax: (405) 849-9528	
E-mail Address: bryan.curtis@chk.com		
C. Site Name: Rogers J Pad		
Street Address: <i>(if different from above)</i>		
If "NO," street address describe physical location with driving directions:		
From the intersection of HWY 468 and FM 1019, travel south on FM 1019 for 2.6 miles to gate on east side of road (left). Pass through gate and continue east on lease road for 2.56 miles to location on the left.		
City or nearest city: Big Wells	County: Dimmit	ZIP Code: 78830
D. TCEQ Account Identification Number <i>(leave blank if unknown)</i> :		
E. TCEQ Customer Reference Number <i>(leave blank if unknown)</i> : 600514004		
TCEQ Regulated Entity Number <i>(leave blank if unknown)</i> :		
F. Does the site have a Title V Permit?		☐ YES ☒ NO
G. Title V Permit Number:		
H. Is this a small business?		☐ YES ☒ NO
II. Attach the Following Documentations		
A. Copies of a previously completed Form PI-7 and all supporting documentation.		
B. A list of each source of air emissions at the site.		
C. A summary of the certified emission rates.		
D. A process description.		
III. Maintain Records On Site to Demonstrate Continuing Compliance and Make the Records Available on Request		

Texas Commission on Environmental Quality
Form APD – CERT
Certification of Emission Limits
(Page 2)

IV. Purpose of this Certification (<i>choose and complete all that are appropriate</i>)	
This certification is intended to establish emission rates below state and federal rule thresholds and triggers for:	
☒ 30 TAC § 106.4 for Permits by Rule	☐ Permit by Rule Number:
☐ HR VOC Emissions Cap and Trade Program	☐ Emissions Banking and Trading Program (other than HRVOC)
☐ 30 TAC § 115 for Volatile Organic Compounds	☐ 30 TAC § 117 for Nitrogen Oxides
☒ 40 CFR Part 60, Subpart OOOOa	☐ 40 CFR Part 61, Subpart
☐ 40 CFR Part 63, Subpart	☐ Title V Permit Major Source Applicability
☐ Standard Permit:	☐ Other:
V. Requests Associated with this Certification	
A. Are you requesting to withdraw your Title V operating permit application?	☐ YES ☒ NO
<i>If "YES," submit the original of this certification, directly to the assigned Title V permit reviewer and send a copy to the locations indicated in the Mailing Instruction below.</i>	
B. Are you requesting to void an issued Title V operating permit or authorization to operate under a general operating permit?	☐ YES ☒ NO
<i>If "YES," submit this certification to the locations indicated in the Mailing Instructions page 9</i>	
C. For issued Title V permits, are you subject to Title V permitting requirements, but are submitting this certification to demonstrate that you are not subject to MACT requirements?	☐ YES ☐ NO
<i>If "YES," submit this certification to the locations indicated in the Mailing Instructions page 9</i>	
D. For pending Title V permits, are you subject to Title V permitting requirements, but are submitting this certification to demonstrate that you are not subject to MACT requirements?	☐ YES ☐ NO
<i>If "YES," submit the original of this certification directly to the assigned Title V permit reviewer and send a copy to the locations indicated in the Mailing Instructions page 9.</i>	
VI. Certification by Responsible Official	
All representations in this certification of emissions are conditions upon which the stationary source shall operate. This certification reflects the maximum emission rates for the operation of this facility. The facility will operate in compliance with all regulations of the Texas Commission on Environmental Quality and with Federal U.S. Environmental Protection Agency regulations governing air pollution. It shall be unlawful for any person to vary from such representation unless the certification is first revised. The signature below indicates that, based on information and belief formed after reasonable inquiry, the statements, and information contained in the attached documents are true, accurate, and complete.	
NAME and TITLE: <u>Brian Wasinger, Production Manager</u>	
SIGNATURE: <u>Signed electronically in STEERS</u> Date: _____	
ORIGINAL SIGNATURE REQUIRED	

Reminder: The original of this certification must be sent to the TCEQ in Austin and copies sent to the appropriate TCEQ Regional office and any local air pollution control programs with jurisdiction. A copy must also be maintained on site or, for sites that normally operate unattended, at an office within Texas having day-to-day operational control of the site.

**Texas Commission on Environmental Quality
Form APD - CERT
Certification of Emission Limits**

EMISSION RATE DATA									
FIN	Facility Name	EPN	Point Name	Author-ization Type	Author-ization Date	Permit or Registration Number (if applicable)	Air Contaminant Name	Maximum Certified Emission Rates	
								Pounds/ Hour	Tons/ Year
FUG	Sitewide Fugitive	FUG	Sitewide Fugitive	PBR	12/2016	106.352	VOC	0.39	1.66
MSS	MSS Activities	MSS	MSS Activities	PBR	12/2016	106.359	VOC	27.97	17.71
				PBR	12/2016	106.359	NOx	10.91	3.92
				PBR	12/2016	106.359	CO	21.77	7.83
				PBR	12/2016	106.359	SO2	0.26	0.09
TANK 1	Tank 1 - Oil/Water Combo	TANK 1	Tank 1 - Oil/Water Combo	PBR	12/2016	106.352	VOC	5.58	2.83
C LOAD	Crude Loading	C LOAD	Crude Loading	PBR	12/2016	106.352	VOC	46.48	0.04
ENG 1	230 Hp or Smaller Engine	ENG 1	230 Hp or Smaller Engine	PBR	12/2016	106.512	NOx	0.51	2.22
				PBR	12/2016	106.512	CO	1.01	4.43
				PBR	12/2016	106.512	VOC ^a	0.39	1.72
				PBR	12/2016	106.512	PM10	0.04	0.16
				PBR	12/2016	106.512	SO2	0.01	0.03
				PBR	12/2016	106.512	CH2O	0.04	0.17
						Emission Totals:	NOx	-	6.14
							CO	-	12.26
							VOC	-	23.96
							SO ₂	-	0.12
							PM ₁₀	-	0.16

^aVOC includes formaldehyde.

TCEQ 10489 (Revised 08/13)

This form for use by facilities subject to air quality permits requirements and may be revised periodically. (APDG 5375v9)



TCEQ Use Only

TCEQ Core Data Form

For detailed instructions regarding completion of this form, please read the Core Data Form Instructions or call 512-239-5175.

SECTION I: General Information

1. Reason for Submission (If other is checked please describe in space provided.)		
☒ New Permit, Registration or Authorization (Core Data Form should be submitted with the program application.)		
☐ Renewal (Core Data Form should be submitted with the renewal form)	☐ Other	
2. Customer Reference Number (if issued)	Follow this link to search for CN or RN numbers in Central Registry**	3. Regulated Entity Reference Number (if issued)
CN 600514004		RN

SECTION II: Customer Information

4. General Customer Information		5. Effective Date for Customer Information Updates (mm/dd/yyyy)			
☐ New Customer		☐ Update to Customer Information		☐ Change in Regulated Entity Ownership	
☐ Change in Legal Name (Verifiable with the Texas Secretary of State or Texas Comptroller of Public Accounts)					
The Customer Name submitted here may be updated automatically based on what is current and active with the Texas Secretary of State (SOS) or Texas Comptroller of Public Accounts (CPA).					
6. Customer Legal Name (If an individual, print last name first: eg: Doe, John)				<i>If new Customer, enter previous Customer below:</i>	
7. TX SOS/CPA Filing Number		8. TX State Tax ID (11 digits)		9. Federal Tax ID (9 digits)	
				10. DUNS Number (if applicable)	
11. Type of Customer:		☐ Corporation		☐ Individual	
Government: ☐ City ☐ County ☐ Federal ☐ State ☐ Other		☐ Sole Proprietorship		Partnership: ☐ General ☐ Limited	
12. Number of Employees		☐ 0-20 ☐ 21-100 ☐ 101-250 ☐ 251-500 ☐ 501 and higher		13. Independently Owned and Operated?	
				☐ Yes ☐ No	
14. Customer Role (Proposed or Actual) – as it relates to the Regulated Entity listed on this form. Please check one of the following:					
☐ Owner		☐ Operator		☐ Owner & Operator	
☐ Occupational Licensee		☐ Responsible Party		☐ Voluntary Cleanup Applicant	
				☐ Other:	
15. Mailing Address:					
City		State		ZIP	ZIP + 4
16. Country Mailing Information (if outside USA)				17. E-Mail Address (if applicable)	
18. Telephone Number		19. Extension or Code		20. Fax Number (if applicable)	
() -				() -	

SECTION III: Regulated Entity Information

21. General Regulated Entity Information (If 'New Regulated Entity' is selected below this form should be accompanied by a permit application)	
☒ New Regulated Entity ☐ Update to Regulated Entity Name ☐ Update to Regulated Entity Information	
The Regulated Entity Name submitted may be updated in order to meet TCEQ Agency Data Standards (removal of organizational endings such as Inc, LP, or LLC.)	
22. Regulated Entity Name (Enter name of the site where the regulated action is taking place.)	
Rogers J Pad	

23. Street Address of the Regulated Entity: (No PO Boxes)								
	City		State		ZIP		ZIP + 4	
24. County	Dimmit							
Enter Physical Location Description if no street address is provided.								
25. Description to Physical Location:	From the intersection of HWY 468 and FM 1019, travel south on FM 1019 for 2.6 miles to gate on east side of road (left). Pass through gate and continue east on lease road for 2.56 miles to location on the left.							
26. Nearest City					State		Nearest ZIP Code	
Big Wells					TX		78830	
27. Latitude (N) In Decimal:		28.513967		28. Longitude (W) In Decimal:		-99.475070		
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds			
28	30	50.3	99	28	30.2			
29. Primary SIC Code (4 digits)		30. Secondary SIC Code (4 digits)		31. Primary NAICS Code (5 or 6 digits)		32. Secondary NAICS Code (5 or 6 digits)		
1311				211111				
33. What is the Primary Business of this entity? (Do not repeat the SIC or NAICS description.)								
Oil and Natural Gas Gathering								
34. Mailing Address:		Chesapeake Operating, LLC						
		P. O. Box 18496						
		City	Oklahoma City	State	OK	ZIP	73154	ZIP + 4
35. E-Mail Address:		Bryan.curtis@chk.com						
36. Telephone Number			37. Extension or Code			38. Fax Number (if applicable)		
(405) 935-9528						(405) 849-9528		

39. TCEQ Programs and ID Numbers Check all Programs and write in the permits/registration numbers that will be affected by the updates submitted on this form. See the Core Data Form instructions for additional guidance.

☐ Dam Safety	☐ Districts	☐ Edwards Aquifer	☐ Emissions Inventory Air	☐ Industrial Hazardous Waste
☐ Municipal Solid Waste	☒ New Source Review Air	☐ OSSF	☐ Petroleum Storage Tank	☐ PWS
☐ Sludge	☐ Storm Water	☐ Title V Air	☐ Tires	☐ Used Oil
☐ Voluntary Cleanup	☐ Waste Water	☐ Wastewater Agriculture	☐ Water Rights	☐ Other:

SECTION IV: Preparer Information

40. Name:	Bryan Curtis, P.E.	41. Title:	Supervisor – Air Permitting
42. Telephone Number	43. Ext./Code	44. Fax Number	45. E-Mail Address
(405) 935-9528		(405) 849-9528	Bryan.curtis@chk.com

SECTION V: Authorized Signature

46. By my signature below, I certify, to the best of my knowledge, that the information provided in this form is true and complete, and that I have signature authority to submit this form on behalf of the entity specified in Section II, Field 6 and/or as required for the updates to the ID numbers identified in field 39.

Company:	Chesapeake Operating, LLC	Job Title:	Production Manager
Name(In Print) :	Brian Wasinger	Phone:	(405) 935-8000
Signature:	Signed electronically in STEERS	Date:	



Texas Commission on Environmental Quality
Table 29 Reciprocating Engines

I. Engine Data											
Manufacturer: 230 Hp or Smaller Engine			Model No. TBD			Serial No. TBD			Manufacture Date: Post 2011		
Rebuilds Date: N/A			No. of Cylinders: TBD			Compression Ratio: TBD			EPN: ENG 1		
Application: ☐ Gas Compression ☐ Electric Generation ☐ Refrigeration ☐ Emergency/Stand by ☒ 4 Stroke Cycle ☐ 2 Stroke Cycle ☐ Carbureted ☒ Spark Ignited ☐ Dual Fuel ☐ Fuel Injected ☐ Diesel ☒ Naturally Aspirated ☐ Blower /Pump Scavenged ☐ Turbo Charged and I.C. ☒ Turbo Charged ☐ Intercooled ☐ I.C. Water Temperature ☐ Lean Burn ☒ Rich Burn											
Ignition/Injection Timing: Fixed:						Variable:					
Manufacture Horsepower Rating: ≤ 230						Proposed Horsepower Rating: ≤ 230					
Discharge Parameters											
Stack Height (Feet)			Stack Diameter (Feet)			Stack Temperature (°F)			Exit Velocity (FPS)		
10			0.33			1200			130		
II. Fuel Data											
Type of Fuel: ☒ Field Gas ☐ Landfill Gas ☐ LP Gas ☒ Natural Gas ☐ Digester Gas ☐ Diesel											
Fuel Consumption (BTU/bhp-hr): 8000				Heat Value: 1265 Btu/scf (HHV)				(LHV)			
Sulfur Content (grains/100 scf - weight %): Up to 23 ppm H ₂ S											
III. Emission Factors (Before Control)											
NO _x		CO		SO ₂		VOC		Formaldehyde		PM ₁₀	
g/hp-hr	ppmv	g/hp-hr	ppmv	g/hp-hr	ppmv	g/hp-hr	ppmv	g/hp-hr	ppmv	g/hp-hr	ppmv
1.0		2.0				0.7		0.0205 lb/MMbtu			
Source of Emission Factors: ☐ Manufacturer Data ☒ AP-42 ☒ Other (specify): NSPS JJJJ											
IV. Emission Factors (Post Control)											
NO _x		CO		SO ₂		VOC		Formaldehyde		PM ₁₀	
g/hp-hr	ppmv	g/hp-hr	ppmv	g/hp-hr	ppmv	g/hp-hr	ppmv	g/hp-hr	ppmv	g/hp-hr	ppmv
1.0		2.0				0.7		0.0205 lb/MMbtu			
Method of Emission Control: ☐ NSCR Catalyst ☐ Lean Operation ☐ Parameter Adjustment ☐ Stratified Charge ☐ JLCC Catalyst ☒ Other (Specify): Engine may be equipped with a catalyst											
Note: Must submit a copy of any manufacturer control information that demonstrates control efficiency.											
Is Formaldehyde included in the VOCs?										☐ Yes ☒ No	
V. Federal and State Standards (Check all that apply)											
☒ NSPS JJJJ ☒ MACT ZZZZ ☐ NSPS IIII ☐ Title 30 Chapter 117 - List County: _____											
VI. Additional Information											
1. Submit a copy of the engine manufacturer's site rating or general rating specification data. 2. Submit a typical fuel gas analysis, including sulfur content and heating value. For gaseous fuels, provide mole percent of constituents. 3. Submit description of air/fuel ratio control system (manufacturer information is acceptable).											

**CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY, TEXAS**

PROCESS DESCRIPTION

Chesapeake Operating, LLC (COLLC) owns and operates the Rogers J Pad (Facility), which is located in Dimmit County, Texas. The Facility is an oil and natural gas gathering facility. Natural gas, oil, and produced water are produced from the wellheads at the Facility.

Annual natural gas production is expected to be about 2,555 million standard cubic feet (MMSCF). All gas produced from the wells on-site flows to a pipeline. All liquids flow to a central production facility (CPF). Maximum daily gas production is expected to be 7 million standard cubic feet per day (MMSCFD). COLLC will maintain sufficient records to demonstrate that actual emissions do not exceed the annual limits certified in this APD-Cert.

Oil, gas, and water from the wellheads pass through a series of separators. Gas from the separators flows to the sales line and fluids flow to the CPF. During separator maintenance periods, oil and water will be transferred to the combination storage tank. The average annual amount of oil/water sent to the combination tank is estimated to be about 365 barrels per year. The maximum daily amount of oil/water sent to the combination tank is estimated to be about 10 barrels per day. All of the liquids are assumed to be gasoline RVP-7.8 for calculation purposes. The oil/water is transferred offsite via trucks. The trucks are in dedicated normal service. One (1) 230 Hp or smaller engine may be located at the site.

A ProMax process simulator run was used to estimate VOC flash emissions from the combination tank. The ProMax run is based on samples pulled from the same reservoir as the Rogers J Pad, and uses the temperature (120° F) and pressure (250 psig) comparable to the predicted site conditions. The equipment configuration used in the ProMax run is comparable to the expected equipment configuration at the Facility. Both the Rogers J site and the sampled site are natural gas sites with associated liquid hydrocarbons. Working and breathing losses from the combination tank were estimated using the TANKS 4.0.9d methodology.

The gas analysis used in the fugitive calculations is from a site in the same reservoir as the Rogers J Pad. Both the Rogers J site and the sampled site are natural gas sites with associated liquid hydrocarbons.

Emissions from MSS activities are included in this application. Approximately 1,000 cubic feet of gas could be vented to the atmosphere per hour during an uncontrolled MSS activity. It is estimated that annual gas venting during MSS activities will not exceed 1940 MSCF of vented gas. During well unloading events, gas could be controlled via a portable flare. It is estimated that approximately 44,948 MSCF of gas could be flared.

The Facility is a new site that will be constructed after September 18, 2015; therefore,

the site is not subject to NSPS Subpart OOOO. One tank is proposed for the site. VOC emissions will be less than 6 T/yr; therefore, the tank will not be subject to NSPS Subpart OOOOa. The site may be equipped with intermittent and/or low bleed pneumatic controllers which are not subject to Subpart OOOOa. The fugitive equipment components will be subject to the LDAR monitoring requirements of Subpart OOOOa.

All emission sources at the Facility are authorized under Texas Commission on Environmental Quality (TCEQ) permit by rule (PBR) 106.352, 106.359, and 106.512.

**TABLE 1
EMISSIONS SUMMARY
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY**

FIN Number	EPN Number	Description	NO_x (TPY)	PM₁₀ (TPY)	SO₂ (TPY)	CO (TPY)	VOC (TPY)
FUG	FUG	Sitewide Fugitive	--	--	--	--	1.66
TANK 1	TANK 1	Tank 1 - Oil/Water Combo	--	--	--	--	2.83
C LOAD	C LOAD	Crude Loading	--	--	--	--	0.04
ENG 1	ENG 1	230 Hp or Smaller Engine	2.22	0.16	0.03	4.43	1.72
MSS	MSS	MSS Activities	3.92	--	0.09	7.83	17.71
Total			6.14	0.16	0.12	12.26	23.96

FIN Number	EPN Number	Description	NO_x (lb/hr)	PM₁₀ (lb/hr)	SO₂ (lb/hr)	CO (lb/hr)	VOC (lb/hr)
FUG	FUG	Sitewide Fugitive	--	--	--	--	0.39
TANK 1	TANK 1	Tank 1 - Oil/Water Combo	--	--	--	--	5.58
C LOAD	C LOAD	Crude Loading	--	--	--	--	46.48
ENG 1	ENG 1	230 Hp or Smaller Engine	0.51	0.04	0.01	1.01	0.39
MSS	MSS	MSS Activities	10.91	--	0.26	21.77	27.97
Total			11.42	0.04	0.27	22.78	80.81

Note: Hourly emissions are based on producing 10 bbl oil/water per day for Rogers J Pad

**TABLE 2
EQUIPMENT FUGITIVE EMISSIONS
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY**

VOC EMISSIONS	Per Equipment (lb/hr)	Per Equipment (TPY)	Qty of Equipment	Total VOC Emissions (lb/hr) ^a	Total VOC Emissions (TPY) ^a
Oil Tanks	0.05	0.22	1	0.05	0.22
Water Tanks	0.02	0.11	0	0.00	0.00
Inlet Separators	0.07	0.30	3	0.21	0.90
Heater Treaters	0.18	0.81	0	0.00	0.00
Low Pressure Towers	0.10	0.44	0	0.00	0.00
Flares	0.16	0.71	0	0.00	0.00
Wellheads	0.03	0.12	3	0.09	0.36
Compressors	0.04	0.18	1	0.04	0.18
Generators	0.01	0.06	0	0.00	0.00
Total Sitewide VOC Fugitive Emissions				0.39	1.66

	Qty	wt% VOC			Per Equipment Emissions (TPY)	Total Emissions (TPY)
		Gas/Vapor	Water	Light Liquid		
Oil Tanks	1	85%	1%	100%	0.22	0.22
Water Tanks	0	50%	1%	100%	0.11	0.00
Inlet Separators	3	20%	1%	45%	0.30	0.90
Heater Treaters	0	65%	1%	100%	0.81	0.00
Low Pressure Towers	0	75%	1%	100%	0.44	0.00
Flares	0	80%	1%	100%	0.71	0.00
Wellheads	3	30%	1%	25%	0.12	0.36
Compressors	1	30%	1%	25%	0.18	0.18
Generators	0	30%	1%	25%	0.06	0.00

^a Total VOC Emissions = Per Equipment Emissions x Number of Equipment

Oil Tanks								
Component Type	Type of Service	Oil and Gas Production			Potential VOC Emission Rates		H ₂ S Emissions (lb/hr)	H ₂ S Emissions (TPY)
		Number of Components	Emission Factors (lb/hr-component)	Percent VOC				
					(lb/hr)	(T/yr)		
Valves	Gas/Vapor	0	0.00992	85.00%	0.0000	0.0000	0	0
Flanges	Gas/Vapor	1	0.00086	85.00%	0.001	0.003	0.00086	0.0037668
Compressor Seals	Gas/Vapor	0	0.0194	85.00%	0.0000	0.0000	0	0
Relief Valves	Gas/Vapor	0	0.0194	85.00%	0.0000	0.0000	0	0
Connectors	Gas/Vapor	12	0.00044	85.00%	0.005	0.02	0.00528	0.0231264
Other	Gas/Vapor	2.25	0.0194	85.00%	0.04	0.16	0.04365	0.191187
Valves	Water	0	0.000216	1.00%	0.0000	0.0000	0	0
Pump Seals	Water	0	0.0000529	1.00%	0.0000	0.0000	0	0
Flanges	Water	0	0.00000617	1.00%	0.0000	0.0000	0	0
Relief Valves	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Connectors	Water	0	0.000243	1.00%	0.0000	0.0000	0	0
Other	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Valves	Light Liquid	1	0.0055	100.00%	0.01	0.02	0.0055	0.02409
Pump Seals	Light Liquid	0	0.02866	100.00%	0.0000	0.0000	0	0
Flanges	Light Liquid	0	0.000243	100.00%	0.0000	0.0000	0	0
Relief Valves	Light Liquid	0	0.0165	100.00%	0.0000	0.0000	0	0
Connectors	Light Liquid	4	0.000463	100.00%	0.002	0.01	0.001852	0.00811176
Other	Light Liquid	0	0.0165	100.00%	0.0000	0.0000	0	0
Totals:	---	20	---	---	0.05	0.22	0.057142	0.25028196

TABLE 2 (Continued)
EQUIPMENT FUGITIVE EMISSIONS
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY

Water Tanks								
Valves	Gas/Vapor	0	0.00992	50.00%	0.0000	0.0000	0	0
Flanges	Gas/Vapor	1	0.00086	50.00%	0.0004	0.002	0.00086	0.0037668
Compressor Seals	Gas/Vapor	0	0.0194	50.00%	0.0000	0.0000	0	0
Relief Valves	Gas/Vapor	0	0.0194	50.00%	0.0000	0.0000	0	0
Connectors	Gas/Vapor	12	0.00044	50.00%	0.003	0.01	0.00528	0.0231264
Other	Gas/Vapor	2.25	0.0194	50.00%	0.02	0.10	0.04365	0.191187
Valves	Water	1	0.000216	1.00%	0.0000	0.0000	0.000216	0.00094608
Pump Seals	Water	0	0.0000529	1.00%	0.0000	0.0000	0	0
Flanges	Water	0	0.00000617	1.00%	0.0000	0.0000	0	0
Relief Valves	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Connectors	Water	4	0.000243	1.00%	0.0000	0.0000	0.000972	0.00425736
Other	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Valves	Light Liquid	0	0.0055	100.00%	0.0000	0.0000	0	0
Pump Seals	Light Liquid	0	0.02866	100.00%	0.0000	0.0000	0	0
Flanges	Light Liquid	0	0.000243	100.00%	0.0000	0.0000	0	0
Relief Valves	Light Liquid	0	0.0165	100.00%	0.0000	0.0000	0	0
Connectors	Light Liquid	0	0.000463	100.00%	0.0000	0.0000	0	0
Other	Light Liquid	0	0.0165	100.00%	0.0000	0.0000	0	0
Totals:	---	20	---	---	0.02	0.11	0.050978	0.22328364

Unfired Separators								
Valves	Gas/Vapor	6	0.00992	20.00%	0.01	0.05	0.05952	0.2606976
Flanges	Gas/Vapor	0	0.00086	20.00%	0.0000	0.0000	0	0
Compressor Seals	Gas/Vapor	0	0.0194	20.00%	0.0000	0.0000	0	0
Relief Valves	Gas/Vapor	1	0.0194	20.00%	0.004	0.02	0.0194	0.084972
Connectors	Gas/Vapor	30	0.00044	20.00%	0.003	0.01	0.0132	0.057816
Other	Gas/Vapor	3	0.0194	20.00%	0.01	0.05	0.0582	0.254916
Valves	Water	0	0.000216	1.00%	0.0000	0.0000	0	0
Pump Seals	Water	0	0.0000529	1.00%	0.0000	0.0000	0	0
Flanges	Water	0	0.00000617	1.00%	0.0000	0.0000	0	0
Relief Valves	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Connectors	Water	0	0.000243	1.00%	0.0000	0.0000	0	0
Other	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Valves	Light Liquid	8	0.0055	45.00%	0.02	0.09	0.044	0.19272
Pump Seals	Light Liquid	0	0.02866	45.00%	0.0000	0.0000	0	0
Flanges	Light Liquid	1	0.000243	45.00%	0.0001	0.0004	0.000243	0.00106434
Relief Valves	Light Liquid	0	0.0165	45.00%	0.0000	0.0000	0	0
Connectors	Light Liquid	20	0.000463	45.00%	0.004	0.02	0.00926	0.0405588
Other	Light Liquid	2	0.0165	45.00%	0.01	0.07	0.033	0.14454
Totals:	---	71	---	---	0.07	0.30	0.236823	1.03728474

Heater Treaters								
Valves	Gas/Vapor	8	0.00992	65.00%	0.05	0.23	0.07936	0.3475968
Flanges	Gas/Vapor	0	0.00086	65.00%	0.0000	0.0000	0	0
Compressor Seals	Gas/Vapor	0	0.0194	65.00%	0.0000	0.0000	0	0
Relief Valves	Gas/Vapor	1	0.0194	65.00%	0.01	0.06	0.0194	0.084972
Connectors	Gas/Vapor	15	0.00044	65.00%	0.004	0.02	0.0066	0.028908
Other	Gas/Vapor	2	0.0194	65.00%	0.03	0.11	0.0388	0.169944
Valves	Water	3	0.000216	1.00%	0.0000	0.0000	0.000648	0.00283824
Pump Seals	Water	0	0.0000529	1.00%	0.0000	0.0000	0	0
Flanges	Water	0	0.00000617	1.00%	0.0000	0.0000	0	0
Relief Valves	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Connectors	Water	6	0.000243	1.00%	0.0000	0.0000	0.001458	0.00638604
Other	Water	2	0.0309	1.00%	0.001	0.003	0.0618	0.270684
Valves	Light Liquid	9	0.0055	100.00%	0.05	0.22	0.0495	0.21681
Pump Seals	Light Liquid	0	0.02866	100.00%	0.0000	0.0000	0	0
Flanges	Light Liquid	1	0.000243	100.00%	0.0002	0.001	0.000243	0.00106434
Relief Valves	Light Liquid	0	0.0165	100.00%	0.0000	0.0000	0	0
Connectors	Light Liquid	15	0.000463	100.00%	0.01	0.03	0.006945	0.0304191
Other	Light Liquid	2	0.0165	100.00%	0.03	0.14	0.033	0.14454
Totals:	---	64	---	---	0.18	0.81	0.297754	1.30416252

TABLE 2 (Continued)
EQUIPMENT FUGITIVE EMISSIONS
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY

Low Pressure Towers								
Valves	Gas/Vapor	3	0.00992	75.00%	0.02	0.10	0.02976	0.1303488
Flanges	Gas/Vapor	1	0.00086	75.00%	0.001	0.003	0.00086	0.0037668
Compressor Seals	Gas/Vapor	0	0.0194	75.00%	0.0000	0.0000	0	0
Relief Valves	Gas/Vapor	1	0.0194	75.00%	0.01	0.06	0.0194	0.084972
Connectors	Gas/Vapor	10	0.00044	75.00%	0.003	0.01	0.0044	0.019272
Other	Gas/Vapor	1	0.0194	75.00%	0.01	0.06	0.0194	0.084972
Valves	Water	0	0.000216	1.00%	0.0000	0.0000	0	0
Pump Seals	Water	0	0.0000529	1.00%	0.0000	0.0000	0	0
Flanges	Water	0	0.00000617	1.00%	0.0000	0.0000	0	0
Relief Valves	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Connectors	Water	0	0.000243	1.00%	0.0000	0.0000	0	0
Other	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Valves	Light Liquid	4	0.0055	100.00%	0.02	0.10	0.022	0.09636
Pump Seals	Light Liquid	0	0.02866	100.00%	0.0000	0.0000	0	0
Flanges	Light Liquid	0	0.000243	100.00%	0.0000	0.0000	0	0
Relief Valves	Light Liquid	0	0.0165	100.00%	0.0000	0.0000	0	0
Connectors	Light Liquid	15	0.000463	100.00%	0.01	0.03	0.006945	0.0304191
Other	Light Liquid	1	0.0165	100.00%	0.02	0.07	0.0165	0.07227
Totals:	---	36	---	---	0.10	0.44	0.119265	0.5223807

Flares								
Valves	Gas/Vapor	9	0.00992	80.00%	0.07	0.31	0.08928	0.3910464
Flanges	Gas/Vapor	2	0.00086	80.00%	0.001	0.01	0.00172	0.0075336
Compressor Seals	Gas/Vapor	0	0.0194	80.00%	0.0000	0.0000	0	0
Relief Valves	Gas/Vapor	0	0.0194	80.00%	0.0000	0.0000	0	0
Connectors	Gas/Vapor	20	0.00044	80.00%	0.01	0.03	0.0088	0.038544
Other	Gas/Vapor	3	0.0194	80.00%	0.05	0.20	0.0582	0.254916
Valves	Water	0	0.000216	1.00%	0.0000	0.0000	0	0
Pump Seals	Water	0	0.0000529	1.00%	0.0000	0.0000	0	0
Flanges	Water	0	0.00000617	1.00%	0.0000	0.0000	0	0
Relief Valves	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Connectors	Water	0	0.000243	1.00%	0.0000	0.0000	0	0
Other	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Valves	Light Liquid	3	0.0055	100.00%	0.02	0.07	0.0165	0.07227
Pump Seals	Light Liquid	0	0.02866	100.00%	0.0000	0.0000	0	0
Flanges	Light Liquid	0	0.000243	100.00%	0.0000	0.0000	0	0
Relief Valves	Light Liquid	0	0.0165	100.00%	0.0000	0.0000	0	0
Connectors	Light Liquid	8	0.000463	100.00%	0.004	0.02	0.003704	0.01622352
Other	Light Liquid	1	0.0165	100.00%	0.02	0.07	0.0165	0.07227
Totals:	---	46	---	---	0.16	0.71	0.194704	0.85280352

Wellheads								
Valves	Gas/Vapor	0	0.00992	30.00%	0.0000	0.0000	0	0
Flanges	Gas/Vapor	0	0.00086	30.00%	0.0000	0.0000	0	0
Compressor Seals	Gas/Vapor	0	0.0194	30.00%	0.0000	0.0000	0	0
Relief Valves	Gas/Vapor	0	0.0194	30.00%	0.0000	0.0000	0	0
Connectors	Gas/Vapor	0	0.00044	30.00%	0.0000	0.0000	0	0
Other	Gas/Vapor	0	0.0194	30.00%	0.0000	0.0000	0	0
Valves	Water	0	0.000216	1.00%	0.0000	0.0000	0	0
Pump Seals	Water	0	0.0000529	1.00%	0.0000	0.0000	0	0
Flanges	Water	0	0.00000617	1.00%	0.0000	0.0000	0	0
Relief Valves	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Connectors	Water	0	0.000243	1.00%	0.0000	0.0000	0	0
Other	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Valves	Light Liquid	8	0.0055	25.00%	0.01	0.05	0.044	0.19272
Pump Seals	Light Liquid	0	0.02866	25.00%	0.0000	0.0000	0	0
Flanges	Light Liquid	5	0.000243	25.00%	0.0003	0.001	0.001215	0.0053217
Relief Valves	Light Liquid	0	0.0165	25.00%	0.0000	0.0000	0	0
Connectors	Light Liquid	30	0.000463	25.00%	0.004	0.02	0.01389	0.0608382
Other	Light Liquid	3	0.0165	25.00%	0.01	0.05	0.0495	0.21681
Totals:	---	46	---	---	0.03	0.12	0.108605	0.4756899

TABLE 2 (Continued)
EQUIPMENT FUGITIVE EMISSIONS
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY

Compressors								
Valves	Gas/Vapor	3	0.00992	30.00%	0.01	0.04	0.02976	0.1303488
Flanges	Gas/Vapor	3	0.00086	30.00%	0.001	0.004	0.00258	0.0113004
Compressor Seals	Gas/Vapor	0	0.0194	30.00%	0.0000	0.0000	0	0
Relief Valves	Gas/Vapor	0	0.0194	30.00%	0.0000	0.0000	0	0
Connectors	Gas/Vapor	26	0.00044	30.00%	0.003	0.01	0.01144	0.0501072
Other	Gas/Vapor	0	0.0194	30.00%	0.0000	0.0000	0	0
Valves	Water	0	0.000216	1.00%	0.0000	0.0000	0	0
Pump Seals	Water	0	0.0000529	1.00%	0.0000	0.0000	0	0
Flanges	Water	0	0.00000617	1.00%	0.0000	0.0000	0	0
Relief Valves	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Connectors	Water	0	0.000243	1.00%	0.0000	0.0000	0	0
Other	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Valves	Light Liquid	8	0.0055	25.00%	0.01	0.05	0.044	0.19272
Pump Seals	Light Liquid	0	0.02866	25.00%	0.0000	0.0000	0	0
Flanges	Light Liquid	10	0.000243	25.00%	0.001	0.003	0.00243	0.0106434
Relief Valves	Light Liquid	0	0.0165	25.00%	0.0000	0.0000	0	0
Connectors	Light Liquid	40	0.000463	25.00%	0.005	0.02	0.01852	0.0811176
Other	Light Liquid	3	0.0165	25.00%	0.01	0.05	0.0495	0.21681
Totals:	---	93	---	---	0.04	0.18	0.15823	0.6930474

Generators (NG)								
Valves	Gas/Vapor	3	0.00992	30.00%	0.01	0.04	0.02976	0.1303488
Flanges	Gas/Vapor	3	0.00086	30.00%	0.001	0.004	0.00258	0.0113004
Compressor Seals	Gas/Vapor	0	0.0194	30.00%	0.0000	0.0000	0	0
Relief Valves	Gas/Vapor	0	0.0194	30.00%	0.0000	0.0000	0	0
Connectors	Gas/Vapor	26	0.00044	30.00%	0.003	0.01	0.01144	0.0501072
Other	Gas/Vapor	0	0.0194	30.00%	0.0000	0.0000	0	0
Valves	Water	0	0.000216	1.00%	0.0000	0.0000	0	0
Pump Seals	Water	0	0.0000529	1.00%	0.0000	0.0000	0	0
Flanges	Water	0	0.00000617	1.00%	0.0000	0.0000	0	0
Relief Valves	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Connectors	Water	0	0.000243	1.00%	0.0000	0.0000	0	0
Other	Water	0	0.0309	1.00%	0.0000	0.0000	0	0
Valves	Light Liquid	0	0.0055	25.00%	0.0000	0.0000	0	0
Pump Seals	Light Liquid	0	0.02866	25.00%	0.0000	0.0000	0	0
Flanges	Light Liquid	0	0.000243	25.00%	0.0000	0.0000	0	0
Relief Valves	Light Liquid	0	0.0165	25.00%	0.0000	0.0000	0	0
Connectors	Light Liquid	0	0.000463	25.00%	0.0000	0.0000	0	0
Other	Light Liquid	0	0.0165	25.00%	0.0000	0.0000	0	0
Totals:	---	32	---	---	0.01	0.06	0.04378	0.1917564

TABLE 3
GAS ANALYSIS
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY

Component	Mole %	Molecular Weight	lb/100 mole	Wt % Total	Wt % Hydrocarbon	Wt % VOC
H2S	0.0023	34.08	0.08	0.004	--	--
H2O	0.0000	18.00	0.00	0.00	--	--
N2	0.1870	28.01	5.24	0.24	--	--
CO2	0.9010	44.01	39.65	1.84	--	--
Methane	75.7017	16.04	1214.26	56.39	56.39	--
Ethane	13.8550	30.07	416.62	19.35	19.35	--
Propane	6.2080	44.10	273.77	12.71	12.71	12.98%
Isobutane	0.7210	58.12	41.90	1.95	1.95	1.99%
n-Butane	1.5270	58.12	88.75	4.12	4.12	4.21%
Isopentane	0.2960	72.15	21.36	0.99	0.99	1.01%
n-Pentane	0.3060	72.15	22.08	1.03	1.03	1.05%
Hexanes+	0.2950	100.00	29.50	1.37	1.37	1.40%
Total	100.00	--	2153.21	99.99	97.91	22.64%

Notes:

- Gas analysis provided by SPL sampled 2/12/2015.
The H2S has been increased to 23 ppm due to wells in the area showing higher H2S.
The methane has been decreased to account for the additional H2S.
This representative analysis is from a nearby site.
- Wt % VOC is the VOC % in the hydrocarbon portion of the gas.

TABLE 4
NORMALIZING PROMAX RESULTS
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY

Promax was run using estimated production levels to predict emissions from the equipment at the pad. The results have been normalized to determine the lb of VOC emissions per bbl of oil/water produced. The lb/bbl factors are used in this evaluation.

Promax Inputs:

1000 BOPD
324 BWPD
1692 MCFD

Promax Results:

Calculated emission factor (lb/bbl) for oil/water tank:

= 12.82 lb VOC/bbl oil/water

TABLE 5
ESTIMATED MAXIMUM HOURLY EMISSIONS FROM STORAGE TANK
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY

Identification - Vertical Fixed Roof Tanks	
Tank ID	Tank 1 Oil/Water Combo
State	Texas
Description	400 BBL Tank
Throughput (BPD)	10
Tank Dimensions	
Shell Height (ft)	20.0
Diameter (ft)	12.0
Volume (gal)	16,800
Turnovers	9.13
Net Throughput (gal/yr)	153,300
Other Inputs	
Shell & Roof Color/Shade	White
Shell & Roof Condition	Good
Meteorological Data	San Antonio, Texas
Tank Contents	
Mixture/Component	Gasoline (RVP 7.8)
Tank VOC Emissions	
VOC Standing & Working Losses (lb/yr) ^a	2,069.17
VOC Standing & Working Losses (lb/hr) ^a	0.24
VOC Loss Factor (lb/bbl) ^b	12.82
Total VOC Emissions (lb/hr) ^c	5.58

^a Standing and working losses calculated using the TANKS 4.0.9d methodology.
Hourly emissions are based on annual / 8760 hr/yr.

^b Emission factors developed from Promax run. See Table 4.

^c Total VOC Emissions (lb/hr) = (VOC Loss Factor (lb VOC/bbl oil) x Throughput (bbl/day) / 24 hr/day) + Standing & Working Losses (lb/hr)

TABLE 6
ESTIMATED MAXIMUM HOURLY EMISSIONS FROM CRUDE OIL/WATER LOADING
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY

Pad Name	Material Name	Saturation Factor^a (S)	Max True Vapor Pressure^b (P)	Molecular Weight of Vapors^b (M) (lb/lb-mole)	Temp of Loaded Liquid^b (F)	Emission Factor^a (lb VOC/10³ gal)	Estimated Hourly Throughput^c (gal)	Total Hourly VOC Emissions^d (lb/hr)
Rogers J Pad	Oil/Water	0.6	6.34	68	95	5.81	8,000	46.48

^a Per AP-42, 5th Edition (6/08), Section 5.2, Equation 1

$$\text{Emission Factor (lb VOC/10}^3\text{gal)} = \frac{S \times P \times M \times 12.46}{F + 460}$$

Saturation Factor = 0.6 for submerged loading: dedicated normal service

^b True vapor pressure, weight of vapors and temp of loaded liquid obtained from TANKS 4.0.9d using Gasoline (RVP 7.8).

^c Throughput is the amount of oil/water loaded out from tank(s).

^d Hourly Emissions = Hourly Throughput / 1000 x Emission Factor

TABLE 7
ESTIMATED ANNUAL EMISSIONS FROM STORAGE TANK
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMITT COUNTY

Identification - Vertical Fixed Roof Tanks	
Tank ID	Tank 1 Oil/Water Combo
State	Texas
Description	400 BBL Tank
Throughput (BBL)	365
Tank Dimensions	
Shell Height (ft)	20.0
Diameter (ft)	12.0
Volume (gal)	16,800
Turnovers	0.91
Net Throughput (gal/yr)	15,330
Other Inputs	
Shell & Roof Color/Shade	White
Shell & Roof Condition	Good
Meteorological Data	San Antonio, Texas
Tank Contents	
Mixture/Component	Gasoline (RVP 7.8)
Tank VOC Emissions	
VOC Standing Losses (T/yr) ^a	0.43
VOC Working Losses (T/yr) ^a	0.06
VOC Loss Factor (lb/bbl) ^b	12.82
Total VOC Emissions (T/yr) ^c	2.83

^a Standing and working losses calculated using the TANKS 4.0.9d methodology.

^b Emission factors developed from Promax run. See Table 4.

^c Total VOC Losses (T/yr) = (VOC Loss Factor (lb VOC/bbl oil) x Throughput (bbl) x 1T/2000 lb) + Standing Losses (T/yr) + Working Losses (T/yr)

TABLE 8
ESTIMATED ANNUAL EMISSIONS FROM CRUDE OIL/WATER LOADING
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY

Pad Name	Material Name	Saturation Factor ^a (S)	Avg True Vapor Pressure ^b (P)	Molecular Weight of Vapors ^b (M) (lb/lb-mole)	Temp of Loaded Liquid ^b (F)	Emission Factor ^a (lb VOC/10 ³ gal)	Annual Throughput ^c (gals)	Total Annual VOC Emissions ^d (T/yr)
Rogers J Pad	Oil/Water	0.6	4.85	68.00	68.60	4.66	15,330	0.04

^a Per AP-42, 5th Edition (6/08), Section 5.2, Equation 1

$$\text{Emission Factor (lb VOC/10}^3\text{gal)} = \frac{S \times P \times M \times 12.46}{F + 460}$$

Saturation Factor = 0.6 for submerged loading: dedicated normal service

^b True vapor pressure, weight of vapors and temp of loaded liquid obtained from TANKS 4.0.9d using Gasoline (RVP 7.8).

^c Throughput is the amount of oil/water loaded out from tank(s).

^d Uncontrolled Annual VOC Emissions = Annual Throughput / 1000 x Emission Factor / 2000 lb/T

TABLE 9
ESTIMATED EMISSIONS FROM 230 HP OR SMALLER ENGINE (230 HP) NATURAL GAS-FIRED ENGINE - ENG 1
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY

Input Parameters for Emission Calculations

Design Firing Rating	1.84	MMBtu/hr
Engine Rating	230	Horse Power
Fuel Consumption	8000	BTU/hp-hr
Operating Hours per Year	8,760	hr/yr

Annual Natural Gas Usage Per Year	16118	MMBtu/Yr
Average Heating Value of Gas Burned	1265	Btu/Cubic Feet
Estimated Natural Gas Usage Per Hour	0.001455	MM Cubic Feet/Hr

POLLUTANT	EMISSION FACTOR	CAPACITY	CONVERSION FACTOR	HOURLY EMISSIONS	ANNUAL OPERATING HOURS	WEIGHT CONVERSION	ANNUAL EMISSIONS
NOx ^a	1 $\frac{\text{g NOx}}{\text{hp-hr}}$ x	230 HP	x 0.0022 $\frac{\text{lb}}{\text{gr}}$	= 0.51 $\frac{\text{lb NOx}}{\text{hr}}$	8760 $\frac{\text{Hours}}{\text{yr}}$ x	$\frac{1}{2000} \frac{\text{ton}}{\text{lbs}}$	= 2.22 $\frac{\text{tons NOx}}{\text{yr}}$
CO ^a	2 $\frac{\text{g CO}}{\text{hp-hr}}$ x	230 HP	x 0.0022 $\frac{\text{lb}}{\text{gr}}$	= 1.01 $\frac{\text{lb CO}}{\text{hr}}$	8760 $\frac{\text{Hours}}{\text{yr}}$ x	$\frac{1}{2000} \frac{\text{ton}}{\text{lbs}}$	= 4.43 $\frac{\text{tons CO}}{\text{yr}}$
VOC ^a	0.7 $\frac{\text{g VOC}}{\text{hp-hr}}$ x	230 HP	x 0.0022 $\frac{\text{lb}}{\text{gr}}$	= 0.35 $\frac{\text{lb VOC}}{\text{hr}}$	8760 $\frac{\text{Hours}}{\text{yr}}$ x	$\frac{1}{2000} \frac{\text{ton}}{\text{lbs}}$	= 1.55 $\frac{\text{tons VOC}}{\text{yr}}$
CH ₂ O ^a	0.0205 $\frac{\text{lb CH}_2\text{O}}{\text{MMBtu}}$ x	1.84 $\frac{\text{MMBtu}}{\text{hr}}$		= 0.04 $\frac{\text{lb CH}_2\text{O}}{\text{hr}}$	8760 $\frac{\text{Hours}}{\text{yr}}$ x	$\frac{1}{2000} \frac{\text{ton}}{\text{lbs}}$	= 0.17 $\frac{\text{tons CH}_2\text{O}}{\text{yr}}$
SO ₂ ^a	0.0042 $\frac{\text{lb SO}_2}{\text{MMBtu}}$ x	1.84 $\frac{\text{MMBtu}}{\text{hr}}$		= 0.01 $\frac{\text{lb SO}_2}{\text{hr}}$	8760 $\frac{\text{Hours}}{\text{yr}}$ x	$\frac{1}{2000} \frac{\text{ton}}{\text{lbs}}$	= 0.03 $\frac{\text{tons SO}_2}{\text{yr}}$
PM ₁₀ ^a	0.01941 $\frac{\text{lb PM}_{10}}{\text{MMBtu}}$ x	1.84 $\frac{\text{MMBtu}}{\text{hr}}$		= 0.04 $\frac{\text{lb PM}_{10}}{\text{hr}}$	8760 $\frac{\text{Hours}}{\text{yr}}$ x	$\frac{1}{2000} \frac{\text{ton}}{\text{lbs}}$	= 0.16 $\frac{\text{tons PM}_{10}}{\text{yr}}$

^a Emission Factors obtained from NSPS Subpart JJJJ and AP-42.

NOx Emission Factor =	1	Grams/HP-HR NSPS Subpart JJJJ Table 1.
CO Emission Factor =	2	Grams/HP-HR NSPS Subpart JJJJ Table 1.
VOC Emission Factor =	0.7	Grams/HP-HR NSPS Subpart JJJJ Table 1.
CH ₂ O Emission Factor =	0.0205	lb/MMBtu AP-42 Table 3.2-3
SO ₂ Emission Factor =	0.00416	lb/MMBtu AP-42 scaled to 23 ppm H ₂ S
PM ₁₀ Emission Factor =	0.01941	lb/MMBtu AP-42 Table 3.2-3

TABLE 10
POTENTIAL EMISSIONS FROM UNCONTROLLED MSS ACTIVITIES
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY

UNCONTROLLED MSS RATES							
Uncontrolled MSS Rates and Gas Composition							
Volume of Gas (MCF/Hr)		1					
Volume of Gas (MCF/Yr)		1940					
	Mole %	MCF/Hr	Cu Ft/ #	lbs/hr	MCF/Yr	Cu Ft/ #	lbs/yr
N2	0.1870%	0.002	13.5460	0.15	3.628	13.5460	267.83
CO2	0.9010%	0.009	8.6229	1.04	17.479	8.6229	2027.04
H2S	0.0023%	0.00002	11.1351	0.002	0.0446	11.1351	4.01
C1	75.7017%	0.757	23.6540	32.00	1468.613	23.6540	62087.30
C2	13.8550%	0.139	12.6200	11.01	268.787	12.6200	21298.49
C3	6.2080%	0.062	8.6059	7.20	120.435	8.6059	13994.47
IC4	0.7210%	0.007	6.5291	1.07	13.987	6.5291	2142.26
NC4	1.5270%	0.015	6.5291	2.30	29.624	6.5291	4537.23
IC5	0.2960%	0.003	5.2596	0.57	5.742	5.2596	1091.72
NC5	0.3060%	0.003	5.2596	0.57	5.936	5.2596	1128.60
C6+	0.2950%	0.003	4.4035	0.68	5.723	4.4035	1299.65
Total	100.00%	1.000		56.59	1939.999		109878.60
Total VOC (lbs)				12.39	24193.93		
					Total VOC (T/yr) 12.10		

Notes:

1. It is estimated that up to 1000 cubic feet of gas could be vented to atmosphere during an uncontrolled MSS activity and one event could occur per hour.
2. It is estimated that up to 1940 MCF of gas could be released per year from uncontrolled MSS activities.

TABLE 11
POTENTIAL EMISSIONS FROM CONTROLLED MSS EMISSIONS
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY

40 CFR 98.223(f)(2)

$$E_{s,n} = \sum_{p=1} V_p \times \left((0.37 \times 10^{-3}) \times (CD_p)^2 \times WD_p \times SP_p \right) + \sum_{q=1} (SFR_p \times (HR_{p,q} - 1))$$

where:

$w = 1$, $V_p = 1$ (i.e. one well and one event)

V _p		CD _p or TD _p		WD _p		SP _p		SFR _p		HR _{p,q}		Z _{p,q}		Equation 1st term		Equation 2nd term		E _{s,n}	
Value	Units	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units
1		2.375	inch	15000	feet	350.00	psia	62,500	scf/hr	720	hours	1		10,957	scf	44,937,500	scf	44,948,457	scf

Well Unloading MSS Emissions							
Volume of Gas (MCF/Hr)			62.5				
Volume of Gas (MCF/Yr)			44,948				
	Mole %	MCF/Hr	Cu Ft / #	lbs/hr	MCF/Yr	Cu Ft / #	lbs/yr
N2	0.1870%	0.117	13.5460	8.64	84.053	13.5460	6,205.01
CO2	0.9010%	0.563	8.6229	65.29	404.981	8.6229	46,965.75
H2S	0.0023%	0.00144	11.1351	0.13	1.0338	11.1351	92.84
C1	75.7017%	47.314	23.6540	2,000.25	34026.400	23.6540	1,438,505.12
C2	13.8550%	8.659	12.6200	686.13	6227.545	12.6200	493,466.32
C3	6.2080%	3.880	8.6059	450.85	2790.372	8.6059	324,239.42
IC4	0.7210%	0.451	6.5291	69.08	324.075	6.5291	49,635.48
NC4	1.5270%	0.954	6.5291	146.12	686.356	6.5291	105,122.60
IC5	0.2960%	0.185	5.2596	35.17	133.046	5.2596	25,295.84
NC5	0.3060%	0.191	5.2596	36.31	137.541	5.2596	26,150.47
C6+	0.2950%	0.184	4.4035	41.78	132.597	4.4035	30,111.73
Total	100.00%	62.499		3,539.75	44948.000		2,545,790.58
Total VOC (lb/hr)				779.31			560,556
					Total VOC (T/yr)		280.28
					Flare Destruction Efficiency		98%
					Controlled VOC (T/yr)		5.61
					Controlled VOC (lb/hr)		15.58

TCEQ Flare NOx factor ^a :	0.1380 lb/MMBtu
TCEQ Flare CO factor ^a :	0.2755 lb/MMBtu
Gas Heating Value:	1264.5 Btu/scf
Flare tip diameter:	0.25 ft
Flare tip velocity:	353.68 ft/sec
NOx emissions from flare:	3.92 T/yr
CO emissions from flare:	7.83 T/yr
NOx emissions from flare:	10.91 lb/hr
CO emissions from flare:	21.77 lb/hr

^a Flare CO and NOx emission factors from TCEQ Air Permit Technical Guidance for Chemical Sources: Flares and Vapor Oxidizers, October 2000 RG-109 (Draft), Table 4, high Btu, "other" flare type.

TABLE 12
CONTROLLED MSS - SO₂ EMISSIONS
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY

Standard Pressure:	14.7 psi	
Gas Constant:	10.73 psi ft ³ /lb mol/R	
Std Temp:	528 deg R	
H ₂ S Volume Constant:	11.1351 cu ft/lb	
H ₂ S Volume:	1.44 scf/hr	(See Table 11)
	1033.80 scf/yr	(See Table 11)

SO₂ Emissions:

$$PV = nRT$$

$$\begin{aligned} \text{lb mole H}_2\text{S/yr} &= \frac{\text{Volume (V)} \times \text{Pressure (P)}}{\text{Gas Constant (R)} \times \text{Std Temp (T)}} \\ &= 2.682 \text{ lb mole H}_2\text{S/yr} \end{aligned}$$

$$\begin{aligned} \text{lb mole H}_2\text{S/hr} &= \frac{\text{Volume (V)} \times \text{Pressure (P)}}{\text{Gas Constant (R)} \times \text{Std Temp (T)}} \\ &= 0.004 \text{ lb mole H}_2\text{S/hr} \end{aligned}$$

One Mole H₂S will form one mole SO₂:

$$\begin{aligned} \text{SO}_2 \text{ (T/yr)} &= \frac{\text{lb mole H}_2\text{S/yr} \times 1 \text{ lb mole SO}_2/\text{lb mole H}_2\text{S}}{1 \text{ lb mole SO}_2/64 \text{ lb}} \times \frac{1 \text{ T}}{2000 \text{ lb}} \\ &= \boxed{0.09 \text{ T SO}_2/\text{yr}} \end{aligned}$$

$$\begin{aligned} \text{SO}_2 \text{ (lb/hr)} &= \frac{\text{lb mole H}_2\text{S/hr} \times 1 \text{ lb mole SO}_2/\text{lb mole H}_2\text{S}}{1 \text{ lb mole SO}_2/64 \text{ lb}} \\ &= \boxed{0.26 \text{ lb SO}_2/\text{hr}} \end{aligned}$$

TABLE 13
NO2 SCREEN MODELING INPUTS AND RESULTS
CHESAPEAKE OPERATING, LLC
ROGERS J PAD
DIMMIT COUNTY

	ENG 1		Total	
Inputs				
NO _x Emission Rate	0.51 lb/hr NOx	0.0643 g/sec		
NO _x /NO ₂ Conversion Factor	0.2			
NO ₂ Emission Rate	0.1020 lb/hr NO ₂	0.0129 g/sec		
Stack Height	10.00 ft	3.0480 m		
Stack Inside Diameter	0.33 ft	0.1006 m		
Stack Exit Velocity	130.00 ft/sec	39.6240 m/sec		
Stack Gas Exit Temp	1,200 ° F	922.0389 ° K		
Ambient Air Temp	--	293 ° K		
Receptor Height	0 ft	0 m		
Urban/Rural	Rural	Rural		
Downwash	None	None		
Distance to Property Line	315 ft	96 m		
Number of Identical Emission Points		1		
Screen Modeling Results (hourly)				
Maximum Modeled Concentration at Property Line		8.97	µg/m ³	
Hourly Results				
Modeled Concentration			8.97	µg/m ³
Background Concentration			70.0	µg/m ³
Total Concentration			79.0	µg/m ³
Is Total Concentration less than 188 µg/m ³ ?			Yes	
Annual Results				
Conversion Factor (hourly to annual)			0.08	
Annual Concentration			0.72	µg/m ³
Background Concentration			20.00	µg/m ³
Total Concentration			20.72	µg/m ³
Is Total Concentration less than 100 µg/m ³ ?			Yes	

11/28/16
13:13:32

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 13043 ***

Rogers J ENG 1 NO2

SIMPLE TERRAIN INPUTS:

SOURCE TYPE = POINT
EMISSION RATE (G/S) = 0.129000E-01
STACK HEIGHT (M) = 3.0480
STK INSIDE DIAM (M) = 0.1006
STK EXIT VELOCITY (M/S) = 39.6240
STK GAS EXIT TEMP (K) = 922.0389
AMBIENT AIR TEMP (K) = 293.1500
RECEPTOR HEIGHT (M) = 0.0000
URBAN/RURAL OPTION = RURAL
BUILDING HEIGHT (M) = 0.0000
MIN HORIZ BLDG DIM (M) = 0.0000
MAX HORIZ BLDG DIM (M) = 0.0000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 0.671 M**4/S**3; MOM. FLUX = 1.263 M**4/S**2.

*** FULL METEOROLOGY ***

*** SCREEN AUTOMATED DISTANCES ***

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
96.	8.970	4	4.5	4.5	1440.0	6.58	7.96	4.60	NO
100.	8.933	4	4.5	4.5	1440.0	6.58	8.26	4.76	NO
200.	6.804	4	2.0	2.0	640.0	10.99	15.73	8.80	NO
300.	5.294	4	1.5	1.5	480.0	13.63	22.81	12.47	NO
400.	4.271	4	1.0	1.0	320.0	18.92	29.80	15.93	NO
500.	3.613	4	1.0	1.0	320.0	18.92	36.43	18.85	NO
600.	3.012	4	1.0	1.0	320.0	18.92	42.96	21.69	NO
700.	2.520	4	1.0	1.0	320.0	18.92	49.40	24.46	NO
800.	2.127	4	1.0	1.0	320.0	18.92	55.76	27.16	NO
900.	2.094	6	1.0	1.0	10000.0	24.64	31.39	14.37	NO
1000.	2.121	6	1.0	1.0	10000.0	24.64	34.44	15.26	NO
1100.	2.102	6	1.0	1.0	10000.0	24.64	37.47	16.05	NO
1200.	2.063	6	1.0	1.0	10000.0	24.64	40.49	16.83	NO
1300.	2.013	6	1.0	1.0	10000.0	24.64	43.48	17.59	NO
1400.	1.954	6	1.0	1.0	10000.0	24.64	46.46	18.33	NO

1500.	1.890	6	1.0	1.0	10000.0	24.64	49.42	19.06	NO
1600.	1.824	6	1.0	1.0	10000.0	24.64	52.36	19.77	NO
1700.	1.758	6	1.0	1.0	10000.0	24.64	55.28	20.47	NO
1800.	1.693	6	1.0	1.0	10000.0	24.64	58.20	21.15	NO
1900.	1.628	6	1.0	1.0	10000.0	24.64	61.09	21.83	NO
2000.	1.566	6	1.0	1.0	10000.0	24.64	63.97	22.49	NO
2100.	1.505	6	1.0	1.0	10000.0	24.64	66.84	23.05	NO
2200.	1.447	6	1.0	1.0	10000.0	24.64	69.70	23.60	NO
2300.	1.393	6	1.0	1.0	10000.0	24.64	72.54	24.14	NO
2400.	1.341	6	1.0	1.0	10000.0	24.64	75.37	24.67	NO
2500.	1.292	6	1.0	1.0	10000.0	24.64	78.19	25.19	NO
2600.	1.246	6	1.0	1.0	10000.0	24.64	81.00	25.70	NO
2700.	1.202	6	1.0	1.0	10000.0	24.64	83.80	26.21	NO
2800.	1.160	6	1.0	1.0	10000.0	24.64	86.59	26.70	NO
2900.	1.121	6	1.0	1.0	10000.0	24.64	89.36	27.19	NO
3000.	1.084	6	1.0	1.0	10000.0	24.64	92.13	27.67	NO
3500.	0.9267	6	1.0	1.0	10000.0	24.64	105.83	29.63	NO
4000.	0.8050	6	1.0	1.0	10000.0	24.64	119.33	31.45	NO
4500.	0.7084	6	1.0	1.0	10000.0	24.64	132.65	33.15	NO
5000.	0.6302	6	1.0	1.0	10000.0	24.64	145.80	34.76	NO
5500.	0.5658	6	1.0	1.0	10000.0	24.64	158.81	36.29	NO
6000.	0.5121	6	1.0	1.0	10000.0	24.64	171.69	37.74	NO
6500.	0.4666	6	1.0	1.0	10000.0	24.64	184.45	39.13	NO
7000.	0.4277	6	1.0	1.0	10000.0	24.64	197.09	40.47	NO
7500.	0.3950	6	1.0	1.0	10000.0	24.64	209.63	41.62	NO
8000.	0.3665	6	1.0	1.0	10000.0	24.64	222.07	42.73	NO
8500.	0.3414	6	1.0	1.0	10000.0	24.64	234.42	43.79	NO
9000.	0.3193	6	1.0	1.0	10000.0	24.64	246.68	44.83	NO
9500.	0.2996	6	1.0	1.0	10000.0	24.64	258.87	45.82	NO
10000.	0.2819	6	1.0	1.0	10000.0	24.64	270.97	46.79	NO
15000.	0.1733	6	1.0	1.0	10000.0	24.64	388.48	55.23	NO
20000.	0.1245	6	1.0	1.0	10000.0	24.64	500.99	60.61	NO
25000.	0.9623E-01	6	1.0	1.0	10000.0	24.64	609.78	65.15	NO
30000.	0.7791E-01	6	1.0	1.0	10000.0	24.64	715.61	69.11	NO
40000.	0.5654E-01	6	1.0	1.0	10000.0	24.64	920.24	74.74	NO
50000.	0.4409E-01	6	1.0	1.0	10000.0	24.64	1117.44	79.43	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND					96. M:				
96.	8.970	4	4.5	4.5	1440.0	6.58	7.96	4.60	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

 *** SUMMARY OF SCREEN MODEL RESULTS ***

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
-----	-----	-----	-----
SIMPLE TERRAIN	8.970	96.	0.



Certificate of Analysis

Number: 4030-15020365-019A

Pleasanton Laboratory

627 2nd Street
Pleasanton, TX 78064
Phone 877-SPL-LABS

Jonathan A. Wilson
Chesapeake Energy Corporation
1164 FM2367
Carrizo Springs, TX 78834

Feb. 27, 2015

Station Name: Rogers B 2H CTALL
Station Number: 1283246602
Station Location: CARRIZO SPRINGS-COI, TX
Sample Point: Downstream
Property ID: 832466
Analyzed: 02/27/2015 14:29:17 by VT

Sampled By: JOSE
Sample Of: Gas Spot
Sample Date: 02/12/2015
Sample Conditions: 118.5 psig, @ 62.56 °F
Method: GPA-2261M
Cylinder No: 4030-00581

Analytical Data

Components	Mol. %	Wt. %	GPM at 14.73 psia		
Nitrogen	0.187	0.244		GPM TOTAL C2+	6.504
Carbon Dioxide	0.901	1.843		GPM TOTAL C3+	2.785
Methane	75.704	56.452		GPM TOTAL iC5+	0.349
Ethane	13.855	19.365	3.719		
Propane	6.208	12.725	1.716		
Iso-butane	0.721	1.948	0.237		
n-Butane	1.527	4.126	0.483		
Iso-pentane	0.296	0.993	0.109		
n-Pentane	0.306	1.026	0.111		
Hexanes***	0.177	0.709	0.073		
Heptanes***	0.088	0.410	0.041		
Octanes***	0.030	0.159	0.015		
	100.000	100.000	6.504		

Physical Properties	Total
Relative Density Real Gas	0.7453
Calculated Molecular Weight	21.51
Compressibility Factor	0.9962

GPA 2172-09 Calculation:

Calculated Gross BTU per ft³ @ 14.73 psia & 60°F

Real Gas Dry BTU	1286.4
Water Sat. Gas Base BTU	1264.5
As Delivered BTU	1283

Comments: H₂O Mol% : 1.740 ; Wt% : 1.461
Note *** denotes 60% C₆, 30% C₇, 10% C₈
H₂S 7 ppm

Hydrocarbon Laboratory Manager

Quality Assurance: The above analyses are performed in accordance with ASTM, UOP, GPA guidelines for quality assurance, unless otherwise stated.

EPA TANKS 4.0.9d FIXED-ROOF TANK EMISSIONS - ANNUAL
ROGERS J PAD
DIMMIT COUNTY

Tank Identification	Tank 1 Oil/Water Combo
Actual Location	Dimmit County
Location for Calculation Purposes	San Antonio, Texas
Contents of Tank	Gasoline (RVP 7.8)
Tank/Roof Type	Cone
Underground?	Aboveground
Diameter, ft	12.0
Shell Height or Length, ft	20.0
Nominal Capacity, gal	16800
Throughput, gallons/yr	15330
Tank Paint Color	White
Tank Paint Condition	Good
Effective Diameter, ft	12.0
Geometric Capacity, gal	16920
Maximum Liquid Height, ft	19.0
Average Liquid Height, ft	14.0
Cone Tank Roof Slope, ft/ft	0.0625
Dome Tank Roof Radius, ft	N/A
Dome Tank Roof Height, ft	N/A
Roof Outage, ft	0.1250
Vapor Space Outage, ft	6.1250
Vapor Space Volume, ft^3	692.7212
Average Daily Minimum Ambient Temperature, F	57.7250
Average Daily Maximum Ambient Temperature, F	79.5083
Daily Total Solar Insolation Factor, Btu/ft^2/day	1568.8737
Daily Average Ambient Temperature, F	68.6167
Tank Paint Solar Absorbance, dimensionless	0.17
Daily Vapor Temperature Range, R	23.1518
Daily Average Liquid Surf. Temperature, F	70.7349
Daily Minimum Liquid Surf. Temperature, F	64.9470
Daily Maximum Liquid Surf. Temperature, F	76.5229
Liquid Bulk Temperature	68.6367
Vapor Molecular Weight, lb/lbmol	68.0
Antoine's Coefficient A	N/A
Antoine's Coefficient B	N/A
Antoine's Coefficient C	N/A
Type of Substance (for use in calculations)	Gas
Vapor Pressure at Daily Av. Liquid Surf. Temp., psia	4.8549
Vapor Pressure at Daily Min. Liquid Surf. Temp., psia	4.3372
Vapor Pressure at Daily Max. Liquid Surf. Temp., psia	5.4213
Vapor Pressure Calculation Method	AP-42 Figure 7.1-14b: RVP=7.8 ASTM Slope=3
Vapor Density, lb/ft^3	0.0580
Daily Vapor Pressure range, psi	1.0841
Breather Vent Pressure Setting, psig	0.03
Breather Vent Vacuum Setting, psig	-0.03
Breather Vent Pressure Setting Range, psi	0.06
Ambient Pressure, psia	14.3260
Vapor Space Expansion Factor	0.1518
Vented Vapor Saturation Factor	0.3882
Annual Turnovers	0.9060
Turnover Factor	1.0000
Working Loss Product Factor	1.00
Standing Storage Loss, lb/yr	864.18483
Working Loss, lb/yr	120.49862
Total Losses, lb/yr	984.68345
Standing Storage Loss, TPY	0.43209
Working Loss, TPY	0.06025
Total Losses, TPY	0.49234

Based on AP-42, February 1996, Section 7.1.3.1.

EPA TANKS 4.0.9d FIXED-ROOF TANK EMISSIONS - HOURLY
ROGERS J PAD
DIMMIT COUNTY

Tank Identification	Tank 1 Oil/Water Combo
Actual Location	Dimmit County
Location for Calculation Purposes	San Antonio, Texas
Contents of Tank	Gasoline (RVP 7.8)
Tank/Roof Type	Cone
Underground?	Aboveground
Diameter, ft	12.0
Shell Height or Length, ft	20.0
Nominal Capacity, gal	16800
Throughput, gallons/yr	153300
Tank Paint Color	White
Tank Paint Condition	Good
Effective Diameter, ft	12.0
Geometric Capacity, gal	16920
Maximum Liquid Height, ft	19.0
Average Liquid Height, ft	14.0
Cone Tank Roof Slope, ft/ft	0.0625
Dome Tank Roof Radius, ft	N/A
Dome Tank Roof Height, ft	N/A
Roof Outage, ft	0.1250
Vapor Space Outage, ft	6.1250
Vapor Space Volume, ft^3	692.7212
Average Daily Minimum Ambient Temperature, F	57.7250
Average Daily Maximum Ambient Temperature, F	79.5083
Daily Total Solar Insolation Factor, Btu/ft^2/day	1568.8737
Daily Average Ambient Temperature, F	68.6167
Tank Paint Solar Absorbance, dimensionless	0.17
Daily Vapor Temperature Range, R	23.1518
Daily Average Liquid Surf. Temperature, F	70.7349
Daily Minimum Liquid Surf. Temperature, F	64.9470
Daily Maximum Liquid Surf. Temperature, F	76.5229
Liquid Bulk Temperature	68.6367
Vapor Molecular Weight, lb/lbmol	68.0
Antoine's Coefficient A	N/A
Antoine's Coefficient B	N/A
Antoine's Coefficient C	N/A
Type of Substance (for use in calculations)	Gas
Vapor Pressure at Daily Av. Liquid Surf. Temp., psia	4.8549
Vapor Pressure at Daily Min. Liquid Surf. Temp., psia	4.3372
Vapor Pressure at Daily Max. Liquid Surf. Temp., psia	5.4213
Vapor Pressure Calculation Method	AP-42 Figure 7.1-14b: RVP=7.8 ASTM Slope=3
Vapor Density, lb/ft^3	0.0580
Daily Vapor Pressure range, psi	1.0841
Breather Vent Pressure Setting, psig	0.03
Breather Vent Vacuum Setting, psig	-0.03
Breather Vent Pressure Setting Range, psi	0.06
Ambient Pressure, psia	14.3260
Vapor Space Expansion Factor	0.1518
Vented Vapor Saturation Factor	0.3882
Annual Turnovers	9.0603
Turnover Factor	1.0000
Working Loss Product Factor	1.00
Standing Storage Loss, lb/yr	864.18483
Working Loss, lb/yr	1204.98618
Total Losses, lb/yr	2069.17101
Standing Storage Loss, TPY	0.43209
Working Loss, TPY	0.60249
Total Losses, TPY	1.03459

Based on AP-42, February 1996, Section 7.1.3.1.

Eagle Ford Production Zone - La Salle County, TX using Brownlow No. 1-H (8/17/2010)

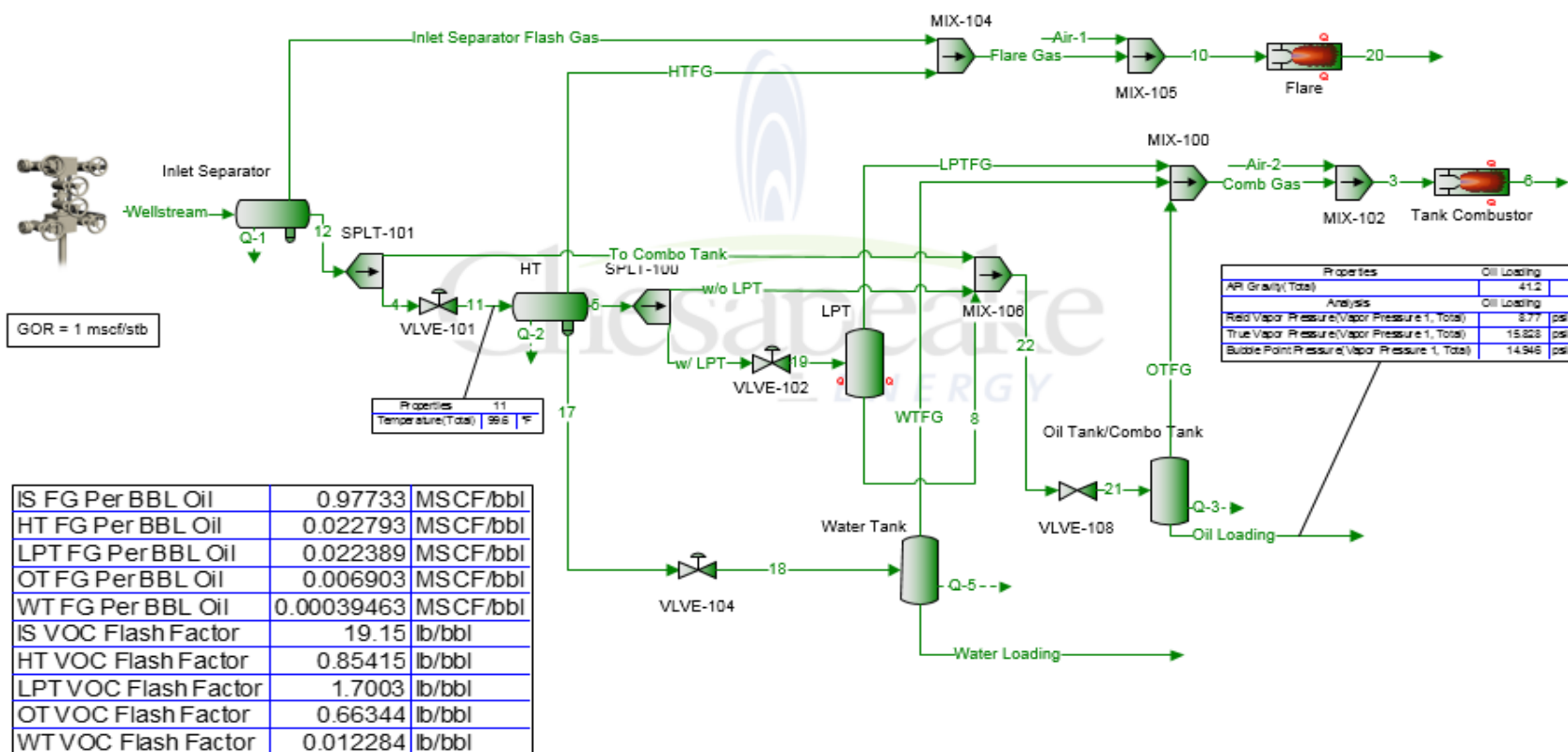
Scenario	IS Press	% to Combo	HT Temp	GOR	Oil Loading	Produced Gas	Combo Water	IS	OT
	psig	%	°F	mscf/bo*	barrel	BPD		mscf/bbl oil	
Skeleton Facility	50	100	120	2.5	1000	1696	322	1.696	0.019
Skeleton Facility	75	100	120	2.5	1000	1695	323	1.695	0.033
Skeleton Facility	100	100	120	2.5	1000	1694	323	1.694	0.050
Skeleton Facility	125	100	120	2.5	1000	1693	323	1.693	0.067
Skeleton Facility	150	100	120	2.5	1000	1693	324	1.693	0.084
Skeleton Facility	175	100	120	2.5	1000	1692	324	1.692	0.102
Skeleton Facility	200	100	120	2.5	1000	1692	324	1.692	0.119
Skeleton Facility	250	100	120	2.5	1000	1692	324	1.692	0.153
Skeleton Facility	300	100	120	2.5	1000	1693	324	1.693	0.186
Skeleton Facility	350	100	120	2.5	1000	1693	324	1.693	0.219
Skeleton Facility	400	100	120	2.5	1000	1694	324	1.694	0.250
Skeleton Facility	450	100	120	2.5	1000	1694	324	1.694	0.281
Skeleton Facility	500	100	120	2.5	1000	1694	325	1.694	0.311
Skeleton Facility	550	100	120	2.5	1000	1695	325	1.695	0.341
Skeleton Facility	600	100	120	2.5	1000	1695	325	1.695	0.370

								HAPs mass% of component as a percentage of VOC				
IS	OT	OT	Tks & TL	API	RVP	TVP	BP Pressure	Oil Tank Flash				
lb VOC/bbl oil	Net Heating Value (btu/scf)				psi	psia	psia	B	T	E	X	n-Hexane
38.871	1.301	1944	1944	29.5	6.6	15.8	14.9	0.357	0.321	0.075	0.169	2.046
36.112	2.594	2039	2039	29.7	7.2	15.8	14.9	0.339	0.289	0.066	0.149	1.936
33.960	4.060	2089	2089	29.8	7.5	15.9	14.9	0.331	0.275	0.062	0.140	1.885
32.212	5.590	2114	2114	29.9	7.7	15.9	14.9	0.328	0.267	0.060	0.136	1.861
30.742	7.123	2126	2126	29.9	7.7	15.9	14.9	0.327	0.264	0.059	0.133	1.851
29.477	8.626	2130	2130	30.0	7.8	15.9	14.9	0.327	0.263	0.059	0.133	1.850
28.372	10.081	2129	2129	30.0	7.7	15.9	14.9	0.329	0.264	0.059	0.133	1.853
26.524	12.821	2117	2117	30.0	7.7	15.9	14.9	0.333	0.267	0.060	0.135	1.869
25.037	15.329	2098	2098	29.9	7.5	15.9	14.9	0.337	0.272	0.061	0.138	1.892
23.819	17.618	2076	2076	29.9	7.4	15.8	14.9	0.343	0.279	0.063	0.141	1.917
22.808	19.710	2054	2054	29.8	7.3	15.8	14.9	0.348	0.286	0.065	0.145	1.942
21.963	21.630	2031	2031	29.8	7.1	15.8	14.9	0.354	0.293	0.066	0.149	1.969
21.253	23.399	2008	2008	29.7	7.0	15.8	14.9	0.360	0.300	0.068	0.154	1.995
20.658	25.034	1985	1985	29.7	6.8	15.8	14.9	0.365	0.308	0.070	0.158	2.020
20.158	26.553	1964	1964	29.6	6.7	15.8	14.9	0.370	0.315	0.072	0.162	2.045

**Eagle Ford Production Zone, La Salle County, TX – using Brownlow No. 1-H
(8/17/2010)**

Names	Units	Inlet Separator	Flash Gas	HTFG	Flare Gas	LPTFG	OTFG	WTFG	Comb Gas	Oil Loading	Water Loading
Temperature	*F		100*	96*	94.14	92.59	96*	96*	92.66	96	95
Pressure	psig		100*	35*	35	5	0.25	0.25*	0.25	0.25*	0.25
Molecular Weight	lb/lbmol		23.81	29.75	23.94	40.5	45.51	28.8	41.51	193.2	18.02
Std Liquid Volumetric Flow	bbld		470.7	12.28	483	14.17	4.645	0.2023	19.02	1000	967.2
Std Vapor Volumetric Flow	MSCFD		977.3	22.79	1000	22.39	6.903	0.3946	29.69	564.1	713.3
Volumetric Net Ideal Gas Heating Value	Btu/ft ³		1261	1543	1267	2079	2336	1392	2129		

HTFG Net IG Heating Value	1543	Btu/ft ³
Combustor Gas Net IG Heating Value	2129	Btu/ft ³
Flare Gas Net IG Heating Value	1267	Btu/ft ³



SUBJECT TO CHANGE

Creation Date: 11/19/2015 - Last Edit Date: 11/19/2015 3:58:29 PM
X:\Regulatory Compliance\EHS\Air Permitting\Bryan\Eagle Ford Promaxes\600-50p100Sep-35p120HT-OT-WT-Combustors - using Brownlow No. 1-H.pmx

**Black Oil PVT Fluid Study
for
Chesapeake Operating, Inc.
Brownlow No. 1-H
Eagle Ford Field
La Salle County, Texas**

The analysis, opinions and interpretations contained in this report are based upon observations, assumptions, empirical factors, inferences and data supplied by the customer, which are not infallible. The results expressed in this report represent the best judgment of FESCO. Accordingly, FESCO assumes no responsibility and makes no warranty as to the accuracy or correctness of any analysis, opinion or interpretation. FESCO shall not be liable or responsible for any loss, cost, damage, claim or expense whatsoever incurred or sustained by the customer resulting from any analysis, opinion or interpretation made by any of our employees.



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November 11, 2010

Mr. Mike Laue
Chesapeake Operating, Inc.
501 Graham Road
College Station, Texas 77845

Re: Well: Brownlow No. 1-H
Field: Eagle Ford
Location: La Salle County, Texas
Formation: Eagle Ford
Perforations: Horizontal Completion
Test Type: Black Oil PVT Fluid Study

Dear Mr. Laue:

The attached report contains laboratory results from a reservoir fluid study conducted to determine the type and character of the reservoir fluid. FESCO performed the study using separator gas and oil samples collected on August 17, 2010 from the first-stage lease separator by FESCO. FESCO then sent the separator fluid samples to its PVT laboratory in Alice, Texas. The laboratory performed extended compositional analyses of the separator gas (C_{11+}) and separator oil (C_{31+}). Tables 1-A through 1-C list the compositional analyses of the separator gas, separator oil and mathematically recombined wellstream fluid through C_{7+} , C_{11+} and C_{31+} , respectively. Table 2 reports the fluid properties measured as the separator oil was flashed from separator conditions to ambient laboratory conditions.

The separator gas and oil were recombined in a visual cell at the reported producing gas-oil ratio (GOR) of 536 Scf/Sep Bbl (585 Scf/STB). The recombined reservoir fluid was then examined at reservoir temperature (230 °F) and at pressures ranging from 7000 to 800 psig. **A bubble point was observed at 2640 psig and 230 °F.** The static reservoir pressure (4860 psig) is higher than the observed bubble point pressure. Therefore, the reservoir fluid exists as undersaturated (single-phase) oil at static reservoir conditions. Table 3 reports the pressure-volume relation of the reservoir fluid during this Constant Composition Expansion (CCE) process. Figures 1 through 4 illustrate the data reported in Table 3 versus pressure.

Table 4 provides results from a multi-stage separator test to measure the solution GOR, oil formation volume factor and evolved fluid properties. Figures 5 through 7 illustrate the data reported in Table 4 versus pressure. The Appendix contains the C_{7+} compositional analysis of each flashed gas from the multi-stage separator test.

The recombined reservoir oil was then differentially liberated at several pressure steps below the bubble point pressure. Table 5 reports the reservoir fluid viscosity measurements at selected pressures and reservoir temperature. Figures 8 and 9 illustrate the data reported in Table 5. The minimum oil viscosity occurred at the bubble point pressure. At pressures above the bubble point, the oil viscosity increased due to fluid compression. At pressures below the bubble point, the oil viscosity increased due to evolution and removal of solution gas. The evolved gas viscosity was calculated from the gas specific gravity and the Lucas correlation.

Table 6 contains the fluid properties measured at each differential liberation (DL) pressure step including the solution GOR (R_{sD}), relative oil volume (B_{oD}), live oil density and evolved gas properties. Figure 11 illustrates the solution GOR measured during the DL experiment. The live oil density increases during the DL experiment and reaches a maximum at ambient pressure due to the evolution and removal of solution gas as illustrated in Figure 10. The relative oil volume reaches its maximum at the bubble point. It then decreases during the DL experiment due to the evolution and removal of solution gas as shown in Figure 13. Figures 14 through 16 depict the evolved gas properties (gas formation volume factor, gas deviation factor and gas specific gravity factors) measured during each DL step.

Table 7 contains the differential liberation results from Table 6 adjusted to the separator test conditions listed in Table 4. The corresponding adjusted solution GOR (R_s) and relative oil volume (B_o) from Table 7 are illustrated in Figures 17 through 19.

Thank you for this opportunity to serve Chesapeake Operating, Inc. Please call me if you have any questions or concerns regarding this report.

Sincerely,

FESCO, Ltd.

Conan Pierce
Corporate Engineer
Alice, Texas
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WELL SUMMARY

WELL INFORMATION

Company:	Chesapeake Operating, Inc.
Well Name:	Brownlow No. 1-H
Field:	Eagle Ford
Location:	La Salle County, Texas

RESERVOIR INFORMATION

Formation:	Eagle Ford
Perforations:	Horizontal Completion
Reservoir Datum:	Unavailable
Reservoir Temperature:	230 °F
Static Reservoir Pressure:	4860 psig
Flowing Reservoir Pressure:	Unavailable

SAMPLING INFORMATION

Sampling Date:	08/17/10
Sampled By:	FESCO, Ltd. - Alice, Texas
Sample Type:	1st Stage Separator Gas and Oil
Flowing Tubing Pressure:	550 psig
1st Stage Separator Pressure:	210 psig
1st Stage Separator Temperature:	140 °F
2nd Stage Separator Pressure:	Not Present
2nd Stage Separator Temperature:	Not Present

PRODUCTION INFORMATION

Test Date:	08/17/10
Gas Rate:	281 Mscf/d
Oil Rate:	480.00 STB/d
Water Rate:	1551.00 STB/d
Stock Tank Gas-Oil Ratio:	585 (Scf Sep Gas / STB Oil)
Separator Gas-Oil Ratio:	536 (Scf Sep Gas / Sep Bbl Oil)
Shrinkage Factor:	0.91587 (ST Oil Vol / Sep Oil Vol)



RESULTS SUMMARY

Company:	Chesapeake Operating, Inc.
Well:	Brownlow No. 1-H
Type of Test:	Black Oil PVT Fluid Study
Reservoir Fluid Type:	Undersaturated Oil
Saturation Conditions:	
Pressure (Bubble Point):	2640 psig
Temperature:	230 °F
Oil Compressibility:	17.5556E-06 (vol/vol/psi)
Average Undersaturated Oil Compressibility:	12.4268E-06 (vol/vol/psi)
Report Date:	11/10/2010



SUMMARY OF SAMPLES

Company: Chesapeake Operating, Inc.
Well: Brownlow No. 1-H
Sample Date: 08/17/10

Separator Conditions

Pressure: 210 psig Temperature: 140 °F

Laboratory Quality Test

Separator Gas:	<u>Pressure</u>	<u>Temperature</u>
Cylinder ID No. G-1186*	202 psig	72 °F
Cylinder ID No. G-2182	195 psig	72 °F

Separator Liquid:	<u>BP Pressure</u>	<u>Temperature</u>
Cylinder ID No. T-945*	144 psig	72 °F
Cylinder ID No. T-548	143 psig	72 °F

Report Date: 11/10/2010

* Samples used in fluid study



TABLE 1-A

**COMPOSITIONAL ANALYSIS OF THE SEPARATOR GAS, OIL
AND MATHEMATICALLY RECOMBINED WELLSTREAM THROUGH C₇₊**

SEPARATOR GOR.....: 536 Scf/Sep Bbl

SEPARATOR PRESSURE.....: 210 psig

SEPARATOR TEMPERATURE.....: 140 °F

Component	SEPARATOR GAS		SEPARATOR OIL		WELLSTREAM	
	Mole%	* GPM	Mole %	Liquid Volume %	Mole %	Liquid Volume %
Hydrogen Sulfide	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.388	0.000	0.013	0.002	0.192	0.046
Carbon Dioxide	1.051	0.000	0.105	0.026	0.557	0.206
Methane	67.114	0.000	4.253	1.042	34.260	12.621
Ethane	15.619	4.155	3.924	1.517	9.506	5.526
Propane	8.423	2.305	5.275	2.099	6.778	4.054
Iso-butane	1.065	0.346	1.169	0.553	1.119	0.796
N-butane	2.889	0.905	4.193	1.910	3.570	2.445
2-2 Dimethylpropane	0.008	0.003	0.005	0.003	0.007	0.006
Iso-pentane	0.830	0.302	1.978	1.047	1.430	1.137
N-pentane	1.048	0.378	2.983	1.562	2.059	1.621
2-2 Dimethylbutane	0.066	0.027	0.020	0.012	0.042	0.038
Cyclopentane	0.314	0.092	0.000	0.000	0.150	0.096
2-3 Dimethylbutane	0.130	0.053	0.313	0.185	0.226	0.201
2 Methylpentane	0.342	0.141	1.132	0.679	0.755	0.681
3 Methylpentane	0.002	0.001	0.677	0.400	0.355	0.315
Other Hexanes	0.000	0.000	0.000	0.000	0.000	0.000
n-Hexane	0.093	0.038	1.968	1.170	1.073	0.959
Heptanes Plus	0.618	0.271	71.992	87.792	37.921	69.252
TOTAL	100.000	9.018	100.000	100.000	100.000	100.000

HEPTANES PLUS (C ₇₊) FRACTION CHARACTERISTICS					
COMPONENT	Specific Gravity		Molecular Weight lb/lb-mole	Vapor Volume Scf/Gal	Gross Heating Value ***
	°API	**			
Gas	N/A	3.5824	103.755	22.838	5,398
Oil	35.495	0.8473	225.553	11.923	132,885
Wellstream	N/A	0.8469	224.606	11.967	N/A

TOTAL SAMPLE CHARACTERISTICS						
COMPONENT	Specific Gravity		Molecular Weight lb/lb-mole	Vapor Volume Scf/Gal	GHV	
	°API	**			Dry ***	Saturated ***
Gas	N/A	0.8614	24.815	110.895	1,453	1428
Oil	43.144	0.8102	176.859	14.539	N/A	128,382
Wellstream	65.552	0.7181	104.280	21.855	N/A	N/A

* GPM (gallons per Mscf) determined at 14.65 psia and 60 °F

** Gas specific gravity determined relative to air (SG=1.000).
Oil and wellstream specific gravity determined relative to water (SG=1.000).

*** Gross Heating Value units for gas (real basis) and oil are BTU/Scf and BTU/Gal, respectively.



TABLE 1-B

**COMPOSITIONAL ANALYSIS OF THE SEPARATOR GAS, OIL
AND MATHEMATICALLY RECOMBINED WELLSTREAM THROUGH C₁₁₊**

SEPARATOR GOR.....: 536 Scf/Sep Bbl

SEPARATOR PRESSURE.....: 210 psig

SEPARATOR TEMPERATURE.....: 140 °F

Component	SEPARATOR GAS		SEPARATOR OIL		WELLSTREAM	
	Mole%	* GPM	Mole %	Liquid Volume %	Mole %	Liquid Volume %
Hydrogen Sulfide	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.388	0.000	0.013	0.002	0.192	0.046
Carbon Dioxide	1.051	0.000	0.105	0.026	0.557	0.206
Methane	67.114	0.000	4.253	1.042	34.260	12.621
Ethane	15.619	4.155	3.924	1.517	9.506	5.526
Propane	8.423	2.305	5.275	2.099	6.778	4.054
Iso-butane	1.065	0.346	1.169	0.553	1.119	0.796
N-butane	2.889	0.905	4.193	1.910	3.570	2.445
2-2 Dimethylpropane	0.008	0.003	0.005	0.003	0.007	0.006
Iso-pentane	0.830	0.302	1.978	1.047	1.430	1.137
N-pentane	1.048	0.378	2.983	1.562	2.059	1.621
2-2 Dimethylbutane	0.066	0.027	0.020	0.012	0.042	0.038
Cyclopentanes	0.314	0.092	0.000	0.000	0.150	0.096
2-3 Dimethylbutane	0.130	0.053	0.313	0.185	0.226	0.201
2 Methylpentane	0.342	0.141	1.132	0.679	0.755	0.681
3 Methylpentane	0.002	0.001	0.677	0.400	0.355	0.315
Other Hexanes	0.000	0.000	0.000	0.000	0.000	0.000
n-Hexane	0.093	0.038	1.968	1.170	1.073	0.959
Methylcyclopentane	0.000	0.000	0.745	0.381	0.389	0.299
Benzene	0.038	0.011	0.316	0.128	0.183	0.111
Cyclohexane	0.067	0.023	0.737	0.363	0.417	0.308
2-Methylhexane	0.051	0.024	0.488	0.328	0.280	0.282
3-Methylhexane	0.044	0.020	0.638	0.423	0.354	0.354
2,2,4 Trimethylpentane	0.000	0.000	0.001	0.000	0.000	0.000
Other Heptanes	0.058	0.025	1.034	0.651	0.568	0.538
n-Heptane	0.085	0.039	1.655	1.104	0.905	0.908
Methylcyclohexane	0.049	0.020	1.217	0.707	0.659	0.576
Toluene	0.026	0.009	0.873	0.423	0.469	0.341
Other C8's	0.065	0.030	2.920	1.979	1.557	1.586
n-Octane	0.019	0.010	1.317	0.975	0.697	0.776
Ethylbenzene	0.003	0.001	0.516	0.288	0.271	0.227
M&P-Xylene	0.012	0.005	0.922	0.517	0.488	0.411
O-Xylene	0.004	0.002	0.448	0.246	0.236	0.195
Other C-9's	0.031	0.016	2.757	2.087	1.456	1.656
n-Nonane	0.015	0.008	1.136	0.925	0.601	0.735
Other C10's	0.039	0.022	3.962	3.296	2.089	2.612
n-Decane	0.004	0.002	1.112	0.987	0.583	0.778
Undecanes Plus	0.008	0.005	49.199	71.983	25.717	56.556
TOTAL	100.000	9.018	100.000	100.000	100.000	100.000



TABLE 1-B

COMPOSITIONAL ANALYSIS OF THE SEPARATOR GAS, OIL AND MATHEMATICALLY RECOMBINED WELLSTREAM THROUGH C₁₁₊

SEPARATOR GOR.....: 536 Scf/Sep Bbl
SEPARATOR PRESSURE.....: 210 psig
SEPARATOR TEMPERATURE.....: 140 °F

UNDECANES PLUS (C ₁₁₊) FRACTION CHARACTERISTICS					
COMPONENT	Specific Gravity		Molecular Weight lb/lb-mole	Vapor Volume Scf/Gal	Gross Heating Value *** ****
	°API	**			
Gas	N/A	0.8250	156.000	16.784	8,400
Oil	31.706	0.8670	276.900	9.937	134,092
Wellstream	N/A	0.8670	276.883	9.938	N/A

TOTAL SAMPLE CHARACTERISTICS						
COMPONENT	Specific Gravity		Molecular Weight lb/lb-mole	Vapor Volume Scf/Gal	GHV	
	°API	**			Dry ***	Saturated ***
Gas	N/A	0.8614	24.815	110.895	1,453	1428
Oil	43.144	0.8102	176.859	14.539	N/A	128,382
Wellstream	65.552	0.7181	104.280	21.855	N/A	N/A

* GPM (gallons per Mscf) determined at 14.65 psia and 60 °F

** Gas specific gravity determined relative to air (SG=1.000).
Oil and wellstream specific gravity determined relative to water (SG=1.000).

*** Gross Heating Value units for gas (real basis) and oil are BTU/Scf and BTU/Gal, respectively.



TABLE 1-C

**COMPOSITIONAL ANALYSIS OF THE SEPARATOR GAS, OIL
AND MATHEMATICALLY RECOMBINED WELLSTREAM THROUGH C₃₁₊**

SEPARATOR GOR.....: 536 Scf/Sep Bbl

SEPARATOR PRESSURE.....: 210 psig

SEPARATOR TEMPERATURE.....: 140 °F

Component	SEPARATOR GAS		SEPARATOR OIL		WELLSTREAM	
	Mole%	* GPM	Mole %	Liquid Volume %	Mole %	Liquid Volume %
Hydrogen Sulfide	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	0.388	0.000	0.013	0.002	0.192	0.046
Carbon Dioxide	1.051	0.000	0.105	0.026	0.557	0.206
Methane	67.114	0.000	4.253	1.042	34.260	12.617
Ethane	15.619	4.155	3.924	1.517	9.506	5.525
Propane	8.423	2.305	5.275	2.098	6.778	4.053
Iso-butane	1.065	0.346	1.169	0.553	1.119	0.795
N-butane	2.889	0.905	4.193	1.910	3.570	2.445
2-2 Dimethylpropane	0.008	0.003	0.005	0.003	0.007	0.006
Iso-pentane	0.830	0.302	1.978	1.046	1.430	1.137
N-pentane	1.048	0.378	2.983	1.562	2.059	1.621
2-2 Dimethylbutane	0.066	0.027	0.020	0.012	0.042	0.038
Cyclopentanes	0.314	0.092	0.000	0.000	0.150	0.096
2-3 Dimethylbutane	0.130	0.053	0.313	0.185	0.226	0.201
2 Methylpentane	0.342	0.141	1.132	0.679	0.755	0.681
3 Methylpentane	0.002	0.001	0.677	0.399	0.355	0.315
Other Hexanes	0.000	0.000	0.000	0.000	0.000	0.000
n-Hexane	0.093	0.038	1.968	1.170	1.073	0.959
Methylcyclopentane	0.000	0.000	0.745	0.381	0.389	0.299
Benzene	0.038	0.011	0.316	0.128	0.183	0.111
Cyclohexane	0.067	0.023	0.737	0.362	0.417	0.308
2-Methylhexane	0.051	0.024	0.488	0.328	0.280	0.282
3-Methylhexane	0.044	0.020	0.638	0.423	0.354	0.353
2,2,4 Trimethylpentane	0.000	0.000	0.001	0.000	0.000	0.000
Other Heptanes	0.058	0.025	1.034	0.651	0.568	0.537
n-Heptane	0.085	0.039	1.655	1.103	0.905	0.908
Methylcyclohexane	0.049	0.020	1.217	0.707	0.659	0.576
Toluene	0.026	0.009	0.873	0.423	0.469	0.341
Other C8's	0.065	0.030	2.920	1.978	1.557	1.586
n-Octane	0.019	0.010	1.317	0.975	0.697	0.776
Ethylbenzene	0.003	0.001	0.516	0.288	0.271	0.227
M&P-Xylene	0.012	0.005	0.922	0.517	0.488	0.411
O-Xylene	0.004	0.002	0.448	0.246	0.236	0.195
Other C-9's	0.031	0.016	2.757	2.086	1.456	1.656
n-Nonane	0.015	0.008	1.136	0.924	0.601	0.735
Other C10's	0.039	0.022	3.962	3.294	2.089	2.612
n-Decane	0.004	0.002	1.112	0.987	0.583	0.778
Undecanes	0.008	0.005	4.371	3.730	2.288	2.935
Dodecanes	0.000	0.000	3.795	3.497	1.983	2.748
Tridecanes	0.000	0.000	3.770	3.725	1.970	2.927



TABLE 1-C

**COMPOSITIONAL ANALYSIS OF THE SEPARATOR GAS, OIL
AND MATHEMATICALLY RECOMBINED WELLSTREAM THROUGH C₃₁₊**

SEPARATOR GOR.....: 536 Scf/Sep Bbl

SEPARATOR PRESSURE.....: 210 psig

SEPARATOR TEMPERATURE.....: 140 °F

Component	SEPARATOR GAS		SEPARATOR OIL		WELLSTREAM	
	Mole%	* GPM	Mole %	Liquid Volume %	Mole %	Liquid Volume %
Tetradecanes	0.000	0.000	3.346	3.541	1.749	2.782
Pentadecanes	0.000	0.000	3.198	3.626	1.671	2.849
Hexadecanes	0.000	0.000	2.665	3.229	1.393	2.537
Heptadecanes	0.000	0.000	2.411	3.089	1.260	2.427
Octadecanes	0.000	0.000	2.263	3.052	1.182	2.398
Nonadecanes	0.000	0.000	2.246	3.156	1.174	2.480
Eicosanes	0.000	0.000	1.869	2.731	0.977	2.146
Heneicosanes	0.000	0.000	1.702	2.616	0.889	2.055
Docosanes	0.000	0.000	1.535	2.459	0.802	1.932
Tricosanes	0.000	0.000	1.425	2.340	0.745	1.838
Tetracosanes	0.000	0.000	1.332	2.292	0.696	1.801
Pentacosanes	0.000	0.000	1.236	2.206	0.646	1.734
Hexacosanes	0.000	0.000	1.193	2.206	0.624	1.734
Heptacosanes	0.000	0.000	1.145	2.196	0.598	1.726
Octacosanes	0.000	0.000	1.117	2.215	0.584	1.740
Nonacosanes	0.000	0.000	1.014	2.076	0.530	1.631
Triacotanes	0.000	0.000	1.016	2.145	0.531	1.685
Hentriacotanes Plus	0.000	0.000	6.550	15.865	3.424	12.465
TOTALS	100.000	9.018	100.000	100.000	100.000	100.000

TOTAL SAMPLE CHARACTERISTICS						
COMPONENT	Specific Gravity		Molecular Weight lb/lb-mole	Vapor Volume Scf/Gal	GHV	
	°API	**			Dry ***	Saturated ***
Gas	N/A	0.8614	24.815	110.895	1,453	1428
Oil	43.144	0.8102	176.859	14.539	N/A	128,382
Wellstream	65.552	0.7181	104.280	21.855	N/A	N/A

* GPM (gallons per Mscf) determined at 14.65 psia and 60 °F

** Gas specific gravity determined relative to air (SG=1.000).

Oil and wellstream specific gravity determined relative to water (SG=1.000).

*** Gross Heating Value units for gas (real basis) and oil are BTU/Scf and BTU/Gal, respectively.