**TITAN Engineering, Inc.**
***Environmental Consulting and Management***

August 31, 2012

Air Permits Initial Review Team (APIRT) Section, MC 161
Texas Commission on Environmental Quality
12100 Park 35 Circle, Building C, Third Floor
Austin, Texas 78753

***via FedEx***

**Subject: Oil and Gas Standard Permit Registration**
**Burlington Resources Oil & Gas Company LP**
**Lackey Land A639 Unit A1 & B1**
**DeWitt County, Texas**
**CN602989436, RN106485683**

Dear Mr. Johnny Bowers:

On behalf of Burlington Resources Oil & Gas Company LP (Burlington), TITAN Engineering, Inc. (TITAN) is submitting this Oil and Gas Standard Permit (SP) Registration to the Texas Commission on Environmental Quality (TCEQ) for operations at Lackey Land A639 Unit A1 & B1 (the Site) located near Yorktown in DeWitt County, TX. Upon authorization, this standard permit will authorize the following project:

- Six (6) controlled atmospheric condensate storage tanks and associated loading;
- Two (2) controlled atmospheric produced water storage tanks and associated loading;
- One (1) flare combustion control device; and,
- Piping and fugitive components.

TITAN and Burlington Resources believe that the Site and its associated air emissions meet the requirements of the TCEQ Non-Rule Standard Permit for Oil and Gas Handling and Production Facilities and 30 TAC §116.610, §116.611, §116.614, and §116.615. Please note that the Site name was listed erroneously in the Initial Notification (IN) but is rightly listed in all the attachments. This Standard Permit Registration has been prepared in accordance with TCEQ guidance and includes the following attachments:

- Attachment 1 presents a process description, area map, receptor map, process flow diagram, and plot plan;
- Attachment 2 contains the applicable TCEQ forms and tables;
- Attachment 3 presents emission rate calculations;
- Attachment 4 describes how the Site qualifies for Standard Permit;
- Attachment 5 includes an impacts evaluation; and
- Attachment 6 includes supporting documentation.

TITAN and Burlington would like to collectively thank you in advance for your review and concurrence with this Oil and Gas Standard Permit Registration. If you have any questions regarding the information presented in this letter and attachments, please do not hesitate to contact Mr. James Woodall at 832-486-6508 or james.woodall@conocophillips.com or me at 469-365-1168 or cchermak@titanengineering.com.

Sincerely,
**TITAN Engineering, Inc.**

Christina Chermak
Project Manager

Attachments

cc: Ms. Rosario Torres, TCEQ Region 14 – Corpus Christi
Mr. James Woodall, Sr. Environmental Specialist, ConocoPhillips Company
TCEQ Revenue Section, MC-214, Bldg. A, Third Floor, Austin, Texas 78753 (Form PI-1S, CORE Data form, and fee only)

# OIL AND GAS STANDARD PERMIT REGISTRATION

*CN602989436*
*RN106485683*

***Burlington Resources Oil & Gas Company LP***
***Lackey Land A639 Unit A1 & B1***
*DeWitt County, Texas*

**Project No. 507-72.009**

**August 2012**

# ATTACHMENT 1
# PROCESS/PROJECT DESCRIPTION

## OIL AND GAS STANDARD PERMIT REGISTRATION

## LACKEY LAND A639 UNIT A1 & B1

## BURLINGTON RESOURCES OIL & GAS COMPANY LP

## ATTACHMENT 1
## PROCESS/PROJECT DESCRIPTION

This Standard Permit registration is being submitted to authorize six (6) controlled atmospheric condensate storage tanks and associated loading, two (2) controlled atmospheric produced water storage tanks and associated loading, one (1) flare combustion control device, and piping and fugitive components (the Project) at the Site. Figure 1-1 is an area map showing the location of the Site and the surrounding area and Figure 1-2 is a map demonstrating the nearest receptor. Figure 1-3 is a process flow diagram for the Site and Figure 1-4 is a plot-plan of the site demonstrating the location of various equipment components.

Normal Operations

The Site has two (2) wells which will produce high pressure gas and liquids (condensate and water). The mixture extracted from the wells will first pass through a high pressure (HP) separator where the high pressure gas will be collected and sent to pipeline. Liquids from the HP separator will then pass to a low pressure (LP) separator. Low pressure gas off of the LP separator will go to sales as well, via a low pressure pipeline.

Pressurized liquids from the LP separator will be divided into both produced water and condensate streams. Condensate is routed to the condensate storage tanks (FINs [Facility Identification Number] TK-01, TK-02, TK-03, TK-04, TK-05 and TK-06) and water is routed to the produced water tanks (FIN TK-07 and TK-08). The emissions associated with the flash from the pressure change as well as the working/breathing emissions from all tanks are routed to a flare (FIN FL-1) and are captured and controlled at a 98% efficiency. As demonstrated in the calculations, assist gas is sent to the flare to ensure that the waste gas stream can sustain combustion.

The condensate and produced water tanks are loaded out periodically (FINs TRUCK1 and TRUCK2), emissions from which are also controlled by the flare (FIN FL-1). The Site will also emit emissions due to equipment component leaks (FIN FUG).

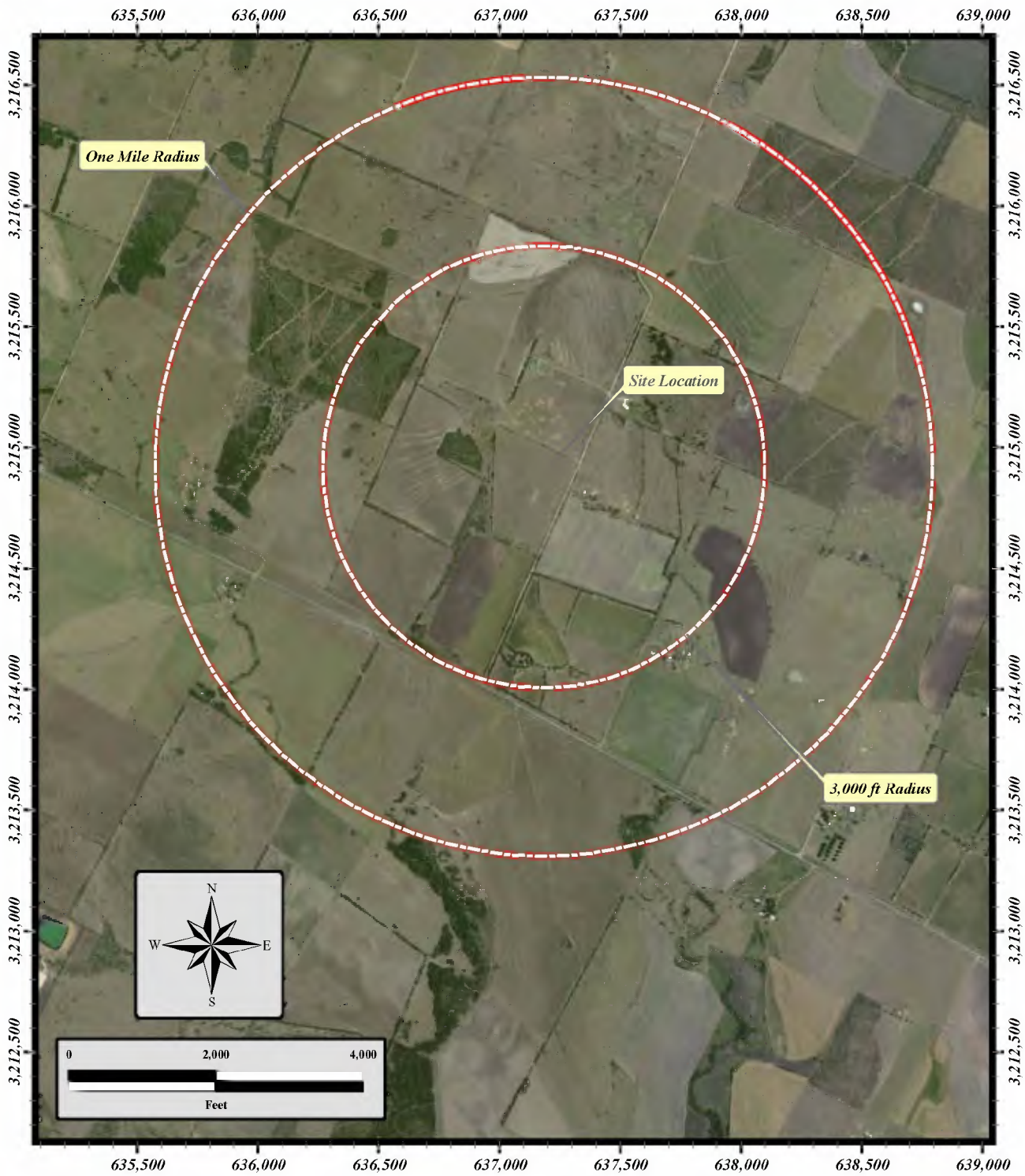
Scheduled Maintenance Startup and Shutdown Events

In accordance with TCEQ guidance and the non-rule Oil & Gas Standard Permit, a representation of planned Maintenance, Startup and Shutdown events are included in this Standard Permit registration in addition to the normal operating scenario.

It is conservatively planned that the flare will be down for maintenance 2% of the year. During this time, the well would be shut in and therefore gas and liquids would not be producing, but any liquids previously in storage tanks (FINs TK-01, TK-02, TK-03, TK-04, TK-05, TK-06, TK-07 and TK-08) would have standing losses emitted to atmosphere.

Additionally, during engine maintenance events at downstream sites the LP separator gas (FIN SEP-GAS) is sent to the flare (FIN FL-1) for combustion. This scenario is conservatively predicted to occur 6% of the year.

Attachment 3 contains emission rate calculations for the air emission sources and a summary of the Site's emission rates.




*Grid Presented is UTM Zone 14, NAD 1983*

**TITAN Engineering, Inc.**
2801 Network Boulevard, Suite 200
Frisco, Texas 75034
*Phone: (469) 365-1100 Fax: (469) 365-1199*
www.titanengineering.com • www.apexcos.com
*A Division of Apex Companies, LLC*

**FIGURE 1-1 AREA MAP**

**Burlington Resources Oil & Gas Company LP**
**Standard Permit Registration**
**Lackey Land A639 Unit A1 & B1**
**TITAN Project No. 84800507-72.009**
**August 2012**
*from USGS Quadrangle New Davy, Texas*
*Ground Condition Depicted October 2011*
*Digital Data Courtesy of ESRI Online Datasets*

**FIGURE 1-2 RECEPTOR MAP**

**Burlington Resources Oil & Gas Company LP**
**Standard Permit Registration**
**Lackey Land A639 Unit A1 & B1**
**TITAN Project No. 84800507-72.009**
**August 2012**

*from USGS Quadrangle New Davy, Texas*
*Ground Condition Depicted October 2011*
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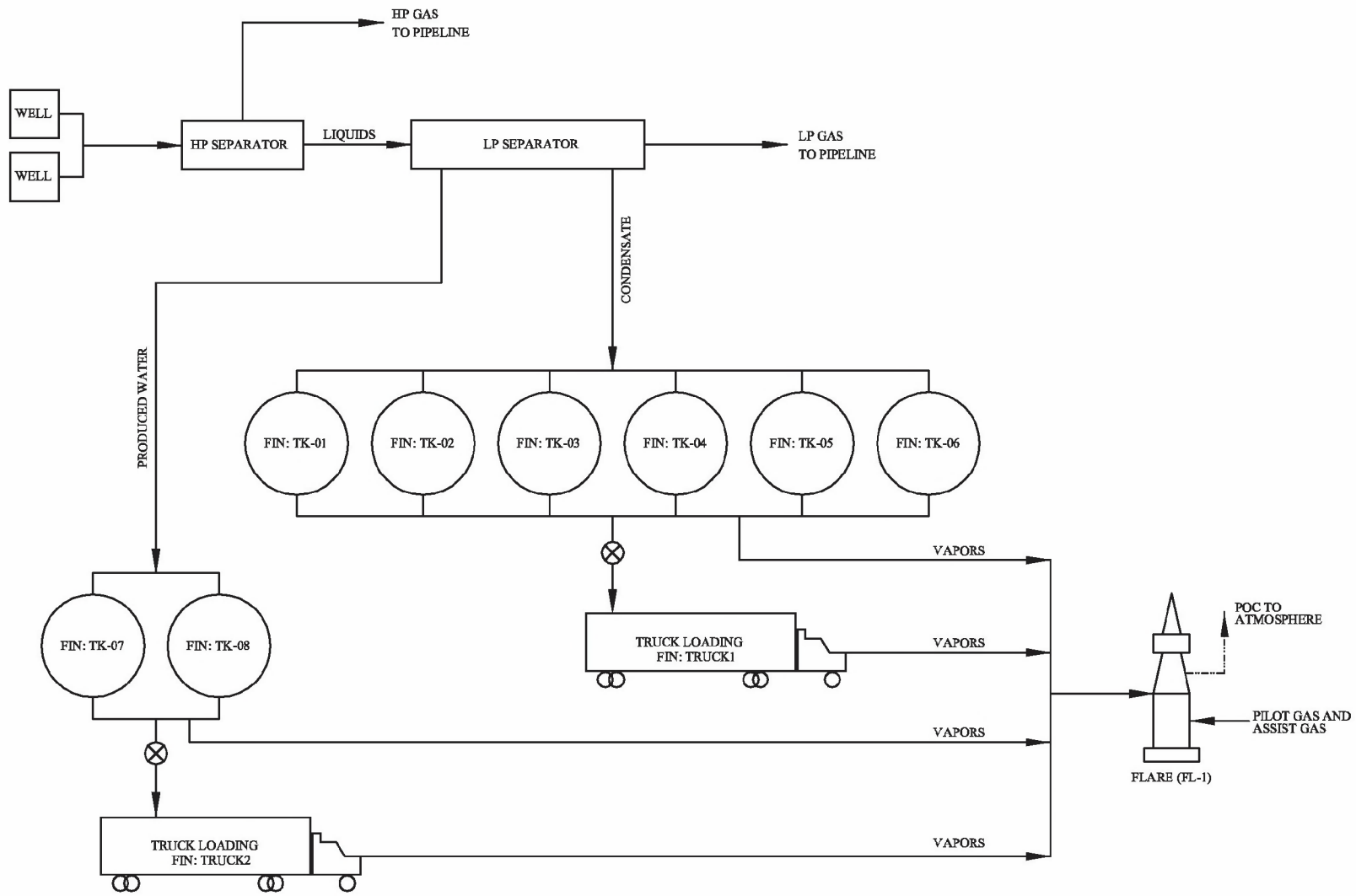


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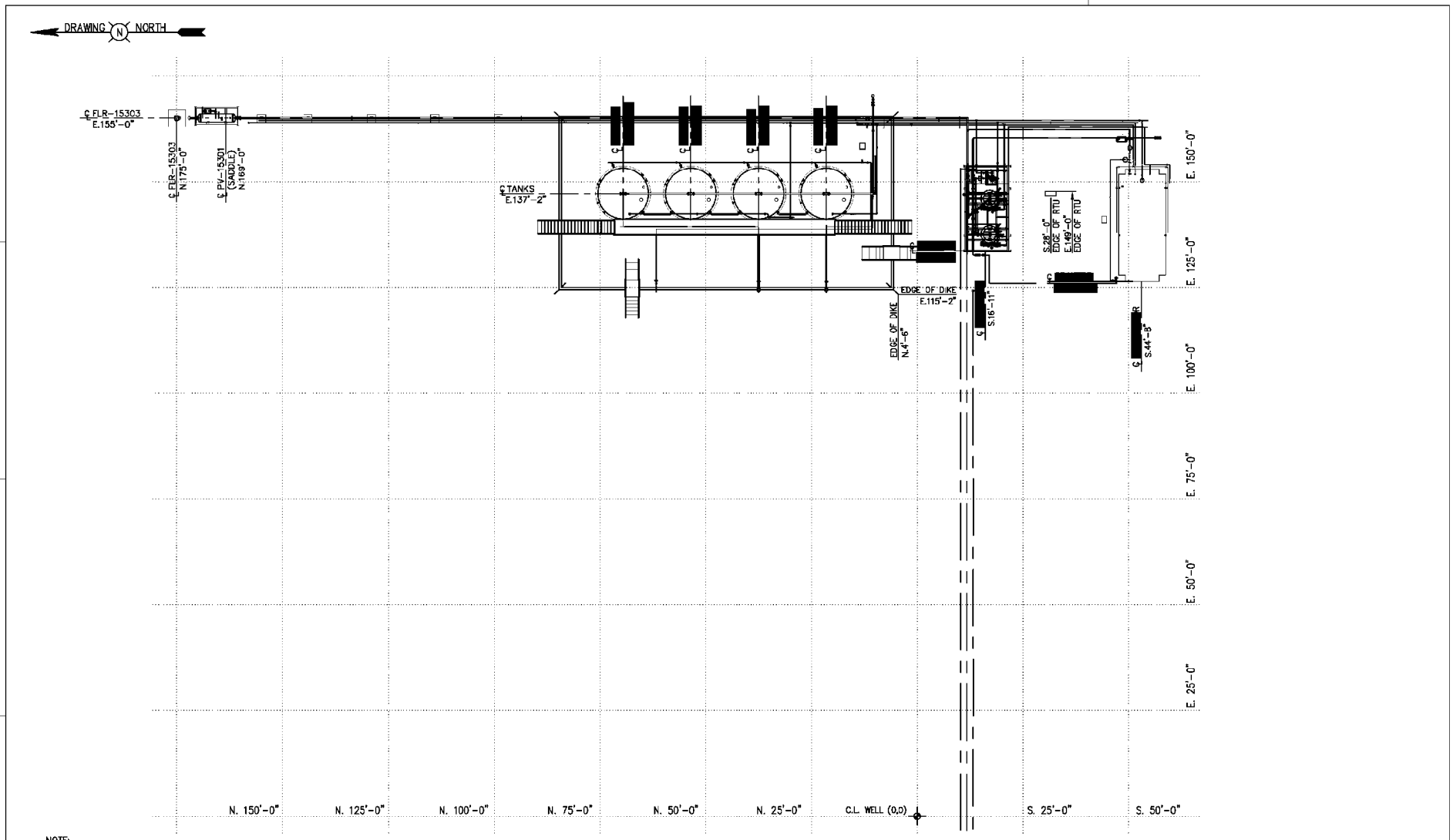
**FIGURE 1-3**
**SIMPLIFIED PROCESS FLOW DIAGRAM**

Burlington Resources Oil & Gas Company LP
Lackey Land A639 Unit A1 & B1
Standard Permit Registration

| DESIGNED BY: | DETAILED BY: | CHECKED BY: |
|---|---|---|
| Burlington | LLA | VC |
| FILE NAME: T:\ConocoPhillips\ 507-72.009 \Report\ATT1 | | |
| DATE: August /2012 | PROJECT NO.: 84800507-72.009 | PLOT SCALE: NTS |
| DRAWING NO.: TEI-0000 | REVISION: 2 | FIGURE: 1-3 |



EFSCOP00009331




NOTE:

1. FLARE LINE SHALL BE LOCATED 15' FROM PROPERTY LINE. THE COORDINATES (RELATIVE TO THE PROPERTY LINE) ON THIS PLOT PLAN MAY DIFFER FROM THE ACTUAL DISTANCES. FIELD SHALL CONFIRM ACTUAL LOCATIONS RELATIVE TO PROPERTY LINE.

REFERENCE DRAWINGS:

| NO. | DATE | REVISION | DRW. | DES. | CHK. | APP. |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

| NO. | DATE | REVISION | DRW. | DES. | CHK. | APP. |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| C | 08/15/1 | ISSUED FOR CONSTRUCTION | WJL | WJL | DP | DP |

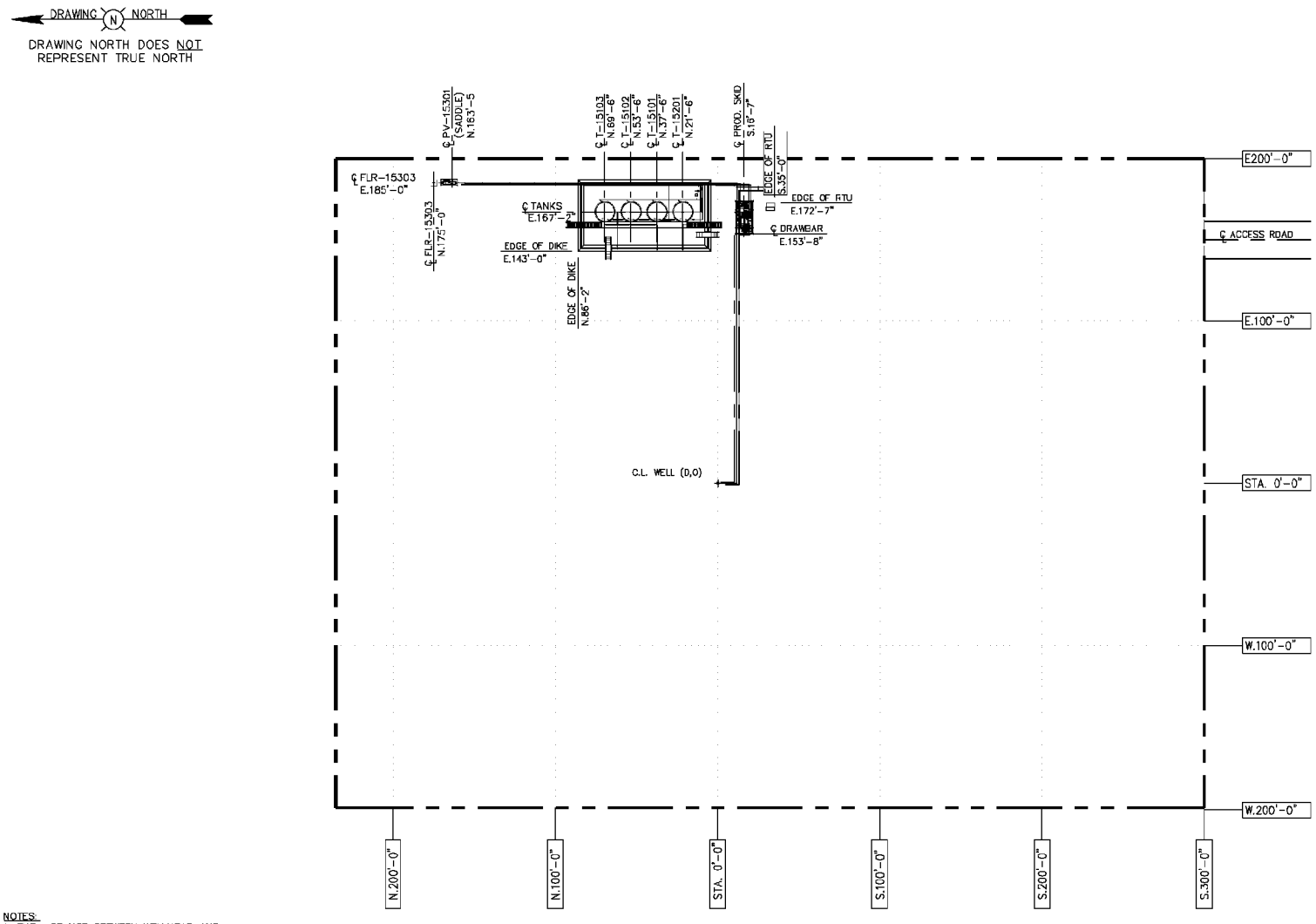
ConocoPhillips
EAGLE FORD

LACKEY UNIT A1 FACILITY

PLOT PLAN

Figure 1-4

| | |
|---|---|
| SCALE: NONE | PLOT SCALE: 1=' |
| AREA: | LOCATION: DEWITT COUNTY |
| DWG. NO: LAKA1-30000 | REV. 0 |




NOTES:
1. THE DISTANCE BETWEEN WELLHEAD AND PROPERTY LINE MAY VARY. INSTALLATION CONTRACTOR SHALL CONFIRM DISTANCE AND SET FLARE 15' FROM PROPERTY LINE. USE THE FLARE AS THE REFERENCE POINT FOR SETTING FACILITY.

REFERENCE DRAWINGS:

| NO. | DATE | REVISION | DRW. | DES. | CHK. | APP. |
|---|---|---|---|---|---|---|
| | | | | | | |

| NO | DATE | REVISION | DRW. | DES. | CHK. | APP. |
|---|---|---|---|---|---|---|
| 0 | 01/15/13 | ISSUED FOR CONSTRUCTION | TN | WJL | SC | SS |

ConocoPhillips
FAGLE FORD

LACKEY UNIT B1 FACILITY

OVERALL PLOT PLAN
Figure 1-5

SCALE: 1/32"=1'-0"
PLOT SCALE: 1=1
LOCATION: DEWITT COUNTY
DWG. NO.: LAKB1-30000
REV.: 0

# ATTACHMENT 2
# TCEQ FORMS AND TABLES

## OIL AND GAS STANDARD PERMIT REGISTRATION

## LACKEY LAND A639 UNIT A1 & B1

## BURLINGTON RESOURCES OIL & GAS COMPANY LP

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. Attachments** **Describe Any Attachments:** *(ex. Title V Application, Waste Transporter Application, etc.)*

☑ Yes ☐ No Oil and Gas Standard Permit Registration

| 3. Customer Reference Number *(if issued)* | Follow this link to search for CN or RN numbers in Central Registry** | 4. Regulated Entity Reference Number *(if issued)* |
|---|---|---|
| CN 602989436 | | RN 106485683 |

## SECTION II: Customer Information

**5. Effective Date for Customer Information Updates (mm/dd/yyyy)**

**6. Customer Role** (Proposed or Actual) – *as it relates to the Regulated Entity listed on this form. Please check only one of the following:*

☐ Owner ☐ Operator ☑ Owner & Operator
☐ Occupational Licensee ☐ Responsible Party ☐ Voluntary Cleanup Applicant ☐ Other: _____

**7. General Customer Information**

☐ New Customer ☐ Update to Customer Information ☐ Change in Regulated Entity Ownership
☐ Change in Legal Name (Verifiable with the Texas Secretary of State) ☑ No Change**

***If "No Change" and Section I is complete, skip to Section III – Regulated Entity Information.***

| 8. Type of Customer: | ☐ Corporation | ☐ Individual | ☐ Sole Proprietorship- D.B.A |
|---|---|---|---|
| ☐ City Government | ☐ County Government | ☐ Federal Government | ☐ State Government |
| ☐ Other Government | ☐ General Partnership | ☐ Limited Partnership | ☐ Other: _____ |

| 9. Customer Legal Name *(If an individual, print last name first: ex: Doe, John)* | *If new Customer, enter previous Customer below* | *End Date:* |
|---|---|---|
| | | |

| 10. Mailing Address: | | | | | | | |
|---|---|---|---|---|---|---|---|
| City | | State | | ZIP | | ZIP + 4 | |

| 11. Country Mailing Information *(If outside USA)* | 12. E-Mail Address *(If applicable)* |
|---|---|
| | |

| 13. Telephone Number | 14. Extension or Code | 15. Fax Number *(if applicable)* |
|---|---|---|
| | | |

| 16. Federal Tax ID *(9 digits)* | 17. TX State Franchise Tax ID *(11 digits)* | 18. DUNS Number *(if applicable)* | 19. TX SOS Filing Number *(if applicable)* |
|---|---|---|---|
| | | | |

**20. Number of Employees**

☐ 0-20 ☐ 21-100 ☐ 101-250 ☐ 251-500 ☐ 501 and higher

**21. Independently Owned and Operated?**

☐ Yes ☐ No

## SECTION III: Regulated Entity Information

**22. 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 ☐ No Change** *(See below)*

****If "NO CHANGE" is checked and Section I is complete, skip to Section IV, Preparer Information.**

**23. Regulated Entity Name** *(name of the site where the regulated action is taking place)*

Lackey Land A639 Unit A1 & B1

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 24. Street Address of the Regulated Entity: *(No P.O. Boxes)* | | | | | | | |
| | City | | State | | ZIP | | ZIP + 4 |
| 25. Mailing Address: | 600 N Dairy Ashford | | | | | | |
| | Westlake 3, #15012 | | | | | | |
| | City | Houston | State | TX | ZIP | 77079 | ZIP + 4 |

| | |
|---|---|
| 26. E-Mail Address: | james.woodall@conocophillips.com |

| 27. Telephone Number | 28. Extension or Code | 29. Fax Number *(if applicable)* |
|---|---|---|
| (832) 486-6508 | | 832-486-6431 |

| 30. Primary SIC Code (4 digits) | 31. Secondary SIC Code (4 digits) | 32. Primary NAICS Code (5 or 6 digits) | 33. Secondary NAICS Code (5 or 6 digits) |
|---|---|---|---|
| 1311 | | 211111 | |

34. What is the Primary Business of this entity? *(Please do not repeat the SIC or NAICS description.)*

Natural Gas Production

**Questions 34 – 37 address geographic location. Please refer to the instructions for applicability.**

| | |
|---|---|
| 35. Description to Physical Location: | From the intersection of TX 72 and TX 119 in Yorktown, TX., follow TX 119 for 7.1 miles. Turn right onto Co. Rd. 3019/H Koopman Rd. Follow for 0.6 miles, lease road will be on the left. |

| 36. Nearest City | County | State | Nearest ZIP Code |
|---|---|---|---|
| Yorktown | DeWitt | TX | 78164 |

| 37. Latitude (N) In Decimal: | | | 38. Longitude (W) In Decimal: | | |
|---|---|---|---|---|---|
| Degrees | Minutes | Seconds | Degrees | Minutes | Seconds |
| 29 | 03 | 19.22 | 97 | 35 | 25.91 |

**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 or the updates may not be made. If your Program is not listed, check other and write it in. See the Core Data Form instructions for additional guidance.

| | | | | |
|---|---|---|---|---|
| ☐ Dam Safety | ☐ Districts | ☐ Edwards Aqulfer | ☐ Industrial Hazardous Waste | ☐ Municipal Solid Waste |
| ☑ New Source Review – Air | ☐ OSSF | ☐ Petroleum Storage Tank | ☐ PWS | ☐ Sludge |
| ☐ Stormwater | ☐ Title V – Air | ☐ Tires | ☐ Used Oil | ☐ Utilities |
| ☐ Voluntary Cleanup | ☐ Waste Water | ☐ Wastewater Agriculture | ☐ Water Rights | ☐ Other: |

## SECTION IV: Preparer Information

| | | | |
|---|---|---|---|
| 40. Name: | James Woodall | 41. Title: | Sr. Environmental Specialist |

| 42. Telephone Number | 43. Ext./Code | 44. Fax Number | 45. E-Mail Address |
|---|---|---|---|
| (832) 486-6508 | N/A | | james.woodall@conocophillips.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 9 and/or as required for the updates to the ID numbers identified in field 39.

***(See the Core Data Form instructions for more information on who should sign this form.)***

| | | | |
|---|---|---|---|
| Company: | Burlington Resources Oil & Gas Company LP | Job Title: | Manager of Production Operations-GCBU |
| Name *(In Print)* : | Randy Black | Phone: | (832) 486-6508 |
| Signature: | | Date: | 8/23/12 |

**Texas Commission on Environmental Quality**
**Form PI-1S**
**Registrations for Air Standard Permit**
**(Page 1)**

| **I. Registrant Information** | | |
|---|---|---|
| **A.** Is a TCEQ Core Data Form (TCEQ Form No. 10400) attached? Core Data Form required for Standard Permits 6004, 6006, 6007, 6008, and 6013. | | ☒ YES ☐ NO |
| Customer Reference Number (CN): CN602989436 | | |
| Regulated Entity Number (RN): RN106485683 | | |
| **B.** Company or Other Legal Customer Name (must be same as Core Data "Customer"): Burlington Resources Oil & Gas Company LP | | |
| Company Official Contact Name: Randy Black | | |
| Title: Manager of Production Operations- GCBU | | |
| Mailing Address: 600 N Dairy Ashford, Westlake 3, #15012 | | |
| City: Houston | State: TX | ZIP Code: 77079 |
| Phone No.: 832-486-6508 | Fax No.: 832-486-6431 | E-mail Address: randy.c.black@conocophillips.com |
| **C.** Technical Contact Name: James Woodall | | |
| Title: Sr. Environmental Specialist | | |
| Mailing Address: 600 N Dairy Ashford, Westlake 3, #15012 | | |
| City: Houston | State: TX | ZIP Code: 77079 |
| Phone No.: 832-486-6508 | Fax No.: 832-486-6431 | E-mail Address: james.woodall@conocophillips.com |
| **D.** Facility Location Information (Street Address): | | |
| If no street address, provide clear driving directions to the site in writing: | | |
| From the intersection of TX 72 and TX 119 in Yorktown, TX., follow TX 119 for 7.1 miles. Turn right onto Co. Rd. 3019/H Koopman Rd. Follow for 0.6 miles, lease road will be on the left. | | |
| City: Yorktown | County: DeWitt | ZIP Code: 78164 |
| Latitude (nearest second): 29°03'19.22"N | Longitude (nearest second): 97°35'25.91"W | |
| **II. Facility and Site Information** | | |
| **A.** Name and Type of Facility: Lackey Land A639 Unit A1 & B1 | | ☒ Permanent ☐ Portable |
| **B.** Type of Action: | ☒ Initial Application ☐ Renewal | ☐ Change to Registration |
| | Registration No.: 104959 | ☐ Expiration Date: |
| **C.** List the Standard Permit Claimed: 6002 | | |
| Description: Oil and Gas Facilities | | |
| **D.** Concrete Batch Plant Standard Permit: *(Check one)* | | |
| ☐ Central Mix ☐ Ready Mix ☐ Specialty Mix ☐ Enhanced Controls for Concrete Batch Plants | | |

**Texas Commission on Environmental Quality**
**Registrations for Air Standard Permit**
**PI-1S**
**(Page 2)**

| **II. Facility and Site Information *(continued)*** | | |
|---|---|---|
| **E.** Proposed Start of Construction: | Length of Time at the Site: | |
| **F.** Is there a previous Standard Exemption or Permit by Rule for the facilities in this registration? *(Attach details regarding changes)* | | ☐ YES ☒ NO |
| If "YES," list Permit No.: | | |
| **G.** Are there any other facilities at this site which are authorized by an air Standard Permit? | | ☐ YES ☒ NO |
| If "YES," list Permit No.: | | |
| **H.** Are there any other air preconstruction permits at this site? | | ☐ YES ☒ NO |
| If "YES," list Permit No.: | | |
| Are there any other air preconstruction permits at this site that would be directly associated with this project? | | ☐ YES ☒ NO |
| If "YES," list Permit No.: | | |
| **I.** TCEQ Account Identification Number (if known): | | |
| **J.** Is this facility located at a site which is required to obtain a federal operating permit pursuant to 30 TAC Chapter 122? | | ☐ YES ☒ NO ☐ To Be Determined |
| **K.** Identify the requirements of 30 TAC Chapter 122 that will be triggered if this Form PI-1S application is approved. | | |
| ☐ Application for an FOP | ☐ FOP Significant Revision | ☐ FOP Minor |
| ☐ Operational Flexibility/Off-Permit Notification | ☐ Streamlined Revision for GOP | |
| ☐ To Be Determined | ☒ None | |
| **L.** Identify the type(s) issued and/or FOP application(s) submitted/pending for the site. *(check all that apply)* | | |
| ☐ SOP ☐ GOP | ☐ GOP Application/Revision Application: Submitted or Under APD Review | |
| ☐ SOP Application Review Application: Submitted or Under APD Review | | ☒ N/A |
| **III. Fee Information** | | |
| **A.** Is a copy of the check or money order attached? | | ☒ YES ☐ NO |
| Check/Money Order/Transaction Number | | |
| Company name on Check: TITAN Engineering, Inc. | | |
| Fee Amount: $850.00 | | |

**Texas Commission on Environmental Quality**
**Registrations for Air Standard Permit**

**PI-1S**
**(Page 3)**

| **IV. Public Notice *(If* Applicable*)*** | | | |
|---|---|---|---|
| **A.** Is the plant located at a site contiguous or adjacent to the public works project? | | | ☐ YES ☐ NO |
| **B.** Name of Public Place: | | | |
| Physical Address: | | | |
| City: | County: | | |
| **C.** Small Business Classification: | | | ☐ YES ☐ NO |
| **D.** Concrete batch plants with enhanced controls, permanent rock crushers, and animal carcass incinerators shall place a copy of the technically complete application at the appropriate TCEQ regional office only. | | | |
| **E.** Please furnish the names of the state legislators who represent the area where the facility site is located: | | | |
| State Senator: | | | |
| State Representative: | | | |
| **F.** For Concrete Batch Plants, name of the County Judge for this facility site**:** | | | |
| County Judge: | | | |
| Mailing Address: | | | |
| City: | State: | ZIP Code: | |
| **G.** For Concrete Batch Plants, is the facility located in a municipality and/or extraterritorial jurisdiction of a municipality? | | | ☐ YES ☐ NO |
| If "YES," list the name(s) of the Presiding Officer(s) for the municipality and/or extraterritorial jurisdiction: | | | |
| | | | |
| Title: | | | |
| Mailing Address: | | | |
| City: | State: | ZIP Code: | |
| **V. Technical Information Including State and Federal Regulatory Requirements** ***Registrants must be in compliance with all applicable state and federal regulations and standards to claim a Standard Permit.*** | | | |
| **A.** Is confidential information submitted and properly marked with this registration? | | | ☐ YES ☒ NO |
| **B.** Is a process flow diagram and a process description attached? | | | ☒ YES ☐ NO |
| **C.** Is a plot plan attached? | | | ☒ YES ☐ NO |
| **D.** Are emissions data and calculations for this claim attached? | | | ☒ YES ☐ NO |
| **E.** Is information attached showing how the general requirements and applicability (30 TAC § 116.610 and 116.615) are met? | | | ☒ YES ☐ NO |
| **F.** Is information attached showing how the specific requirements are met? | | | ☒ YES ☐ NO |

**Texas Commission on Environmental Quality**
**Form PI-1S**
**General Application for Air Permit Renewals**
**(Page 4)**

| VI. Signature Requirements |
|---|
| The signature below indicates that I have knowledge of the facts herein set forth and that the same are true and correct to the best of my knowledge and belief. I further state that to the best of my knowledge and belief, the project for which application is made will not in any way violate any provision of the Texas Water Code (TWC), Chapter 7, Texas Clean Air Act (TCAA), as amended, or any of the air quality rules and regulations of the Texas Commission on Environmental Quality or any local governmental ordinance or resolution enacted pursuant to the TCAA. I further state that I have read and understand TWC §§ 7.177 7.183, which defines ***Criminal Offenses*** for certain violations, including intentionally or knowingly making or causing to be made false material statements or representations in this application, and TWC §§ 7.187, pertaining to ***Criminal Penalties***. |
| Name: Randy Black<br>*Print Full Name* |
| Signature: RP<br>*Original Signature Required* |
| Date: 8/23/12 |

CASH ONLY IF ALL CheckLock™ SECURITY FEATURES LISTED ON BACK INDICATE NO TAMPERING OR COPYING

**TITAN ENGINEERING, INC.**
2801 NETWORK BLVD, SUITE 200
FRISCO, TX 75034

**BANK OF TEXAS, NA**
DALLAS, TX
32-1432/1110

**24960**

8/29/2012

PAY TO THE ORDER OF TCEQ $ **850.00

Eight Hundred Fifty and 00/100********** DOLLARS

Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

VOID AFTER 90 DAYS

MEMO Agency Fee: 84800507-72.009

⑈024960⑈ ⑆111014325⑆ ⑈8092671152⑈

Details on Back

Intuit® CheckLock™ Secure Check

**TITAN ENGINEERING, INC.** **24960**

TCEQ 8/29/2012

| Date | Type | Reference | Original Amt. | Balance Due | Discount | Payment |
|---|---|---|---|---|---|---|
| 8/29/2012 | Bill | 84800507-72.009 | 850.00 | 850.00 | | 850.00 |
| | | | | | Check Amount | 850.00 |

Bank of Texas Operati Agency Fee: 84800507-72.009 850.00

# Texas Commission on Environmental Quality

OGS New Project Notification for New Registration

## Site Information (Regulated Entity)

| | |
|---|---|
| What is the name of the site to be authorized? | Lackey Land Unit A1 & Lackey Land Unit B1 |
| Does the site have a physical address? | |
| County | DEWITT |
| Latitude (N) (##.######) | 29.055303 |
| Longitude (W) (-###.######) | -97.59053 |
| Primary SIC Code | 1311 |
| Secondary SIC Code | |
| Primary NAICS Code | 211111 |
| Secondary NAICS Code | |
| Regulated Entity Site Information | |
| What is the Regulated Entity's Number (RN)? | |
| What is the name of the Regulated Entity (RE)? | Lackey Land Unit A1 & Lackey Land Unit B1 |
| Does the RE site have a physical address? | No |
| Because there is no physical address, describe how to locate this site: | From the intersection of TX-72 and TX-119 in Yorktown, TX., follow TX-119 north for 7.1 miles. Turn right onto Co.Rd. 3019/H Koopmann Rd. and continue for 0.6 miles. Lease entrance will be on left. |
| City | Yorktown |
| State | TX |
| ZIP | 78164 |
| County | DEWITT |
| Latitude (N) (##.######) | 29.055303 |
| Longitude (W) (-###.######) | -97.59053 |
| What is the primary business of this entity? | Natural Gas Production |

## Burling-Customer (Applicant) Information

| | |
|---|---|
| How is this applicant associated with this site? | Owner Operator |
| What is the applicant's Customer Number (CN)? | CN602989436 |
| Type of Customer | Corporation |
| Full legal name of the applicant: | |
| Legal Name | Burlington Resources Oil & Gas Company LP |
| Texas SOS Filing Number | 14500511 |

| | |
|---|---|
| Federal Tax ID | |
| State Franchise Tax ID | 32003073841 |
| DUNS Number | 131117566 |
| Number of Employees | 501+ |
| Independently Owned and Operated? | Yes |
| I certify that the full legal name of the entity applying for this permit has been provided and is legally authorized to do business in Texas. | Yes |
| Responsible Authority Contact | |
| Organization Name | Burlington Resources Oil & Gas Company LP |
| Prefix | MR |
| First | James |
| Middle | |
| Last | Woodall |
| Suffix | |
| Title | Sr. Environmental Specialist |
| Responsible Authority Mailing Address | |
| Enter new address or copy one from list: | |
| Address Type | Domestic |
| Mailing Address (include Suite or Bldg. here, if applicable) | 600 N DAIRY ASHFORD ST |
| Routing (such as Mail Code, Dept., or Attn:) | Westlake 3, #15012 |
| City | HOUSTON |
| State | TX |
| ZIP | 77079 |
| Phone (###-###-####) | 8324866508 |
| Extension | |
| Alternate Phone (###-###-####) | |
| Fax (###-###-####) | 8324866431 |
| E-mail | james.woodall@conocophillips.com |

## Responsible Official Contact

| | |
|---|---|
| Person TCEQ should contact for questions about this application: | |
| Same as another contact? | |
| Organization Name | Burlington Resources Oil & Gas Company LP |
| Prefix | MR |
| First | Randy |

| | |
|---|---|
| Middle | |
| Last | Black |
| Suffix | |
| Title | Manager of Puduction Operations- GCBU |
| Enter new address or copy one from list: | Burlington Resources Oil & Gas Company LP |
| Mailing Address | |
| Address Type | Domestic |
| Mailing Address (include Suite or Bldg. here, if applicable) | 600 N DAIRY ASHFORD ST |
| Routing (such as Mail Code, Dept., or Attn:) | Westlake 3, #15012 |
| City | HOUSTON |
| State | TX |
| ZIP | 77079 |
| Phone (###-###-####) | 8324866508 |
| Extension | |
| Alternate Phone (###-###-####) | |
| Fax (###-###-####) | 8324866431 |
| E-mail | randy.c.black@conocophillips.com |

## Technical Contact

| | |
|---|---|
| Person TCEQ should contact for questions about this application: | |
| Same as another contact? | Burlington Resources Oil & Gas Company LP |
| Organization Name | Burlington Resources Oil & Gas Company LP |
| Prefix | MR |
| First | James |
| Middle | |
| Last | Woodall |
| Suffix | |
| Title | Sr. Environmental Specialist |
| Enter new address or copy one from list: | |
| Mailing Address | |
| Address Type | Domestic |
| Mailing Address (include Suite or Bldg. here, if applicable) | 600 N DAIRY ASHFORD ST |
| Routing (such as Mail Code, Dept., or Attn:) | Westlake 3, #15012 |
| City | HOUSTON |
| State | TX |

| | |
|---|---|
| ZIP | 77079 |
| Phone (###-###-####) | 8324866508 |
| Extension | |
| Alternate Phone (###-###-####) | |
| Fax (###-###-####) | 8324866431 |
| E-mail | james.woodall@conocophillips.com |

## OGS New Project Notification

| | |
|---|---|
| 1) Select the authorization this site or changes to this site will most likely be authorized under based on expected worst-case operations (including planned MSS activities if MSS emissions are being registered with this project). | 6002 - NON RULE 2011-FEB-27 |
| 2) What is the lease name submitted to the Railroad Commission (RRC)? If there are well(s) co-located with the site, include the well number(s) assigned by the RRC. | NA |
| 3) Provide a brief process description for this site or description of changes to this site. | The production site extracts natural gas from the wellhead and sends down the pipeline. Hydrocarbon Liquids are collected and sent off site periodically. |
| 4) What is the site's latitude? (North) | 29.055303 |
| 5) What is the site's longitude? (West) | -97.590531 |
| 6) What method was used to determine the site's latitude and longitude? | Map |
| 7) Does this business qualify as a small business, non-profit organization, or small government entity? | No |

## Signature

The signature below indicates to the best of my knowledge that the information submitted is true and complete, and that I have signature authority to submit this application on behalf of the regulated entity.

1. I am James Woodall, the owner of the STEERS account ER020324.
2. I have the authority to sign this data on behalf of the applicant named above.
3. I have personally examined the foregoing and am familiar with its content and the content of any attachments, and based upon my personal knowledge and/or inquiry of any individual responsible for information contained herein, that this information is true, accurate, and complete.
4. I further certify that I have not violated any term in my TCEQ STEERS participation agreement and that I have no reason to believe that the confidentiality or use of my password has been compromised at any time.
5. I understand that use of my password constitutes an electronic signature legally equivalent to my written

signature.

6. I also understand that the attestations of fact contained herein pertain to the implementation, oversight and enforcement of a state and/or federal environmental program and must be true and complete to the best of my knowledge.
7. I am aware that criminal penalties may be imposed for statements or omissions that I know or have reason to believe are untrue or misleading.
8. I am knowingly and intentionally signing OGS New Project Notification for New Registration.
9. My signature indicates that I am in agreement with the information on this form, and authorize its submittal to the TCEQ.

OWNER OPERATOR Signature: James Woodall OWNER OPERATOR

| | |
|---|---|
| Account Number: | ER020324 |
| Signature IP Address: | 138.32.80.20 |
| Signature Date: | 2012-07-31 |
| Signature Hash: | AA06BD67D3B72ED49336BE1B65B794CDB78BFA0ECB7C0D5E82BDCEE54CEC562C |
| Form Hash Code at time of Signature: | 6E1AD0D16FDA6AE2F3B65A4B8BE64A0DF43FB0AD0B24B3553AE5E9D92EA29A80 |

## Fee Payment

| | |
|---|---|
| Transaction by: | The application fee payment transaction was made by ER025071/Christina I Chermak |
| Paid by: | The application fee was paid by CHRISTINA CHERMAK |
| Fee Amount: | 50 |
| Paid Date: | The application fee was paid on 2012-08-08 |
| Transaction/Voucher number: | The transaction number is 582EA000125673 and the voucher number is 159525 |

## Submission

| | |
|---|---|
| Reference Number: | The application reference number is 52622 |
| Submitted by: | The application was submitted by ER025071/Christina I Chermak |
| Submitted Timestamp: | The application was submitted on 2012-08-08 at 10:09:59 CDT |
| Submitted From: | The application was submitted from IP address 12.237.12.100 |
| Confirmation Number: | The confirmation number is 58627 |
| Steers Version: | The STEERS version is 5.80 |

## Additional Information

Application Creator: This account was created by Christina I Chermak

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

**Table 1(a) Emissions Point Summary**

| Permit Number: | 104959 | RN Number: | RN106485683 | Date: | August 2012 |
|---|---|---|---|---|---|
| Company Name: | Burlington Resources Oil & Gas Company LP | | | | |

Review of applications and issuance of permits will be expedited by supplying all necessary information requested on this Table.

| AIR CONTAMINANT DATA | | | | | | EMISSION POINT DISCHARGE PARAMETERS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Emission Point | | | 2. Component or Air Contaminant Name | 3. Air Contaminant Emission Rate | | 4. UTM Coordinates of Emission Point | | | 5. Building Height (ft) | 6. Height Above Ground (ft) | Source | | | | | |
| | | | | | | | | | | | 7. Stack Exit Data | | | 8. Fugitives | | |
| EPN (A) | FIN (B) | NAME (C) | | Pounds per Hour (A) | TPY (B) | Zone | East (meters) | North (meters) | | | Diameter (ft) (A) | Velocity (fps) (B) | Tempera-ture (°F) (C) | Length (ft) (A) | Width (ft) (B) | Axis Degrees (C) |
| Normal Operations | | | | | | | | | | | | | | | | |
| FUG | FUG | Site Fugitives | VOC | 0.96 | 4.20 | 14 | -- | -- | -- | 3.0 | -- | -- | -- | -- | -- | -- |
| | | | Benzene | 0.004 | 0.02 | | | | | | | | | | | |
| | | | $H_2S$ | 0.0004 | 0.001 | | | | | | | | | | | |
| FL-1 | TK-01<br>TK-02<br>TK-03<br>TK-04<br>TK-05<br>TK-06 | Controlled Condensate Tank Emissions | VOC | 2.81 | 6.95 | 14 | -- | -- | -- | 30.0 | -- | -- | -- | -- | -- | -- |
| | | | Benzene | 0.01 | 0.01 | | | | | | | | | | | |
| | | | $H_2S$ | 0.001 | 0.003 | | | | | | | | | | | |
| FL-1 | TK-07<br>TK-08 | Controlled PW Tank Emissions | VOC | 0.06 | 0.21 | 14 | -- | -- | -- | 30.0 | -- | -- | -- | -- | -- | -- |
| | | | Benzene | 0.0002 | 0.0004 | | | | | | | | | | | |
| | | | $H_2S$ | 0.00002 | 0.0001 | | | | | | | | | | | |
| FL-1 | TRUCK1 | Controlled Condensate Truck Loading | VOC | 0.74 | 0.67 | 14 | -- | -- | -- | 30.0 | -- | -- | -- | -- | -- | -- |
| | | | Benzene | 0.002 | 0.002 | | | | | | | | | | | |
| FL-1 | TRUCK2 | Controlled Produced Water Truck Loading | VOC | 0.36 | 0.14 | 14 | -- | -- | -- | 30.0 | -- | -- | -- | -- | -- | -- |
| | | | Benzene | 0.001 | 0.0003 | | | | | | | | | | | |
| FL-1 | FL-1 | Flare Combustion (normal operations waste gas, assist, and pilot) | CO | 2.42 | 5.93 | 14 | -- | -- | -- | 30.0 | -- | -- | -- | -- | -- | -- |
| | | | $NO_X$ | 1.21 | 2.96 | | | | | | | | | | | |
| | | | $SO_2$ | 0.09 | 0.42 | | | | | | | | | | | |
| | | | $H_2S$ | 0.001 | 0.01 | | | | | | | | | | | |
| | | | VOC | 0.01 | 0.04 | | | | | | | | | | | |
| | | | Benzene | 0.000003 | 0.00001 | | | | | | | | | | | |

2-13



EFSCOP00009347

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

**Table 1(a) Emissions Point Summary**

| Permit Number: | 104959 | RN Number: | RN106485683 | Date: | August 2012 |
|---|---|---|---|---|---|
| Company Name: | Burlington Resources Oil & Gas Company LP | | | | |

Review of applications and issuance of permits will be expedited by supplying all necessary information requested on this Table.

| AIR CONTAMINANT DATA | | | | | | EMISSION POINT DISCHARGE PARAMETERS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Emission Point | | | 2. Component or Air Contaminant Name | 3. Air Contaminant Emission Rate | | 4. UTM Coordinates of Emission Point | | | 5. Building Height (ft) | 6. Height Above Ground (ft) | Source | | | | | |
| | | | | | | | | | | | 7. Stack Exit Data | | | 8. Fugitives | | |
| EPN (A) | FIN (B) | NAME (C) | | Pounds per Hour (A) | TPY (B) | Zone | East (meters) | North (meters) | | | Diameter (ft) (A) | Velocity (fps) (B) | Tempera-ture (°F) (C) | Length (ft) (A) | Width (ft) (B) | Axis Degrees (C) |
| Scheduled Maintenance Startup and Shutdown Events | | | | | | | | | | | | | | | | |
| FL-1 | SEP-GAS | Low Pressure Separator Gas to Flare | VOC | 66.94 | 17.59 | 14 | -- | -- | -- | 30.0 | -- | -- | -- | -- | -- | -- |
| | | | Benzene | 0.38 | 0.10 | | | | | | | | | | | |
| | | | $H_2S$ | 0.07 | 0.02 | | | | | | | | | | | |
| FL-1 | FL-1 | Flare Combustion (lp separator waste gas) | CO | 50.13 | 13.18 | 14 | -- | -- | -- | 30.0 | -- | -- | -- | -- | -- | -- |
| | | | $NO_X$ | 25.11 | 6.60 | | | | | | | | | | | |
| | | | $SO_2$ | 6.32 | 1.81 | | | | | | | | | | | |
| | | | $H_2S$ | 0.07 | 0.02 | | | | | | | | | | | |
| TK-01 | TK-01 | Uncontrolled Condensate Tank Standing Loss Emissions (during flare downtime) | VOC | 2.06 | 0.18 | 14 | -- | -- | -- | 25.0 | -- | -- | -- | -- | -- | -- |
| TK-02 | TK-02 | | Benzene | 0.01 | 0.001 | | | | | | | | | | | |
| TK-03 | TK-03 | | | | | | | | | | | | | | | |
| TK-04 | TK-04 | | | | | | | | | | | | | | | |
| TK-05 | TK-05 | | | | | | | | | | | | | | | |
| TK-06 | TK-06 | | | | | | | | | | | | | | | |
| TK-07 | TK-07 | Uncontrolled PW Tank Standing Loss Emissions (during flare downtime) | VOC | 0.001 | 0.0001 | 14 | -- | -- | -- | 25.0 | -- | -- | -- | -- | -- | -- |
| TK-08 | TK-08 | | Benzene | 0.000002 | 0.0000002 | | | | | | | | | | | |

2-14



EFSCOP00009348

# ATTACHMENT 3
# EMISSION RATE CALCULATIONS

## OIL AND GAS STANDARD PERMIT REGISTRATION

## LACKEY LAND A639 UNIT A1 & B1

## BURLINGTON RESOURCES OIL & GAS COMPANY LP

**TABLE 3-1**
**SUMMARY OF PROPOSED ALLOWABLE EMISSION RATES**

**OIL & GAS STANDARD PERMIT REGISTRATION**

**LACKEY LAND A639 UNIT A1 & B1**

**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

| | | | Proposed Allowable Hourly and Annual Emission Rates | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CO | | $NO_X$ | | $PM/PM_{10}/PM_{2.5}$ | | $SO_2$ | | VOC | | Benzene | | $H_2S$ | |
| EPN | FIN | Description | (lb/hr) | (T/yr) | (lb/hr) | (T/yr) | (lb/hr) | (T/yr) | (lb/hr) | (T/yr) | (lb/hr) | (T/yr) | (lb/hr) | (T/yr) | (lb/hr) | (T/yr) |
| Normal Operations | | | | | | | | | | | | | | | | |
| FUG | FUG | Site Fugitives | -- | -- | -- | -- | -- | -- | -- | -- | 0.96 | 4.20 | 0.004 | 0.02 | 0.0004 | 0.001 |
| FL-1 | TK-01<br>TK-02<br>TK-03<br>TK-04<br>TK-05<br>TK-06 | Controlled Condensate Tank Emissions | -- | -- | -- | -- | -- | -- | -- | -- | 2.81 | 6.95 | 0.01 | 0.01 | 0.001 | 0.003 |
| FL-1 | TK-07<br>TK-08 | Controlled PW Tank Emissions | -- | -- | -- | -- | -- | -- | -- | -- | 0.06 | 0.21 | 0.0002 | 0.0004 | 0.00002 | 0.0001 |
| FL-1 | TRUCK1 | Controlled Condensate Truck Loading | -- | -- | -- | -- | -- | -- | -- | -- | 0.74 | 0.67 | 0.002 | 0.002 | -- | -- |
| FL-1 | TRUCK2 | Controlled Produced Water Truck Loading | -- | -- | -- | -- | -- | -- | -- | -- | 0.36 | 0.14 | 0.001 | 0.0003 | -- | -- |
| FL-1 | FL-1 | Flare Combustion (normal operations waste gas, assist, and pilot) | 2.42 | 5.93 | 1.21 | 2.96 | -- | -- | 0.09 | 0.42 | 0.01 | 0.04 | 0.000003 | 0.00001 | 0.001 | 0.01 |
| Scheduled Maintenance, Startup and Shutdown Events | | | | | | | | | | | | | | | | |
| FL-1 | SEP-GAS | Low Pressure Separator Gas to Flare | -- | -- | -- | -- | -- | -- | -- | -- | 66.94 | 17.59 | 0.38 | 0.10 | 0.07 | 0.02 |
| FL-1 | FL-1 | Flare Combustion (lp separator waste gas) | 50.13 | 13.18 | 25.11 | 6.60 | -- | -- | 6.32 | 1.81 | -- | -- | -- | -- | 0.07 | 0.02 |
| TK-01<br>TK-02<br>TK-03<br>TK-04<br>TK-05<br>TK-06 | TK-01<br>TK-02<br>TK-03<br>TK-04<br>TK-05<br>TK-06 | Uncontrolled Condensate Tank Standing Loss Emissions (during flare downtime) | -- | -- | -- | -- | -- | -- | -- | -- | 2.06 | 0.18 | 0.01 | 0.001 | -- | -- |
| TK-07<br>TK-08 | TK-07<br>TK-08 | Uncontrolled PW Tank Standing Loss Emissions (during flare downtime) | -- | -- | -- | -- | -- | -- | -- | -- | 0.001 | 0.0001 | 0.000002 | 0.0000002 | -- | -- |
| | | **Site-Wide Emissions:** | **52.55** | **19.11** | **26.32** | **9.56** | **0.00** | **0.00** | **6.41** | **2.23** | **73.94** | **29.98** | **0.41** | **0.13** | **0.14** | **0.05** |



EFSCOP00009350

**CALCULATION OF SITE FUGITIVES (FIN FUG) POTENTIAL TO EMIT**

**OIL & GAS STANDARD PERMIT REGISTRATION**

**LACKEY LAND A639 UNIT A1 & B1**

**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

| Component | Number of Components | Emission Factors [a] (lb/hr-component) | Annual Operating Hours (hr/yr) | Maximum VOC[a] (wt%) | Maximum Benzene[a] (wt%) | Maximum $H_2S$ (wt%) | Reduction Credit [a] (%) | PTE VOC | | PTE Benzene | | PTE $H_2S$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Hourly [b] (lb/hr) | Annual [c] (T/yr) | Hourly [b] (lb/hr) | Annual [c] (T/yr) | Hourly [b] (lb/hr) | Annual [c] (T/yr) |
| Valves | | | | | | | | | | | | | |
| Gas Streams | 86 | 0.00992 | 8,760 | 40% | 0.23% | 0.04% | 0% | 0.34 | 1.49 | 0.002 | 0.01 | 0.0003 | 0.001 |
| Light Oil | 74 | 0.0055 | 8,760 | 100% | 0.31% | -- | 0% | 0.41 | 1.78 | 0.001 | 0.01 | -- | -- |
| Water/Light Oil | 85 | 0.000216 | 8,760 | -- | 0.02% | -- | 0% | 0.02 | 0.08 | 0.000004 | 0.00002 | -- | -- |
| Pumps | | | | | | | | | | | | | |
| Water/Light Oil | 1 | 0.000052 | 8,760 | -- | 0.02% | -- | 0% | 0.0001 | 0.0002 | 0.00000001 | 0.00000005 | -- | -- |
| Flanges | | | | | | | | | | | | | |
| Gas Streams | 144 | 0.00086 | 8,760 | 40% | 0.23% | 0.04% | 0% | 0.05 | 0.22 | 0.0003 | 0.001 | 0.00005 | 0.0002 |
| Light Oil | 76 | 0.000243 | 8,760 | 100% | 0.31% | -- | 0% | 0.02 | 0.08 | 0.0001 | 0.0003 | -- | -- |
| Water/Light Oil | 16 | 0.000006 | 8,760 | -- | 0.02% | -- | 0% | 0.0001 | 0.0004 | 0.00000002 | 0.0000001 | -- | -- |
| Connectors | | | | | | | | | | | | | |
| Gas Streams | 157 | 0.00044 | 8,760 | 40% | 0.23% | 0.04% | 0% | 0.03 | 0.12 | 0.0002 | 0.001 | 0.00003 | 0.0001 |
| Light Oil | 138 | 0.000463 | 8,760 | 100% | 0.31% | -- | 0% | 0.06 | 0.28 | 0.0002 | 0.001 | -- | -- |
| Water/Light Oil | 141 | 0.000243 | 8,760 | -- | 0.02% | -- | 0% | 0.03 | 0.15 | 0.00001 | 0.00003 | -- | -- |
| | | | | | | | **TOTAL:** | **0.96** | **4.20** | **0.004** | **0.02** | **0.0004** | **0.001** |

[a] Fugitive Emission Factors and Reduction Credits are per TCEQ Technical Guidance Document for Equipment Leak Fugitives, dated October 2000. The emission factors are for total hydrocarbon, except for the emission factors associated with Water/Light Oil. As indicated on page 6 of 55 in the mentioned Guidance document, these factors are based off of a known stream constituency of 50%-99% water, and remainder VOC. Therefore, applying a VOC wt % would be double counting for the reduction due to water.

[b] Hourly VOC emission rates are calculated as follows:
(86 components) * (0.00992 lb/hr-component) * (40% VOC) * (100% - 0% reduction credit) = 0.34 lb/hr

[c] Annual VOC emission rates are calculated as follows:
(86 components) * (0.00992 lb/hr-component) * (8,760 hr/yr) * (40% VOC) * (100% - 0% reduction credit) / (2,000 lb/T) = 1.49 T/yr



EFSCOP00009351

**SUMMARY OF TANKS SENT TO FLARE POTENTIAL TO EMIT**

**OIL & GAS STANDARD PERMIT REGISTRATION**

**LACKEY LAND A639 UNIT A1 & B1**

**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

| | | | VOC Emissions | | | | | | | | Benzene Emissions | | | | | | | | $H_2S$ Emissions[c] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Flash Emissions[a] | | WB Emissions[b] | | Uncontrolled Total | | Controlled Total[d] | | Flash Emissions[a] | | WB Emissions[b] | | Uncontrolled Total | | Controlled Total[d] | | Uncontrolled Total | | Controlled Total[d] | |
| **EPN** | **FIN** | **Description** | **Hourly (lb/hr)** | **Annual (T/yr)** | **Hourly (lb/hr)** | **Annual (T/yr)** | **Hourly (lb/hr)** | **Annual (T/yr)** | **Hourly (lb/hr)** | **Annual (T/yr)** | **Hourly (lb/hr)** | **Annual (T/yr)** | **Hourly (lb/hr)** | **Annual (T/yr)** | **Hourly (lb/hr)** | **Annual (T/yr)** | **Hourly (lb/hr)** | **Annual (T/yr)** | **Hourly (lb/hr)** | **Annual (T/yr)** | **Hourly (lb/hr)** | **Annual (T/yr)** |
| FL-1 | TK-01<br>TK-02<br>TK-03<br>TK-04<br>TK-05<br>TK-06 | 500 bbl Condensate Storage Tanks | 74.17 | 324.86 | 66.41 | 22.53 | 140.58 | 347.39 | 2.81 | 6.95 | 0.15 | 0.66 | 0.21 | 0.07 | 0.36 | 0.73 | 0.01 | 0.01 | 0.03 | 0.13 | 0.001 | 0.003 |
| FL-1 | TK-07<br>TK-08 | 500 bbl Produced Water Storage Tanks | 2.36 | 10.34 | 0.66 | 0.02 | 3.02 | 10.36 | 0.06 | 0.21 | 0.005 | 0.02 | 0.001 | 0.00004 | 0.01 | 0.02 | 0.0002 | 0.0004 | 0.001 | 0.004 | 0.00002 | 0.0001 |

Notes:

[a] VOC and Benzene Flash Emissions are calculated using the WinSim stream simulation program. Data inputs included the pressurized stream data and throughputs represented in this submittal. See the pages at the end of this attachment for a printout of the data inputs and emissions reports.

[b] The Working/Breathing emissions are calculated using AP 42 Chapter 7 calculations with data inputs from the stream data and throughputs. See the following pages for the represented calculations.

[c] The Ideal Gas Law was used to estimate the H2S emission rates using the maximum sulfur concentration in the gas coming off the tanks (200 ppm). An example calculation for hourly H2S emissions from FIN TK-07 and TK-08 follows:

$H_2S$ (lb/hr) = (% Vol $H_2S$ in stream) * (Total Volumetric Flow of Gas, scf/hr) * (1 atm STP) * (34.0798 lb/lb-mol H2S) / (1.314, atm-scf/lb-mol-K) / (298 K)

$H_2S$ (lb/hr) = (200 ppm /10^6) * (45.24 scf/hr) * (1 atm) * (34.0789 lb/lbmol H2S) / (1.314, atm-scf/lb-mol-K) / (298 K)

$H_2S$ (lb/hr) = 0.0010 lb/hr

[d] All VOC tank emissions are routed to the flare control device with a capture and control efficiency of 98%. $H_2S$ emissions are captured at 98% and then 98% converted to $SO_2$ during combustion.



EFSCOP00009352

**CALCULATION OF STORAGE TANK WORKING AND BREATHING POTENTIAL TO EMIT**

**OIL & GAS STANDARD PERMIT REGISTRATION**

**LACKEY LAND A639 UNIT A1 & B1**

**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

| Variable | Description | Units | Value |
|---|---|---|---|
| $L_T$ | total loss = Ls + Lw | Ton/yr | See Table |
| $L_S$ | standing loss = 365 Vv Wv Ke Ks | lb/yr | See Table |
| $L_W$ | working loss = 0.001 Mv PV Q Kn Kp | lb/yr | See Table |
| $L_H$ | working loss = 0.001 Mv Pmax Qh | lb/hr | See Table |
| | Roof Construction | | Cone |
| RVP | Condensate Reid Vapor Pressure | psia | 10.32 |
| ΔPb | Breather vent pressure range | psi | 0.06 |
| I | Solar insolation factor | Btu/ft2-day | 1521 |
| $P_A$ | Atmospheric Pressure | psia | 14.7 |
| Mv | Vapor Molecular Weight | lb/lb-mol | 33 |
| T | Annual Average Temperature | °F | 72.1 |
| $T_{AX}$ | Daily Maximum Ambient Temperature | °R | 541.6 |
| $T_{AN}$ | Daily Minimum Ambient Temperature | °R | 522.5 |
| $\Delta T_A$ | Daily average ambient temperature range | °R | 19.1 |
| Kp | Product factor | | 1 |

| | | Tank Specifications | | | | | | | Material Specifications | | | | | | | | | | | | | | | | VOC | | Benzene | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | V/H | D | H/L | Capacity | Color | | α | Mv | $P_{MAX}$ | $Q^2$ | | ΔTv | Hvo | Vv | $T_{LA}$ | $P_{VA}$ | Wv | ΔPv | Ke | Ks | Kn | $L_S$ | $L_W$ | $L_T$ | $L_H$ | $L_T$ | $L_H$ |
| Material | No. of Tanks | Tank Type | Tank Diameter (ft) | Tank Height/ Length (ft) | Tank Capacity (bbl) | Paint Color | Paint Conditions | Paint Solar Absorbance Factor | Vapor Molecular Weight | Reid Vapor Pressure (psia) | Max. Hourly Thruput (bbl/hr) | Annual thruput (bbl) | Daily Vapor Temp. Range °F | Vapor Space Dutage (ft) | Vapor Space Volume (ft3) | Daily Average Liquid Surface Temp °R | Average Vapor Pressure (psia) | Vapor Density (lb/ft3) | Daily Vapor Pressure Range | Vapor Space Expan. Factor | Vented Vapor Sat Factor | Turnover Factor | Standing Loss per tank (lb/yr) | Working Loss per tank (lb/yr) | Total Loss (lb/hr) | Total Loss (T/yr) | Total Loss (lb/hr) | Total Loss (T/yr) |
| Condensate | 6 | V | 12 | 25 | 500 | Gray | Good | 0.54 | 33 | 10.32 | 195 | 365,000 | 36.75 | 12.63 | 1428.4 | 539.8 | 10.670 | 0.06079 | 2.97590 | 0.7916 | 0.12 | 0.21 | 18,064.21 | 26,989.23 | **66.41** | **22.53** | **0.21** | **0.07** |
| PW | 2 | V | 12 | 25 | 500 | Gray | Good | 0.54 | 33 | 0.103 | 195 | 146,000 | 36.75 | 12.63 | 1428.4 | 539.8 | 0.029 | 0.00017 | 0.01633 | 0.0662 | 0.98 | 0.27 | 11.50 | 37.72 | **0.66** | **0.02** | **0.001** | **0.00004** |

NOTE: Tank working and breathing emissions are based on the equations found in EPA AP 42 Chapter 7. All factors used are represented in the table on this page. The Condensate Reid Vapor Pressure and Vapor Molecular Weight are determined based on the WinSim condensate stream and Off Gas stream. All other variables are found in AP 42 Chapter 7 or are default unit values.



EFSCOP00009353

**CALCULATION OF TRUCK LOADING POTENTIAL TO EMIT**

**OIL & GAS STANDARD PERMIT REGISTRATION**

**LACKEY LAND A639 UNIT A1 & B1**

**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

Sample Calculations for condensate:

Loading Loss (lb/Mgal) = 12.46 * S * P * M / T (AP-42 Section 5.2)
Maximum Loading Loss = 12.46 * 0.60 * 10.320 * 33 / 560 = 4.546 lb/Mgal

Annual Emissions = (Annual Throughput, Mgal/yr) * (Average Loading Loss, lb/Mgal) * ( 1 - Control Efficiency) / (2000 lb/T)
Annual Emissions = (15330.00 Mgal/yr) * (4.370 lb/Mgal) * ( 1 - 0.98) / (2000 lb/T) = 0.67 T/yr

Hourly PTE = (Hourly Throughput, Mgal/hr) * (Maximum Loading Loss, lb/Mgal) * ( 1 - Control Efficiency)
Hourly PTE = (8.19 Mgal/yr) * (4.546 lb/Mgal) * ( 1 - 0.98) = 0.74 lb/hr

| | | | | | | | | | | | | VOC | | Benzene | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FIN | EPN | Facility Name | S | P @ 560 °R (psia) | P @531.7 °R (psia) | M | Maximum Loading Loss (lb/Mgal) | Average Loading Loss (lb/Mgal) | Hourly Throughput (Mgal/hr) | Annual Throughput (Mgals/yr) | Capture and Control Efficiency | Hourly PTE (lb/hr) | Annual PTE (T/yr) | Hourly PTE (lb/hr) | Annual PTE (T/yr) |
| TRUCK1 | FL-1 | Condensate Truck Loading | 0.60 | 10.32 | 9.418 | 33 | 4.546 | 4.370 | 8.19 | 15,330.00 | 0.98 | 0.74 | 0.67 | 0.002 | 0.002 |
| TRUCK2 | FL-1 | Produced Water Truck Loading | 0.60 | 0.10 | 0.021 | 33 | 0.044 | 0.046 | 8.19 | 6,132.00 | 0.98 | 0.36 | 0.14 | 0.001 | 0.0003 |

Daily maximum and daily minimum ambient temperature from Tanks 4.09d for this area's annual averages (81.6 and 62.5, for average of 72.1).

Annual Average Condensate Vapor Pressure at $T_{LA}$ :

P = exp{ [ (2799/(T+459.6) - 2.227]log10(RVP) - 7261/(T+459.6) + 12.82}
exp{ [ (2799/(72.1+459.6) - 2.227]log10(10.32) - 7261/(72.1+459.6) + 12.82}
9.418 psia

Annual Average Produced Water Vapor Pressure at $T_{LA}$ :

P = exp{ [ (2799/(T+459.6) - 2.227]log10(RVP) - 7261/(T+459.6) + 12.82}
exp{ [ (2799/(72.1+459.6) - 2.227]log10(10.32*.01) - 7261/(72.1+459.6) + 12.82}
0.021 psia



EFSCOP00009354

**SUMMARY OF PROCESS FLARE FUEL GAS COMBUSTION AND WASTE GAS COMBUSTION POTENTIAL TO EMIT- NORMAL OPERATIONS**

**OIL & GAS STANDARD PERMIT REGISTRATION**

**LACKEY LAND A639 UNIT A1 & B1**

**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

| EPN | FIN | Description | CO | | $NO_X$ | | $SO_2$ | | $H_2S$ | | VOC | | Benzene | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (lb/hr) | (T/yr) | (lb/hr) | (T/yr) | (lb/hr) | (T/yr) | (lb/hr) | (T/yr) | (lb/hr) | (T/yr) | (lb/hr) | (T/yr) |
| FL-1 | FL-1 | Pilot Gas Combustion | 0.01 | 0.04 | 0.003 | 0.01 | 0.0005 | 0.002 | 0.0000002 | 0.000001 | 0.0001 | 0.0004 | 0.00000003 | 0.0000001 |
| FL-1 | FL-1 | Flare Assist Gas Combustion | 0.44 | 1.93 | 0.22 | 0.96 | 0.04 | 0.18 | 0.00001 | 0.00004 | 0.01 | 0.04 | 0.000003 | 0.00001 |
| FL-1 | FL-1 | Waste Gas Combustion | 1.97 | 3.96 | 0.99 | 1.99 | 0.05 | 0.24 | 0.001 | 0.01 | -- | -- | -- | -- |
| | | **Totals:** | **2.42** | **5.93** | **1.21** | **2.96** | **0.09** | **0.42** | **0.001** | **0.01** | **0.01** | **0.04** | **0.000003** | **0.00001** |

NOTE: Pilot Gas Combustion and Flare Assist Gas Combustion calculations are shown on the following page. Waste Gas Combustion shown here is the combined sum of the waste gas from the Condensate and Produced Water tanks and loading operations shown on subsequent pages.



EFSCOP00009355

## CALCULATION OF FLARE PILOT GAS and FLARE ASSIST GAS POTENTIAL TO EMIT

## OIL & GAS STANDARD PERMIT REGISTRATION

## LACKEY LAND A639 UNIT A1 & B1

## BURLINGTON RESOURCES OIL & GAS COMPANY LP

| EPN | FIN | Description | LHV (Btu/scf) | Heat Release scf/hr | Operating Hours (hr/yr) | Pollutant | Emission Factors | Units | Emission Rates Hourly [a] (lb/hr) | Emission Rates Annual [b] (T/yr) |
|---|---|---|---|---|---|---|---|---|---|---|
| FL-1 | FL-1 | Flare 1- Process Pilot Gas Combustion | 1,292 | 15 | 8,760 | CO | 0.2755 | lb/MMBtu | 0.01 | 0.04 |
| | | | | | | $NO_X$ | 0.138 | lb/MMBtu | 0.003 | 0.01 |
| | | | | | | $PM/PM_{10}/PM_{2.5}$ | -- [c] | -- | -- | -- |
| | | | | | | $SO_2$ | 200 | ppm $H_2S$ | 0.0005 | 0.002 |
| | | | | | | $H_2S$ | 200 | ppm $H_2S$ | 0.0000002 | 0.000001 |
| | | | | | | VOC | 5.5 | lb/MMscf | 0.0001 | 0.0004 |
| | | | | | | Benzene | 0.0021 | lb/MMscf | 0.00000003 | 0.0000001 |
| FL-1 | FL-1 | Flare 1- Process Flare Assist Gas Combustion | 1,292 | 1,250 | 8,760 | CO | 0.2755 | lb/MMBtu | 0.44 | 1.93 |
| | | | | | | $NO_X$ | 0.138 | lb/MMBtu | 0.22 | 0.96 |
| | | | | | | $PM/PM_{10}/PM_{2.5}$ | -- [c] | -- | -- | -- |
| | | | | | | $SO_2$ | 200 | ppm $H_2S$ | 0.04 | 0.18 |
| | | | | | | $H_2S$ | 200 | ppm $H_2S$ | 0.00001 | 0.00004 |
| | | | | | | VOC | 5.5 | lb/MMscf | 0.01 | 0.04 |
| | | | | | | Benzene | 0.0021 | lb/MMscf | 0.000003 | 0.00001 |

[a] Emission Factors for CO and $NO_X$ are based upon the Draft TNRCC Guidance Document for Flares and Vapor Oxidizers (dated 10/00) for other high-Btu flares. An example calculation for hourly CO emissions for EPN FL-1 follows:

CO (lb/hr) = (Heat Release, scf/hr) * (Lower Heating Value, Btu/scf) * (MM/$10^6$)*(Emission Factor, lb/MMBtu)

CO (lb/hr) = (15 scf/hr) * (1,292 Btu/scf) * (MM/10^6)*(0.2755 lb/MMBtu)

= 0.01 lb/hr CO

The Emission Factors for VOC and Benzene were based upon AP-42 Table 1.4-2 and 1.4-3 (dated 7/98). An example calculation for hourly VOC emissions for EPN FL-1 follows:

VOC (lb/hr) = (Heat Release, scf/hr) * (MM/$10^6$) * (Emission Factor, lb/MMscf)

VOC (lb/hr) = (15 scf/hr) * (MM/10^6) * (5.5 lb/MMscf)

= 0.0001 lb/hr VOC

A material balance approach was used to estimate the $SO_2$ and $H_2S$ emission rates using the maximum sulfur concentration in the natural gas. As shown in Figure 5-1, $H_2S$ concentration at the site is conservatively represented at 150 ppm. When used as a pilot gas or flare assist gas, 98% of this concentration will be converted to $SO_2$, and 2% will remain uncombusted and unconverted. An example calculation for hourly $SO_2$ emissions for the pilot gas of EPN FL-01 follows:

$SO_2$ (lb/hr) = Heat Release (scf/hr)*(Sulfur Content, ppmv)*(98% conversion to $SO_2$)*(1 lb-mol/379 scf)*(34.065 lb H2S/lb-mol)*(64.06 lb $SO_2$/34.065 lb H2S)

$SO_2$ (lb/hr) = (15 scf/hr)*((200 ppm H2S)/(10^6 scf gas))*(98% converted to SO2)*(1 lb-mol/379 scf)*(34.065 lb H2S/lb-mol)*(64.06 lb SO2/34.065 lb H2S)

= 0.0005 lb/hr $SO_2$

[b] An example calculation for annual CO emissions for EPN FL-1 follows:

CO (T/yr) = (Hourly Emissions, lb/hr)*(Annual Operating Hours, hr/yr)*(1 T/2,000 lb)

CO (T/yr) = (0.01 lb/hr)*(8,760 hr/yr)*(1 T/2,000 lb)

CO (T/yr) = 0.04 T/yr CO

[c] The process flares are smokeless per 40 CFR §60.18 requirements; therefore, PM emissions are negligible.



EFSCOP00009356

**PROCESS FLARE WASTE GAS COMBUSTION EMISSIONS**

**OIL & GAS STANDARD PERMIT REGISTRATION**

**LACKEY LAND A639 UNIT A1 & B1**

**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

| EPN | FIN | Description | LHV[a] (Btu/scf) | Waste Gas Flow Rate Hourly (MMBtu/hr) | Waste Gas Flow Rate Annual (MMBtu/yr) | Pollutant | Emission Factors | Units | Potential to Emit Hourly[b] (lb/hr) | Potential to Emit Annual[c] (T/yr) |
|---|---|---|---|---|---|---|---|---|---|---|
| FL-1 | FL-1 | Process Flare | 1,749 | 6.42 | 27,524.00 | CO | 0.2755 | lb/MMBtu | 1.77 | 3.79 |
| | | Condensate Tanks and Loading | | | | $NO_X$ | 0.1380 | lb/MMBtu | 0.89 | 1.90 |
| | | | | | | $PM/PM_{10}/PM_{2.5}$ | -- [e] | -- | -- | -- |
| | | | | | | $SO_2$ | -- [c] | -- | 0.05 | 0.23 |
| | | | | | | $H_2S$ | -- [c] | -- | 0.0006 | 0.003 |
| FL-1 | FL-1 | Process Flare | 1,722 | 0.74 | 1,241.56 | CO | 0.2755 | lb/MMBtu | 0.20 | 0.17 |
| | | Produced Water Tank and Loading | | | | $NO_X$ | 0.1380 | lb/MMBtu | 0.10 | 0.09 |
| | | | | | | $PM/PM_{10}/PM_{2.5}$ | -- [e] | -- | -- | -- |
| | | | | | | $SO_2$ | -- [c] | -- | 0.002 | 0.007 |
| | | | | | | $H_2S$ | -- [c] | -- | 0.0006 | 0.003 |

[a] Waste gas stream lower heating value was taken from WinSim calculated stream value.

[b] Emission Factors for CO and $NO_X$ are based upon the Draft TNRCC Guidance Document for Flares and Vapor Oxidizers (dated 10/00) for other high-Btu flares. An example calculation for hourly CO emissions for EPN Fl-1 follows:

CO (lb/hr) = (Hourly Waste Gas Flow Rate, MMBtu/hr)*(Emission Factor, lb/MMBtu)

CO (lb/hr) = (6.42 MMBtu/hr)*(0.2755 lb/MMBtu)

= 1.77 lb/hr CO

[c] $H_2S$ emissions are routed from the tanks to the flare and from the seperator to the flare and then converted to $SO_2$. $SO_2$ emission rates were determined based on the combustion efficiency of 98% $H_2S$ converted to $SO_2$. $H_2S$ emitted at the flare is 2% of the stream not converted by combustion. An example calculation for hourly $SO_2$ emissions for EPN FL-1 follows:

$SO_2$ (lb/hr) = (Source $H_2S$ Emission Rate, lb/hr) * (98% captured H2S stream) * (98% conversion to $SO_2$ at combustion) * (1 mol $H_2S$/34.07 lb $H_2S$) * (64.06 lb SO2/1 mol $SO_2$)

$SO_2$ (lb/hr) = (0.03 lb/hr H2S at Condensate Tanks) * (98%) * (98%) * (1 mol H2S/34.07 lb H2S) * (64.06 lb SO2/1 mol SO2)

= 0.05 lb/hr $SO_2$

[d] An example calculation for annual CO emissions for EPN FL-1 follows:

CO (T/yr) = (Annual Waste Gas Flow Rate, MMBtu/yr) * (Emission Factor, lb/MMBtu) * (1 T / 2,000 lb)

CO (T/yr) = (27,524.00 MMBtu/yr) * (0.2755 lb/MMBtu) * (1 T / 2,000 lb)

= 3.79 T/yr CO

[e] The process flares are smokeless per 40 CFR §60.18 requirements; therefore, PM emissions are negligible.



EFSCOP00009357

**CALCULATION OF FLARE FEED RATES FROM FINs TK-01 THROUGH TK-06, and TRUCK1**

**OIL & GAS STANDARD PERMIT REGISTRATION**

**LACKEY LAND A639 UNIT A1 & B1**

**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

**TK-01 through TK-06 and TRUCK1 Total Emissions:**[a]

| | |
|---|---|
| VOC Emissions (lb/hr): | 177.58 |
| VOC Emissions (TPY): | 380.89 |
| Hydrocarbon Emissions (lb/hr): | 302.16 |
| Hydrocarbon Emissions (TPY): | 648.10 |

| Constituent | Heating Value[b] (Btu/lb) | Condensate Tanks Flash Gas Weight (%) | TK-01 through TK-06 and TRUCK1 Emissions [c] Hourly (lb/hr) | TK-01 through TK-06 and TRUCK1 Emissions [c] Annual (T/yr) | Flare Feed Rate [d] Hourly (MMBtu/hr) | Flare Feed Rate [d] Annual (MMBtu/yr) |
|---|---|---|---|---|---|---|
| Methane | 23,861 | 20.22% | 61.10 | 131.05 | 1.43 | 6,128.89 |
| Ethane | 22,304 | 19.43% | 58.71 | 125.93 | 1.28 | 5,505.14 |
| Propane | 21,646 | 20.60% | 62.24 | 133.51 | 1.32 | 5,664.32 |
| I-Butane | 21,242 | 6.78% | 20.49 | 43.94 | 0.43 | 1,829.41 |
| N-Butane | 21,293 | 13.06% | 39.46 | 84.64 | 0.82 | 3,532.39 |
| I-Pentane | 21,025 | 5.96% | 18.01 | 38.63 | 0.37 | 1,591.90 |
| N-Pentane | 21,072 | 5.40% | 16.32 | 35.00 | 0.34 | 1,445.54 |
| Cyclopentane | 20,350 | 0.00% | 0.00 | 0.00 | 0.00 | 0.00 |
| n-Hexane | 20,928 | 3.48% | 10.52 | 22.55 | 0.22 | 924.98 |
| Cyclohexane | 20,195 | 0.27% | 0.82 | 1.75 | 0.02 | 69.27 |
| Other Hexanes | 20,928 | 0.00% | 0.00 | 0.00 | 0.00 | 0.00 |
| Heptanes | 20,825 | 1.69% | 5.11 | 10.95 | 0.10 | 446.95 |
| Octanes | 20,747 | 0.52% | 1.57 | 3.37 | 0.03 | 137.04 |
| Nonanes | 20,687 | 0.13% | 0.39 | 0.84 | 0.01 | 34.06 |
| Decanes Plus | 20,638 | 0.29% | 0.88 | 1.88 | 0.02 | 76.05 |
| Benzene | 18,172 | 0.12% | 0.36 | 0.78 | 0.01 | 27.78 |
| Toluene | 18,422 | 0.26% | 0.79 | 1.69 | 0.01 | 61.02 |
| Ethylbenzene | 18,658 | 0.04% | 0.12 | 0.26 | 0.002 | 9.51 |
| Xylene | 18,438 | 0.17% | 0.51 | 1.10 | 0.01 | 39.75 |
| | VOC | 58.77% | | | | |
| | | | | **Total:** | **6.42** | **27,524.00** |

[a] Total VOC Emissions were determined by adding the Uncontrolled Streams for FINs TK-01 through TK-06 on the Tank Summary table with the uncontrolled emissions from the Condensate Truck Loading FIN TRUCK1. Total Hydrocarbon Emissions were calculated as follows:

Total HC (lb/hr) = VOC Emissions (lb/hr) * (1/ VOC% of stream)

Total HC (lb/hr) = (177.58 lb/hr) * (1 / 58.77%)

Total HC (lb/hr) = 302.16 lb/hr

[b] Heating values taken from Perry's Chemical Engineers' Handbook , Table 3-207 (pg. 3-155)

[c] Emission Rates were proportioned from the Total Hydrocarbon Emissions using the Condensate Flash Gas stream constituents weight percents, generated by the WinSim program.

[d] An example calculation for the hourly flare feed rate for Methane is demonstrated.

MMBtu/hr Methane = Methane Heating Value (Btu/lb) * Hourly Methane Emissions (lb/hr) * 98% of stream is combusted / 10^6

MMBtu/hr Methane = (23,861 Btu/lb) * (61.10 lb/hr) * 98% / (10^6)

MMBtu/hr Methane = 1.43 MMBtu/hr

An example calculation for the annual flare feed rate for Methane is demonstrated.

MMBtu/yr Methane = Methane Heating Value (Btu/lb) * Annual Methane Emissions (T/yr) * (2,000 lb/T) * 98% of stream is combusted / 10^6

MMBtu/yr Methane = (23,861 Btu/lb) * (131.05 T/yr) * (2,000 lb/T) * 98% / (10^6)

MMBtu/yr Methane = 6,128.89 MMBtu/yr



EFSCOP00009358

**CALCULATION OF FLARE FEED RATES FROM FINs TK-07, TK-08, and TRUCK2**

**OIL & GAS STANDARD PERMIT REGISTRATION**

**LACKEY LAND A639 UNIT A1 & B1**

**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

**TK-07, TK-08 and TRUCK2 Total Emissions:** [a]

| | |
|---|---|
| VOC Emissions (lb/hr): | 21.02 |
| VOC Emissions (TPY): | 17.36 |
| Hydrocarbon Emissions (lb/hr): | 35.75 |
| Hydrocarbon Emissions (TPY): | 29.53 |

| Constituent | Heating Value[b] (Btu/lb) | Produced Water Tanks Flash Gas Weight (%) | TK-07, TK-08 and TRUCK2 Emissions [c] Hourly (lb/hr) | TK-07, TK-08 and TRUCK2 Emissions [c] Annual (T/yr) | Flare Feed Rate [d] Hourly (MMBtu/hr) | Flare Feed Rate [d] Annual (MMBtu/yr) |
|---|---|---|---|---|---|---|
| Methane | 23,861 | 19.66% | 7.03 | 5.81 | 0.16 | 271.72 |
| Ethane | 22,304 | 19.06% | 6.81 | 5.63 | 0.15 | 246.12 |
| Propane | 21,646 | 20.40% | 7.29 | 6.02 | 0.15 | 255.41 |
| I-Butane | 21,242 | 6.82% | 2.44 | 2.01 | 0.05 | 83.68 |
| N-Butane | 21,293 | 13.13% | 4.69 | 3.88 | 0.10 | 161.93 |
| I-Pentane | 21,025 | 6.00% | 2.15 | 1.77 | 0.04 | 72.94 |
| N-Pentane | 21,072 | 5.43% | 1.94 | 1.60 | 0.04 | 66.08 |
| Cyclopentane | 20,350 | 0.00% | 0.00 | 0.00 | 0.00 | 0.00 |
| n-Hexane | 20,928 | 3.50% | 1.25 | 1.03 | 0.03 | 42.25 |
| Cyclohexane | 20,195 | 0.28% | 0.10 | 0.08 | 0.002 | 3.17 |
| Other Hexanes | 20,928 | 0.00% | 0.00 | 0.00 | 0.00 | 0.00 |
| Heptanes | 20,825 | 1.70% | 0.61 | 0.50 | 0.01 | 20.41 |
| Octanes | 20,747 | 0.52% | 0.19 | 0.15 | 0.004 | 6.10 |
| Nonanes | 20,687 | 0.13% | 0.05 | 0.04 | 0.001 | 1.62 |
| Decanes Plus | 20,638 | 0.29% | 0.10 | 0.09 | 0.002 | 3.64 |
| Benzene | 18,172 | 0.12% | 0.04 | 0.04 | 0.001 | 1.42 |
| Toluene | 18,422 | 0.26% | 0.09 | 0.08 | 0.002 | 2.89 |
| Ethylbenzene | 18,658 | 0.04% | 0.01 | 0.01 | 0.0002 | 0.37 |
| Xylene | 18,438 | 0.17% | 0.06 | 0.05 | 0.001 | 1.81 |
| | VOC | 58.79% | | | | |
| | | | | **Total:** | **0.74** | **1241.56** |

[a] Total VOC Emissions were determined by adding the Uncontrolled Streams for FINs TK-07 and TK-08 on the Tank Summary table and the uncontrolled emissions associated with the produced water loading, FIN TRUCK2. Total Hydrocarbon Emissions were calculated as follows:

Total HC (lb/hr) = VOC Emissions (lb/hr) * (1/ VOC% of stream)

Total HC (lb/hr) = (21.02 lb/hr) * (1/ 58.79%)

Total HC (lb/hr) = 35.75 lb/hr

[b] Heating values taken from Perry's Chemical Engineers' Handbook , Table 3-207 (pg. 3-155)

[c] Emission Rates were proportioned from the Total Hydrocarbon Emissions using the Produced Water Flash Gas stream constituents weight percents, generated by the WinSim program.

[d] An example calculation for the hourly flare feed rate for Methane is demonstrated.

MMBtu/hr Methane = Methane Heating Value (Btu/lb) * Hourly Methane Emissions (lb/hr) * 98% of stream is combusted / 10^6

MMBtu/hr Methane = (23,861 Btu/lb) * (7.03 lb/hr) * 98% / (10^6)

MMBtu/hr Methane = 0.16 MMBtu/hr

An example calculation for the annual flare feed rate for Methane is demonstrated.

MMBtu/yr Methane = Methane Heating Value (Btu/lb) * Annual Methane Emissions (T/yr) * (2,000 lb/T) * 98% of stream is combusted / 10^6

MMBtu/yr Methane = (23,861 Btu/lb) * (5.81 T/yr) * (2,000 lb/T) * 98% / (10^6)

MMBtu/yr Methane = 271.72 MMBtu/yr



EFSCOP00009359

CALCULATION OF STORAGE TANK WORKING AND BREATHING POTENTIAL TO EMIT DURING FLARE DOWNTIME -SMSS

OIL & GAS STANDARD PERMIT REGISTRATION

LACKEY LAND A639 UNIT A1 & B1

BURLINGTON RESOURCES OIL & GAS COMPANY LP

| Variable | Description | Units | Value |
|---|---|---|---|
| $L_T$ | total loss = Ls + Lw | Ton/yr | See Table |
| $L_S$ | standing loss = 365 Vv Wv Ke Ks | lb/yr | See Table |
| $L_W$ | working loss = 0.001 Mv Pv Q Kn Kp | lb/yr | See Table |
| $L_H$ | working loss = 0.001 Mv Pmax Qh | lb/hr | See Table |
| | Roof Construction | | Cone |
| RVP | Condensate Reid Vapor Pressure | psia | 10.32 |
| ΔPb | Breather vent pressure range | psi | 0.06 |
| I | Solar insolation factor | Btu/ft2-day | 1521 |
| $P_A$ | Atmospheric Pressure | psia | 14.7 |
| Mv | Vapor Molecular Weight | lb/lb-mol | 33 |
| T | Annual Average Temperature | °F | 72.1 |
| $T_{AX}$ | Daily Maximum Ambient Temperature | °R | 541.6 |
| $T_{AN}$ | Daily Minimum Ambient Temperature | °R | 522.5 |
| $\Delta T_A$ | Daily average ambient temperature range | °R | 19.1 |
| Kp | Product factor | | 1 |

| | | Tank Specifications | | | | | | | Material Specifications | | | | | | | | | | | | | VOC | | Benzene | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | V/H | D | H/L | Capacity | Color | | α | Mv | $P_{MAX}$ | $Q^2$ | ΔTv | Hvo | $T_{LA}$ Daily | $P_{VA}$ | Wv | ΔPv | Ke | Ks | $L_S$ | $L_T$ | $L_H$ | $L_T$ | $L_H$ |
| Material | No. of Tanks | Tank Type | Tank Diameter (ft) | Tank Height/ Length (ft) | Tank Capacity (bbl) | Paint Color | Paint Conditions | Paint Solar Absorbance Factor | Vapor Molecular Weight | Reid Vapor Pressure (psia) | Max. Hourly Storage (bbl/hr) | Daily Vapor Temp. Range °F | Vapor Space Outage (ft) | Average Liquid Surface Temp °R | Average Vapor Pressure (psia) | Vapor Density (lb/ft3) | Daily Vapor Pressure Range | Vapor Space Expan. Factor | Vented Vapor Sat. Factor | Standing Loss per tank (lb/yr) | Total Loss (lb/hr) | Total Loss (T/yr) | Total Loss (lb/hr) | Total Loss (T/yr) |
| Condensate | 6 | V | 12 | 25 | 500 | Gray | Good | 0.54 | 33 | 10.32 | 500 | 36.75 | 12.63 | 539.8 | 10.670 | 0.06079 | 2.97590 | 0.7916 | 0.12 | 361.28 | **2.06** | **0.18** | **0.01** | **0.001** |
| PW | 2 | V | 12 | 25 | 500 | Gray | Good | 0.54 | 33 | 0.103 | 500 | 36.75 | 12.63 | 539.8 | 0.029 | 0.00017 | 0.01833 | 0.0662 | 0.98 | 0.23 | **0.001** | **0.0001** | **0.000002** | **0.0000002** |

NOTE: Tank working and breathing emissions are based on the equations found in EPA AP 42 Chapter 7. All factors used are represented in the table on this page. The Condensate Reid Vapor Pressure and Vapor Molecular Weight are determined based on the WinSim condensate stream and Off Gas stream. All other variables are found in AP 42 Chapter 7 or are default unit values.

The emissions shown are due to flare maintenance occuring 2% of the year. During the flare downtime the wellheads would be shut in. Therefore, there would be no condensate or produced water liquids flowing to the tanks; however, any liquid already in the tanks would remain and have breathing (standing losses) emissions. These emissions would not be controlled, as the flare is down for maintenance. The calculations shown demonstrate this alternative operating scenario regarding flare maintenance and downtime. Based on 2% downtime, this scenario is being shown to occur for 175.2 hours in a year.

As shown on the summary page representing the Tank Emission sent to Flare, $H_2S$ emissions are represented as occuring when the liquid streams flash during the change from a pressurized flow to the atmospheric tank. Due to the chemical properties of $H_2S$ the most conservative approach is to represent that all $H_2S$ in the liquid will immediately flash, and there will be no $H_2S$ emitted during working and breathing while the liquids are stored. Since there will be no liquid flow during the flare downtime, there are no flash emissions and therefore no $H_2S$ emissions from the standing loss of the tanks.



EFSCOP00009360

**CALCULATION OF SEPARATOR GAS ROUTED TO FLARE POTENTIAL TO EMIT - SMSS**

**OIL & GAS STANDARD PERMIT REGISTRATION**

**LACKEY LAND A639 UNIT A1 & B1**

**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

| | | | | | | | | | | | Potential to Emit (PTE) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | VOC | | Benzene | | $H_2S$ | |
| Facility Identification Number (FIN) | Gas Throughput at Site (MSCF/day) | Gas Throughput (MSCF/hr) | Percentage of Year Separator Stream to Flare | Number of Hours per Year sent to Flare | Gas Volume Sent to Flare (MSCF/yr) | Gas Stream Molecular Weight (lb/lb-mol) | Max VOC Percentage in Gas (wt%) | Max Benzene Percentage in Gas (wt%) | Max $H_2S$ Percentage in Gas (wt%) | Capture and Control Efficiency on Flare (%) | Hourly Emission Rate[b] (lb/hr) | Annual Emission Rate[c] (T/yr) | Hourly Emission Rate[b] (lb/hr) | Annual Emission Rate[c] (T/yr) | Hourly Emission Rate (lb/hr) | Annual Emission Rate (T/yr) |
| SEP-GAS | 3000 | 125.00 | 6% | 525.6 | 65,700 | 25.37 | 40% | 0.23% | 0.04% | 98% | 66.94 | 17.59 | 0.38 | 0.10 | 0.07 | 0.02 |

[a] During engine maintenance at other downstream sites, the low pressure separator gas at this site may be routed to flare 6% of the year.

[b] Hourly VOC emission rates are calculated as follows:

(Gas Throughput, MSCF/hr) / (379 scf/lb-mol) * (Gas Stream MW, lb/lb-mol) * (Maximum VOC Percentage in Gas) * (Capture and Control Efficiency on Flare) = (VOC Emissions, lb/hr)

(125.00 MSCF/hr) / (379 scf/lb-mol) * (25.37 lb/lb-mol) * (40%) * (100% - 98%) * (1000 scf/Mscf) = 66.94 lb/hr

[c] Annual VOC emission rates are calculated as follows:

(Gas Throughput at Site, MSCF/yr) / (379 scf/lb-mol) * (Gas Stream MW, lb/lb-mol) * (Max VOC Percentage in Gas) * (Capture and Control Efficiency on Flare) * (1000 scf/Mscf) / (2000 lb/T) = (VOC Emissions, T/yr)

(65,700 MSCF/yr) / (379 scf/lb-mol) * (25.37 lb/lb-mol) * (40%) * (100% - 98%) * (1000 scf/Mscf) / (2000 lb/T) = 17.59 T/yr



EFSCOP00009361

**PROCESS FLARE WASTE GAS COMBUSTION EMISSIONS - SMSS**

**OIL & GAS STANDARD PERMIT REGISTRATION**

**LACKEY LAND A639 UNIT A1 & B1**

**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

| EPN | FIN | Description | LHV[a] (Btu/scf) | Waste Gas Flow Rate Hourly (MMBtu/hr) | Waste Gas Flow Rate Annual (MMBtu/yr) | Pollutant | Emission Factors | Units | Potential to Emit Hourly[b] (lb/hr) | Potential to Emit Annual[c] (T/yr) |
|---|---|---|---|---|---|---|---|---|---|---|
| FL-1 | FL-1 | Process Flare | 1,461 | 181.97 | 95,649.82 | CO | 0.2755 | lb/MMBtu | 50.13 | 13.18 |
| | | LP Separator Gas to Flare Event | | | | $NO_X$ | 0.1380 | lb/MMBtu | 25.11 | 6.60 |
| | | | | | | $PM/PM_{10}/PM_{2.5}$ | -- [e] | -- | -- | -- |
| | | | | | | $SO_2$ | -- [c] | -- | 6.32 | 1.81 |
| | | | | | | $H_2S$ | -- [c] | -- | 0.07 | 0.02 |

[a] Waste gas stream lower heating value was taken from the inlet gas analysis.

[b] Emission Factors for CO and $NO_X$ are based upon the Draft TNRCC Guidance Document for Flares and Vapor Oxidizers (dated 10/00) for other high-Btu flares. An example calculation for hourly CO emissions for EPN Fl-1 follows:

CO (lb/hr) = (Hourly Waste Gas Flow Rate, MMBtu/hr)*(Emission Factor, lb/MMBtu)

CO (lb/hr) = (181.97 MMBtu/hr)*(0.2755 lb/MMBtu)

= 50.13 lb/hr CO

[c] $H_2S$ emissions are routed from the separator to the flare and then converted to $SO_2$. $SO_2$ emission rates were determined based on the combustion efficiency of 98% $H_2S$ converted to $SO_2$. $H_2S$ emitted at the flare is 2% of the captured stream not converted by combustion. An example calculation for hourly $SO_2$ emissions for EPN FL-1 follows:

$SO_2$ (lb/hr) = (Source $H_2S$ Emission Rate, lb/hr) * (98% captured H2S stream) * (98% conversion to $SO_2$ at combustion) * (1 mol $H_2S$/34.07 lb $H_2S$) * (64.06 lb SO2/1 mol $SO_2$)

$SO_2$ (lb/hr) = (3.50 lb/hr H2S off Separator) * (98%) * (98%) * (1 mol H2S/34.07 lb H2S) * (64.06 lb SO2/1 mol SO2)

= 6.32 lb/hr $SO_2$

[d] An example calculation for annual CO emissions for EPN FL-1 follows:

CO (T/yr) = (Annual Waste Gas Flow Rate, MMBtu/yr) * (Emission Factor, lb/MMBtu) * (1 T / 2,000 lb)

CO (T/yr) = (95,649.82 MMBtu/yr) * (0.2755 lb/MMBtu) * (1 T / 2,000 lb)

= 13.18 T/yr CO

[e] The process flares are smokeless per 40 CFR §60.18 requirements; therefore, PM emissions are negligible.



EFSCOP00009362

**CALCULATION OF FLARE FEED RATES FROM LP SEPARATOR - SMSS**

**OIL & GAS STANDARD PERMIT REGISTRATION**

**LACKEY LAND A639 UNIT A1 & B1**

**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

| | |
|---|---|
| **Max BD Volume (Mscf/hr)** | 125.00 |
| **Max BD Volume (Mscf/yr)** | 65,700 |
| **Gas Density (lb/scf)** | 0.0672 |

| Constituent | Heating Value[a] (Btu/lb) | Inlet Gas Weight (%) | Separator BD Emissions[b] Hourly (lb/hr) | Separator BD Emissions[b] Annual (T/yr) | Flare Feed Rate[c] Hourly (MMBtu/hr) | Flare Feed Rate[c] Annual (MMBtu/yr) |
|---|---|---|---|---|---|---|
| Methane | 23,861 | 43.51% | 3,654.84 | 960.49 | 85.46 | 44,919.77 |
| Ethane | 22,304 | 15.52% | 1,303.68 | 342.61 | 28.50 | 14,977.48 |
| Propane | 21,646 | 11.95% | 1,003.80 | 263.80 | 21.29 | 11,192.02 |
| I-Butane | 21,242 | 4.19% | 351.96 | 92.50 | 7.33 | 3,851.17 |
| N-Butane | 21,293 | 7.63% | 640.92 | 168.43 | 13.37 | 7,029.30 |
| I-Pentane | 21,025 | 4.53% | 380.52 | 100.00 | 7.84 | 4,120.90 |
| N-Pentane | 21,072 | 3.91% | 328.44 | 86.31 | 6.78 | 3,564.70 |
| Cyclopentane | 20,350 | 0.00% | 0.00 | 0.00 | 0.00 | 0.00 |
| n-Hexane | 20,928 | 1.50% | 126.00 | 33.11 | 2.58 | 1,358.14 |
| Cyclohexane | 20,195 | 0.44% | 36.96 | 9.71 | 0.73 | 384.34 |
| Other Hexanes | 20,928 | 3.27% | 274.68 | 72.19 | 5.63 | 2,961.15 |
| Heptanes | 20,825 | 0.90% | 75.60 | 19.87 | 1.54 | 811.03 |
| Octanes | 20,747 | 0.11% | 9.24 | 2.43 | 0.19 | 98.81 |
| Nonanes | 20,687 | 0.05% | 4.20 | 1.10 | 0.09 | 44.60 |
| Decanes Plus | 20,638 | 0.00% | 0.00 | 0.00 | 0.00 | 0.00 |
| Benzene | 18,172 | 0.15% | 12.60 | 3.31 | 0.22 | 117.89 |
| Toluene | 18,422 | 0.22% | 18.48 | 4.86 | 0.33 | 175.48 |
| Ethylbenzene | 18,658 | 0.004% | 0.34 | 0.09 | 0.01 | 3.29 |
| Xylene | 18,438 | 0.05% | 4.20 | 1.10 | 0.08 | 39.75 |
| | | | | **Totals:** | **181.97** | **95,649.82** |

[a] Heating values taken from Perry's Chemical Engineers' Handbook , Table 3-207 (pg. 3-155)

[b] Constituent Emission Rates were calculated from the known maximum blowdown volumes and density then proportioned using the Inlet Gas stream constituents weight percents. An example calculation for Methane emissions is as follows:

Methane (lb/hr) = Maximum BD Volume (Mscf/hr) * Gas Density (lb/scf) * Inlet Gas Weight % * 1000
Methane (lb/hr) = (125.00 Mscf/hr) * (0.0672 lb/scf) * 43.51% * 1,000
Methane (lb/hr) = 3,654.84 lb/hr

[c] An example calculation for the hourly flare feed rate for Methane is demonstrated.

MMBtu/hr Methane = Methane Heating Value (Btu/lb) * Hourly Methane Emissions (lb/hr) * 98% of stream is combusted / 10^6
MMBtu/hr Methane = (23,861 Btu/lb) * (3,654.84 lb/hr) * 98% / (10^6)
MMBtu/hr Methane = 85.46 MMBtu/hr

An example calculation for the annual flare feed rate for Methane is demonstrated.

MMBtu/yr Methane = Methane Heating Value (Btu/lb) * Annual Methane Emissions (T/yr) * (2,000 lb/T) * 98% of stream is combusted / 10^6
MMBtu/yr Methane = (23,861 Btu/lb) * (960.49 T/yr) * (2,000 lb/T) * 98% / (10^6)
MMBtu/yr Methane = 44,919.77 MMBtu/yr



EFSCOP00009363

**Site Fugitive**

| | GWF | DWF | GWF w/temp | DWF w/temp |
|---|---|---|---|---|
| Valves | | | | |
| Gas Streams | 48 | 86 | 68 | 94 |
| Light Oil | 29 | 74 | 49 | 86 |
| Water/Light Oil | 43 | 85 | 50 | 99 |
| Pumps | | | | |
| Water/Light Oil | 1 | 1 | 2 | 2 |
| Compressors | | | | |
| Gas | 0 | 0 | 1 | 1 |
| Flanges | | | | |
| Gas Streams | 78 | 144 | 80 | 156 |
| Light Oil | 46 | 76 | 46 | 77 |
| Water/Light Oil | 8 | 16 | 9 | 20 |
| Connectors | | | | |
| Gas Streams | 75 | 157 | 111 | 180 |
| Light Oil | 69 | 139 | 102 | 179 |
| Water/Light Oil | 98 | 141 | 112 | 206 |

**Lab Analyses**

| Component | STREAM 1 Inlet Gas mole % | STREAM 2 LP Condensate mole % | STREAM 1 Inlet Gas mole % | STREAM 2 LP Condensate mole % | STREAM 1 Inlet Gas mole % | STREAM 2 LP Condensate mole % | STREAM 1 Inlet Gas mole % | STREAM 2 LP Condensate mole % | STREAM 1 Inlet Gas mole % | STREAM 2 LP Condensate mole % | STREAM 1 Inlet Gas mole % | STREAM 2 LP Condensate mole % | STREAM 1 Inlet Gas mole % | STREAM 2 LP Condensate mole % | STREAM 1 Inlet Gas mole % | STREAM 2 LP Condensate mole % | STREAM 1 Inlet Gas mole % | STREAM 2 LP Condensate mole % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Santa Fe Pacific | | Santa Fe Pacific 28B-1 | | Kernco 1 CF | | Schendel 33B | | Sugarloaf CF-1 | | Hilliard Fc | | Hilliard Fc | | Earl 31 | | Eclipse North | |
| Nitrogen | 0.041% | 0.063% | 0.060% | 0.503% | 0.095% | 0.019% | 0.254% | 0.046% | 0.254% | 0.000% | 0.042% | 0.069% | 0.000% | 0.044% | 0.037% | 0.130% | 0.010% | |
| Carbon Dioxide | 1.368% | 0.054% | 0.854% | 0.106% | 1.547% | 0.091% | 2.372% | 0.125% | 1.123% | 0.031% | 2.252% | 0.166% | 2.435% | 0.069% | 2.435% | 0.148% | 2.420% | 0.054% |
| Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Hydrogen Sulfide | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| Methane | 51.655% | 1.451% | 74.931% | 3.706% | 68.416% | 1.955% | 70.652% | 2.101% | 69.799% | 1.891% | 55.122% | 0.683% | 51.043% | 0.954% | 51.047% | 1.566% | 53.840% | 0.723% |
| Ethane | 20.942% | 2.300% | 12.787% | 2.101% | 13.711% | 1.870% | 11.029% | 2.084% | 13.078% | 1.666% | 20.669% | 1.691% | 21.651% | 1.636% | 21.681% | 2.710% | 12.690% | 1.443% |
| Propane | 13.702% | 4.295% | 5.686% | 3.014% | 6.930% | 3.295% | 6.979% | 3.619% | 6.871% | 2.564% | 12.583% | 3.055% | 13.265% | 2.984% | 13.261% | 4.942% | 5.200% | 2.930% |
| I-Butane | 2.468% | 1.537% | 1.414% | 1.810% | 1.712% | 1.994% | 1.063% | 1.260% | 1.829% | 1.401% | 2.578% | 1.566% | 2.632% | 1.664% | 2.632% | 2.114% | 0.970% | 1.811% |
| N-Butane | 5.021% | 4.592% | 1.980% | 3.761% | 2.913% | 5.082% | 2.236% | 3.992% | 3.330% | 3.577% | 4.095% | 4.471% | 4.503% | 3.666% | 4.506% | 5.423% | 1.490% | 3.936% |
| I-Pentane | 1.515% | 3.054% | 0.762% | 3.626% | 1.301% | 6.039% | 0.661% | 2.779% | 1.593% | 3.554% | 0.669% | 4.696% | 1.359% | 3.468% | 1.369% | 3.928% | 0.430% | 3.500% |
| N-Pentane | 1.461% | 3.342% | 0.560% | 3.685% | 1.250% | 7.432% | 0.665% | 3.830% | 1.375% | 4.111% | 0.718% | 7.121% | 1.202% | 3.832% | 1.202% | 4.543% | 0.366% | 3.848% |
| Cyclopentane | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.746% |
| n-Hexane | 0.478% | 7.644% | 0.166% | 3.930% | 0.495% | 8.487% | 0.318% | 3.968% | 0.441% | 5.164% | 0.173% | 17.836% | 0.367% | 3.430% | 0.367% | 7.770% | 0.410% | 3.568% |
| Cyclohexane | 0.151% | 0.773% | 0.074% | 0.673% | 0.173% | 1.770% | 0.088% | 1.076% | 0.130% | 0.369% | 0.126% | 2.952% | 0.146% | 0.738% | 0.146% | 0.825% | 0.000% | 3.394% |
| Other Hexane | 0.628% | 3.433% | 0.385% | 5.816% | 0.995% | 10.022% | 0.401% | 4.276% | 0.963% | 4.221% | 0.271% | 17.982% | 0.769% | 2.999% | 0.769% | 3.731% | 0.000% | 4.037% |
| Heptane | 0.291% | 7.067% | 0.163% | 11.914% | 0.360% | 22.420% | 0.193% | 7.763% | 0.227% | 10.202% | 0.061% | 20.610% | 0.200% | 9.632% | 0.200% | 7.943% | 0.000% | 8.155% |
| Cyclohexane | 0.029% | 6.303% | 0.018% | 8.677% | 0.048% | 11.660% | 0.044% | 6.816% | 0.025% | 6.851% | 0.009% | 6.966% | 0.032% | 9.041% | 0.032% | 6.901% | 0.000% | 6.997% |
| Benzene | 0.011% | 6.218% | 0.018% | 6.932% | 0.016% | 4.468% | 0.025% | 6.367% | 0.010% | 6.235% | 0.006% | 3.263% | 0.030% | 6.744% | 0.010% | 6.383% | 0.000% | 6.756% |
| Octane Plus | 0.008% | 46.611% | 0.004% | 32.200% | 0.000% | 4.474% | 0.007% | 46.045% | 0.000% | 40.790% | 0.000% | 2.377% | 0.000% | 41.730% | 0.000% | 41.230% | 0.000% | 38.066% |
| Benzene | 0.046% | 0.252% | 0.022% | 0.419% | 0.057% | 0.754% | 0.027% | 0.426% | 0.050% | 0.294% | 0.016% | 1.240% | 0.050% | 0.316% | 0.050% | 0.342% | 0.000% | 0.470% |
| Toluene | 0.061% | 1.340% | 0.051% | 2.370% | 0.094% | 4.004% | 0.062% | 1.624% | 0.061% | 2.163% | 0.018% | 3.469% | 0.074% | 2.527% | 0.074% | 1.667% | 0.000% | 2.791% |
| Ethylbenzene | 0.002% | 0.453% | 0.001% | 0.767% | 0.002% | 0.699% | 0.004% | 0.443% | 0.001% | 0.671% | 0.001% | 0.341% | 0.002% | 0.625% | 0.002% | 0.510% | 0.000% | 0.655% |
| Xylene | 0.009% | 2.577% | 0.024% | 3.744% | 0.019% | 3.266% | 0.023% | 2.834% | 0.012% | 3.784% | 0.006% | 2.192% | 0.033% | 4.334% | 0.010% | 3.169% | 0.000% | 4.334% |
| Totals | 100.01% | 100.00% | 100.01% | 100.00% | 100.01% | 100.00% | 100.01% | 100.00% | 100.01% | 100.00% | 100.01% | 100.00% | 100.01% | 100.00% | 100.01% | 100.00% | 100.01% | 100.00% |
| Specific Gravity | 1.0024 | 0.7785 | 0.7821 | 0.7438 | 0.8781 | 0.6955 | 0.8185 | 0.7873 | 0.8794 | 0.7598 | 0.9496 | 0.6912 | 1.0167 | 0.7608 | 1.0167 | 0.7596 | 0.7548 | 0.7672 |
| Inlet Gas Lower Heating Value Btu/cf | 1674 | | 1319.7 | | 1448 | | 1334.5 | | 1460.7 | | 1544.4 | | 1539.1 | | 1539 | | 1236 | |
| Inlet Gas Higher Heating Value Btu/cf | 1788 | | 1342.6 | | 1473.1 | | 1367.6 | | 1485.9 | | 1571.1 | | 1667.4 | | 1667 | | 1257 | |

**WinSim PW**

| | Santa Fe Pacific #1 | Santa Fe Pacific 28B-1 | Kernco 1 CF | Schendel 33B | Schendel 33B | Sugarloaf CF-1 | Hilliard Fc | Earl 31 | Eclipse North |
|---|---|---|---|---|---|---|---|---|---|
| Molecular Weight | 36.8886 | 33.8098 | 40.011 | 34.6041 | 33.2248 | 4.25640 | 36.5486 | 39.1735 | 36.1465 |
| Lower Heating Value | 1895.26 | 1673.52 | 2061.850 | 1778.923 | 1722.260 | 2108.58 | 1933.79 | 2030.896 | 1669 |
| Methane | 0.106544 | 0.185792 | 0.114922 | 0.153681 | 0.196557 | 0.089267 | 0.132233 | 0.082207 | 0.139576 |
| Ethane | 0.217029 | 0.154521 | 0.146616 | 0.20311 | 0.190577 | 0.173859 | 0.230314 | 0.198892 | 0.221461 |
| Propane | 0.287507 | 0.189166 | 0.198462 | 0.255094 | 0.200412 | 0.208916 | 0.238177 | 0.285984 | 0.240273 |
| I-Butane | 0.060518 | 0.079404 | 0.076014 | 0.057179 | 0.068208 | 0.053124 | 0.079429 | 0.083845 | 0.074601 |
| N-Butane | 0.150574 | 0.128311 | 0.147468 | 0.138749 | 0.13126 | 0.128823 | 0.136113 | 0.16387 | 0.131794 |
| I-Pentane | 0.046691 | 0.060826 | 0.085319 | 0.043223 | 0.059970 | 0.039599 | 0.054849 | 0.056853 | 0.054443 |
| N-Pentane | 0.047385 | 0.048286 | 0.084014 | 0.048956 | 0.054826 | 0.078098 | 0.047126 | 0.051726 | 0.045345 |
| Cyclopentane | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.003171527 |
| n-Hexane | 0.016265 | 0.048859 | 0.012658 | 0.016223 | 0.016991 | 0.135631 | 0.012622 | 0.028431 | 0.015234 |
| Cyclohexane | 0.002492 | 0.003183 | 0.005142 | 0.003288 | 0.002762 | 0.009088 | 0.003286 | 0.002392 | 0.003385 |
| Other Hexane | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.028998 |
| Heptane | 0.010831 | 0.020382 | 0.031659 | 0.012664 | 0.016995 | 0.027154 | 0.051761 | 0.016689 | 0.014825 |
| Octane | 0.003315 | 0.005849 | 0.006018 | 0.003578 | 0.005196 | 0.004308 | 0.004018 | 0.003745 | 0.004123 |
| Nonane | 0.000996 | 0.001294 | 0.000829 | 0.001215 | 0.001145 | 0.003612 | 0.001230 | 0.000943 | 0.001237 |
| Decane Plus | 0.003223 | 0.002408 | 0.002838 | 0.003259 | 0.002465 | 0.001430 | 0.002709 | 0.003847 | 0.000752136 |
| Benzene | 0.000934 | 0.001725 | 0.002586 | 0.001188 | 0.001185 | 0.004081 | 0.001744 | 0.001386 | 0.001746 |
| Toluene | 0.001513 | 0.003958 | 0.004014 | 0.002186 | 0.002635 | 0.003312 | 0.003859 | 0.002043 | 0.003146 |
| Ethylbenzene | 0.000079 | 0.000474 | 0.000369 | 0.000229 | 0.000196 | 0.001147 | 0.000408 | 0.000238 | 0.000147 |
| Xylene | 0.001053 | 0.003693 | 0.011974 | 0.001432 | 0.001672 | 0.006024 | 0.001761 | 0.001958 | 0.001829 |

**WinSim Cond**

| | Santa Fe Pacific #1 | Santa Fe Pacific 28B-1 | Kernco 1 CF | Schendel 33B | Schendel 33B | Sugarloaf CF-1 | Hilliard Fc | Earl 31 | Eclipse North |
|---|---|---|---|---|---|---|---|---|---|
| Molecular Weight | 37.1739 | 34.0405 | 40.2042 | 40.2892 | 33.3996 | 41.6076 | 36.8902 | 39.5526 | 36.452 |
| Lower Heating Value | 1925.010 | 1698.550 | 2087.580 | 2087.580 | 1748.820 | 2116.31 | 1853.840 | 2037.420 | 1880.37 |
| Reid Vapor Pressure | 12.26 | 10.24 | 13.77 | 11.05 | 10.32 | 14.42 | 11.56 | 13.44 | 11.64 |
| Methane | 0.09253 | 0.190184 | 0.118215 | 0.139385 | 0.202244 | 0.089848 | 0.13651 | 0.083937 | 0.12259 |
| Ethane | 0.221236 | 0.157474 | 0.14868 | 0.20333 | 0.194334 | 0.173877 | 0.232424 | 0.201939 | 0.223879 |
| Propane | 0.290144 | 0.190297 | 0.200761 | 0.25619 | 0.206033 | 0.207914 | 0.236699 | 0.287994 | 0.241072 |
| I-Butane | 0.065201 | 0.079514 | 0.076135 | 0.056626 | 0.067844 | 0.0620963 | 0.079114 | 0.081697 | 0.078055 |
| N-Butane | 0.149212 | 0.127721 | 0.146649 | 0.137405 | 0.130556 | 0.12684 | 0.135616 | 0.161971 | 0.130478 |
| I-Pentane | 0.046241 | 0.060445 | 0.084729 | 0.0447787 | 0.059642 | 0.0660322 | 0.054928 | 0.056136 | 0.053946 | 37 |
| N-Pentane | 0.046529 | 0.048101 | 0.083455 | 0.0484185 | 0.053967 | 0.07654 | 0.04665 | 0.051267 | 0.046118 | 2 |
| Cyclopentane | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.003144251 |
| n-Hexane | 0.026016 | 0.048534 | 0.072329 | 0.0334914 | 0.034795 | 0.114084 | 0.033851 | 0.026567 | 0.015316 |
| Cyclohexane | 0.002475 | 0.003949 | 0.005105 | 0.0036524 | 0.0027455 | 0.00798418 | 0.00226 | 0.003139 | 0.003355 |
| Other Hexane | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.027149 |
| Heptane | 0.010734 | 0.020267 | 0.031543 | 0.012381 | 0.016898 | 0.026912 | 0.050244 | 0.015472 | 0.014965 |
| Octane | 0.003623 | 0.003984 | 0.005968 | 0.003739 | 0.005185 | 0.004259 | 0.004853 | 0.00337 | 0.004780 |
| Nonane | 0.000983 | 0.001284 | 0.000824 | 0.001205 | 0.001306 | 0.003542 | 0.001285 | 0.000938 | 0.001270 |
| Decane Plus | 0.003195 | 0.002389 | 0.002816 | 0.003216 | 0.002284 | 0.001410 | 0.002707 | 0.00261 | 0.000745309 |
| Benzene | 0.000994 | 0.00174 | 0.002561 | 0.001076 | 0.001193 | 0.004025 | 0.001658 | 0.001202 | 0.001858 |
| Toluene | 0.001509 | 0.002934 | 0.004012 | 0.002165 | 0.002128 | 0.0882029 | 0.002811 | 0.002139 | 0.003856 |
| Ethylbenzene | 0.000197 | 0.000421 | 0.000369 | 0.000227 | 0.000196 | 0.000139 | 0.000396 | 0.000238 | 0.000139 |
| Xylene | 0.001041 | 0.001816 | 0.011897 | 0.001132 | 0.001656 | 0.005941 | 0.001744 | 0.001838 | 0.001836 |

**Total VOC - PW**

| | Santa Fe Pacific #1 | Santa Fe Pacific 28B-1 | Kernco 1 CF | Schendel 33B | Schendel 33B | Sugarloaf CF-1 | Hilliard Fc | Earl 31 | Eclipse North |
|---|---|---|---|---|---|---|---|---|---|
| 25 | 0.230808 | 0.23901 | 0.23796 | 0.2194007 | 0.1472030 | 0.172707 | 0.304105 | 0.2040 | 0.075664150 |
| 50 | 0.477274 | 0.678161 | 0.679555 | 0.443882 | 0.294611 | 0.367511 | 0.208212 | 0.736914 | 0.151329583 |
| 100 | 0.954747 | 1.369037 | 1.369187 | 0.88775 | 0.589222 | 0.701502 | 0.416423 | 1.47383 | 0.308260012 |
| 200 | 1.909496 | 2.712851 | 2.725174 | 1.77554 | 1.178443 | 1.403007 | 0.832847 | 2.953817 | 0.616522585 |
| 400 | 3.818992 | 5.425295 | 5.436758 | 3.551051 | 2.36689 | 2.806012 | 1.66569 | 5.895318 | 1.257267172 |

**Flowrates - PW**

| | Santa Fe Pacific #1 | Santa Fe Pacific 28B-1 | Kernco 1 CF | Schendel 33B | Schendel 33B | Sugarloaf CF-1 | Hilliard Fc | Earl 31 | Eclipse North |
|---|---|---|---|---|---|---|---|---|---|
| 25 | 3.74068 | 6.36151 | 4.44648 | 3.95199 | 2.82731 | 1.25181 | 1.80014 | 5.10125 | 1.17859 |
| 50 | 7.48536 | 12.703 | 8.89296 | 7.90398 | 5.65462 | 4.50361 | 3.60081 | 18.2025 | 2.55717 |
| 100 | 14.9907 | 25.4568 | 17.7859 | 15.8081 | 11.3092 | 9.00722 | 7.20161 | 26.4051 | 5.20906 |
| 200 | 29.9814 | 50.812 | 36.6608 | 31.6159 | 22.6185 | 18.0144 | 14.4032 | 48.8713 | 10.4181 |
| 400 | 59.9628 | 101.624 | 73.1437 | 63.2818 | 45.2369 | 36.0289 | 28.8064 | 81.6412 | 20.836 |

**Total VOC - Cond**

| | Santa Fe Pacific #1 | Santa Fe Pacific 28B-1 | Kernco 1 CF | Schendel 33B | Schendel 33B | Sugarloaf CF-1 | Hilliard Fc | Earl 31 | Eclipse North |
|---|---|---|---|---|---|---|---|---|---|
| 50 | 5.918696 | 8.98207 | 9.936992 | 5.570062 | 3.737866 | 5.517304 | 2.674688 | 9.612233 | 1.675135577 |
| 150 | 17.76808 | 26.94027 | 38.005548 | 15.71033 | 11.14061 | 16.443738 | 8.077538 | 28.661839 | |
| 200 | 23.67842 | 35.747384 | 48.121557 | 22.280232 | 14.80527 | 21.952852 | 10.76209 | 38.079201 | |
| 250 | 29.59846 | 44.727374 | 59.054693 | 27.850246 | 18.54325 | 27.370164 | 13.450392 | 47.691461 | |
| 300 | 35.51819 | 53.707388 | 69.20589 | 33.420367 | 22.28122 | 32.77927 | 16.135068 | 57.118775 | |
| 350 | 41.43783 | 62.687288 | 78.142912 | 38.990475 | 25.9459 | 38.295574 | 18.819757 | 66.731028 | 11.75944419 |
| 400 | 47.35753 | 71.66731 | 88.27463 | 44.560474 | 29.68385 | 43.709588 | 21.504467 | 76.343282 | |
| 500 | 59.19647 | 89.49819 | 108.343133 | 55.699757 | 37.08545 | 54.532166 | 26.90732 | 95.382791 | 16.78484457 |
| 1000 | 118.39355 | 179.08212 | 208.491706 | 111.510362 | 74.17355 | 109.37255 | 53.814647 | 190.85895 | 33.53636604 |

**Flowrate - Cond**

| | Santa Fe Pacific #1 | Santa Fe Pacific 28B-1 | Kernco 1 CF | Schendel 33B | Schendel 33B | Sugarloaf CF-1 | Hilliard Fc | Earl 31 | Eclipse North |
|---|---|---|---|---|---|---|---|---|---|
| 50 | 96.9889 | 170.847 | 131.335 | 100.725 | 73.0203 | 71.8192 | 47.0319 | 134.31 | 28.2073 |
| 150 | 281.907 | 512.542 | 386.703 | 302.178 | 217.626 | 214.049 | 142.036 | 400.346 | |
| 200 | 375.876 | 680.183 | 530.655 | 402.904 | 289.218 | 284.46 | 189.068 | 532.073 | |
| 250 | 469.844 | 850.951 | 682.031 | 503.63 | 362.228 | 356.28 | 237.041 | 666.383 | |
| 300 | 563.813 | 1021.8 | 795.993 | 604.361 | 436.251 | 426.691 | 284.073 | 798.11 | |
| 350 | 657.782 | 1192.65 | 927.389 | 705.082 | 506.847 | 498.51 | 331.105 | 932.439 | 198.035 |
| 400 | 751.751 | 1363.49 | 1061.31 | 805.803 | 579.867 | 568.921 | 378.137 | 1066.73 | |
| 500 | 939.689 | 1701.9 | 1326.64 | 1009.24 | 724.478 | 711.151 | 473.141 | 1332.77 | 282.637 |
| 1000 | 1879.38 | 3407.69 | 2650.7 | 2016.1 | 1448.95 | 1423.71 | 946.283 | 2665.53 | 564.71 |

**Total benzene - Cond, lb/hr**

| | Santa Fe Pacific #1 | Santa Fe Pacific 28B-1 | Kernco 1 CF | Schendel 33B | Schendel 33B | Sugarloaf CF-1 | Hilliard Fc | Earl 31 | Eclipse North |
|---|---|---|---|---|---|---|---|---|---|
| 50 | 0.008485 | 0.0299 | 0.036485 | 0.015335 | 0.00780 | 0.338594 | 0.005128 | 0.016711 | 0.08499 |
| 150 | 0.025454 | 0.07769 | 0.107152 | 0.04594 | 0.022366 | 0.394461 | 0.015486 | 0.049812 | |
| 200 | 0.033938 | 0.103459 | 0.143333 | 0.061265 | 0.029709 | 0.125534 | 0.020613 | 0.066201 | |
| 250 | 0.042423 | 0.129449 | 0.178818 | 0.076581 | 0.03721 | 0.157228 | 0.025843 | 0.082912 | |
| 300 | 0.050907 | 0.155439 | 0.235 | 0.091897 | 0.044711 | 0.188301 | 0.030971 | 0.099302 | |
| 350 | 0.059392 | 0.181429 | 0.250485 | 0.107213 | 0.052065 | 0.219996 | 0.036099 | 0.116013 | 0.03605 |
| 400 | 0.067877 | 0.207418 | 0.286666 | 0.12253 | 0.059566 | 0.251068 | 0.041126 | 0.132724 | |
| 500 | 0.084846 | 0.258898 | 0.369.333 | 0.153462 | 0.074442 | 0.313836 | 0.051584 | 0.165824 | 0.050026 |
| 1000 | 0.169691 | 0.518296 | 0.7159 | 0.306625 | 0.14884 | 0.628292 | 0.10188 | 0.331648 | 0.099258 |

**Total benzene - PW, lb/hr**

| | Santa Fe Pacific #1 | Santa Fe Pacific 28B-1 | Kernco 1 CF | Schendel 33B | Schendel 33B | Sugarloaf CF-1 | Hilliard Fc | Earl 31 | Eclipse North |
|---|---|---|---|---|---|---|---|---|---|
| 25 | 0.000338 | 0.000966 | 0.001201 | 0.000601 | 0.00029 | 0.300994 | 0.000196 | 0.000636 | |
| 50 | 0.00067 | 0.001933 | 0.002403 | 0.001202 | 0.00285 | 0.301987 | 0.000393 | 0.00127 | |
| 100 | 0.00135 | 0.003873 | 0.004815 | 0.002404 | 0.001162 | 0.303974 | 0.000785 | 0.00254 | |
| 200 | 0.00270 | 0.007751 | 0.009634 | 0.004808 | 0.002324 | 0.307949 | 0.001571 | 0.005087 | |
| 400 | 0.005403 | 0.015461 | 0.019272 | 0.009615 | 0.004647 | 0.315898 | 0.003141 | 0.010174 | |



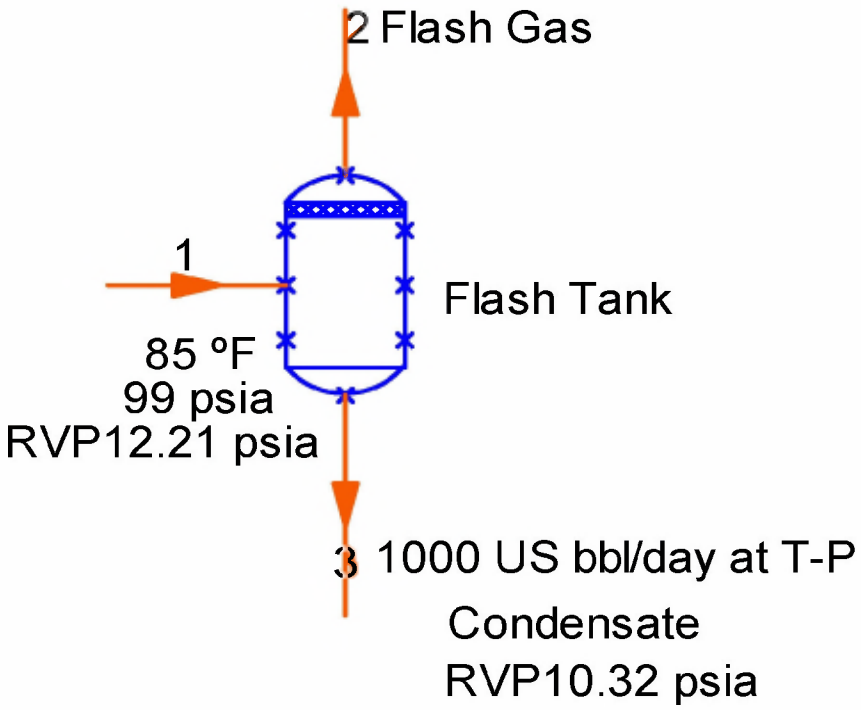
EFSCOP00009364

# DESIGN II for Windows

CONDENSATE SUMMARY REPORT

## Simulation Result: SOLUTION REACHED

**Problem:**
**Project:**
**Task:**
**By:**
**At:** 7-Feb-12 11:24 AM



# Details for Stream 1

## Stream 1 (Strm 1)

| Thermodynamic Methods | | | | | | |
|---|---|---|---|---|---|---|
| | K-Value: | PENG-ROB | Enthalpy: | PENG-ROB | Density: | STD |
| | Liquid 1 Visc: | NBS81 | Liquid 1 ThC: | NBS81 | Liquid 1 Den: | STD |
| | Liquid 2 Visc: | STEAM | Liquid 2 ThC: | STEAM | Liquid 2 Den: | STD |

**Flowrates**

| Component Name | Total lbmol/hr | Vapor lbmol/hr | Liquid 1 lbmol/hr | Liquid 2 lbmol/hr | Total mole % | K-Value |
|---|---|---|---|---|---|---|
| 46 : NITROGEN | 0.039681 | 0 | 0.039681 | 0 | 0.042 | |
| 49 : CARBON DIOXIDE | 0.029288 | 0 | 0.029288 | 0 | 0.031 | |
| 2 : METHANE | 1.78659 | 0 | 1.78659 | 0 | 1.89098 | |
| 3 : ETHANE | 1.47008 | 0 | 1.47008 | 0 | 1.55598 | |
| 4 : PROPANE | 2.42243 | 0 | 2.42243 | 0 | 2.56397 | |
| 5 : ISOBUTANE | 1.32364 | 0 | 1.32364 | 0 | 1.40099 | |
| 6 : N-BUTANE | 3.37949 | 0 | 3.37949 | 0 | 3.57696 | |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 | |
| 7 : ISOPENTANE | 3.35776 | 0 | 3.35776 | 0 | 3.55396 | |
| 8 : N-PENTANE | 3.88401 | 0 | 3.88401 | 0 | 4.11096 | |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 | |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 | |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 | |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 | |
| 10 : N-HEXANE | 7.01502 | 0 | 7.01502 | 0 | 7.42493 | |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 | |
| 40 : BENZENE | 0.277767 | 0 | 0.277767 | 0 | 0.293997 | |
| 38 : CYCLOHEXANE | 0.745435 | 0 | 0.745435 | 0 | 0.788992 | |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 | |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 | |
| 11 : N-HEPTANE | 9.63869 | 0 | 9.63869 | 0 | 10.2019 | |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 | |
| 41 : TOLUENE | 2.04357 | 0 | 2.04357 | 0 | 2.16298 | |
| 12 : N-OCTANE | 8.36228 | 0 | 8.36228 | 0 | 8.85091 | |
| 45 : ETHYL BENZENE | 0.63395 | 0 | 0.63395 | 0 | 0.670993 | |
| 43 : M-XYLENE | 3.58451 | 0 | 3.58451 | 0 | 3.79396 | |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 | |
| 13 : N-NONANE | 5.94742 | 0 | 5.94742 | 0 | 6.29494 | |
| 14 : N-DECANE | 38.5377 | 0 | 38.5377 | 0 | 40.7896 | |
| 62 : WATER | 0 | 0 | 0 | 0 | 0 | |
| Total | 94.4794 | 0 | 94.4794 | 0 | 100 | |

**Flowrates**

| Component Name | Total lb/hr | Vapor lb/hr | Liquid 1 lb/hr | Liquid 2 lb/hr | Total mass % |
|---|---|---|---|---|---|
| 46 : NITROGEN | 1.1116 | 0 | 1.1116 | 0 | 0.010617 |
| 49 : CARBON DIOXIDE | 1.28894 | 0 | 1.28894 | 0 | 0.012311 |
| 2 : METHANE | 28.6622 | 0 | 28.6622 | 0 | 0.273765 |
| 3 : ETHANE | 44.2025 | 0 | 44.2025 | 0 | 0.422197 |
| 4 : PROPANE | 106.814 | 0 | 106.814 | 0 | 1.02023 |
| 5 : ISOBUTANE | 76.9301 | 0 | 76.9301 | 0 | 0.734793 |
| 6 : N-BUTANE | 196.416 | 0 | 196.416 | 0 | 1.87606 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 |
| 7 : ISOPENTANE | 242.249 | 0 | 242.249 | 0 | 2.31383 |
| 8 : N-PENTANE | 280.216 | 0 | 280.216 | 0 | 2.67646 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 10 : N-HEXANE | 604.498 | 0 | 604.498 | 0 | 5.77383 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 |
| 40 : BENZENE | 21.6958 | 0 | 21.6958 | 0 | 0.207226 |
| 38 : CYCLOHEXANE | 62.7328 | 0 | 62.7328 | 0 | 0.599188 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 11 : N-HEPTANE | 965.777 | 0 | 965.777 | 0 | 9.22455 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 |
| 41 : TOLUENE | 188.282 | 0 | 188.282 | 0 | 1.79836 |
| 12 : N-OCTANE | 955.173 | 0 | 955.173 | 0 | 9.12327 |
| 45 : ETHYL BENZENE | 67.3001 | 0 | 67.3001 | 0 | 0.642813 |
| 43 : M-XYLENE | 380.532 | 0 | 380.532 | 0 | 3.63462 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 |
| 13 : N-NONANE | 762.756 | 0 | 762.756 | 0 | 7.28541 |
| 14 : N-DECANE | 5483 | 0 | 5483 | 0 | 52.3705 |
| 62 : WATER | 0 | 0 | 0 | 0 | 0 |
| Total | 10469.6 | 0 | 10469.6 | 0 | 100 |



EFSCOP00009366

**Flowrates**

| Component Name | Total ft3/hr | Vapor ft3/hr | Liquid 1 ft3/hr | Liquid 2 ft3/hr | Total volume % |
|---|---|---|---|---|---|
| 46 : NITROGEN | 0.101325 | 0 | 0.101325 | 0 | 0.042 |
| 49 : CARBON DIOXIDE | 0.074787 | 0 | 0.074787 | 0 | 0.031 |
| 2 : METHANE | 4.56203 | 0 | 4.56203 | 0 | 1.89098 |
| 3 : ETHANE | 3.75384 | 0 | 3.75384 | 0 | 1.55598 |
| 4 : PROPANE | 6.18564 | 0 | 6.18564 | 0 | 2.56397 |
| 5 : ISOBUTANE | 3.37991 | 0 | 3.37991 | 0 | 1.40099 |
| 6 : N-BUTANE | 8.6295 | 0 | 8.6295 | 0 | 3.57696 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 |
| 7 : ISOPENTANE | 8.57401 | 0 | 8.57401 | 0 | 3.55396 |
| 8 : N-PENTANE | 9.91777 | 0 | 9.91777 | 0 | 4.11096 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 10 : N-HEXANE | 17.9128 | 0 | 17.9128 | 0 | 7.42493 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 |
| 40 : BENZENE | 0.709274 | 0 | 0.709274 | 0 | 0.293997 |
| 38 : CYCLOHEXANE | 1.90346 | 0 | 1.90346 | 0 | 0.788992 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 11 : N-HEPTANE | 24.6123 | 0 | 24.6123 | 0 | 10.2019 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 |
| 41 : TOLUENE | 5.21823 | 0 | 5.21823 | 0 | 2.16298 |
| 12 : N-OCTANE | 21.353 | 0 | 21.353 | 0 | 8.85091 |
| 45 : ETHYL BENZENE | 1.61878 | 0 | 1.61878 | 0 | 0.670993 |
| 43 : M-XYLENE | 9.15301 | 0 | 9.15301 | 0 | 3.79396 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 |
| 13 : N-NONANE | 15.1867 | 0 | 15.1867 | 0 | 6.29494 |
| 14 : N-DECANE | 98.4057 | 0 | 98.4057 | 0 | 40.7896 |
| 62 : WATER | 0 | 0 | 0 | 0 | 0 |
| Total | 241.252 | 0 | 241.252 | 0 | 100 |

**Flowrates**

| Component Name | Total SCF/hr | Vapor SCF/hr | Liquid 1 SCF/hr | Liquid 2 SCF/hr | Total std vol % |
|---|---|---|---|---|---|
| 46 : NITROGEN | 0.02209 | 0 | 0.02209 | 0 | 0.009331 |
| 49 : CARBON DIOXIDE | 0.025142 | 0 | 0.025142 | 0 | 0.01062 |
| 2 : METHANE | 1.53263 | 0 | 1.53263 | 0 | 0.647368 |
| 3 : ETHANE | 1.9886 | 0 | 1.9886 | 0 | 0.839965 |
| 4 : PROPANE | 3.37562 | 0 | 3.37562 | 0 | 1.42583 |
| 5 : ISOBUTANE | 2.19129 | 0 | 2.19129 | 0 | 0.925578 |
| 6 : N-BUTANE | 5.39236 | 0 | 5.39236 | 0 | 2.27767 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 |
| 7 : ISOPENTANE | 6.21906 | 0 | 6.21906 | 0 | 2.62687 |
| 8 : N-PENTANE | 7.11949 | 0 | 7.11949 | 0 | 3.0072 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 10 : N-HEXANE | 14.5974 | 0 | 14.5974 | 0 | 6.16577 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 |
| 40 : BENZENE | 0.393302 | 0 | 0.393302 | 0 | 0.166127 |
| 38 : CYCLOHEXANE | 1.28389 | 0 | 1.28389 | 0 | 0.542303 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 11 : N-HEPTANE | 22.5025 | 0 | 22.5025 | 0 | 9.5048 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 |
| 41 : TOLUENE | 3.4629 | 0 | 3.4629 | 0 | 1.46269 |
| 12 : N-OCTANE | 21.6644 | 0 | 21.6644 | 0 | 9.15082 |
| 45 : ETHYL BENZENE | 1.23798 | 0 | 1.23798 | 0 | 0.52291 |
| 43 : M-XYLENE | 7.02333 | 0 | 7.02333 | 0 | 2.96658 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 |
| 13 : N-NONANE | 16.9434 | 0 | 16.9434 | 0 | 7.15671 |
| 14 : N-DECANE | 119.773 | 0 | 119.773 | 0 | 50.5909 |
| 62 : WATER | 0 | 0 | 0 | 0 | 0 |
| Total | 236.748 | 0 | 236.748 | 0 | 100 |



EFSCOP00009367

**Properties**

| | | |
|---|---|---|
| **Temperature** | F | 85 |
| **Pressure** | psia | 98.696 |
| **Enthalpy** | Btu/hr | -1378318 |
| **Entropy** | Btu/hr/R | -1475.157 |
| **Vapor Fraction** | | 0 |

| | | Total | Liquid 1 |
|---|---|---|---|
| **Flowrate** | lbmol/hr | 94.4794 | 94.4794 |
| **Flowrate** | lb/hr | 10469.6341 | 10469.6341 |
| **Mole Fraction** | | 1 | 1 |
| **Mass Fraction** | | 1 | 1 |
| **Molecular Weight** | | 110.814 | 110.814 |
| **Enthalpy** | Btu/lbmol | -14588.5624 | -14588.5624 |
| **Enthalpy** | Btu/lb | -131.6491 | -131.6491 |
| **Entropy** | Btu/lbmol/R | -15.6135 | -15.6135 |
| **Entropy** | Btu/lb/R | -0.140899 | -0.140899 |
| **Cp** | Btu/lbmol/R | | 55.8362 |
| **Cp** | Btu/lb/R | | 0.5039 |
| **Cv** | Btu/lbmol/R | | 48.8226 |
| **Cv** | Btu/lb/R | | 0.4406 |
| **Cp/Cv** | | | 1.1437 |
| **Density** | lb/ft3 | | 43.3971 |
| **Z-Factor** | | | 0.043122 |
| **Flowrate (T-P)** | gal/min | | 30.0801 |
| **Flowrate (STP)** | gal/min | | 29.5167 |
| **Specific Gravity** | GPA STP | | 0.709076 |
| **Viscosity** | cP | | 0.491656 |
| **Thermal Conductivity** | Btu/hr/ft/R | | 0.068131 |
| **Surface Tension** | dyne/cm | | 19.4032 |
| **Reid Vapor Pressure (ASTM-A** | psia | | 12.21 |
| **True Vapor Pressure at 100 F** | psia | | 82.45 |
| **Critical Temperature (Cubic El** | F | 588.5647 | |
| **Critical Pressure (Cubic EOS)** | psia | 471.2788 | |
| **Dew Point Temperature** | F | 447.0109 | |
| **Bubble Point Temperature** | F | 141.3488 | |
| **Water Dew Point Temperature could not be calculated** | | | |
| **Stream Vapor Pressure** | psia | 76.9265 | |
| **Latent Heat of Vaporization (N** | Btu/lb | 103.4356 | |
| **Latent Heat of Vaporization (P** | Btu/lb | 321.512 | |
| **CO2 Freeze Up** | | No | |
| **Heating Value (gross)** | Btu/SCF | 6022.54 | |
| **Heating Value (net)** | Btu/SCF | 5594.31 | |
| **Wobbe Number** | Btu/SCF | 2913.69 | |
| **Average Hydrogen Atoms** | | 17.0212 | |
| **Average Carbon Atoms** | | 7.7964 | |
| **Hydrogen to Carbon Ratio** | | 2.1832 | |

# Details for Stream 2

## Stream 2 (Flash Gas)

| Thermodynamic Methods | K-Value: | PENG-ROB | Enthalpy: | PENG-ROB | Density: | STD |
|---|---|---|---|---|---|---|
| | Vapor Visc: | NBS81 | Vapor ThC: | NBS81 | Vapor Den: | STD |

**Flowrates**

| Component Name | Total lbmol/hr | Vapor lbmol/hr | Incipient Liquid 1 mol fra | Liquid 2 lbmol/hr | Total mole % | K-Value |
|---|---|---|---|---|---|---|
| 46 : NITROGEN | 0.037901 | 0.037901 | 0.00001963 | 0 | 1.00301 | 511.085 |
| 49 : CARBON DIOXIDE | 0.020943 | 0.020943 | 0.00009201 | 0 | 0.554237 | 60.2372 |
| 2 : METHANE | 1.59102 | 1.59102 | 0.002156 | 0 | 42.1049 | 195.278 |
| 3 : ETHANE | 0.815699 | 0.815699 | 0.007215 | 0 | 21.5867 | 29.9201 |
| 4 : PROPANE | 0.589715 | 0.589715 | 0.020206 | 0 | 15.6063 | 7.72352 |
| 5 : ISOBUTANE | 0.147324 | 0.147324 | 0.012969 | 0 | 3.8988 | 3.00619 |
| 6 : N-BUTANE | 0.283516 | 0.283516 | 0.034134 | 0 | 7.50299 | 2.1981 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 | 1.48838 |
| 7 : ISOPENTANE | 0.104334 | 0.104334 | 0.03587 | 0 | 2.7611 | 0.769753 |
| 8 : N-PENTANE | 0.094408 | 0.094408 | 0.041781 | 0 | 2.49841 | 0.597971 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 | 0.360909 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 | 0.263381 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 | 0.236664 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 | 0.210746 |
| 10 : N-HEXANE | 0.050962 | 0.050962 | 0.076781 | 0 | 1.34866 | 0.17565 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 | 0.154099 |
| 40 : BENZENE | 0.001906 | 0.001906 | 0.003041 | 0 | 0.050429 | 0.165807 |
| 38 : CYCLOHEXANE | 0.004118 | 0.004118 | 0.008173 | 0 | 0.108966 | 0.133321 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 | 0.065693 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 | 0.066054 |
| 11 : N-HEPTANE | 0.021285 | 0.021285 | 0.106035 | 0 | 0.56328 | 0.053122 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 | 0.051298 |
| 41 : TOLUENE | 0.003591 | 0.003591 | 0.022491 | 0 | 0.095027 | 0.042251 |
| 12 : N-OCTANE | 0.005709 | 0.005709 | 0.092134 | 0 | 0.151073 | 0.016397 |
| 45 : ETHYL BENZENE | 0.000418 | 0.000418 | 0.006985 | 0 | 0.011062 | 0.015837 |
| 43 : M-XYLENE | 0.001977 | 0.001977 | 0.039498 | 0 | 0.052332 | 0.013249 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 | 0.007514 |
| 13 : N-NONANE | 0.001286 | 0.001286 | 0.065558 | 0 | 0.03403 | 0.005191 |
| 14 : N-DECANE | 0.002598 | 0.002598 | 0.424861 | 0 | 0.068751 | 0.001618 |
| 62 : WATER | 0 | 0 | 0 | 0 | 0 | 0.024719 |
| Total | 3.77871 | 3.77871 | 1 | 0 | 100 | |

**Flowrates**

| Component Name | Total lb/hr | Vapor lb/hr | Incipient Liquid 1 mass fra | Liquid 2 lb/hr | Total mass % |
|---|---|---|---|---|---|
| 46 : NITROGEN | 1.06173 | 1.06173 | 0.000005 | 0 | 0.84126 |
| 49 : CARBON DIOXIDE | 0.921677 | 0.921677 | 0.000036 | 0 | 0.730287 |
| 2 : METHANE | 25.5247 | 25.5247 | 0.000303 | 0 | 20.2244 |
| 3 : ETHANE | 24.5264 | 24.5264 | 0.001902 | 0 | 19.4334 |
| 4 : PROPANE | 26.0029 | 26.0029 | 0.007813 | 0 | 20.6033 |
| 5 : ISOBUTANE | 8.56248 | 8.56248 | 0.00661 | 0 | 6.78444 |
| 6 : N-BUTANE | 16.478 | 16.478 | 0.0174 | 0 | 13.0562 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 |
| 7 : ISOPENTANE | 7.52729 | 7.52729 | 0.02269 | 0 | 5.96421 |
| 8 : N-PENTANE | 6.81113 | 6.81113 | 0.02643 | 0 | 5.39677 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 10 : N-HEXANE | 4.39148 | 4.39148 | 0.05802 | 0 | 3.47957 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 |
| 40 : BENZENE | 0.148841 | 0.148841 | 0.002083 | 0 | 0.117934 |
| 38 : CYCLOHEXANE | 0.346514 | 0.346514 | 0.006031 | 0 | 0.274559 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 11 : N-HEPTANE | 2.13269 | 2.13269 | 0.0932 | 0 | 1.68982 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 |
| 41 : TOLUENE | 0.330835 | 0.330835 | 0.01817 | 0 | 0.262136 |
| 12 : N-OCTANE | 0.652059 | 0.652059 | 0.0923 | 0 | 0.516656 |
| 45 : ETHYL BENZENE | 0.044373 | 0.044373 | 0.006502 | 0 | 0.035159 |
| 43 : M-XYLENE | 0.209928 | 0.209928 | 0.03677 | 0 | 0.166336 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 |
| 13 : N-NONANE | 0.164918 | 0.164918 | 0.07373 | 0 | 0.130672 |
| 14 : N-DECANE | 0.369617 | 0.369617 | 0.5301 | 0 | 0.292864 |
| 62 : WATER | 0 | 0 | 0 | 0 | 0 |
| Total | 126.208 | 126.208 | 1 | 0 | 100 |
| | Total VOC | 74.173055 | | | |

**Flowrates**

| Component Name | Total ft3/hr | Vapor ft3/hr | Liquid 1 ft3/hr | Liquid 2 ft3/hr | Total volume % |
|---|---|---|---|---|---|
| 46 : NITROGEN | 14.5332 | 14.5332 | 0 | 0 | 1.00301 |
| 49 : CARBON DIOXIDE | 8.03064 | 8.03064 | 0 | 0 | 0.554237 |
| 2 : METHANE | 610.08 | 610.08 | 0 | 0 | 42.1049 |
| 3 : ETHANE | 312.781 | 312.781 | 0 | 0 | 21.5867 |
| 4 : PROPANE | 226.127 | 226.127 | 0 | 0 | 15.6063 |
| 5 : ISOBUTANE | 56.4917 | 56.4917 | 0 | 0 | 3.8988 |
| 6 : N-BUTANE | 108.715 | 108.715 | 0 | 0 | 7.50299 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 |
| 7 : ISOPENTANE | 40.0071 | 40.0071 | 0 | 0 | 2.7611 |
| 8 : N-PENTANE | 36.2007 | 36.2007 | 0 | 0 | 2.49841 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 10 : N-HEXANE | 19.5414 | 19.5414 | 0 | 0 | 1.34866 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 |
| 40 : BENZENE | 0.730698 | 0.730698 | 0 | 0 | 0.050429 |
| 38 : CYCLOHEXANE | 1.57887 | 1.57887 | 0 | 0 | 0.108966 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 11 : N-HEPTANE | 8.16166 | 8.16166 | 0 | 0 | 0.56328 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 |
| 41 : TOLUENE | 1.3769 | 1.3769 | 0 | 0 | 0.095027 |
| 12 : N-OCTANE | 2.18897 | 2.18897 | 0 | 0 | 0.151073 |
| 45 : ETHYL BENZENE | 0.160277 | 0.160277 | 0 | 0 | 0.011062 |
| 43 : M-XYLENE | 0.758265 | 0.758265 | 0 | 0 | 0.052332 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 |
| 13 : N-NONANE | 0.493085 | 0.493085 | 0 | 0 | 0.03403 |
| 14 : N-DECANE | 0.996164 | 0.996164 | 0 | 0 | 0.068751 |
| 62 : WATER | 0 | 0 | 0 | 0 | 0 |
| Total | 1448.95 | 1448.95 | 0 | 0 | 100 |

**Flowrates**

| Component Name | Total SCF/hr | Vapor SCF/hr | Liquid 1 SCF/hr | Liquid 2 SCF/hr | Total std vol % |
|---|---|---|---|---|---|
| 46 : NITROGEN | 14.3828 | 14.3828 | 0 | 0 | 1.00301 |
| 49 : CARBON DIOXIDE | 7.94752 | 7.94752 | 0 | 0 | 0.554237 |
| 2 : METHANE | 603.766 | 603.766 | 0 | 0 | 42.1049 |
| 3 : ETHANE | 309.544 | 309.544 | 0 | 0 | 21.5867 |
| 4 : PROPANE | 223.787 | 223.787 | 0 | 0 | 15.6063 |
| 5 : ISOBUTANE | 55.9071 | 55.9071 | 0 | 0 | 3.8988 |
| 6 : N-BUTANE | 107.59 | 107.59 | 0 | 0 | 7.50299 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 |
| 7 : ISOPENTANE | 39.593 | 39.593 | 0 | 0 | 2.7611 |
| 8 : N-PENTANE | 35.8261 | 35.8261 | 0 | 0 | 2.49841 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 10 : N-HEXANE | 19.3391 | 19.3391 | 0 | 0 | 1.34866 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 |
| 40 : BENZENE | 0.723136 | 0.723136 | 0 | 0 | 0.050429 |
| 38 : CYCLOHEXANE | 1.56253 | 1.56253 | 0 | 0 | 0.108966 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 11 : N-HEPTANE | 8.07719 | 8.07719 | 0 | 0 | 0.56328 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 |
| 41 : TOLUENE | 1.36265 | 1.36265 | 0 | 0 | 0.095027 |
| 12 : N-OCTANE | 2.16632 | 2.16632 | 0 | 0 | 0.151073 |
| 45 : ETHYL BENZENE | 0.158619 | 0.158619 | 0 | 0 | 0.011062 |
| 43 : M-XYLENE | 0.750418 | 0.750418 | 0 | 0 | 0.052332 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 |
| 13 : N-NONANE | 0.487982 | 0.487982 | 0 | 0 | 0.03403 |
| 14 : N-DECANE | 0.985855 | 0.985855 | 0 | 0 | 0.068751 |
| 62 : WATER | 0 | 0 | 0 | 0 | 0 |
| Total | 1433.96 | 1433.96 | 0 | 0 | 100 |



EFSCOP00009370

**Properties**

| | | | |
|---|---|---|---|
| **Temperature** | F | 70 | |
| **Pressure** | psia | 14.7 | |
| **Enthalpy** | Btu/hr | 1877.667 | |
| **Entropy** | Btu/hr/R | 16.51078 | |
| **Vapor Fraction** | | 1 | |
| | | Total | Vapor |
| **Flowrate** | lbmol/hr | 3.7787 | 3.7787 |
| **Flowrate** | lb/hr | 126.2076 | 126.2076 |
| **Mole Fraction** | | 1 | 1 |
| **Mass Fraction** | | 1 | 1 |
| **Molecular Weight** | | 33.3996 | 33.3996 |
| **Enthalpy** | Btu/lbmol | 496.9069 | 496.9069 |
| **Enthalpy** | Btu/lb | 14.8776 | 14.8776 |
| **Entropy** | Btu/lbmol/R | 4.3694 | 4.3694 |
| **Entropy** | Btu/lb/R | 0.130822 | 0.130822 |
| **Cp** | Btu/lbmol/R | | 14.2137 |
| **Cp** | Btu/lb/R | | 0.4256 |
| **Cv** | Btu/lbmol/R | | 12.1626 |
| **Cv** | Btu/lb/R | | 0.3642 |
| **Cp/Cv** | | | 1.1686 |
| **Density** | lb/ft3 | | 0.087103 |
| **Z-Factor** | | | 0.991797 |
| **Flowrate (T-P)** | ft3/s | | 0.402487 |
| **Flowrate (STP)** | MMSCFD | | 0.034415 |
| **Viscosity** | cP | | 0.009775 |
| **Thermal Conductivity** | Btu/hr/ft/R | | 0.013158 |
| **Critical Temperature (Cubic E** | F | 164.3905 | |
| **Critical Pressure (Cubic EOS)** | psia | 1500.0638 | |
| **Dew Point Temperature** | F | 70.0076 | |
| **Bubble Point Temperature** | F | -263.5786 | |
| **Water Dew Point Temperature could not be calculated** | | | |
| **Stream Vapor Pressure** | psia | 1339.1519 | |
| **Vapor Sonic Velocity** | ft/s | 950.84 | |
| **CO2 Freeze Up** | | No | |
| **Heating Value (gross)** | Btu/SCF | 1908.74 | |
| **Heating Value (net)** | Btu/SCF | 1748.82 | |
| **Wobbe Number** | Btu/SCF | 1768.44 | |
| **Average Hydrogen Atoms** | | 6.3573 | |
| **Average Carbon Atoms** | | 2.2092 | |
| **Hydrogen to Carbon Ratio** | | 2.8776 | |
| **Methane Number** | | 42.19 | |
| **Motor Octane Number** | | 99.32 | |

# Details for Stream 3

## Stream 3 (Condensate)

| Thermodynamic Methods | | | | | | |
|---|---|---|---|---|---|---|
| | K-Value: | PENG-ROB | Enthalpy: | PENG-ROB | Density: | STD |
| | Liquid 1 Visc: | NBS81 | Liquid 1 ThC: | NBS81 | Liquid 1 Den: | STD |
| | Liquid 2 Visc: | NBS81 | Liquid 2 ThC: | NBS81 | Liquid 2 Den: | STD |

**Flowrates**

| Component Name | Total lbmol/hr | Vapor lbmol/hr | Liquid 1 lbmol/hr | Liquid 2 lbmol/hr | Total mole % | K-Value |
|---|---|---|---|---|---|---|
| 46 : NITROGEN | 0.00178 | 0 | 0.00178 | 0 | 0.001963 | |
| 49 : CARBON DIOXIDE | 0.008345 | 0 | 0.008345 | 0 | 0.009201 | |
| 2 : METHANE | 0.195565 | 0 | 0.195565 | 0 | 0.215616 | |
| 3 : ETHANE | 0.654385 | 0 | 0.654385 | 0 | 0.721478 | |
| 4 : PROPANE | 1.83271 | 0 | 1.83271 | 0 | 2.02062 | |
| 5 : ISOBUTANE | 1.17632 | 0 | 1.17632 | 0 | 1.29692 | |
| 6 : N-BUTANE | 3.09598 | 0 | 3.09598 | 0 | 3.4134 | |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 | |
| 7 : ISOPENTANE | 3.25343 | 0 | 3.25343 | 0 | 3.587 | |
| 8 : N-PENTANE | 3.7896 | 0 | 3.7896 | 0 | 4.17814 | |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 | |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 | |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 | |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 | |
| 10 : N-HEXANE | 6.96406 | 0 | 6.96406 | 0 | 7.67807 | |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 | |
| 40 : BENZENE | 0.275861 | 0 | 0.275861 | 0 | 0.304144 | |
| 38 : CYCLOHEXANE | 0.741317 | 0 | 0.741317 | 0 | 0.817323 | |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 | |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 | |
| 11 : N-HEPTANE | 9.6174 | 0 | 9.6174 | 0 | 10.6035 | |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 | |
| 41 : TOLUENE | 2.03998 | 0 | 2.03998 | 0 | 2.24913 | |
| 12 : N-OCTANE | 8.35658 | 0 | 8.35658 | 0 | 9.21336 | |
| 45 : ETHYL BENZENE | 0.633532 | 0 | 0.633532 | 0 | 0.698487 | |
| 43 : M-XYLENE | 3.58253 | 0 | 3.58253 | 0 | 3.94984 | |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 | |
| 13 : N-NONANE | 5.94613 | 0 | 5.94613 | 0 | 6.55577 | |
| 14 : N-DECANE | 38.5351 | 0 | 38.5351 | 0 | 42.4861 | |
| 62 : WATER | 0 | 0 | 0 | 0 | 0 | |
| Total | 90.7006 | 0 | 90.7006 | 0 | 100 | |

**Flowrates**

| Component Name | Total lb/hr | Vapor lb/hr | Liquid 1 lb/hr | Liquid 2 lb/hr | Total mass % |
|---|---|---|---|---|---|
| 46 : NITROGEN | 0.049864 | 0 | 0.049864 | 0 | 0.000482 |
| 49 : CARBON DIOXIDE | 0.367266 | 0 | 0.367266 | 0 | 0.003551 |
| 2 : METHANE | 3.13744 | 0 | 3.13744 | 0 | 0.030333 |
| 3 : ETHANE | 19.6761 | 0 | 19.6761 | 0 | 0.190228 |
| 4 : PROPANE | 80.8116 | 0 | 80.8116 | 0 | 0.781284 |
| 5 : ISOBUTANE | 68.3676 | 0 | 68.3676 | 0 | 0.660977 |
| 6 : N-BUTANE | 179.938 | 0 | 179.938 | 0 | 1.73964 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 |
| 7 : ISOPENTANE | 234.722 | 0 | 234.722 | 0 | 2.26929 |
| 8 : N-PENTANE | 273.404 | 0 | 273.404 | 0 | 2.64327 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 10 : N-HEXANE | 600.107 | 0 | 600.107 | 0 | 5.80182 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 |
| 40 : BENZENE | 21.5469 | 0 | 21.5469 | 0 | 0.208315 |
| 38 : CYCLOHEXANE | 62.3863 | 0 | 62.3863 | 0 | 0.603149 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 11 : N-HEPTANE | 963.644 | 0 | 963.644 | 0 | 9.31649 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 |
| 41 : TOLUENE | 187.951 | 0 | 187.951 | 0 | 1.81711 |
| 12 : N-OCTANE | 954.521 | 0 | 954.521 | 0 | 9.22829 |
| 45 : ETHYL BENZENE | 67.2558 | 0 | 67.2558 | 0 | 0.650227 |
| 43 : M-XYLENE | 380.322 | 0 | 380.322 | 0 | 3.67694 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 |
| 13 : N-NONANE | 762.591 | 0 | 762.591 | 0 | 7.37271 |
| 14 : N-DECANE | 5482.63 | 0 | 5482.63 | 0 | 53.0059 |
| 62 : WATER | 0 | 0 | 0 | 0 | 0 |
| Total | 10343.4 | 0 | 10343.4 | 0 | 100 |



EFSCOP00009372

**Flowrates**

| Component Name | Total ft3/hr | Vapor ft3/hr | Liquid 1 ft3/hr | Liquid 2 ft3/hr | Total volume % |
|---|---|---|---|---|---|
| 46 : NITROGEN | 0.004589 | 0 | 0.004589 | 0 | 0.001963 |
| 49 : CARBON DIOXIDE | 0.021514 | 0 | 0.021514 | 0 | 0.009201 |
| 2 : METHANE | 0.504173 | 0 | 0.504173 | 0 | 0.215616 |
| 3 : ETHANE | 1.68703 | 0 | 1.68703 | 0 | 0.721478 |
| 4 : PROPANE | 4.72479 | 0 | 4.72479 | 0 | 2.02062 |
| 5 : ISOBUTANE | 3.03259 | 0 | 3.03259 | 0 | 1.29692 |
| 6 : N-BUTANE | 7.98154 | 0 | 7.98154 | 0 | 3.4134 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 |
| 7 : ISOPENTANE | 8.38745 | 0 | 8.38745 | 0 | 3.587 |
| 8 : N-PENTANE | 9.76972 | 0 | 9.76972 | 0 | 4.17814 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 10 : N-HEXANE | 17.9536 | 0 | 17.9536 | 0 | 7.67807 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 |
| 40 : BENZENE | 0.711179 | 0 | 0.711179 | 0 | 0.304144 |
| 38 : CYCLOHEXANE | 1.91114 | 0 | 1.91114 | 0 | 0.817323 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 11 : N-HEPTANE | 24.794 | 0 | 24.794 | 0 | 10.6035 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 |
| 41 : TOLUENE | 5.25913 | 0 | 5.25913 | 0 | 2.24913 |
| 12 : N-OCTANE | 21.5435 | 0 | 21.5435 | 0 | 9.21336 |
| 45 : ETHYL BENZENE | 1.63327 | 0 | 1.63327 | 0 | 0.698487 |
| 43 : M-XYLENE | 9.2359 | 0 | 9.2359 | 0 | 3.94984 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 |
| 13 : N-NONANE | 15.3293 | 0 | 15.3293 | 0 | 6.55577 |
| 14 : N-DECANE | 99.3449 | 0 | 99.3449 | 0 | 42.4861 |
| 62 : WATER | 0 | 0 | 0 | 0 | 0 |
| Total | 233.829 | 0 | 233.829 | 0 | 100 |

**Flowrates**

| Component Name | Total SCF/hr | Vapor SCF/hr | Liquid 1 SCF/hr | Liquid 2 SCF/hr | Total std vol % |
|---|---|---|---|---|---|
| 46 : NITROGEN | 0.000991 | 0 | 0.000991 | 0 | 0.000427 |
| 49 : CARBON DIOXIDE | 0.007164 | 0 | 0.007164 | 0 | 0.003086 |
| 2 : METHANE | 0.167766 | 0 | 0.167766 | 0 | 0.072265 |
| 3 : ETHANE | 0.885196 | 0 | 0.885196 | 0 | 0.381297 |
| 4 : PROPANE | 2.55386 | 0 | 2.55386 | 0 | 1.10007 |
| 5 : ISOBUTANE | 1.94739 | 0 | 1.94739 | 0 | 0.838838 |
| 6 : N-BUTANE | 4.93997 | 0 | 4.93997 | 0 | 2.12789 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 |
| 7 : ISOPENTANE | 6.02582 | 0 | 6.02582 | 0 | 2.59562 |
| 8 : N-PENTANE | 6.94644 | 0 | 6.94644 | 0 | 2.99217 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 10 : N-HEXANE | 14.4913 | 0 | 14.4913 | 0 | 6.24212 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 |
| 40 : BENZENE | 0.390604 | 0 | 0.390604 | 0 | 0.168252 |
| 38 : CYCLOHEXANE | 1.2768 | 0 | 1.2768 | 0 | 0.54998 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 11 : N-HEPTANE | 22.4528 | 0 | 22.4528 | 0 | 9.6715 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 |
| 41 : TOLUENE | 3.45681 | 0 | 3.45681 | 0 | 1.48902 |
| 12 : N-OCTANE | 21.6496 | 0 | 21.6496 | 0 | 9.32555 |
| 45 : ETHYL BENZENE | 1.23717 | 0 | 1.23717 | 0 | 0.532908 |
| 43 : M-XYLENE | 7.01946 | 0 | 7.01946 | 0 | 3.02362 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 |
| 13 : N-NONANE | 16.9397 | 0 | 16.9397 | 0 | 7.29677 |
| 14 : N-DECANE | 119.765 | 0 | 119.765 | 0 | 51.5886 |
| 62 : WATER | 0 | 0 | 0 | 0 | 0 |
| Total | 232.154 | 0 | 232.154 | 0 | 100 |



EFSCOP00009373

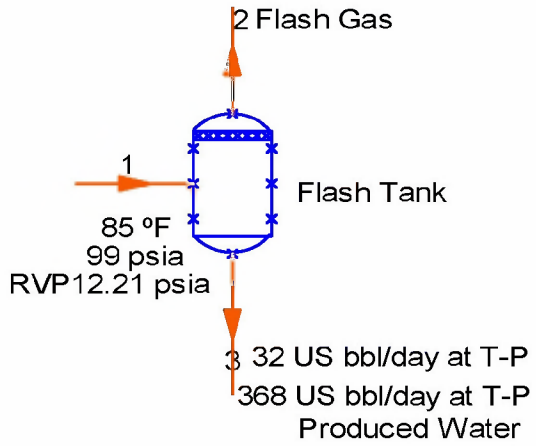
**Properties**

| | | | |
|---|---|---|---|
| **Temperature** | F | 70 | |
| **Pressure** | psia | 14.7 | |
| **Enthalpy** | Btu/hr | -1442720 | |
| **Entropy** | Btu/hr/R | -1594.673 | |
| **Vapor Fraction** | | 0 | |
| | | Total | Liquid 1 |
| **Flowrate** | lbmol/hr | 90.7006 | 90.7006 |
| **Flowrate** | lb/hr | 10343.4265 | 10343.4265 |
| **Mole Fraction** | | 1 | 1 |
| **Mass Fraction** | | 1 | 1 |
| **Molecular Weight** | | 114.0392 | 114.0392 |
| **Enthalpy** | Btu/lbmol | -15906.3873 | -15906.3873 |
| **Enthalpy** | Btu/lb | -139.4818 | -139.4818 |
| **Entropy** | Btu/lbmol/R | -17.5817 | -17.5817 |
| **Entropy** | Btu/lb/R | -0.154173 | -0.154173 |
| **Cp** | Btu/lbmol/R | | 56.3093 |
| **Cp** | Btu/lb/R | | 0.4938 |
| **Cv** | Btu/lbmol/R | | 49.417 |
| **Cv** | Btu/lb/R | | 0.4333 |
| **Cp/Cv** | | | 1.1395 |
| **Density** | lb/ft3 | | 44.2349 |
| **Z-Factor** | | | 0.006668 |
| **Flowrate (T-P)** | gal/min | | 29.1546 |
| **Flowrate (STP)** | gal/min | | 28.9438 |
| **Specific Gravity** | GPA STP | | 0.714392 |
| **Viscosity** | cP | | 0.508786 |
| **Thermal Conductivity** | Btu/hr/ft/R | | 0.066204 |
| **Surface Tension** | dyne/cm | | 21.2054 |
| **Reid Vapor Pressure (ASTM-A** | psia | | 10.32 |
| **True Vapor Pressure at 100 F** | psia | | 19.21 |
| **Critical Temperature (Cubic El** | F | 592.8504 | |
| **Critical Pressure (Cubic EOS)** | psia | 435.6987 | |
| **Dew Point Temperature** | F | 303.3816 | |
| **Bubble Point Temperature** | F | 69.9717 | |
| **Water Dew Point Temperature could not be calculated** | | | |
| **Stream Vapor Pressure** | psia | 14.7 | |
| **Latent Heat of Vaporization (N** | Btu/lb | 130.8233 | |
| **Latent Heat of Vaporization (P** | Btu/lb | 257.0382 | |
| **CO2 Freeze Up** | | No | |
| **Heating Value (gross)** | Btu/SCF | 6193.92 | |
| **Heating Value (net)** | Btu/SCF | 5754.52 | |
| **Wobbe Number** | Btu/SCF | 2942.78 | |
| **Average Hydrogen Atoms** | | 17.4655 | |
| **Average Carbon Atoms** | | 8.0292 | |
| **Hydrogen to Carbon Ratio** | | 2.1753 | |

# DESIGN II for Windows

## Simulation Result: SOLUTION REACHED

**Problem:**
**Project:**
**Task:**
**By:**
**At:** 26-Apr-12 11:37 AM



# Details for Stream 1

## Stream 1 (Strm 1)

| Thermodynamic Methods | K-Value: | PENG-ROB | Enthalpy: | PENG-ROB | Density: | STD |
|---|---|---|---|---|---|---|
| | Liquid 1 Visc: | NBS81 | Liquid 1 ThC: | NBS81 | Liquid 1 Den: | STD |
| | Liquid 2 Visc: | STEAM | Liquid 2 ThC: | STEAM | Liquid 2 Den: | STD |

Flowrates

| Component Name | Total lbmol/hr | Vapor lbmol/hr | Liquid 1 lbmol/hr | Liquid 2 lbmol/hr | Total mole % | K-Value |
|---|---|---|---|---|---|---|
| 46 : NITROGEN | 0.001264 | 0 | 0.000806 | 0.000458 | 0.00042 | 77.2329 |
| 49 : CARBON DIOXIDE | 0.000933 | 0 | 0.000192 | 0.000741 | 0.00031 | 10.4005 |
| 2 : METHANE | 0.056896 | 0 | 0.039427 | 0.017469 | 0.01891 | 31.0343 |
| 3 : ETHANE | 0.046817 | 0 | 0.043361 | 0.003455 | 0.01556 | 5.35432 |
| 4 : PROPANE | 0.077145 | 0 | 0.07522 | 0.001926 | 0.02564 | 1.5099 |
| 5 : ISOBUTANE | 0.042153 | 0 | 0.042008 | 0.000145 | 0.01401 | 0.62562 |
| 6 : N-BUTANE | 0.107625 | 0 | 0.107347 | 0.000277 | 0.03577 | 0.467003 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 | 0.288569 |
| 7 : ISOPENTANE | 0.106933 | 0 | 0.106829 | 0.000104 | 0.03554 | 0.175812 |
| 8 : N-PENTANE | 0.123692 | 0 | 0.123597 | 0.00009494 | 0.04111 | 0.138831 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 | 0.07402 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 | 0.054839 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 | 0.049715 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 | 0.044482 |
| 10 : N-HEXANE | 0.223403 | 0 | 0.223348 | 0.00005464 | 0.07425 | 0.044214 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 | 0.032828 |
| 40 : BENZENE | 0.008846 | 0 | 0.008844 | 0.000001985 | 0.00294 | 0.040563 |
| 38 : CYCLOHEXANE | 0.023739 | 0 | 0.023735 | 0.000004376 | 0.00789 | 0.033323 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 | 0.014751 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 | 0.014682 |
| 11 : N-HEPTANE | 0.306957 | 0 | 0.306932 | 0.00002475 | 0.10202 | 0.014571 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 | 0.011357 |
| 41 : TOLUENE | 0.06508 | 0 | 0.065076 | 0.000004071 | 0.02163 | 0.011305 |
| 12 : N-OCTANE | 0.266308 | 0 | 0.266301 | 0.000007185 | 0.08851 | 0.004876 |
| 45 : ETHYL BENZENE | 0.020189 | 0 | 0.020188 | 0.00000051 | 0.00671 | 0.004566 |
| 43 : M-XYLENE | 0.114154 | 0 | 0.114151 | 0.000002426 | 0.03794 | 0.003841 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 | 0.001809 |
| 13 : N-NONANE | 0.189404 | 0 | 0.189402 | 0.000001756 | 0.06295 | 0.001676 |
| 14 : N-DECANE | 1.22729 | 0 | 1.22728 | 0.000003859 | 0.4079 | 0.000568 |
| 62 : WATER | 297.871 | 0 | 0.002838 | 297.868 | 99 | 6.53841 |
| Total | 300.879 | 0 | 2.98689 | 297.893 | 100 | |

Flowrates

| Component Name | Total lb/hr | Vapor lb/hr | Liquid 1 lb/hr | Liquid 2 lb/hr | Total mass % |
|---|---|---|---|---|---|
| 46 : NITROGEN | 0.0354 | 0 | 0.022568 | 0.012832 | 0.000621 |
| 49 : CARBON DIOXIDE | 0.041048 | 0 | 0.00844 | 0.032609 | 0.00072 |
| 2 : METHANE | 0.912786 | 0 | 0.632525 | 0.280261 | 0.016015 |
| 3 : ETHANE | 1.40769 | 0 | 1.30379 | 0.103898 | 0.024698 |
| 4 : PROPANE | 3.40165 | 0 | 3.31674 | 0.084916 | 0.059682 |
| 5 : ISOBUTANE | 2.44994 | 0 | 2.44149 | 0.008451 | 0.042984 |
| 6 : N-BUTANE | 6.25514 | 0 | 6.23902 | 0.016121 | 0.109746 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 |
| 7 : ISOPENTANE | 7.71476 | 0 | 7.70726 | 0.007497 | 0.135355 |
| 8 : N-PENTANE | 8.92385 | 0 | 8.917 | 0.00685 | 0.156568 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 10 : N-HEXANE | 19.2511 | 0 | 19.2464 | 0.004708 | 0.337758 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 |
| 40 : BENZENE | 0.690932 | 0 | 0.690777 | 0.000155 | 0.012122 |
| 38 : CYCLOHEXANE | 1.99781 | 0 | 1.99744 | 0.000368 | 0.035051 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 11 : N-HEPTANE | 30.7565 | 0 | 30.754 | 0.002479 | 0.53962 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 |
| 41 : TOLUENE | 5.9961 | 0 | 5.99573 | 0.000375 | 0.105201 |
| 12 : N-OCTANE | 30.4188 | 0 | 30.418 | 0.000821 | 0.533695 |
| 45 : ETHYL BENZENE | 2.14327 | 0 | 2.14321 | 0.00005414 | 0.037603 |
| 43 : M-XYLENE | 12.1186 | 0 | 12.1183 | 0.000258 | 0.212619 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 |
| 13 : N-NONANE | 24.291 | 0 | 24.2908 | 0.000225 | 0.426183 |
| 14 : N-DECANE | 174.613 | 0 | 174.613 | 0.000549 | 3.06358 |
| 62 : WATER | 5366.24 | 0 | 0.051125 | 5366.19 | 94.1502 |
| Total | 5699.66 | 0 | 332.908 | 5366.75 | 100 |



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## Flowrates

| Component Name | Total ft3/hr | Vapor ft3/hr | Liquid 1 ft3/hr | Liquid 2 ft3/hr | Total volume % |
|---|---|---|---|---|---|
| **46 : NITROGEN** | 0.002196 | 0 | 0.002063 | 0.000133 | 0.002337 |
| **49 : CARBON DIOXIDE** | 0.000706 | 0 | 0.000491 | 0.000215 | 0.000751 |
| **2 : METHANE** | 0.106029 | 0 | 0.100968 | 0.005061 | 0.112853 |
| **3 : ETHANE** | 0.112045 | 0 | 0.111044 | 0.001001 | 0.119256 |
| **4 : PROPANE** | 0.193187 | 0 | 0.192629 | 0.000558 | 0.20562 |
| **5 : ISOBUTANE** | 0.107619 | 0 | 0.107577 | 0.00004213 | 0.114546 |
| **6 : N-BUTANE** | 0.274985 | 0 | 0.274904 | 0.00008036 | 0.292682 |
| **9 : 2,2-DIMETHYLPROP** | 0 | 0 | 0 | 0 | 0 |
| **7 : ISOPENTANE** | 0.273606 | 0 | 0.273576 | 0.00003011 | 0.291215 |
| **8 : N-PENTANE** | 0.316545 | 0 | 0.316517 | 0.00002751 | 0.336917 |
| **54 : 2,2-DIMETHYLBUTA** | 0 | 0 | 0 | 0 | 0 |
| **55 : 2,3-DIMETHYLBUTA** | 0 | 0 | 0 | 0 | 0 |
| **52 : 2-METHYLPENTANE** | 0 | 0 | 0 | 0 | 0 |
| **53 : 3-METHYLPENTANE** | 0 | 0 | 0 | 0 | 0 |
| **10 : N-HEXANE** | 0.571986 | 0 | 0.57197 | 0.00001583 | 0.608798 |
| **37 : METHYLCYCLOPENTA** | 0 | 0 | 0 | 0 | 0 |
| **40 : BENZENE** | 0.022649 | 0 | 0.022648 | 5.751E-07 | 0.024106 |
| **38 : CYCLOHEXANE** | 0.060784 | 0 | 0.060783 | 0.000001268 | 0.064696 |
| **79 : 2-METHYLHEXANE** | 0 | 0 | 0 | 0 | 0 |
| **80 : 3-METHYLHEXANE** | 0 | 0 | 0 | 0 | 0 |
| **11 : N-HEPTANE** | 0.786027 | 0 | 0.78602 | 0.000007169 | 0.836614 |
| **39 : METHYLCYCLOHEXAN** | 0 | 0 | 0 | 0 | 0 |
| **41 : TOLUENE** | 0.166654 | 0 | 0.166653 | 0.000001179 | 0.17738 |
| **12 : N-OCTANE** | 0.68197 | 0 | 0.681968 | 0.000002082 | 0.72586 |
| **45 : ETHYL BENZENE** | 0.051701 | 0 | 0.051701 | 1.478E-07 | 0.055028 |
| **43 : M-XYLENE** | 0.292329 | 0 | 0.292329 | 7.029E-07 | 0.311143 |
| **42 : O-XYLENE** | 0 | 0 | 0 | 0 | 0 |
| **13 : N-NONANE** | 0.485038 | 0 | 0.485037 | 5.088E-07 | 0.516254 |
| **14 : N-DECANE** | 3.14294 | 0 | 3.14294 | 0.000001118 | 3.34521 |
| **62 : WATER** | 86.3043 | 0 | 0.007268 | 86.2971 | 91.8587 |
| **Total** | 93.9533 | 0 | 7.64908 | 86.3042 | 100 |

## Flowrates

| Component Name | Total SCF/hr | Vapor SCF/hr | Liquid 1 SCF/hr | Liquid 2 SCF/hr | Total std vol % |
|---|---|---|---|---|---|
| **46 : NITROGEN** | 0.000703 | 0 | 0.000448 | 0.000255 | 0.000752 |
| **49 : CARBON DIOXIDE** | 0.000801 | 0 | 0.000165 | 0.000636 | 0.000856 |
| **2 : METHANE** | 0.048809 | 0 | 0.033823 | 0.014986 | 0.052159 |
| **3 : ETHANE** | 0.06333 | 0 | 0.058656 | 0.004674 | 0.067677 |
| **4 : PROPANE** | 0.107501 | 0 | 0.104818 | 0.002684 | 0.114881 |
| **5 : ISOBUTANE** | 0.069785 | 0 | 0.069544 | 0.000241 | 0.074575 |
| **6 : N-BUTANE** | 0.171727 | 0 | 0.171284 | 0.000443 | 0.183515 |
| **9 : 2,2-DIMETHYLPROP** | 0 | 0 | 0 | 0 | 0 |
| **7 : ISOPENTANE** | 0.198054 | 0 | 0.197862 | 0.000192 | 0.21165 |
| **8 : N-PENTANE** | 0.22673 | 0 | 0.226556 | 0.000174 | 0.242294 |
| **54 : 2,2-DIMETHYLBUTA** | 0 | 0 | 0 | 0 | 0 |
| **55 : 2,3-DIMETHYLBUTA** | 0 | 0 | 0 | 0 | 0 |
| **52 : 2-METHYLPENTANE** | 0 | 0 | 0 | 0 | 0 |
| **53 : 3-METHYLPENTANE** | 0 | 0 | 0 | 0 | 0 |
| **10 : N-HEXANE** | 0.464873 | 0 | 0.464759 | 0.000114 | 0.496784 |
| **37 : METHYLCYCLOPENTA** | 0 | 0 | 0 | 0 | 0 |
| **40 : BENZENE** | 0.012525 | 0 | 0.012522 | 0.000002811 | 0.013385 |
| **38 : CYCLOHEXANE** | 0.040887 | 0 | 0.04088 | 0.000007537 | 0.043694 |
| **79 : 2-METHYLHEXANE** | 0 | 0 | 0 | 0 | 0 |
| **80 : 3-METHYLHEXANE** | 0 | 0 | 0 | 0 | 0 |
| **11 : N-HEPTANE** | 0.716621 | 0 | 0.716564 | 0.00005777 | 0.765814 |
| **39 : METHYLCYCLOHEXAN** | 0 | 0 | 0 | 0 | 0 |
| **41 : TOLUENE** | 0.110281 | 0 | 0.110274 | 0.000006898 | 0.117851 |
| **12 : N-OCTANE** | 0.689933 | 0 | 0.689914 | 0.00001861 | 0.737294 |
| **45 : ETHYL BENZENE** | 0.039425 | 0 | 0.039424 | 0.000000996 | 0.042132 |
| **43 : M-XYLENE** | 0.223668 | 0 | 0.223663 | 0.000004754 | 0.239021 |
| **42 : O-XYLENE** | 0 | 0 | 0 | 0 | 0 |
| **13 : N-NONANE** | 0.539585 | 0 | 0.53958 | 0.000005003 | 0.576626 |
| **14 : N-DECANE** | 3.81433 | 0 | 3.81432 | 0.00001199 | 4.07617 |
| **62 : WATER** | 86.0368 | 0 | 0.00082 | 86.036 | 91.9429 |
| **Total** | 93.5764 | 0 | 7.51588 | 86.0605 | 100 |



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## Properties

| | | |
|---|---|---|
| **Temperature** | F | 85 |
| **Pressure** | psia | 98.696 |
| **Enthalpy** | Btu/hr | -5527596 |
| **Entropy** | Btu/hr/R | -8800.654 |
| **Vapor Fraction** | | 0 |

| | | Total | Liquid 1 | Liquid 2 |
|---|---|---|---|---|
| **Flowrate** | lbmol/hr | 300.8794 | 2.9869 | 297.8925 |
| **Flowrate** | lb/hr | 5699.6603 | 332.9075 | 5366.7528 |
| **Mole Fraction** | | 1 | 0.009927 | 0.990073 |
| **Mass Fraction** | | 1 | 0.058408 | 0.941592 |
| **Molecular Weight** | | 18.9433 | 111.4564 | 18.0157 |
| **Enthalpy** | Btu/lbmol | -18371.4665 | -14686.1287 | -18408.4183 |
| **Enthalpy** | Btu/lb | -969.8115 | -131.7657 | -1021.7968 |
| **Entropy** | Btu/lbmol/R | -29.2498 | -15.6913 | -29.3857 |
| **Entropy** | Btu/lb/R | -1.5441 | -0.140784 | -1.6311 |
| **Cp** | Btu/lbmol/R | | 56.3001 | 17.9928 |
| **Cp** | Btu/lb/R | | 0.5051 | 0.9987 |
| **Cv** | Btu/lbmol/R | | 49.2898 | 17.7287 |
| **Cv** | Btu/lb/R | | 0.4422 | 0.9841 |
| **Cp/Cv** | | | 1.1422 | 1.0149 |
| **Density** | lb/ft3 | | 43.5225 | 62.1841 |
| **Z-Factor** | | | 0.043247 | 0.004893 |
| **Flowrate (T-P)** | gal/min | | 0.953713 | 10.7607 |
| **Flowrate (STP)** | gal/min | | 0.937044 | 10.7296 |
| **Specific Gravity** | GPA STP | | 0.710218 | 0.999898 |
| **Viscosity** | cP | | 0.530284 | 0.807243 |
| **Thermal Conductivity** | Btu/hr/ft/R | | 0.067872 | 0.355244 |
| **Surface Tension** | dyne/cm | | 19.7153 | 71.2853 |
| **Reid Vapor Pressure (ASTM-/** | psia | | 12.21 | |
| **True Vapor Pressure at 100 F** | psia | | 63.32 | |
| **Critical Temperature (Cubic E** | F | 695.0113 | | |
| **Critical Pressure (Cubic EOS)** | psia | 3241.3892 | | |
| **Dew Point Temperature** | F | 322.9446 | | |
| **Bubble Point Temperature** | F | 176.6579 | | |
| **Water Dew Point** | F | 325.7686 | | |
| **Liquid 2 Freezing Point** | F | 31.9059 | | |
| **Stream Vapor Pressure** | psia | 57.8837 | | |
| **Latent Heat of Vaporization (N** | Btu/lb | 857.4962 | | |
| **Latent Heat of Vaporization (F** | Btu/lb | 1091.332 | | |
| **CO2 Freeze Up** | | No | | |
| **Heating Value (gross)** | Btu/SCF | 60.23 | | |
| **Heating Value (net)** | Btu/SCF | 55.94 | | |
| **Wobbe Number** | Btu/SCF | 73.86 | | |
| **Average Hydrogen Atoms** | | 2.1502 | | |
| **Average Carbon Atoms** | | 0.078 | | |
| **Hydrogen to Carbon Ratio** | | 27.5793 | | |



EFSCOP00009378

# Details for Stream 2

## Stream 2 (Flash Gas)

| Thermodynamic Methods | K-Value: | PENG-ROB | Enthalpy: | PENG-ROB | Density: | STD |
|---|---|---|---|---|---|---|
| | Vapor Visc: | NBS81 | Vapor ThC: | NBS81 | Vapor Den: | STD |

Flowrates

| Component Name | Total lbmol/hr | Vapor lbmol/hr | Incipient Liquid 1 mol fra | Liquid 2 lbmol/hr | Total mole % | K-Value |
|---|---|---|---|---|---|---|
| 46 : NITROGEN | 0.001171 | 0.001171 | 0.00001941 | 0 | 0.992392 | 511.204 |
| 49 : CARBON DIOXIDE | 0.000298 | 0.000298 | 0.00004187 | 0 | 0.252196 | 60.2301 |
| 2 : METHANE | 0.048035 | 0.048035 | 0.002084 | 0 | 40.7068 | 195.312 |
| 3 : ETHANE | 0.024849 | 0.024849 | 0.007037 | 0 | 21.0585 | 29.9241 |
| 4 : PROPANE | 0.01814 | 0.01814 | 0.0199 | 0 | 15.3723 | 7.72488 |
| 5 : ISOBUTANE | 0.004601 | 0.004601 | 0.012967 | 0 | 3.89922 | 3.00705 |
| 6 : N-BUTANE | 0.008854 | 0.008854 | 0.034129 | 0 | 7.50367 | 2.1986 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 | 1.48838 |
| 7 : ISOPENTANE | 0.003259 | 0.003259 | 0.035867 | 0 | 2.76176 | 0.769993 |
| 8 : N-PENTANE | 0.002949 | 0.002949 | 0.041779 | 0 | 2.49891 | 0.59813 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 | 0.360909 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 | 0.263381 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 | 0.236664 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 | 0.210746 |
| 10 : N-HEXANE | 0.001592 | 0.001592 | 0.076777 | 0 | 1.34915 | 0.175723 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 | 0.154099 |
| 40 : BENZENE | 0.0000595 | 0.0000595 | 0.003041 | 0 | 0.050423 | 0.165793 |
| 38 : CYCLOHEXANE | 0.000129 | 0.000129 | 0.008173 | 0 | 0.108973 | 0.133334 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 | 0.065693 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 | 0.066054 |
| 11 : N-HEPTANE | 0.000665 | 0.000665 | 0.106031 | 0 | 0.563539 | 0.053149 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 | 0.051298 |
| 41 : TOLUENE | 0.000112 | 0.000112 | 0.022491 | 0 | 0.095031 | 0.042254 |
| 12 : N-OCTANE | 0.000178 | 0.000178 | 0.09213 | 0 | 0.151163 | 0.016407 |
| 45 : ETHYL BENZENE | 0.00001305 | 0.00001305 | 0.006985 | 0 | 0.011062 | 0.015838 |
| 43 : M-XYLENE | 0.00006176 | 0.00006176 | 0.039497 | 0 | 0.052339 | 0.013251 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 | 0.007514 |
| 13 : N-NONANE | 0.00004019 | 0.00004019 | 0.065556 | 0 | 0.034056 | 0.005195 |
| 14 : N-DECANE | 0.0000812 | 0.0000812 | 0.424846 | 0 | 0.06881 | 0.00162 |
| 62 : WATER | 0.002914 | 0.002914 | 0.000649 | 0 | 2.4697 | 38.0765 |
| Total | 0.118002 | 0.118002 | 1 | 0 | 100 | |

Flowrates

| Component Name | Total lb/hr | Vapor lb/hr | Incipient Liquid 1 mass fra | Liquid 2 lb/hr | Total mass % |
|---|---|---|---|---|---|
| 46 : NITROGEN | 0.032805 | 0.032805 | 0.000005 | 0 | 0.836733 |
| 49 : CARBON DIOXIDE | 0.013097 | 0.013097 | 0.000016 | 0 | 0.334053 |
| 2 : METHANE | 0.770619 | 0.770619 | 0.000293 | 0 | 19.6557 |
| 3 : ETHANE | 0.747171 | 0.747171 | 0.001856 | 0 | 19.0577 |
| 4 : PROPANE | 0.799846 | 0.799846 | 0.007695 | 0 | 20.4012 |
| 5 : ISOBUTANE | 0.267419 | 0.267419 | 0.006609 | 0 | 6.82089 |
| 6 : N-BUTANE | 0.514621 | 0.514621 | 0.0174 | 0 | 13.1261 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 |
| 7 : ISOPENTANE | 0.235118 | 0.235118 | 0.02269 | 0 | 5.99702 |
| 8 : N-PENTANE | 0.212741 | 0.212741 | 0.02643 | 0 | 5.42626 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 10 : N-HEXANE | 0.137188 | 0.137188 | 0.05802 | 0 | 3.49916 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 |
| 40 : BENZENE | 0.004647 | 0.004647 | 0.002083 | 0 | 0.118539 |
| 38 : CYCLOHEXANE | 0.010822 | 0.010822 | 0.006032 | 0 | 0.27602 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 11 : N-HEPTANE | 0.06663 | 0.06663 | 0.0932 | 0 | 1.6995 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 |
| 41 : TOLUENE | 0.010332 | 0.010332 | 0.01817 | 0 | 0.263526 |
| 12 : N-OCTANE | 0.020375 | 0.020375 | 0.0923 | 0 | 0.519684 |
| 45 : ETHYL BENZENE | 0.001386 | 0.001386 | 0.006503 | 0 | 0.035346 |
| 43 : M-XYLENE | 0.006557 | 0.006557 | 0.03677 | 0 | 0.167235 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 |
| 13 : N-NONANE | 0.005154 | 0.005154 | 0.07373 | 0 | 0.131458 |
| 14 : N-DECANE | 0.011552 | 0.011552 | 0.5301 | 0 | 0.294659 |
| 62 : WATER | 0.052502 | 0.052502 | 0.000102 | 0 | 1.33913 |
| Total | 3.92058 | 3.92058 | 1 | 0 | 100 |
| | Total VOC | 2.35689 | | | |

Flowrates

| Component Name | Total ft3/hr | Vapor ft3/hr | Liquid 1 ft3/hr | Liquid 2 ft3/hr | Total volume % |
|---|---|---|---|---|---|
| 46 : NITROGEN | 0.448928 | 0.448928 | 0 | 0 | 0.992392 |
| 49 : CARBON DIOXIDE | 0.114086 | 0.114086 | 0 | 0 | 0.252196 |
| 2 : METHANE | 18.4145 | 18.4145 | 0 | 0 | 40.7068 |
| 3 : ETHANE | 9.52622 | 9.52622 | 0 | 0 | 21.0585 |
| 4 : PROPANE | 6.95396 | 6.95396 | 0 | 0 | 15.3723 |
| 5 : ISOBUTANE | 1.76389 | 1.76389 | 0 | 0 | 3.89922 |
| 6 : N-BUTANE | 3.39443 | 3.39443 | 0 | 0 | 7.50367 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 |
| 7 : ISOPENTANE | 1.24933 | 1.24933 | 0 | 0 | 2.76176 |
| 8 : N-PENTANE | 1.13043 | 1.13043 | 0 | 0 | 2.49891 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 10 : N-HEXANE | 0.610315 | 0.610315 | 0 | 0 | 1.34915 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 |
| 40 : BENZENE | 0.02281 | 0.02281 | 0 | 0 | 0.050423 |
| 38 : CYCLOHEXANE | 0.049296 | 0.049296 | 0 | 0 | 0.108973 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 11 : N-HEPTANE | 0.254928 | 0.254928 | 0 | 0 | 0.563539 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 |
| 41 : TOLUENE | 0.042989 | 0.042989 | 0 | 0 | 0.095031 |
| 12 : N-OCTANE | 0.068381 | 0.068381 | 0 | 0 | 0.151163 |
| 45 : ETHYL BENZENE | 0.005004 | 0.005004 | 0 | 0 | 0.011062 |
| 43 : M-XYLENE | 0.023677 | 0.023677 | 0 | 0 | 0.052339 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 |
| 13 : N-NONANE | 0.015406 | 0.015406 | 0 | 0 | 0.034056 |
| 14 : N-DECANE | 0.031127 | 0.031127 | 0 | 0 | 0.06881 |
| 62 : WATER | 1.11722 | 1.11722 | 0 | 0 | 2.4697 |
| Total | 45.2369 | 45.2369 | 0 | 0 | 100 |

Flowrates

| Component Name | Total SCF/hr | Vapor SCF/hr | Liquid 1 SCF/hr | Liquid 2 SCF/hr | Total std vol % |
|---|---|---|---|---|---|
| 46 : NITROGEN | 0.444389 | 0.444389 | 0 | 0 | 0.992392 |
| 49 : CARBON DIOXIDE | 0.112933 | 0.112933 | 0 | 0 | 0.252196 |
| 2 : METHANE | 18.2283 | 18.2283 | 0 | 0 | 40.7068 |
| 3 : ETHANE | 9.42992 | 9.42992 | 0 | 0 | 21.0585 |
| 4 : PROPANE | 6.88366 | 6.88366 | 0 | 0 | 15.3723 |
| 5 : ISOBUTANE | 1.74606 | 1.74606 | 0 | 0 | 3.89922 |
| 6 : N-BUTANE | 3.36012 | 3.36012 | 0 | 0 | 7.50367 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 |
| 7 : ISOPENTANE | 1.2367 | 1.2367 | 0 | 0 | 2.76176 |
| 8 : N-PENTANE | 1.119 | 1.119 | 0 | 0 | 2.49891 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 10 : N-HEXANE | 0.604145 | 0.604145 | 0 | 0 | 1.34915 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 |
| 40 : BENZENE | 0.022579 | 0.022579 | 0 | 0 | 0.050423 |
| 38 : CYCLOHEXANE | 0.048798 | 0.048798 | 0 | 0 | 0.108973 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 11 : N-HEPTANE | 0.252351 | 0.252351 | 0 | 0 | 0.563539 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 |
| 41 : TOLUENE | 0.042555 | 0.042555 | 0 | 0 | 0.095031 |
| 12 : N-OCTANE | 0.06769 | 0.06769 | 0 | 0 | 0.151163 |
| 45 : ETHYL BENZENE | 0.004954 | 0.004954 | 0 | 0 | 0.011062 |
| 43 : M-XYLENE | 0.023437 | 0.023437 | 0 | 0 | 0.052339 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 |
| 13 : N-NONANE | 0.01525 | 0.01525 | 0 | 0 | 0.034056 |
| 14 : N-DECANE | 0.030813 | 0.030813 | 0 | 0 | 0.06881 |
| 62 : WATER | 1.10592 | 1.10592 | 0 | 0 | 2.4697 |
| Total | 44.7796 | 44.7796 | 0 | 0 | 100 |



EFSCOP00009380

## Properties

| | | | |
|---|---|---|---|
| **Temperature** | F | 70 | |
| **Pressure** | psia | 14.7 | |
| **Enthalpy** | Btu/hr | 58.32183 | |
| **Entropy** | Btu/hr/R | 0.5324383 | |
| **Vapor Fraction** | | 1 | |
| | | Total | Vapor |
| **Flowrate** | lbmol/hr | 0.118002 | 0.118002 |
| **Flowrate** | lb/hr | 3.9206 | 3.9206 |
| **Mole Fraction** | | 1 | 1 |
| **Mass Fraction** | | 1 | 1 |
| **Molecular Weight** | | 33.2248 | 33.2248 |
| **Enthalpy** | Btu/lbmol | 494.2461 | 494.2461 |
| **Enthalpy** | Btu/lb | 14.8758 | 14.8758 |
| **Entropy** | Btu/lbmol/R | 4.5121 | 4.5121 |
| **Entropy** | Btu/lb/R | 0.135806 | 0.135806 |
| **Cp** | Btu/lbmol/R | | 14.1614 |
| **Cp** | Btu/lb/R | | 0.4262 |
| **Cv** | Btu/lbmol/R | | 12.1089 |
| **Cv** | Btu/lb/R | | 0.3645 |
| **Cp/Cv** | | | 1.1695 |
| **Density** | lb/ft3 | | 0.086668 |
| **Z-Factor** | | | 0.991556 |
| **Flowrate (T-P)** | ft3/s | | 0.012566 |
| **Flowrate (STP)** | MMSCFD | | 0.001075 |
| **Viscosity** | cP | | 0.009689 |
| **Thermal Conductivity** | Btu/hr/ft/R | | 0.013084 |
| **Critical Temperature (Cubic E** | F | 175.9172 | |
| **Critical Pressure (Cubic EOS)** | psia | 1535.7271 | |
| **Dew Point Temperature** | F | 69.9999 | |
| **Bubble Point Temperature** | F | -263.9276 | |
| **Water Dew Point** | F | 71.5026 | |
| **Stream Vapor Pressure** | psia | 1330.5419 | |
| **Vapor Sonic Velocity** | ft/s | 953.44 | |
| **CO2 Freeze Up** | | No | |
| **Heating Value (gross)** | Btu/SCF | 1879.52 | |
| **Heating Value (net)** | Btu/SCF | 1722.26 | |
| **Wobbe Number** | Btu/SCF | 1745.68 | |
| **Average Hydrogen Atoms** | | 6.3008 | |
| **Average Carbon Atoms** | | 2.1748 | |
| **Hydrogen to Carbon Ratio** | | 2.8972 | |
| **Methane Number** | | 42.52 | |
| **Motor Octane Number** | | 99.52 | |



EFSCOP00009381

# Details for Stream 3

## Stream 3 (Produced Water)

| Thermodynamic Methods | K-Value: | PENG-ROB | Enthalpy: | PENG-ROB | Density: | STD |
|---|---|---|---|---|---|---|
| | Liquid 1 Visc: | NBS81 | Liquid 1 ThC: | NBS81 | Liquid 1 Den: | STD |
| | Liquid 2 Visc: | STEAM | Liquid 2 ThC: | STEAM | Liquid 2 Den: | STD |

Flowrates

| Component Name | Total lbmol/hr | Vapor lbmol/hr | Liquid 1 lbmol/hr | Liquid 2 lbmol/hr | Total mole % | K-Value |
|---|---|---|---|---|---|---|
| 46 : NITROGEN | 0.00009266 | 0 | 0.00005608 | 0.00003658 | 0.00003081 | |
| 49 : CARBON DIOXIDE | 0.000635 | 0 | 0.000121 | 0.000514 | 0.000211 | |
| 2 : METHANE | 0.008862 | 0 | 0.00602 | 0.002841 | 0.002946 | |
| 3 : ETHANE | 0.021967 | 0 | 0.020328 | 0.00164 | 0.007304 | |
| 4 : PROPANE | 0.059006 | 0 | 0.057482 | 0.001524 | 0.019619 | |
| 5 : ISOBUTANE | 0.037552 | 0 | 0.037456 | 0.00009597 | 0.012486 | |
| 6 : N-BUTANE | 0.09877 | 0 | 0.098585 | 0.000185 | 0.03284 | |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 | |
| 7 : ISOPENTANE | 0.103674 | 0 | 0.103606 | 0.00006798 | 0.03447 | |
| 8 : N-PENTANE | 0.120743 | 0 | 0.120681 | 0.00006151 | 0.040146 | |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 | |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 | |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 | |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 | |
| 10 : N-HEXANE | 0.221811 | 0 | 0.221778 | 0.00003321 | 0.07375 | |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 | |
| 40 : BENZENE | 0.008786 | 0 | 0.008785 | 0.000001241 | 0.002921 | |
| 38 : CYCLOHEXANE | 0.023611 | 0 | 0.023608 | 0.000002682 | 0.00785 | |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 | |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 | |
| 11 : N-HEPTANE | 0.306292 | 0 | 0.306278 | 0.00001387 | 0.101839 | |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 | |
| 41 : TOLUENE | 0.064968 | 0 | 0.064966 | 0.000002339 | 0.021601 | |
| 12 : N-OCTANE | 0.26613 | 0 | 0.266126 | 0.000003721 | 0.088485 | |
| 45 : ETHYL BENZENE | 0.020176 | 0 | 0.020176 | 2.723E-07 | 0.006708 | |
| 43 : M-XYLENE | 0.114092 | 0 | 0.114091 | 0.000001288 | 0.037934 | |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 | |
| 13 : N-NONANE | 0.189363 | 0 | 0.189363 | 8.382E-07 | 0.062961 | |
| 14 : N-DECANE | 1.22721 | 0 | 1.2272 | 0.000001694 | 0.408033 | |
| 62 : WATER | 297.868 | 0 | 0.001874 | 297.866 | 99.0379 | |
| Total | 300.761 | 0 | 2.88858 | 297.873 | 100 | |

Flowrates

| Component Name | Total lb/hr | Vapor lb/hr | Liquid 1 lb/hr | Liquid 2 lb/hr | Total mass % |
|---|---|---|---|---|---|
| 46 : NITROGEN | 0.002596 | 0 | 0.001571 | 0.001025 | 0.00004557 |
| 49 : CARBON DIOXIDE | 0.027951 | 0 | 0.005323 | 0.022628 | 0.000491 |
| 2 : METHANE | 0.142167 | 0 | 0.096584 | 0.045583 | 0.002496 |
| 3 : ETHANE | 0.660518 | 0 | 0.611218 | 0.049299 | 0.011597 |
| 4 : PROPANE | 2.60181 | 0 | 2.53461 | 0.067192 | 0.04568 |
| 5 : ISOBUTANE | 2.18253 | 0 | 2.17695 | 0.005578 | 0.038319 |
| 6 : N-BUTANE | 5.74052 | 0 | 5.72978 | 0.010734 | 0.100786 |
| 9 : 2,2-DIMETHYLPROP | 0 | 0 | 0 | 0 | 0 |
| 7 : ISOPENTANE | 7.47964 | 0 | 7.47473 | 0.004904 | 0.13132 |
| 8 : N-PENTANE | 8.71111 | 0 | 8.70667 | 0.004437 | 0.152941 |
| 54 : 2,2-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 55 : 2,3-DIMETHYLBUTA | 0 | 0 | 0 | 0 | 0 |
| 52 : 2-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 53 : 3-METHYLPENTANE | 0 | 0 | 0 | 0 | 0 |
| 10 : N-HEXANE | 19.1139 | 0 | 19.111 | 0.002862 | 0.335582 |
| 37 : METHYLCYCLOPENTA | 0 | 0 | 0 | 0 | 0 |
| 40 : BENZENE | 0.686285 | 0 | 0.686188 | 0.00009694 | 0.012049 |
| 38 : CYCLOHEXANE | 1.98699 | 0 | 1.98676 | 0.000226 | 0.034886 |
| 79 : 2-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 80 : 3-METHYLHEXANE | 0 | 0 | 0 | 0 | 0 |
| 11 : N-HEPTANE | 30.6899 | 0 | 30.6885 | 0.00139 | 0.538821 |
| 39 : METHYLCYCLOHEXAN | 0 | 0 | 0 | 0 | 0 |
| 41 : TOLUENE | 5.98577 | 0 | 5.98555 | 0.000216 | 0.105092 |
| 12 : N-OCTANE | 30.3984 | 0 | 30.398 | 0.000425 | 0.533705 |
| 45 : ETHYL BENZENE | 2.14188 | 0 | 2.14185 | 0.00002891 | 0.037605 |
| 43 : M-XYLENE | 12.112 | 0 | 12.1119 | 0.000137 | 0.21265 |
| 42 : O-XYLENE | 0 | 0 | 0 | 0 | 0 |
| 13 : N-NONANE | 24.2859 | 0 | 24.2857 | 0.000108 | 0.426386 |
| 14 : N-DECANE | 174.602 | 0 | 174.602 | 0.000241 | 3.06548 |
| 62 : WATER | 5366.19 | 0 | 0.033753 | 5366.15 | 94.2141 |
| Total | 5695.74 | 0 | 329.368 | 5366.37 | 100 |



EFSCOP00009382

## Flowrates

| Component Name | Total ft3/hr | Vapor ft3/hr | Liquid 1 ft3/hr | Liquid 2 ft3/hr | Total volume % |
|---|---|---|---|---|---|
| **46 : NITROGEN** | 0.000155 | 0 | 0.000145 | 0.00001058 | 0.000166 |
| **49 : CARBON DIOXIDE** | 0.00046 | 0 | 0.000312 | 0.000149 | 0.000492 |
| **2 : METHANE** | 0.016337 | 0 | 0.015515 | 0.000822 | 0.017458 |
| **3 : ETHANE** | 0.052861 | 0 | 0.052387 | 0.000474 | 0.056489 |
| **4 : PROPANE** | 0.148578 | 0 | 0.148137 | 0.000441 | 0.158776 |
| **5 : ISOBUTANE** | 0.096556 | 0 | 0.096528 | 0.00002775 | 0.103183 |
| **6 : N-BUTANE** | 0.254118 | 0 | 0.254065 | 0.00005341 | 0.27156 |
| **9 : 2,2-DIMETHYLPROP** | 0 | 0 | 0 | 0 | 0 |
| **7 : ISOPENTANE** | 0.267022 | 0 | 0.267003 | 0.00001966 | 0.28535 |
| **8 : N-PENTANE** | 0.311026 | 0 | 0.311008 | 0.00001779 | 0.332374 |
| **54 : 2,2-DIMETHYLBUTA** | 0 | 0 | 0 | 0 | 0 |
| **55 : 2,3-DIMETHYLBUTA** | 0 | 0 | 0 | 0 | 0 |
| **52 : 2-METHYLPENTANE** | 0 | 0 | 0 | 0 | 0 |
| **53 : 3-METHYLPENTANE** | 0 | 0 | 0 | 0 | 0 |
| **10 : N-HEXANE** | 0.571554 | 0 | 0.571545 | 0.000009602 | 0.610784 |
| **37 : METHYLCYCLOPENTA** | 0 | 0 | 0 | 0 | 0 |
| **40 : BENZENE** | 0.022641 | 0 | 0.02264 | 3.589E-07 | 0.024194 |
| **38 : CYCLOHEXANE** | 0.060841 | 0 | 0.060841 | 7.756E-07 | 0.065017 |
| **79 : 2-METHYLHEXANE** | 0 | 0 | 0 | 0 | 0 |
| **80 : 3-METHYLHEXANE** | 0 | 0 | 0 | 0 | 0 |
| **11 : N-HEPTANE** | 0.789316 | 0 | 0.789312 | 0.000004011 | 0.843492 |
| **39 : METHYLCYCLOHEXAN** | 0 | 0 | 0 | 0 | 0 |
| **41 : TOLUENE** | 0.167424 | 0 | 0.167424 | 6.764E-07 | 0.178916 |
| **12 : N-OCTANE** | 0.685837 | 0 | 0.685835 | 0.000001076 | 0.73291 |
| **45 : ETHYL BENZENE** | 0.051995 | 0 | 0.051995 | 7.873E-08 | 0.055564 |
| **43 : M-XYLENE** | 0.294024 | 0 | 0.294024 | 3.725E-07 | 0.314205 |
| **42 : O-XYLENE** | 0 | 0 | 0 | 0 | 0 |
| **13 : N-NONANE** | 0.488008 | 0 | 0.488007 | 2.424E-07 | 0.521503 |
| **14 : N-DECANE** | 3.16264 | 0 | 3.16263 | 4.897E-07 | 3.37971 |
| **62 : WATER** | 86.1358 | 0 | 0.004828 | 86.131 | 92.0479 |
| **Total** | 93.5772 | 0 | 7.44419 | 86.133 | 100 |

## Flowrates

| Component Name | Total SCF/hr | Vapor SCF/hr | Liquid 1 SCF/hr | Liquid 2 SCF/hr | Total std vol % |
|---|---|---|---|---|---|
| **46 : NITROGEN** | 0.00005158 | 0 | 0.00003122 | 0.00002036 | 0.0000552 |
| **49 : CARBON DIOXIDE** | 0.000545 | 0 | 0.000104 | 0.000441 | 0.000584 |
| **2 : METHANE** | 0.007602 | 0 | 0.005165 | 0.002437 | 0.008136 |
| **3 : ETHANE** | 0.029716 | 0 | 0.027498 | 0.002218 | 0.031804 |
| **4 : PROPANE** | 0.082224 | 0 | 0.0801 | 0.002123 | 0.088001 |
| **5 : ISOBUTANE** | 0.062167 | 0 | 0.062009 | 0.000159 | 0.066535 |
| **6 : N-BUTANE** | 0.157599 | 0 | 0.157304 | 0.000295 | 0.168672 |
| **9 : 2,2-DIMETHYLPROP** | 0 | 0 | 0 | 0 | 0 |
| **7 : ISOPENTANE** | 0.192018 | 0 | 0.191893 | 0.000126 | 0.20551 |
| **8 : N-PENTANE** | 0.221325 | 0 | 0.221212 | 0.000113 | 0.236876 |
| **54 : 2,2-DIMETHYLBUTA** | 0 | 0 | 0 | 0 | 0 |
| **55 : 2,3-DIMETHYLBUTA** | 0 | 0 | 0 | 0 | 0 |
| **52 : 2-METHYLPENTANE** | 0 | 0 | 0 | 0 | 0 |
| **53 : 3-METHYLPENTANE** | 0 | 0 | 0 | 0 | 0 |
| **10 : N-HEXANE** | 0.46156 | 0 | 0.461491 | 0.0000691 | 0.49399 |
| **37 : METHYLCYCLOPENTA** | 0 | 0 | 0 | 0 | 0 |
| **40 : BENZENE** | 0.012441 | 0 | 0.012439 | 0.000001757 | 0.013315 |
| **38 : CYCLOHEXANE** | 0.040666 | 0 | 0.040661 | 0.00000462 | 0.043523 |
| **79 : 2-METHYLHEXANE** | 0 | 0 | 0 | 0 | 0 |
| **80 : 3-METHYLHEXANE** | 0 | 0 | 0 | 0 | 0 |
| **11 : N-HEPTANE** | 0.715069 | 0 | 0.715036 | 0.00003238 | 0.765311 |
| **39 : METHYLCYCLOHEXAN** | 0 | 0 | 0 | 0 | 0 |
| **41 : TOLUENE** | 0.110091 | 0 | 0.110087 | 0.000003964 | 0.117826 |
| **12 : N-OCTANE** | 0.689471 | 0 | 0.689461 | 0.000009639 | 0.737915 |
| **45 : ETHYL BENZENE** | 0.0394 | 0 | 0.039399 | 5.317E-07 | 0.042168 |
| **43 : M-XYLENE** | 0.223547 | 0 | 0.223544 | 0.000002524 | 0.239254 |
| **42 : O-XYLENE** | 0 | 0 | 0 | 0 | 0 |
| **13 : N-NONANE** | 0.539471 | 0 | 0.539469 | 0.000002388 | 0.577376 |
| **14 : N-DECANE** | 3.81408 | 0 | 3.81408 | 0.000005264 | 4.08207 |
| **62 : WATER** | 86.036 | 0 | 0.000541 | 86.0354 | 92.0811 |
| **Total** | 93.435 | 0 | 7.39152 | 86.0435 | 100 |



EFSCOP00009383

## Properties

| | | |
|---|---|---|
| **Temperature** | F | 70 |
| **Pressure** | psia | 14.7 |
| **Enthalpy** | Btu/hr | -5611337 |
| **Entropy** | Btu/hr/R | -8954.083 |
| **Vapor Fraction** | | 0 |

| | | Total | Liquid 1 | Liquid 2 |
|---|---|---|---|---|
| **Flowrate** | lbmol/hr | 300.7614 | 2.8886 | 297.8728 |
| **Flowrate** | lb/hr | 5695.7397 | 329.3684 | 5366.3714 |
| **Mole Fraction** | | 1 | 0.009604 | 0.990396 |
| **Mass Fraction** | | 1 | 0.057827 | 0.942173 |
| **Molecular Weight** | | 18.9377 | 114.0242 | 18.0156 |
| **Enthalpy** | Btu/lbmol | -18657.1024 | -15909.6223 | -18683.7457 |
| **Enthalpy** | Btu/lb | -985.1814 | -139.5285 | -1037.0845 |
| **Entropy** | Btu/lbmol/R | -29.7714 | -17.5806 | -29.8896 |
| **Entropy** | Btu/lb/R | -1.5721 | -0.154183 | -1.6591 |
| **Cp** | Btu/lbmol/R | | 56.4371 | 17.9991 |
| **Cp** | Btu/lb/R | | 0.495 | 0.9991 |
| **Cv** | Btu/lbmol/R | | 49.5443 | 17.8638 |
| **Cv** | Btu/lb/R | | 0.4345 | 0.9916 |
| **Cp/Cv** | | | 1.1391 | 1.0076 |
| **Density** | lb/ft3 | | 44.2451 | 62.3033 |
| **Z-Factor** | | | 0.006666 | 0.0007479 |
| **Flowrate (T-P)** | gal/min | | 0.928166 | 10.7393 |
| **Flowrate (STP)** | gal/min | | 0.92154 | 10.7275 |
| **Specific Gravity** | GPA STP | | 0.71449 | 1 |
| **Viscosity** | cP | | 0.54774 | 0.975963 |
| **Thermal Conductivity** | Btu/hr/ft/R | | 0.066247 | 0.346918 |
| **Surface Tension** | dyne/cm | | 21.2511 | 72.5713 |
| **Reid Vapor Pressure (ASTM-A)** | | unconverged | | |
| **True Vapor Pressure at 100 F** | psia | | 19.89 | |
| **Critical Temperature (Cubic E** | F | 695.1762 | | |
| **Critical Pressure (Cubic EOS)** | psia | 3237.7821 | | |
| **Dew Point Temperature** | F | 211.5449 | | |
| **Bubble Point Temperature** | F | 70.2894 | | |
| **Water Dew Point Temperature could not be calculated** | | | | |
| **Liquid 2 Freezing Point** | F | 31.986 | | |
| **Stream Vapor Pressure** | psia | 14.7 | | |
| **Latent Heat of Vaporization (N** | Btu/lb | 925.9842 | | |
| **Latent Heat of Vaporization (F** | Btu/lb | 1063.414 | | |
| **CO2 Freeze Up** | | No | | |
| **Heating Value (gross)** | Btu/SCF | 59.51 | | |
| **Heating Value (net)** | Btu/SCF | 55.29 | | |
| **Wobbe Number** | Btu/SCF | 73 | | |
| **Average Hydrogen Atoms** | | 2.1486 | | |
| **Average Carbon Atoms** | | 0.0771 | | |
| **Hydrogen to Carbon Ratio** | | 27.8523 | | |



EFSCOP00009384

# ATTACHMENT 4
# REGULATORY APPLICABILITY

## OIL AND GAS STANDARD PERMIT REGISTRATION

## LACKEY LAND A639 UNIT A1 & B1

## BURLINGTON RESOURCES OIL & GAS COMPANY LP



EFSCOP00009385

## ATTACHMENT 4
## REGULATORY APPLICABILITY

Burlington Resources Oil & Gas Company LP (Burlington) is submitting this Oil and Gas Standard Permit (SP) Registration to authorize Lackey Land A639 Unit A1 & B1 (the Site). The Site will include six (6) controlled atmospheric condensate storage tanks and associated loading, two (2) controlled atmospheric produced water storage tanks and associated loading, one (1) flare combustion control device, and piping and fugitive components. The following paragraphs address the Site's compliance with each of the applicable SP requirements. A copy of this SP is located in Attachment 6 of this SP registration.

**Non-Rule Air Quality Standard Permit for Oil and Gas Handling and Production Facilities, effective February 27, 2011.**

**SP (a)(1)**

This rule states that the requirements in paragraphs (a)-(k) of this standard permit are applicable to projects located in the Barnett Shale (Archer, Bosque, Clay, Comanche, Cooke, Coryell, Dallas, Denton, Eastland, Ellis, Erath, Hill, Hood, Jack, Johnson, Montague, Palo Pinto, Parker, Shackelford, Stephens, Somervell, Tarrant, and Wise Counties) on or after April 1, 2011. For all other projects and dependent facilities, 30 TAC 116.620 is applicable.

**The Site is located in DeWitt County and is therefore not required to meet this SP. However, Burlington has opted to meet the Non-Rule Air Quality Standard Permit voluntarily.**

**SP (a)(2)**

This rule states that only one Air Quality Standard Permit for Oil and Gas Handling and Production Facilities for an oil and gas site (OGS) may be registered for a combination of dependent facilities, and may not be used if operationally dependent facilities are authorized by the permit by rule in 30 TAC 106.352 or 116.111. Existing authorized facilities which are not changing certified character or quantity of emissions must only meet subsections (i) and (k) of this standard permit.

**All facilities at the Site are included in this SP registration, in accordance with this rule.**

**SP (a)(3)**

This rule does not relieve the owner or operator from complying with any other applicable provision of the Texas Health and Safety Code, Texas Water Code, rules of the Texas Commission on Environmental Quality (TCEQ), or any additional local, state, or federal regulations.

**Burlington will comply with the applicable provisions of these regulations.**

**SP (a)(4)**

This rule states that emissions from upsets, emergencies, or malfunctions are not authorized by this standard permit. This standard permit does not regulate methane, ethane, or carbon dioxide.

**This SP registration does not include emissions from upset, emergency, or malfunction events. If any such emission events occur, Burlington Resources will manage them in accordance with 30 TAC Chapter 101.**

**SP (b)(1)-(8)**

These rules state the definitions and scope of a Facility, Receptors, and OGS. The rules also state that the definitions of 30 TAC §122.10 relating to the Federal Operating Permits program apply. A project is defined as any new facility or group of operationally dependent facilities at an OGS or physical or operational changes to existing authorized facilities which increase the potential to emit over previously certified limits and must meet all requirements of this standard permit prior to construction or implementation of changes, including an impacts analysis as specified in paragraph (k) of this SP.

**This permit application was completed according to the definitions and scope laid out in these rules.**

**SP (c)(1)**

This rule states that existing OGS which are authorized by previous versions of this Standard Permit require registration unless the Project can meet exceptions listed in this requirement.

**This Site was not authorized under a previous SP; therefore, this rule does not apply.**

**SP (c)(2)(A)**

This rule states that new, changed, or replacement facilities shall not exceed the thresholds for major source or major modification as defined in 30 TAC §116.12 (Nonattainment and Prevention of Significant Deterioration Review Definitions), and in Federal Clean Air Act, §112(g) or §112(j);

**The Site is located in DeWitt County which is an attainment county. The Site is a new project and emission totals for the Site do not exceed the thresholds for a major source. Therefore the requirements of this rule have been met.**

**SP (c)(2)(B)**

This rule states that all facilities shall comply with all applicable 40 Code of Federal Regulations (CFR), Parts 60, 61, and 63 requirements for New Source Performance Standards (NSPS), National Emission Standards for Hazardous Air Pollutants (NESHAP), and Maximum Achievable Control Technology (MACT).

**NSPS Kb – Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced after July 23, 1984 does not apply to the Site's storage tanks due to their capacities and since the condensate is only stored prior to custody transfer.**

**NSPS KKK – Standards of Performance for Equipment Leaks of VOC From Onshore Natural Gas Processing Plants do not apply since the Site is not a natural gas processing plant.**

**NSPS LLL – Standards of Performance for Onshore Natural Gas Processing: $SO_2$ Emissions does not apply since the Site does not have a sweetening unit or sweetening unit followed by a sulfur recovery unit.**

**The Site is not subject to any Hazardous Air Pollutant (HAP) control requirements listed in 40 CFR Part 61. The Site is not subject to any maximum achievable control requirements listed in 40 CFR Part 63.**

**SP (c)(2)(D)**

This rule states that all facilities shall comply with all applicable requirements of 30 TAC Chapters 111 (Control of Air Pollution from Visible Emissions and Particulate Matter), 112 (Control of Air Pollution from Sulfur Compounds), 113 (Standards of Performance for Hazardous Air Pollutants and for Designated Facilities and Pollutants), 115 (Control of Air Pollution from Volatile Organic Compounds), and 117 (Control of Air Pollution from Nitrogen Compounds).

**Explanations of compliance are provided for all applicable rules.**

**30 TAC Chapter 111 - Control of Air Pollution from Visible Emissions and Particulate Matter Flare control devices found at the site will meet the visible emission requirements listed in 30 TAC 111.111(a)(4). This includes stipulations on visible emissions allowed during periods of time during normal operations.**

**30 TAC Chapter 112 - Control of Air Pollution from Sulfur Compounds regulates controls needed on emissions related to sulfur compounds. The liquids and gases handled on site do not emit over the prescribed rates.**

**30 TAC Chapter 113 - Standards of Performance for Hazardous Air Pollutants and for Designated Facilities and Pollutants addresses the control of hazardous air pollutant (HAP) emissions from designated facilities defined within this chapter including municipal solid waste landfills (MSWLFs), medical waste incinerators, and certain other processes/emissions regulated under 40 CFR Parts 61 and 63. The Site will not generate radionuclide emissions and will not include a MSWLF or medical waste incinerator. Consequently, Subchapters B and D are not applicable. The applicability of Subchapter C of this rule, which implements 40 CFR Part 63 by regulating HAP emissions released from source categories, is discussed above under section (c)(2)(B) of the Non-Rule SP.**

**30 TAC Chapter 115 - Control of Air Pollution from Volatile Organic Compounds regulates VOC emissions according to source type and Site location (county). The Site is located in DeWitt County which is considered a covered attainment county. However, the equipment at the Site is exempt from this rule because it does not meet the requirements set forth for applicability for covered attainment counties.**

**30 TAC Chapter 117 - Control of Air Pollution from Nitrogen Compounds includes regulations for major sources of $NO_X$ in ozone nonattainment areas. The Site is located in DeWitt County, which is not listed in the counties of interest as mentioned in this rule text. NOx emitting sources at the Site are exempt from this rule and its requirements.**

**SP (c)(3)**

This rule states that in order to be eligible for this Standard Permit, an applicant:
(A) shall meet all applicable requirements as set forth in this standard permit;
(B) shall not misrepresent all relevant facts in obtaining the permit; and
(C) shall not be indebted to the state for failure to make payment of penalties or taxes imposed by the commission's jurisdiction.

**Burlington will comply with the requirements listed in this rule.**

**SP (c)(4)(A-D)**

All facilities related to the operation of any OGS, under any version of this standard permit (or co-located at a site with an OGS standard permit), previously authorized by permit by rule under 30 TAC Chapter 106 must be incorporated into this standard permit (previous authorizations will be voided), meet all emission limits established by this standard permit and review in accordance with paragraph (b)(8), and meet the requirements of paragraphs (e), (i), and (j) of this standard permit. The requirements in paragraph (h) (BACT) of this standard permit must be met if facilities are changed to increase the potential to emit.

**The Site was not previously authorized under any Standard Permits and will meet the requirements of this rule.**

**SP (d)**

This rule lists the specific facilities that have been evaluated for standard permit registration, as well as facilities that are not authorized under standard permit.

**The Site does not include any of the facilities listed in the exclusions list of this rule. Additionally, all the facilities located at the Site are listed in the approved facilities list of this rule. Therefore, the requirements of this rule will be met.**

**SP (e)(1)**

All facilities which have the potential to emit air contaminants must be maintained in good working order and operated properly during facility operations. Each operator shall establish and maintain a program to replace, repair, and/or maintain facilities to keep them in good working order. The minimum requirements of this program shall include:

(A) Compliance with manufacturer's specifications and recommended programs;
(B) cleaning and routine inspection of all equipment; and
(C) replacement and repair of equipment on schedules which prevent equipment failures and maintain performance.

**Burlington will comply with the requirements of this rule.**

**SP (e)(2)**

This rule states that any facility shall be operated at least 50 feet from any property line or receptor (whichever is closer to the facility). This distance limitation does not apply to the following:

(A) any fugitive components that are used for isolation and/or safety purposes may be located at 1/2 of the width of any applicable easement;
(B) any facility at a location for which the distance requirements were satisfied at the time this section is claimed, registered, or certified (provided that the authorization was maintained) regardless of whether a receptor is subsequently built or put to use 50 feet from any OGS facility; or
(C) existing facilities which are located less than 50 feet from a property line or receptor when constructed and previously authorized. If modified or replaced the operator shall consider, to the

extent that good engineering practice will permit, moving these facilities to meet the 50-foot requirement. Replacement facilities must meet all other requirements of this section.

**The Site will satisfy the 50-foot requirement.**

**SP (e)(3)**

This rule states that engines and turbines shall meet the emission and performance standards listed in Table 6 and the following requirements:

(A) liquid fueled engines used for back-up power generation and periodic power needs at the OGS are authorized if the fuel has no more than 0.05% sulfur and the engine is operated less than 876 hours per rolling 12-month period;

(B) engines and turbines used for electric generation more than 876 hours per rolling 12-month period are authorized if no reliable electric service is readily available and 30 TAC §106.352(m) Table 6 is met. In all other circumstances, electric generators must meet the technical requirements of the Air Quality Standard Permit for Electric Generating Unit (EGU) and the emissions shall be included in the registration under this section;

(C) all applicable requirements of Chapter 117 of this title (relating to Control of Air Pollution from Nitrogen Compounds);

(D) all applicable requirements of 40 CFR Parts 60 and 63; and

(E) compression ignition engines that are rated less than 225 kilowatts (300 hp) and emit less than or equal to the emission tier for an equivalent-sized model year 2008 non-road compression ignition engine located at 40 CFR §89.112, Table 1 are authorized.

**This Site does not include any engines or turbines; therefore, this rule does not apply.**

**SP (e)(4)**

This rule states that open-topped tanks or ponds containing VOCs or $H_2S$ are allowed up to a potential to emit equal to 1.0 tpy of VOC and 0.1 tpy of $H_2S$.

**This Site does not involve open-topped tanks or ponds containing VOCs or $H_2S$. Therefore, this rule does not apply.**

**SP (e)(5)**

All process equipment and storage facilities individually must meet the requirements of BACT listed in Table 10 in paragraph (m). Any combination of process equipment and storage facilities with an uncontrolled PTE of equal to or greater than 25 tpy of VOC must also meet the requirements of Table 10, row titled "Combined Control Requirements". All of the following streams and facilities must be included for this site-wide assessment:

(A) For any gaseous vent stream with a concentration of 1% VOC must be considered for capture and control requirements;

(B) For any liquid stream with a potential to emit of equal to or greater than 1 tpy VOC for each vessel or storage facility.

**The equipment at the Site will meet the requirements of this rule.**

**SP (e)(6)**

This rule includes requirements for fugitive components based upon the total site fugitive emissions. If the site is subject to LDAR control program, the requirements outlined in Table 9 must be followed.

**The emissions represented in this application are done so in accordance with this rule. This Site is not required to utilize the LDAR control program.**

**SP (e)(7)**

This rule states requirements for tanks and vessels that use paint color to minimize the effects of solar heating. Solar absorptance should be 0.43 or less, as referenced in AP-42 Table 7.1 – 6 and paint shall be applied in sufficient quantity as to be considered solar resistant. Paint coatings shall be maintained in good condition and will not compromise tank integrity. Minimal amounts of rust may be present not to exceed 10% of the external surface area of the roof or walls of the tank and in no way may compromise tank integrity.

**The Site includes a number of liquid storage tanks which will comply with the requirements of this rule.**

**SP (e)(8)**

This rule states that all emission estimation methods including computer programs must be used with monitoring data generated in accordance with Table 8 in section (m). All emission estimation methods must also be used in ways that are consistent with protocols established by the commission or promulgated in federal regulations (NSPS, NESHAPS). Where control is relied upon to meet paragraph (k) (emission limits based on impact evaluation), control monitoring is required.

**The Site will comply with all applicable monitoring and record demonstration requirements, and all emission estimation methods will comply with the requirements of this rule.**

**SP (e)(9)**

This rule states that process reboilers, heaters, and furnaces that are also used for control of waste gas streams:

(A) may claim 50% to 99% destruction efficiency for VOCs and $H_2S$ depending on the design and level of monitoring applied. The 90% destruction may be claimed where the waste gas is delivered to the flame zone or combustion fire box with basic monitoring as specified in 30 TAC §106.352(j). Any value greater than 90% and up to 99% destruction efficiency may be claimed where enhanced monitoring and/or testing are applied as specified in 30 TAC §106.352(j);
(B) if the waste gas is premixed with the primary fuel gas and used as the primary fuel in the device through the primary fuel burners, 99% destruction may be claimed with basic monitoring as specified in 30 TAC §106.352(j);
(C) in systems where the combustion device is designed to cycle on and off, records of run time and enhanced monitoring are required to claim any run time beyond 50%.

**There are no heaters at the Site; therefore, this rule does not apply.**

**SP (e)(10)**

This rule states that Vapor Recovery Systems (VRSs) may claim up to 100% control. The VRUs must meet the appropriate design, monitoring, and recordkeeping in subsection (m) Table 7 and Table 8.

**The Site does not involve the use of a VRU; therefore, this rule does not apply.**

**SP (e)(11)**

This rule includes design parameters that are required of flare combustion control devices in order to be able to claim a 98% destruction efficiency of 98% for VOCs and H2S and 99% for VOCs containing no more than three carbon atoms that contain no elements other than carbon and hydrogen.

**The Site has a flare combustion control device and is claiming a destruction efficiency of 98%. The Site will meet the design parameters required for this destruction efficiency.**

**SP (e)(12)**

This rule establishes the design destruction efficiency that thermal oxidation and vapor combustion control devices may claim, depending on the design and level of monitoring applied, variability of waste gas streams to control, and stack testing.

**The Site does not involve the use of thermal oxidizers; therefore, this rule does not apply.**

**SP (f)(1)**

This rule states that for all previous claims of this standard permit (or previous version of this standard permit) existing authorized facilities, or group of facilities, are not required to meet the requirements of this standard permit, with the exception of planned MSS, until a renewal under the standard permit is submitted after December 31, 2015.

**The Site is not an existing authorized facility under a previous version of the SP; therefore, this rule does not apply.**

**SP (f)(2)**

This rule states that if no other changes, except for authorizing planned MSS, occur at an existing site under this standard permit, or any previous version of this standard permit, paragraph (b)(7) applies.
(A) Records demonstrating compliance Paragraph (i) must be kept;
(B) If the OGS must certify emissions to establish nonapplicability of prevention of significant deterioration (PSD), nonattainment new source review (NNSR), or the federal operating permits program, this certification may be filed using form APD-CERT. No fee is required for this certification;
(C) Planned MSS shall be incorporated at the next revision or update to a registration under this standard permit after January 5, 2012, and no later than any renewal submitted after December 31, 2015.

**The Site is not an existing authorized facility under this SP or a previous version of the SP; therefore, this rule does not apply.**

**SP (f)(3)**

This rule states that facilities, groups of facilities or planned MSS from facilities registered under this standard permit cannot be authorized by a permit under 30 TAC 116.111, General Application.

**This registration includes planned MSS emissions authorized under the Non-Rule Oil & Gas Standard Permit.**

**SP (f)(4)**

This rule states that prior to construction or implementation of changes for any project which meets this standard permit, a notification shall be submitted through the ePermits system (or hard copy). This notification shall include the following:
(A) Identifying information (Core Data) and a general description of the project.
(B) A fee of $25 for small businesses as defined in 30 TAC §106.50 (Registration Fees for Permits by Rule), or $50 for all others.

**An initial notification meeting these requirements was submitted to the TCEQ via the ePermits system on August 8, 2012.**

**SP (f)(5)**

This rule states that for any registration which meets the emission limitations of this standard permit must meet the following:
(A) Within 90 days after start of operation or implemented changes (whichever occurs first), the facilities must be registered with a PI-1S Standard Permit Application.
(B) Include a detailed summary of maximum emissions estimates based on representative gas and liquid analysis, equipment design specifications and operations, material type and throughput, other parameters for determining emissions, and documentation demonstrating compliance with applicable requirements.
(C) Pay registration fee of $475 for small businesses, or $850 for all others.
(D) Construction may begin any time after receipt of written notification to the executive director. Operations may continue after receipt of registration if there are no objections or 45 days after receipt by the executive director of the registration, whichever occurs first.

**This SP registration is being submitted in accordance with these requirements.**

**SP (f)(6)**

This rule states that if an OGS emissions increase, either through a change in production or addition of facilities, the site may change authorization (Level 1 or Level 2 PBR in 30 TAC §106.352 or Standard Permit) within 90 days from the initial notification of construction of an oil and gas facility or within 90 days of the change of production or installation of additional equipment, by submitting an initial registration or revision to the PBR or Standard Permit.

**At the time of this registration, Burlington maintains that the Site should be permitted under the SP level, as reflected in the initial notification.**

**SP (f)(7)**

This rule states that all registrations, registration revisions, and renewals shall be submitted to the commission through a PI-1S Standard Permit Registration Form. Fee requirements do not apply when there are changes in representations with no increase in emissions within 6-months after a standard permit registration has been issued.

**A PI-1S Standard Permit Registration Form is part of this initial SP registration; therefore, the requirements of this rule will be met.**

**SP (g)**

This rule states that any claim under this standard permit must comply with all applicable requirements of 30 TAC §116.610; §116.611, Registration to Use a Standard Permit; §116.614, Standard Permit Fees; and §116.615, General Conditions. This standard permit supersedes: the notification requirements of 30 TAC §116.615, General Conditions; and the emission limitations of 30 TAC §116.610(a)(1), Applicability.

**This SP registration complies with all applicable requirements as listed in this rule and discussed later in this section; therefore, the requirements of this rule will be met.**

**SP (h)**

Total maximum estimated registered or certified emissions shall meet the most stringent of the following:
(1) The applicable limits for a major stationary source or major modification for PSD and NNSR as specified in 30 TAC §116.12.
(2) Paragraph (k) of this standard permit.
(3) The limits set forth by Paragraph (h)(3).

**The Site complies with this rule. Refer to Attachment 5 for the Impacts Evaluation.**

**SP (i)(1)**

This rule states that prior to January 5, 2012, representations and registration of planned MSS is voluntary, but if represented must meet the applicable limits of the standard permit. After January 5, 2012, all emissions from planned MSS activities and facilities must be considered for compliance with applicable limits of the standard permit unless otherwise stated in (b)(7). This section may not be used at a site or for facilities authorized under §116.111 of this title if planned MSS has already been authorized under that permit.

**The Site has not been previously authorized under §116.111. Burlington has voluntarily included MSS activities in this SP registration submittal as opposed to the delayed compliance date. Therefore, the requirements of this rule will be met.**

**SP (i)(2)**

This rule states that releases of air contaminants during, or as result of, planned MSS must be quantified and meet the emission limits in this standard permit, as applicable. This analysis must include:
(A) alternate operational scenarios or redirection of vent streams;
(B) pigging, purging, and blowdowns;
(C) temporary facilities if used for degassing or purging of tanks, vessels, or other facilities;
(D) degassing or purging of tanks, vessels, or other facilities; and
(E) management of sludge from pits, ponds, sumps, and water conveyances.

**This submittal includes emissions representations for alternate operational scenarios during maintenance events. The first scenario occurs when the well is shut in and not producing so that the flare on site may be taken down for maintenance. Emissions related to the standing losses of the liquids already in the storage tanks at the time of shut in are represented in this application as an MSS event. Working losses and flash emissions will not occur as the liquid levels would not be changing.**

**The second scenario occurs when engines located at sites downstream from this one go down for maintenance. This Site would in turn send all low pressure gas from the separator to flare. The proposed site emissions include this maintenance event and the resulting combustion emissions.**

**All other MSS activities listed in this rule do not apply to the Site.**

**SP (i)(3)**

This rule states that other planned MSS activities authorized by this standard permit are limited to the following. These planned MSS activities require only recordkeeping of the activity.
(A) Routine engine component maintenance including filter changes, oxygen sensor replacements, compression checks, overhauls, lubricant changes, spark plug changes, and emission control system maintenance.
(B) Boiler refractory replacements and cleanings.
(C) Heater and heat exchanger cleanings.
(D) Turbine hot standard permit swaps.
(E) Pressure relief valve testing, calibration of analytical equipment; instrumentation/analyzer maintenance; replacement of analyzer filters and screens.

**Burlington will maintain records for the planned MSS activities listed in this SP registration; therefore, the requirements of this rule will be met.**

**SP (i)(4)**

This rule states that engine and compressor startups associated with preventative system shutdown activities have the option to be authorized as part of typical operations if:
(A) prior to operation, alternative operating scenarios to divert gas or liquid streams are registered and certified with all supporting documentation;
(B) engine/compressor shutdowns shall result in no greater than 4 lb/hr of natural gas emissions; and
(C) emissions which result from the subsequent compressor startup activities are controlled to a minimum of 98% efficiency for VOC and $H_2S$.

**There are no engine startups at the Site; therefore, this rule does not apply.**

**SP (j)**

This rule states requirements for sampling, monitoring, and records. The following records shall be maintained at the facility site (or an office within Texas having day-to-day operational control of the plant site) in written or electronic form and be readily available to the agency or local air pollution control program with jurisdiction upon request.
(1) Sampling and demonstrations of compliance shall include the requirements listed in Paragraph (m) Table 7.
(2) Monitoring and records for demonstrations of compliance shall include the requirements listed in Paragraph (m) Table 8.

**Burlington will perform the sampling and monitoring activities and maintain the appropriate records as required in Paragraph (m) Tables 7 and 8; therefore, the requirements of this rule will be met.**

**SP (k)(1)-(2)**

This rule states all impacts evaluations must be completed on a contaminant-by-contaminant basis for any net emissions increases resulting from a project and must meet the following as appropriate:

(A) Compliance with state or federal ambient air standards for nitrogen dioxide ($NO_2$), sulfur dioxide ($SO_2$), and $H_2S$ shall be demonstrated using the shortest distance from any emission point, vent, or fugitive component to the nearest property-line within 1 mile of a project.
(B) Compliance with hourly and annual ESLs for benzene shall be demonstrated using the shortest distance from any emission point, vent, or fugitive component to the nearest receptor within 1 mile of a project.

**Impacts analyses were conducted in accordance with this rule. Please refer to attachment 5 for the impacts evaluation.**

**SP (k)(3)**

This rule states that impacts evaluations are not required under the following cases:
(A) If there is no receptor within 1 mile of a registration, no further ESL review is required.
(B) If there is no property line within 1 mile of a registration, no further ambient air quality standard review is required.
(C) If the project total emissions are less than 0.039 lb/hr benzene, 0.025 lb/hr $H_2S$, 2 lb/hr $SO_2$, or 4 lb/hr $NO_2$, no additional analysis or demonstration of the specified air contaminant is required.

**The Site is within 1/4 mile of the nearest receptor. Hourly total emissions for Benzene, $SO_2$, $NO_x$, and $H_2S$ exceed the limits in subsection (C). Therefore, impact evaluations are required for each of these contaminants and are included in Attachment 5.**

**SP (k)(4)**

This rule states that emission evaluations shall meet the following:
(A) For all evaluations of $NO_X$ to $NO_2$, a conversion factor of 0.20 for 4-stroke rich and lean-burn engines and 0.50 for 2-stroke lean-burn engines may be used.
(B) The maximum predicted concentration or rate at the property boundary or receptor, whichever is appropriate, must not exceed a state or federal ambient air standard or ESL.

**There are no engines on the Site. As shown in Attachment 5, the maximum predicted concentrations at the property boundary or receptor were below the state or federal ambient air standard.**

**SP (k)(5)(A)**

This rule states that the following shall be met for ESL reviews:
(i) If a project's air contaminant maximum predicted concentrations are equal to or less than 10% of the appropriate ESL, no further review is required.
(ii) If a project's air contaminant maximum predicted concentrations combined with project increases for that contaminant over a 60-month period after the effective date of this revised section are equal to or less than 25% of the appropriate ESL, no further review is required.
(iii) In all other cases, all facility emissions at an OGS, regardless of authorization type, located within 1 mile of a project requiring registration under this section shall be evaluated.

**Burlington has evaluated all Site emissions for impacts analysis purposes. Refer to Attachment 5 for modeling results.**

**SP (k)(5)(B)**

This rule states that the following shall be met for state and federal ambient air quality standard reviews:
(i) If a project's air contaminant maximum predicted concentrations are equal to or less than the significant impact level (also known as de minimis impact in Chapter 101 of this title (relating to General Air Quality Rules)), no further review is required;
(ii) In all other cases, all facility emissions at an OGS, regardless of authorization type, located within 1 mile of a project requiring registration under this section shall be evaluated.

**Please refer to Attachment 5.**

**SP (k)(6)**

This rule states that evaluation must comply with one of the methods listed with no changes or exceptions.
(A) Emission impact Tables 2 - 5F in Paragraph (m) may be used in accordance with the limits and descriptions in Paragraph (m) Table 1.
(B) A screening model may be used to demonstrate acceptable emissions from an OGS under this section if all of the parameters in the screening modeling protocol provided by the commission are met.
(C) A refined dispersion model may be used to demonstrate acceptable emissions from an OGS if all of the parameters in the refined dispersion modeling protocol provided by the commission are met.

**Screen modeling was used to satisfy the requirements of this rule for the NOx and $SO_2$ emissions impacts analysis. The TCEQ provided impact Tables were utilized for Benzene and $H_2S$. These results are provided in Attachment 5.**

**SP (l)**

This paragraph states that 30 TAC §116.620 is applicable for existing unchanged facilities and new or changing facilities as specified in paragraph (a)(1) of this standard permit.

**Burlington has voluntarily elected to comply with paragraphs (a) through (k) of this Non-Rule SP. Therefore, paragraph (l) of this rule is not applicable.**

**<u>30 TAC §116.610. Applicability, effective February 1, 2006</u>**

**30 TAC §116.610(a)(1)**

This paragraph of the TCEQ standard permit applicability rules requires that any project with a net increase in any air contaminant other than carbon dioxide, water, nitrogen, methane, ethane, hydrogen, oxygen, or those for which a National Ambient Air Quality Standard (NAAQS) has been established must meet the emission limitations of 30 TAC §106.261(2) or (3) or §106.262(2), unless otherwise specified by a particular standard permit.

**The Site is electing to comply with the requirements of the Non-Rule Air Quality Standard Permit for Oil and Gas Handling and Production Facilities effective February 27, 2011, which supersedes the emission limitations of this rule. Therefore, this rule does not apply.**

**30 TAC §116.610(a)(2)**

This rule states that a project authorized by standard permit must meet the conditions of the standard permit in effect at the time construction or operation is commenced.

**The Site will meet the requirements of the Non-Rule Air Quality SP for Oil and Gas Handling and Production Applicability effective February 27, 2011. Should another SP come into effect prior to TCEQ concurrence with this SP authorization, Burlington will comply with the requirements of that version of the SP.**

**30 TAC §116.610(a)(3)**

This rule requires that the project comply with applicable provisions of the Federal Clean Air Act (FCAA), §111 (concerning New Source Performance Standards (NSPS), as listed under 40 Code of Federal Regulations (CFR) Part 60.

**The applicability of this rule is discussed above under section (c)(2)(B) of the Non-Rule SP.**

**30 TAC §116.610(a)(4)**

This rule requires that the proposed project comply with the applicable provisions of the FCAA, §112 concerning Hazardous Air Pollutants (HAPs), as listed under 40 CFR Part 61.

**The applicability of this rule is discussed above under section (c)(2)(B) of the Non-Rule SP.**

**30 TAC §116.610(a)(5)**

This rule states that the project must comply with applicable maximum achievable control technology (MACT) standards listed under 40 CFR Part 63 or 30 TAC Chapter 113, Subchapter C relating to National Emissions Standards for Hazardous Air Pollutants.

**The applicability of this rule is discussed above under section (c)(2)(B) of the Non-Rule SP.**

**30 TAC §116.610(a)(6)**

This rule applies to facilities that are subject to the Mass Emissions Cap and Trade requirements listed in 30 TAC Chapter 101, Subchapter H, Division 3.

**These requirements do not apply to the Site, which is located in DeWitt County, Texas.**

**30 TAC §116.610(b)**

This rule states that any project, except those authorized under 30 TAC §116.617 of this title (relating to Standard Permits for Pollution Control Permits), which constitute a new major source or major modification under the new source review requirements of the FCAA, Part C or Part D is subject to the requirements of 30 TAC §116.110 rather than 30 TAC Chapter 116 Subchapter F.

**The Site is not a major source of air pollutants, with respect to Prevention of Significant Deterioration (PSD) permitting regulations. The Site is located in DeWitt County, which is an attainment county; therefore, the Site is not required to be evaluated for nonattainment permitting requirements.**

**30 TAC §116.610(c)**

This rule prohibits circumvention of the requirements of 30 TAC §116.110 by artificial limitations.

**Burlington is not taking any artificial limitations on the Site's emissions. Therefore, the condition of this rule has been met.**

**30 TAC §116.610(d)**

This rule states that any project involving a proposed affected facility (as defined in §116.15(1) of this title (relating to Section 112(g) Definitions)) shall comply with all applicable requirements under Subchapter C of this chapter (relating to Hazardous Air Pollutants: Regulations Governing Constructed and Reconstructed Major Sources (FCAA, §112(g), 40 CFR Part 63)).

**The Site is not subject to FCAA §112(g), 40 CFR Part 63 requirements, referenced in 30 TAC Chapter 116 Subchapter C.**

**30 TAC §116.611. Registration to Use a Standard Permit, effective December 11, 2002**

This rule states that, if required, registration to use a standard permit shall be sent by certified mail, return receipt requested, or hand delivered to the executive director, the appropriate commission regional office, and any local air pollution program with jurisdiction, before a standard permit can be issued. The registration, at a minimum, must include the basis of the air emission estimates, quantification of all emission increases and decreases associated with the project, sufficient information to demonstrate the project's compliance with §116.610(b), information describing efforts to minimize emissions increases that will result from the project, a description of the project and related processes, and a description of any equipment installed. A certified registration must be submitted to avoid applicability of Chapter 122 and be maintained in accordance with §116.115.

**A certified registration for this Site is being submitted to the appropriate state and local entities using the required forms and including all appropriate demonstrations of compliance with the requirements of this rule.**

**30 TAC §116.614. Standard Permit Fees, effective October 20, 2002**

This rule states that any person who registers to use a standard permit or an amended standard permit, or to renew a registration to use a standard permit shall remit at the time of registration, a flat fee of $900 for each standard permit being registered. All standard permit fees will be remitted in the form of a check, certified check, electronic funds transfer, or money order made payable to the TCEQ and delivered with the permit registration.

**A fee of $850.00 for this SP is being remitted to the TCEQ with the SP registration. A fee of $50.00 was submitted with the initial notification on August 8, 2012.**

**30 TAC §116.615. General Conditions, effective March 15, 2007**

**30 TAC §116.615(1)**

This condition states that emissions from the facility must comply with all applicable rules and regulations adopted under Texas Health and Safety Code, Chapter 382, and with the intent of the Texas Clean Air Act (TCAA), including protection of health and property of the public.

**The Site emissions will comply with all TCEQ rules and regulations as well as with the intent of the TCAA, including protection of the health and property of the people near the Site.**

**30 TAC §116.615(2)**

This condition states that all representations with regard to construction plans, operating procedures, and maximum emission rates in any registration package become conditions upon which the facility, or changes thereto, must be constructed and operated.

**The Site will be operated as represented in this SP. If any representation changes occur, Burlington will verify that the emission sources remain eligible for a SP and notify the executive director of any changes no later than 30 days after the change, in accordance with this condition.**

**30 TAC §116.615(3)**

This condition states that all changes authorized under standard permit to a facility previously authorized under 30 TAC §116.110 shall be incorporated into that permit at such time as the permit is amended or renewed.

**The Site was not previously authorized under 30 TAC §116.110; therefore, this condition does not apply.**

**30 TAC §116.615(4)**

This condition states that start of construction, construction interruptions exceeding 45 days, and completion of construction shall be reported to the appropriate regional office not later than 15 working days after occurrence of the event, unless otherwise specified in the standard permit.

**Burlington will comply with the reporting requirements listed in this condition.**

**30 TAC §116.615(5)**

This condition lists requirements associated with start-up notification to the appropriate air program regional office and any other air pollution control program having jurisdiction.

**This rule is not applicable for sites subject to the Non-Rule Air Quality SP for Oil and Gas Handling and Production Facilities Applicability sections (a)-(k).**

**30 TAC §116.615(6)**

This condition contains requirements associated with stacks or process vents required to perform sampling operations.

**Burlington will continue to conduct sampling required by this SP, as applicable. Should the TCEQ request stack sampling of other sources authorized by this SP, Burlington will comply with this section.**

**30 TAC §116.615(7)**

This condition requires that the standard permit holder demonstrate or otherwise justify the equivalency of emission control methods, sampling or other emission testing methods, and monitoring methods proposed as alternatives to methods indicated in the conditions of the standard permit.

**Burlington is not proposing alternative emission control methods, sampling or other emission testing methods, or monitoring methods at this time. Should Burlington elect to propose such alternatives, Burlington will do so in accordance with this condition.**

**30 TAC §116.615(8)**

This condition contains the recordkeeping requirements associated with the standard permit.

**Burlington will retain a copy of the SP along with information and data sufficient to demonstrate applicability of, and compliance with, the SP and will be made available at the request of representatives of the executive director, the EPA, or any air pollution control program having jurisdiction.**

**30 TAC §116.615(9)**

This condition requires that facilities covered by the standard permit not be operated unless all air pollution emission capture and abatement equipment is maintained in good working order and operating properly during normal facility operations.

**Equipment will not be operated unless the air emissions control equipment is operating properly during normal facility operations. Any emission events that are not included in this SP will be reported in accordance with 30 TAC §101.201 and §101.211.**

**30 TAC §116.615(10)**

This condition states that registration of a standard permit by a standard permit applicant constitutes an acknowledgement and agreement that the holder will comply with all rules, regulations, and orders of the commission issued in conformity with the TCAA and the conditions precedent to the claiming of the standard permit.

**Burlington will comply with all applicable rules, regulations, and orders of the commission.**

**30 TAC §116.615(11)**

This condition states that if a standard permit for a facility requires a distance, setback, or buffer from other property or structures as a condition of the permit, the determination of whether the distance, setback, or buffer is satisfied shall be made on the basis of conditions existing at the earlier of:

(A) the date new construction, expansion, or modification of a facility begins; or
(B) the date any application or notice of intent is first filed with the commission to obtain approval for the construction or operation of the facility.

**Burlington will comply with the distance determination requirements stated in this rule, as applicable.**

# Air Quality Standard Permits (SP)
# General Requirements Checklist
# Title 30 Texas Administrative Code §§116.610-116.615

Check the most appropriate answer and include any additional information in the spaces provided. If additional space is needed, please include an extra page and reference the rule number. The SP forms, tables, checklists, and guidance documents are available from the TCEQ, Air Permits Division web site at: www.tceq.state.tx.us/permitting/air/nav/standard.html.

Most Standard Permits require registration with the commission's Office of Permitting, Remediation, and Registration in Austin. The facilities and/or changes to facilities can be registered by completing a **Form PI-1S**, "Registration for Air Standard Permit." This checklist should accompany the registration form to expedite any registration review.

| CHECK THE MOST APPROPRIATE ANSWERS AND FILL IN THE REQUESTED INFORMATION | | | |
|---|---|---|---|
| **Rule** | **Questions/Description** | **Information** | **Response** |
| 116.610 (a)(1) | Are there net emissions increases associated with this registration?<br><br>*If "YES," will net emission increases of air contaminants from the project, other than those for which a National Ambient Air Quality Standard (NAAQS) has been established, meet the emission limits of § 106.261 or § 106.262?*<br><br>*If "NO," does the specific standard permit exempt emissions from this limit?* | Attach emissions summary & calculations | ☑ YES ☐ NO<br><br>☐ YES ☑ NO<br><br>☑ YES ☐ NO |
| 116.610 (a)(3) | Do any of the Title 40 Code of Federal Regulations Part (CFR) 60, New Source Performance Standards apply to this registration?<br><br>*If "YES," list subparts* | List subparts: | ☐ YES ☑ NO |
| 116.610 (a)(4) | Do any Hazardous Air Pollutant requirements apply to this registration?<br><br>*If "YES," list subparts* | List subparts: | ☐ YES ☑ NO |
| 116.610 (a)(5) | Do any maximum achievable control technology (MACT) standards as listed under 40 CFR Part 63 or Chapter 113, Subchapter C (National Emissions Standard for Hazardous Air for Source Categories) apply to this registration?<br><br>*If "YES," list subparts* | List subparts: | ☐ YES ☑ NO |
| 116.610 (a)(6) | Will additional emission allowances under Chapter 101, Subchapter H, Division 3, Emissions Banking and Trading, need to be obtained following this registration? | | ☐ YES ☑ NO |

# Air Quality Standard Permits (SP)
# General Requirements Checklist
# Title 30 Texas Administrative Code §§116.610-116.615

| CHECK THE MOST APPROPRIATE ANSWERS AND FILL IN THE REQUESTED INFORMATION | | | |
|---|---|---|---|
| **Rule** | **Questions/Description** | **Information** | **Response** |
| 116.611 (a) (1-6) | Is the following documentation included with this registration: | | ☑ YES ☐ NO |
| | Emissions calculations including the basis of the calculations? | | ☑ YES ☐ NO |
| | Quantification of all emission increases and/or decreases associated with this project? | | ☑ YES ☐ NO |
| | Sufficient information demonstrating that this project does not trigger PSD or NNSR review? | | ☑ YES ☐ NO |
| | Description of efforts to minimize collateral emissions increases associated with this project? | | ☑ YES ☐ NO |
| | Process descriptions including related processes? | | ☑ YES ☐ NO |
| | Description of any equipment being installed? | | ☑ YES ☐ NO |
| 116.614 | Are the required fee and a copy of the check or money order provided with the application? | | ☑ YES ☐ NO |
| 116.615 (1) | Will emissions from the facility comply with all applicable rules and regulations of the commission adopted under Texas Health and Safety Code, Chapter 382, and with the intent of the Texas Clean Air Act? | | ☑ YES ☐ NO |
| 116.615 (2) | Do you understand that all representations with regard to construction plans, operating procedures, and maximum emission rates in this registration become conditions upon which the facility will be constructed and operated? | | ☑ YES ☐ NO |
| 116.615 (3) | Do you understand that all changes authorized by this registration need to be incorporated into the facility's permit if the facility is currently permitted under §116.110 (relating to Applicability)? | *List all related permit numbers:* | ☑ YES ☐ NO |
| 116.615 (9) 617 (e)(1) | Will all air pollution emission capture and abatement equipment be maintained in good working order? | | ☑ YES ☐ NO |
| 116.615 (10) | Will the facility comply with all applicable rules and regulations of the TCEQ, the Texas Health and Safety Code, Chapter 382, and the Texas Clean Air Act? | | ☑ YES ☐ NO |

# ATTACHMENT 5
# IMPACTS EVALUATION

## OIL AND GAS STANDARD PERMIT REGISTRATION

## LACKEY LAND A639 UNIT A1 & B1

## BURLINGTON RESOURCES OIL & GAS COMPANY LP



EFSCOP00009404

**SUMMARY OF $NO_X$ SCREEN3 MODELING RESULTS**

**OIL & GAS STANDARD PERMIT REGISTRATION**

**LACKEY LAND A639 UNIT A1 & B1**

**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

| FIN | EPN | Description | $PTE_{(NOx,HR)}$[a] (lb/hr) | $C_{(NOx,HR)}$[b] (µg/m³) | $GLC_{(NOx,HR)}$[c] (µg/m³) | $R_{(NO_2/NO_X)}$[d] (lb $NO_2$/lb $NO_X$) | $GLC_{(NO_2,HR)}$[e] (µg/m³) | Annual Conversion Factor (CF) | $GLC_{(NOx,YR)}$[d] (µg/m³) |
|---|---|---|---|---|---|---|---|---|---|
| Normal Operations | | | | | | | | | |
| FL-1 | FL-1 | Flare Combustion (normal operations pilot) | 0.003 | 152.30 | 0.46 | 0.75 | 0.34 | 0.08 | 0.03 |
| FL-1 | FL-1 | Flare Combustion (normal operations assist gas) | 0.22 | 12.48 | 2.75 | 0.75 | 2.06 | 0.08 | 0.16 |
| FL-1 | FL-1 | Flare Combustion (normal operations waste gas condensate) | 0.89 | 4.01 | 3.57 | 0.75 | 2.67 | 0.08 | 0.21 |
| FL-1 | FL-1 | Flare Combustion (normal operations waste gas produced water) | 0.10 | 24.00 | 2.40 | 0.75 | 1.80 | 0.08 | 0.14 |
| Maintenance, Startup, and Shutdown | | | | | | | | | |
| FL-1 | FL-1 | Flare Combustion (lp separator waste gas) | 25.11 | 0.17 | 4.29 | 0.75 | 3.22 | 0.08 | 0.26 |
| | | | | | | **Total Engine $NO_2$ Concentration (µg/m³):** | **10.10** | | **0.81** |
| | | | | | | **DeWitt County $NO_2$ Background Concentration (µg/m³)[g]:** | **70.00** | | **20.00** |
| | | | | | | **Total Off-Property Concentration (µg/m³):** | **80.10** | | **20.81** |
| | | | | | | **$NO_2$ NAAQS (µg/m³):** | **188** | | **100** |

[a] $PTE_{(NO_X,HR)}$ = Hourly PTE $NO_X$.

[b] $C_{(NO_X,HR)}$ = Hourly $NO_X$ concentration predicted by SCREEN3 model, using a nominal 1 lb/hr $NO_X$ emission rate.

[c] $GLC_{(NO_X,HR)}$ = Hourly ground level concentration of $NO_X$.
An example calculation for hourly $NO_X$ ground level concentration for FIN FL-1 (normal operations pilot) follows:

$GLC_{(NO_X,HR)} = PTE_{(NO_X,HR)} * C_{(NO_X,HR)}$

$GLC_{(NO_X,HR)} = 0.003$ lb/hr * 152.3 µg/m³/1 lb/hr

$GLC_{(NO_X,HR)} = 0.46$ µg/m³ $NO_X$

[d] $R_{(NO_2/NO_X)}$ = $NO_2/NO_X$ ratio from TCEQ guidance (attached).

[e] $GLC_{(NO_2,HR)}$ = Hourly ground level concentration of $NO_2$.
An example calculation for hourly $NO_2$ ground level concentration for FIN FL-1 follows:

$GLC_{(NO_2,HR)} = GLC_{(NO_X,HR)} * R_{(NO_2/NO_X)}$

$GLC_{(NO_2,HR)} = 0.46$ µg/m³ * 0.75 lb $NO_2$/lb $NO_X$

$GLC_{(NO_2,HR)} = 0.34$ µg/m³ $NO_2$

[f] $GLC_{(NO_2,YR)}$ = Annual ground level concentration of $NO_2$.
An example calculation for annual $NO_2$ ground level concentration for FIN FL-1 follows:

$GLC_{(NO_2,YR)} = GLC_{(NO_2,HR)} * CF$

$GLC_{(NO_2,YR)} = 0.34$ µg/m³ * 0.08

$GLC_{(NO_2,YR)} = 0.03$ µg/m³ $NO_2$

[g] The hourly and annual $NO_2$ background concentration is based on TCEQ Guidance.

Maximum concentrations are shown for each stream sent to the Flare. Note that, the maximum distance is not the same for each stream, but representing all at the maximum concentration is the most conservative approach. Additionally, not all events shown here would occur at the same time (MSS events would not occur during normal operations events), therefore the emissions shown are conservatively represented.



EFSCOP00009405

**SUMMARY OF $SO_2$ SCREEN3 MODELING RESULTS**

**OIL & GAS STANDARD PERMIT REGISTRATION**

**LACKEY LAND A639 UNIT A1 & B1**

**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

| FIN | EPN | Description | $PTE_{(SO2,HR)}$[a] (lb/hr) | $C_{(SO2,HR)}$[b] ($\mu g/m^3$) | $GLC_{(SO_2,HR)}$[c] ($\mu g/m^3$) | Annual Conversion Factor (CF) | $GLC_{(SO2,YR)}$[d] ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|
| Normal Operations | | | | | | | |
| FL-1 | FL-1 | Flare Combustion (normal operations pilot) | 0.0004 | 152.30 | 0.06 | 0.08 | 0.005 |
| FL-1 | FL-1 | Flare Combustion (normal operations assist gas) | 0.03 | 12.48 | 0.37 | 0.08 | 0.03 |
| FL-1 | FL-1 | Flare Combustion (normal operations waste gas condensate) | 0.04 | 4.01 | 0.16 | 0.08 | 0.01 |
| FL-1 | FL-1 | Flare Combustion (normal operations waste gas produced water) | 0.001 | 24.00 | 0.02 | 0.08 | 0.002 |
| Maintenance, Startup, and Shutdown | | | | | | | |
| FL-1 | FL-1 | Flare Combustion (lp separator waste gas) | 4.51 | 0.17 | 0.77 | 0.08 | 0.06 |
| | | | | **Total $SO_2$ Concentration ($\mu g/m^3$):** | **1.39** | | **0.11** |
| | | | | **DeWitt County $SO_2$ Background Concentration ($\mu g/m^3$)[e]:** | **50.00** | | **8.00** |
| | | | | **Total Off-Property Concentration ($\mu g/m^3$):** | **51.39** | | **8.11** |
| | | | | **$SO_2$ NAAQS ($\mu g/m^3$):** | **196** | | **80** |

[a] $PTE_{(SO2,HR)}$ = Hourly PTE SO2.

[b] $C_{(SO2,HR)}$ = Hourly SO2 concentration predicted by SCREEN3 model, using a nominal 1 lb/hr SO2 emission rate.

[c] $GLC_{(SO2,HR)}$ = Hourly ground level concentration of SO2.
An example calculation for hourly SO2 ground level concentration for FIN FL-1 (normal operations pilot) follows:
$GLC_{(SO2,HR)}$ = PTE(SO2,HR) * C(SO2,HR)
$GLC_{(SO2,HR)}$ = (0.000 lb/hr) * (152.30 µg/m3/1 lb/hr)
$GLC_{(SO2,HR)}$ = 0 0.06 µg/m3 SO2

[d] $GLC_{(SO_2,YR)}$ = Annual ground level concentration of $SO_2$.
An example calculation for annual $SO_2$ ground level concentration for FIN FL-1 follows:
$GLC_{(SO_2,YR)}$ = GLC(SO2,HR) * CF
$GLC_{(SO_2,YR)}$ = (0.06 µg/m3) * (0.08)
$GLC_{(SO_2,YR)}$ = 0.005 µg/m3 SO2

[e] The hourly and annual $SO_2$ background concentration is based on TCEQ Guidance.

Maximum concentrations are shown for each stream sent to the Flare. Note that, the maximum distance is not the same for each stream, but representing all at the maximum concentration is the most conservative approach. Additionally, not all events shown here would occur at the same time (MSS events would not occur during normal operations events), therefore the emissions shown are conservatively represented.



EFSCOP00009406

**BENZENE EMISSION IMPACT ANALYSIS**
**OIL AND GAS STANDARD PERMIT REGISTRATION**
**LACKEY LAND A639 UNIT A1 & B1**
**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

**Hourly ESL (µg/m3):** **170**
**Annual ESL (µg/m3):** **4.5**

| | | Benzene Emissions | | Stack Parameters | | G | WR | | Calculated Health Effects Review | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Distance | Height | | | | | |
| EPN | FIN | (lb/hr) | (tpy) | (ft) | (ft) | (µg/m³/lb/hr) | (hourly) | (annual) | (lb/hr) | (tpy) |
| Normal Operations | | | | | | | | | | |
| FUG | FUG | 0.004 | 0.02 | 533 | 3 | 901 | 0.98% | 15.00% | 0.002 | 0.04 |
| | TK-01 | | | | | | | | | |
| | TK-02 | | | | | | | | | |
| | TK-03 | | | | | | | | | |
| FL-1 | TK-04 | 0.01 | 0.01 | 533 | 30 | 43 | 2.46% | 7.50% | 0.10 | 0.43 |
| | TK-05 | | | | | | | | | |
| | TK-06 | | | | | | | | | |
| | TK-07 | | | | | | | | | |
| FL-1 | TK-08 | 0.0001 | 0.0002 | 533 | 30 | 43 | 0.02% | 0.15% | 0.001 | 0.01 |
| FL-1 | TRUCK1 | 0.002 | 0.002 | 533 | 30 | 43 | 0.49% | 1.50% | 0.02 | 0.09 |
| FL-1 | TRUCK2 | 0.001 | 0.0001 | 533 | 30 | 43 | 0.25% | 0.08% | 0.01 | 0.004 |
| FL-1 | FL-1 | 0.000003 | 0.00001 | 533 | 30 | 43 | 0.001% | 0.01% | 0.00003 | 0.0004 |
| Maintenance, Startup, and Shutdown | | | | | | | | | | |
| FL-1 | SEP-GAS | 0.38 | 0.10 | 533 | 30 | 43 | 93.34% | 75.01% | 3.69 | 4.30 |
| TK-01 | TK-01 | | | | | | | | | |
| TK-02 | TK-02 | | | | | | | | | |
| TK-03 | TK-03 | | | | | | | | | |
| TK-04 | TK-04 | 0.01 | 0.001 | 533 | 25 | 274 | 2.46% | 0.75% | 0.02 | 0.01 |
| TK-05 | TK-05 | | | | | | | | | |
| TK-06 | TK-06 | | | | | | | | | |
| TK-07 | TK-07 | | | | | | | | | |
| TK-08 | TK-08 | 0.000002 | 0.0000002 | 533 | 25 | 274 | 0.0005% | 0.0002% | 0.000003 | 0.000001 |
| | **Total** | **0.41** | **0.13** | | | | | | **3.83** | **4.87** |

**Impacts Analysis:**

| | Hourly | Annual |
|---|---|---|
| **Calculated Benzene Emissions (lb/hr):** | **0.41** | **0.13** |
| **Calculated Benzene Health Effects Review (lb/hr):** | **3.83** | **4.87** |

**Per the non-Rule Oil and Gas Standard Permit (k)(4)(B), the site's air contaminant maximum predicted concentrations are less than the appropriate ESL. Therefore the impacts analysis meets the requirements of the Oil and Gas Standard Permit.**

Health Effects Calculations and Impact factors G and WR, and equations from Air Quality Standard Permit for Oil and Gas Handling and Production Facilities (k) and Tables

Table 1: Emission Impact Tables Limits and Descriptions
Table 2: Fugitives and Process Vents Table
Table 3: Flares and Thermal Destruction Devices
Short-Term ESL 170 µg/m³ and Long-Term ESL 4.5 µg/m³ per TCEQ Development Support Document Benzene CAS #: 71-43-2, dated October 15, 2007

NOTE: Not all events shown here would occur at the same time (MSS events would not occur during normal operations events), therefore the analysis shown is conservatively represented.



EFSCOP00009407

## $H_2S$ EMISSION IMPACT ANALYSIS
## OIL AND GAS STANDARD PERMIT REGISTRATION
## LACKEY LAND A639 UNIT A1 & B1
## BURLINGTON RESOURCES OIL & GAS COMPANY LP

**State Property Line Standard (µg/m3):** **108**

| EPN | FIN | $H_2S$ Emissions (lb/hr) | Stack Parameters Distance (ft) | Stack Parameters Height (ft) | G (µg/m³/lb/hr) | WR (hourly) | Calculated Health Effects Review (lb/hr) |
|---|---|---|---|---|---|---|---|
| Normal Operations | | | | | | | |
| FUG | FUG | 0.0004 | 50 | 3 | 4375 | 0.39% | 0.0001 |
| | TK-01 | | | | | | |
| | TK-02 | | | | | | |
| | TK-03 | | | | | | |
| FL-1 | TK-04 | 0.0004 | 50 | 30 | 43 | 0.39% | 0.01 |
| | TK-05 | | | | | | |
| | TK-06 | | | | | | |
| | TK-07 | | | | | | |
| FL-1 | TK-08 | 0.00001 | 50 | 30 | 43 | 0.01% | 0.0002 |
| FL-1 | FL-1 | 0.001 | 50 | 30 | 43 | 0.98% | 0.02 |
| Maintenance, Startup, and Shutdown | | | | | | | |
| FL-1 | SEP-GAS | 0.05 | 50 | 30 | 43 | 49.11% | 1.23 |
| FL-1 | FL-1 | 0.05 | 50 | 30 | 43 | 49.11% | 1.23 |
| | **Total** | **0.10** | | | | | **2.50** |

**Impacts Analysis:**

| | Hourly |
|---|---|
| **Calculated $H_2S$ Emissions (lb/hr):** | **0.10** |
| **Calculated $H_2S$ Health Effects Review (lb/hr):** | **2.50** |

**Per the non-Rule Oil and Gas Standard Permit (k)(4)(B), the site's air contaminant maximum predicted concentrations are less than the appropriate ESL. Therefore the impacts analysis meets the requirements of the Oil and Gas Standard Permit.**

Health Effects Calculations and Impact factors G and WR, and equations from Air Quality Standard Permit for Oil and Gas Handling and Production Facilities (k) and Tables

Table 1: Emission Impact Tables Limits and Descriptions
Table 2: Fugitives and Process Vents Table
Table 3: Flares and Thermal Destruction Devices
State Property Line Standard 108 µg/m³ per 30 TAC Ch 112 and TCEQ Modeling Guidance

NOTE: Not all events shown here would occur at the same time (MSS events would not occur during normal operations events), therefore the analysis shown is conservatively represented.



EFSCOP00009408

06/28/12
15:24:54

```
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 96043 ***

Lackey Land A639 Unit A1 & B1 Flare Normal Ops Pilot


SIMPLE TERRAIN INPUTS:
   SOURCE TYPE            =        FLARE
   EMISSION RATE (G/S)    =      .125800
   FLARE STACK HEIGHT (M) =       9.1440
   TOT HEAT RLS (CAL/S)   =      1356.00
   RECEPTOR HEIGHT (M)    =        .0000
   URBAN/RURAL OPTION     =        RURAL
   EFF RELEASE HEIGHT (M) =       9.2873
   BUILDING HEIGHT (M)    =        .0000
   MIN HORIZ BLDG DIM (M) =        .0000
   MAX HORIZ BLDG DIM (M) =        .0000

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


BUOY. FLUX =     .022 M**4/S**3;  MOM. FLUX =     .014 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 |
|---|---|---|---|---|---|---|---|---|---|
| 1. | .0000 | 1 | 1.0 | 1.0 | 320.0 | 10.75 | .45 | .26 | NO |
| 100. | 152.2 | 3 | 1.0 | 1.0 | 320.0 | 10.75 | 12.47 | 7.45 | NO |
| 200. | 136.1 | 4 | 1.0 | 1.0 | 320.0 | 10.75 | 15.57 | 8.51 | NO |
| 300. | 98.61 | 4 | 1.0 | 1.0 | 320.0 | 10.75 | 22.61 | 12.10 | NO |
| 400. | 69.47 | 4 | 1.0 | 1.0 | 320.0 | 10.75 | 29.46 | 15.27 | NO |
| 500. | 50.93 | 4 | 1.0 | 1.0 | 320.0 | 10.75 | 36.15 | 18.30 | NO |
| 600. | 49.21 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 21.33 | 9.89 | NO |
| 700. | 50.41 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 24.54 | 11.11 | NO |
| 800. | 48.61 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 27.71 | 12.14 | NO |
| 900. | 45.99 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 30.84 | 13.13 | NO |
| 1000. | 43.07 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 33.94 | 14.09 | NO |
| 1100. | 40.09 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 37.02 | 14.95 | NO |
| 1200. | 37.28 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 40.06 | 15.78 | NO |
| 1300. | 34.68 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 43.09 | 16.59 | NO |
| 1400. | 32.29 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 46.09 | 17.37 | NO |
| 1500. | 30.12 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 49.07 | 18.14 | NO |
| 1600. | 28.14 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 52.03 | 18.89 | NO |
| 1700. | 26.35 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 54.98 | 19.62 | NO |
| 1800. | 24.72 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 57.90 | 20.33 | NO |
| 1900. | 23.23 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 60.81 | 21.03 | NO |
| 2000. | 21.88 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 63.71 | 21.72 | NO |
| 2100. | 20.68 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 66.59 | 22.30 | NO |
| 2200. | 19.59 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 69.45 | 22.87 | NO |
| 2300. | 18.59 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 72.31 | 23.42 | NO |
| 2400. | 17.67 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 75.15 | 23.97 | NO |
| 2500. | 16.82 | 6 | 1.0 | 1.0 | 10000.0 | 16.25 | 77.97 | 24.51 | NO |

```
  2600.   16.04        6     1.0    1.0 10000.0   16.25   80.79   25.03    NO
  2700.   15.32        6     1.0    1.0 10000.0   16.25   83.59   25.55    NO
  2800.   14.65        6     1.0    1.0 10000.0   16.25   86.39   26.06    NO
  2900.   14.02        6     1.0    1.0 10000.0   16.25   89.17   26.56    NO
  3000.   13.44        6     1.0    1.0 10000.0   16.25   91.94   27.05    NO
  3500.   11.16        6     1.0    1.0 10000.0   16.25  105.67   29.05    NO
  4000.   9.469        6     1.0    1.0 10000.0   16.25  119.19   30.90    NO
  4500.   8.180        6     1.0    1.0 10000.0   16.25  132.52   32.63    NO
  5000.   7.169        6     1.0    1.0 10000.0   16.25  145.68   34.26    NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND     1. M:
   102.   152.3        3     1.0    1.0   320.0   10.75   12.81    7.66    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         MAX CONC    DIST TO   TERRAIN
  PROCEDURE         (UG/M**3)    MAX (M)    HT (M)
--------------     -----------   -------   -------
SIMPLE TERRAIN       152.3          102.        0.

*******************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
*******************************************************
```

06/29/12
14:43:07

```
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 96043 ***

Lackey Land A639 Unit A1 & B1 Flare Assist


SIMPLE TERRAIN INPUTS:
   SOURCE TYPE            =        FLARE
   EMISSION RATE (G/S)    =      .125800
   FLARE STACK HEIGHT (M) =       9.1440
   TOT HEAT RLS (CAL/S)   =      113048.
   RECEPTOR HEIGHT (M)    =        .0000
   URBAN/RURAL OPTION     =        RURAL
   EFF RELEASE HEIGHT (M) =      10.3309
   BUILDING HEIGHT (M)    =        .0000
   MIN HORIZ BLDG DIM (M) =        .0000
   MAX HORIZ BLDG DIM (M) =        .0000

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


BUOY. FLUX =    1.874 M**4/S**3;  MOM. FLUX =    1.143 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 |
|---|---|---|---|---|---|---|---|---|---|
| 1. | .0000 | 1 | 1.0 | 1.0 | 320.0 | 44.57 | .91 | .83 | NO |
| 100. | 10.86 | 1 | 3.0 | 3.0 | 960.0 | 21.75 | 27.05 | 14.32 | NO |
| 200. | 12.48 | 3 | 3.5 | 3.5 | 1120.0 | 20.11 | 23.78 | 14.30 | NO |
| 300. | 11.65 | 3 | 2.0 | 2.0 | 640.0 | 27.44 | 34.64 | 20.91 | NO |
| 400. | 10.91 | 4 | 3.0 | 3.0 | 960.0 | 21.72 | 29.63 | 15.61 | NO |
| 500. | 10.30 | 4 | 2.5 | 2.5 | 800.0 | 23.99 | 36.36 | 18.71 | NO |
| 600. | 9.635 | 4 | 2.0 | 2.0 | 640.0 | 27.41 | 43.00 | 21.77 | NO |
| 700. | 8.887 | 4 | 1.5 | 1.5 | 480.0 | 33.10 | 49.62 | 24.90 | NO |
| 800. | 8.375 | 4 | 1.5 | 1.5 | 480.0 | 33.10 | 55.95 | 27.56 | NO |
| 900. | 7.752 | 4 | 1.5 | 1.5 | 480.0 | 33.10 | 62.22 | 30.18 | NO |
| 1000. | 7.164 | 4 | 1.0 | 1.0 | 320.0 | 44.48 | 68.82 | 33.54 | NO |
| 1100. | 6.830 | 4 | 1.0 | 1.0 | 320.0 | 44.48 | 74.95 | 35.49 | NO |
| 1200. | 6.481 | 4 | 1.0 | 1.0 | 320.0 | 44.48 | 81.03 | 37.39 | NO |
| 1300. | 6.134 | 4 | 1.0 | 1.0 | 320.0 | 44.48 | 87.07 | 39.23 | NO |
| 1400. | 5.798 | 4 | 1.0 | 1.0 | 320.0 | 44.48 | 93.06 | 41.04 | NO |
| 1500. | 5.478 | 4 | 1.0 | 1.0 | 320.0 | 44.48 | 99.02 | 42.80 | NO |
| 1600. | 5.267 | 6 | 1.0 | 1.0 | 10000.0 | 40.56 | 52.71 | 20.67 | NO |
| 1700. | 5.445 | 6 | 1.0 | 1.0 | 10000.0 | 40.56 | 55.61 | 21.34 | NO |
| 1800. | 5.585 | 6 | 1.0 | 1.0 | 10000.0 | 40.56 | 58.51 | 22.00 | NO |
| 1900. | 5.691 | 6 | 1.0 | 1.0 | 10000.0 | 40.56 | 61.39 | 22.65 | NO |
| 2000. | 5.767 | 6 | 1.0 | 1.0 | 10000.0 | 40.56 | 64.26 | 23.29 | NO |
| 2100. | 5.778 | 6 | 1.0 | 1.0 | 10000.0 | 40.56 | 67.11 | 23.83 | NO |
| 2200. | 5.772 | 6 | 1.0 | 1.0 | 10000.0 | 40.56 | 69.96 | 24.36 | NO |
| 2300. | 5.753 | 6 | 1.0 | 1.0 | 10000.0 | 40.56 | 72.79 | 24.89 | NO |
| 2400. | 5.723 | 6 | 1.0 | 1.0 | 10000.0 | 40.56 | 75.61 | 25.40 | NO |
| 2500. | 5.683 | 6 | 1.0 | 1.0 | 10000.0 | 40.56 | 78.42 | 25.91 | NO |

```
  2600.   5.636        6     1.0    1.0 10000.0   40.56   81.23   26.40    NO
  2700.   5.583        6     1.0    1.0 10000.0   40.56   84.02   26.90    NO
  2800.   5.524        6     1.0    1.0 10000.0   40.56   86.80   27.38    NO
  2900.   5.461        6     1.0    1.0 10000.0   40.56   89.57   27.86    NO
  3000.   5.395        6     1.0    1.0 10000.0   40.56   92.33   28.33    NO
  3500.   4.991        6     1.0    1.0 10000.0   40.56  106.00   30.24    NO
  4000.   4.609        6     1.0    1.0 10000.0   40.56  119.48   32.02    NO
  4500.   4.260        6     1.0    1.0 10000.0   40.56  132.78   33.70    NO
  5000.   3.945        6     1.0    1.0 10000.0   40.56  145.93   35.28    NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND     1. M:
   200.   12.48        3     3.5    3.5  1120.0   20.11   23.78   14.30    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         MAX CONC    DIST TO   TERRAIN
  PROCEDURE         (UG/M**3)    MAX (M)    HT (M)
--------------     -----------   -------   -------
SIMPLE TERRAIN       12.48          200.        0.

*****************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
*****************************************************
```

08/08/12
13:28:26

```
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 96043 ***

Lackey Land A639 Unit A1 & B1 Flare Cond Waste

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE            =        FLARE
   EMISSION RATE (G/S)    =      .125800
   FLARE STACK HEIGHT (M) =       9.1440
   TOT HEAT RLS (CAL/S)   =      449693.
   RECEPTOR HEIGHT (M)    =        .0000
   URBAN/RURAL OPTION     =        RURAL
   EFF RELEASE HEIGHT (M) =      11.4405
   BUILDING HEIGHT (M)    =        .0000
   MIN HORIZ BLDG DIM (M) =        .0000
   MAX HORIZ BLDG DIM (M) =        .0000

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


BUOY. FLUX =    7.456 M**4/S**3;  MOM. FLUX =    4.547 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 |
|---|---|---|---|---|---|---|---|---|---|
| 1. | .0000 | 1 | 1.0 | 1.0 | 320.0 | 107.21 | 1.35 | 1.30 | NO |
| 100. | .9785 | 3 | 10.0 | 10.1 | 3200.0 | 20.98 | 12.61 | 7.68 | NO |
| 200. | 3.959 | 3 | 10.0 | 10.1 | 3200.0 | 20.98 | 23.78 | 14.29 | NO |
| 300. | 3.779 | 3 | 5.0 | 5.1 | 1600.0 | 30.52 | 34.72 | 21.05 | NO |
| 400. | 3.493 | 4 | 8.0 | 8.2 | 2560.0 | 23.28 | 29.65 | 15.64 | NO |
| 500. | 3.319 | 4 | 8.0 | 8.2 | 2560.0 | 23.28 | 36.30 | 18.61 | NO |
| 600. | 3.177 | 4 | 5.0 | 5.1 | 1600.0 | 30.39 | 43.06 | 21.89 | NO |
| 700. | 3.009 | 4 | 5.0 | 5.1 | 1600.0 | 30.39 | 49.49 | 24.64 | NO |
| 800. | 2.827 | 4 | 4.0 | 4.1 | 1280.0 | 35.13 | 55.98 | 27.62 | NO |
| 900. | 2.655 | 4 | 3.5 | 3.6 | 1120.0 | 38.51 | 62.36 | 30.46 | NO |
| 1000. | 2.509 | 4 | 3.5 | 3.6 | 1120.0 | 38.51 | 68.56 | 33.01 | NO |
| 1100. | 2.356 | 4 | 3.0 | 3.1 | 960.0 | 43.02 | 74.86 | 35.30 | NO |
| 1200. | 2.226 | 4 | 3.0 | 3.1 | 960.0 | 43.02 | 80.94 | 37.20 | NO |
| 1300. | 2.099 | 4 | 3.0 | 3.1 | 960.0 | 43.02 | 86.99 | 39.06 | NO |
| 1400. | 1.998 | 4 | 2.5 | 2.6 | 800.0 | 49.34 | 93.18 | 41.30 | NO |
| 1500. | 1.907 | 4 | 2.5 | 2.6 | 800.0 | 49.34 | 99.14 | 43.05 | NO |
| 1600. | 1.819 | 4 | 2.5 | 2.6 | 800.0 | 49.34 | 105.05 | 44.77 | NO |
| 1700. | 1.799 | 5 | 1.0 | 1.0 | 10000.0 | 68.60 | 84.17 | 34.36 | NO |
| 1800. | 1.856 | 5 | 1.0 | 1.0 | 10000.0 | 68.60 | 88.49 | 35.34 | NO |
| 1900. | 1.902 | 5 | 1.0 | 1.0 | 10000.0 | 68.60 | 92.80 | 36.30 | NO |
| 2000. | 1.939 | 5 | 1.0 | 1.0 | 10000.0 | 68.60 | 97.08 | 37.26 | NO |
| 2100. | 1.957 | 5 | 1.0 | 1.0 | 10000.0 | 68.60 | 101.35 | 38.11 | NO |
| 2200. | 1.969 | 5 | 1.0 | 1.0 | 10000.0 | 68.60 | 105.61 | 38.95 | NO |
| 2300. | 1.976 | 5 | 1.0 | 1.0 | 10000.0 | 68.60 | 109.84 | 39.78 | NO |
| 2400. | 1.979 | 5 | 1.0 | 1.0 | 10000.0 | 68.60 | 114.07 | 40.60 | NO |
| 2500. | 1.977 | 5 | 1.0 | 1.0 | 10000.0 | 68.60 | 118.27 | 41.40 | NO |
| 2600. | 1.972 | 5 | 1.0 | 1.0 | 10000.0 | 68.60 | 122.47 | 42.19 | NO |

```
  2700.   1.963        5     1.0    1.0 10000.0   68.60  126.64   42.98    NO
  2800.   1.975        6     1.0    1.1 10000.0   58.45   87.40   29.25    NO
  2900.   2.001        6     1.0    1.1 10000.0   58.45   90.16   29.69    NO
  3000.   2.025        6     1.0    1.1 10000.0   58.45   92.90   30.14    NO
  3500.   2.049        6     1.0    1.1 10000.0   58.45  106.50   31.94    NO
  4000.   2.037        6     1.0    1.1 10000.0   58.45  119.92   33.63    NO
  4500.   2.001        6     1.0    1.1 10000.0   58.45  133.18   35.23    NO
  5000.   1.953        6     1.0    1.1 10000.0   58.45  146.29   36.75    NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND     1. M:
   231.   4.007        3     8.0    8.1  2560.0   23.36   27.29   16.43    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         MAX CONC    DIST TO   TERRAIN
  PROCEDURE         (UG/M**3)    MAX (M)    HT (M)
--------------     -----------   -------   -------
SIMPLE TERRAIN       4.007          231.        0.

*****************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
*****************************************************
```

08/08/12
13:30:41

```
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 96043 ***

Lackey Land A639 Unit A1 & B1 Flare PW Waste

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE            =        FLARE
   EMISSION RATE (G/S)    =      .125800
   FLARE STACK HEIGHT (M) =       9.1440
   TOT HEAT RLS (CAL/S)   =      49732.4
   RECEPTOR HEIGHT (M)    =        .0000
   URBAN/RURAL OPTION     =        RURAL
   EFF RELEASE HEIGHT (M) =       9.9456
   BUILDING HEIGHT (M)    =        .0000
   MIN HORIZ BLDG DIM (M) =        .0000
   MAX HORIZ BLDG DIM (M) =        .0000

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


BUOY. FLUX =     .825 M**4/S**3;  MOM. FLUX =     .503 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 |
|---|---|---|---|---|---|---|---|---|---|
| 1. | .0000 | 1 | 1.0 | 1.0 | 320.0 | 28.48 | .75 | .65 | NO |
| 100. | 21.06 | 2 | 2.5 | 2.5 | 800.0 | 17.36 | 19.38 | 10.81 | NO |
| 200. | 23.85 | 3 | 2.0 | 2.0 | 640.0 | 19.22 | 23.77 | 14.28 | NO |
| 300. | 21.91 | 3 | 1.0 | 1.0 | 320.0 | 28.48 | 34.70 | 21.01 | NO |
| 400. | 20.86 | 4 | 1.5 | 1.5 | 480.0 | 22.31 | 29.67 | 15.67 | NO |
| 500. | 19.27 | 4 | 1.5 | 1.5 | 480.0 | 22.31 | 36.32 | 18.63 | NO |
| 600. | 18.21 | 4 | 1.0 | 1.0 | 320.0 | 28.48 | 43.04 | 21.86 | NO |
| 700. | 16.83 | 4 | 1.0 | 1.0 | 320.0 | 28.48 | 49.47 | 24.61 | NO |
| 800. | 15.25 | 4 | 1.0 | 1.0 | 320.0 | 28.48 | 55.83 | 27.30 | NO |
| 900. | 13.70 | 4 | 1.0 | 1.0 | 320.0 | 28.48 | 62.11 | 29.94 | NO |
| 1000. | 12.28 | 4 | 1.0 | 1.0 | 320.0 | 28.48 | 68.33 | 32.53 | NO |
| 1100. | 11.08 | 4 | 1.0 | 1.0 | 320.0 | 28.48 | 74.50 | 34.53 | NO |
| 1200. | 10.04 | 4 | 1.0 | 1.0 | 320.0 | 28.48 | 80.61 | 36.48 | NO |
| 1300. | 9.140 | 4 | 1.0 | 1.0 | 320.0 | 28.48 | 86.68 | 38.37 | NO |
| 1400. | 9.392 | 6 | 1.0 | 1.0 | 10000.0 | 33.07 | 46.52 | 18.48 | NO |
| 1500. | 9.564 | 6 | 1.0 | 1.0 | 10000.0 | 33.07 | 49.47 | 19.20 | NO |
| 1600. | 9.656 | 6 | 1.0 | 1.0 | 10000.0 | 33.07 | 52.41 | 19.91 | NO |
| 1700. | 9.683 | 6 | 1.0 | 1.0 | 10000.0 | 33.07 | 55.34 | 20.60 | NO |
| 1800. | 9.658 | 6 | 1.0 | 1.0 | 10000.0 | 33.07 | 58.24 | 21.29 | NO |
| 1900. | 9.592 | 6 | 1.0 | 1.0 | 10000.0 | 33.07 | 61.14 | 21.96 | NO |
| 2000. | 9.492 | 6 | 1.0 | 1.0 | 10000.0 | 33.07 | 64.02 | 22.61 | NO |
| 2100. | 9.330 | 6 | 1.0 | 1.0 | 10000.0 | 33.07 | 66.88 | 23.17 | NO |
| 2200. | 9.157 | 6 | 1.0 | 1.0 | 10000.0 | 33.07 | 69.74 | 23.72 | NO |
| 2300. | 8.978 | 6 | 1.0 | 1.0 | 10000.0 | 33.07 | 72.58 | 24.26 | NO |
| 2400. | 8.795 | 6 | 1.0 | 1.0 | 10000.0 | 33.07 | 75.41 | 24.78 | NO |
| 2500. | 8.610 | 6 | 1.0 | 1.0 | 10000.0 | 33.07 | 78.23 | 25.30 | NO |
| 2600. | 8.424 | 6 | 1.0 | 1.0 | 10000.0 | 33.07 | 81.03 | 25.81 | NO |

```
  2700.   8.239        6     1.0    1.0 10000.0   33.07   83.83   26.31    NO
  2800.   8.056        6     1.0    1.0 10000.0   33.07   86.62   26.81    NO
  2900.   7.876        6     1.0    1.0 10000.0   33.07   89.39   27.29    NO
  3000.   7.699        6     1.0    1.0 10000.0   33.07   92.16   27.77    NO
  3500.   6.852        6     1.0    1.0 10000.0   33.07  105.86   29.72    NO
  4000.   6.138        6     1.0    1.0 10000.0   33.07  119.35   31.54    NO
  4500.   5.535        6     1.0    1.0 10000.0   33.07  132.67   33.24    NO
  5000.   5.023        6     1.0    1.0 10000.0   33.07  145.82   34.84    NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND     1. M:
   187.   24.00        3     2.0    2.0   640.0   19.22   22.47   13.52    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         MAX CONC    DIST TO   TERRAIN
  PROCEDURE         (UG/M**3)    MAX (M)    HT (M)
--------------     -----------   -------   -------
SIMPLE TERRAIN       24.00          187.        0.

*****************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
*****************************************************
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08/08/12
13:26:14

```
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 96043 ***

Lackey Land A639 Unit A1 & B1 Flare SMSS

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE            =        FLARE
   EMISSION RATE (G/S)    =      .125800
   FLARE STACK HEIGHT (M) =       9.1440
   TOT HEAT RLS (CAL/S)   =      .127462E+08
   RECEPTOR HEIGHT (M)    =        .0000
   URBAN/RURAL OPTION     =        RURAL
   EFF RELEASE HEIGHT (M) =      20.5029
   BUILDING HEIGHT (M)    =        .0000
   MIN HORIZ BLDG DIM (M) =        .0000
   MAX HORIZ BLDG DIM (M) =        .0000

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


BUOY. FLUX =  211.336 M**4/S**3;  MOM. FLUX =  128.868 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 |
|---|---|---|---|---|---|---|---|---|---|
| 1. | .0000 | 1 | 1.0 | 1.1 | 935.6 | 934.58 | 3.82 | 3.80 | NO |
| 100. | .5441E-02 | 6 | 1.0 | 1.5 | 10000.0 | 149.30 | 37.02 | 36.87 | NO |
| 200. | .6738E-02 | 5 | 1.0 | 1.3 | 10000.0 | 183.32 | 47.95 | 46.94 | NO |
| 300. | .7337E-02 | 5 | 1.0 | 1.3 | 10000.0 | 183.32 | 49.49 | 47.32 | NO |
| 400. | .8008E-02 | 5 | 1.0 | 1.3 | 10000.0 | 183.32 | 51.46 | 47.76 | NO |
| 500. | .2249E-01 | 4 | 20.0 | 22.3 | 6400.0 | 60.81 | 36.96 | 19.85 | NO |
| 600. | .7633E-01 | 1 | 3.0 | 3.2 | 960.0 | 325.19 | 146.38 | 165.73 | NO |
| 700. | .1184 | 1 | 3.0 | 3.2 | 960.0 | 325.19 | 166.82 | 223.92 | NO |
| 800. | .1252 | 1 | 3.0 | 3.2 | 960.0 | 325.19 | 186.84 | 292.62 | NO |
| 900. | .1453 | 1 | 1.5 | 1.6 | 630.9 | 629.88 | 249.13 | 397.19 | NO |
| 1000. | .1662 | 1 | 1.5 | 1.6 | 630.9 | 629.88 | 270.85 | 485.57 | NO |
| 1100. | .1710 | 1 | 1.5 | 1.6 | 630.9 | 629.88 | 286.08 | 581.95 | NO |
| 1200. | .1669 | 1 | 1.5 | 1.6 | 630.9 | 629.88 | 300.61 | 689.92 | NO |
| 1300. | .1617 | 4 | 20.0 | 22.3 | 6400.0 | 60.81 | 87.39 | 39.95 | NO |
| 1400. | .1596 | 4 | 20.0 | 22.3 | 6400.0 | 60.81 | 93.37 | 41.72 | NO |
| 1500. | .1565 | 4 | 20.0 | 22.3 | 6400.0 | 60.81 | 99.31 | 43.46 | NO |
| 1600. | .1528 | 4 | 20.0 | 22.3 | 6400.0 | 60.81 | 105.22 | 45.15 | NO |
| 1700. | .1487 | 4 | 20.0 | 22.3 | 6400.0 | 60.81 | 111.09 | 46.82 | NO |
| 1800. | .1444 | 4 | 20.0 | 22.3 | 6400.0 | 60.81 | 116.94 | 48.46 | NO |
| 1900. | .1399 | 4 | 20.0 | 22.3 | 6400.0 | 60.81 | 122.75 | 50.06 | NO |
| 2000. | .1354 | 4 | 20.0 | 22.3 | 6400.0 | 60.81 | 128.54 | 51.64 | NO |
| 2100. | .1309 | 4 | 20.0 | 22.3 | 6400.0 | 60.81 | 134.29 | 53.20 | NO |
| 2200. | .1265 | 4 | 20.0 | 22.3 | 6400.0 | 60.81 | 140.03 | 54.73 | NO |
| 2300. | .1223 | 4 | 20.0 | 22.3 | 6400.0 | 60.81 | 145.73 | 56.24 | NO |
| 2400. | .1181 | 4 | 20.0 | 22.3 | 6400.0 | 60.81 | 151.42 | 57.73 | NO |
| 2500. | .1141 | 4 | 20.0 | 22.3 | 6400.0 | 60.81 | 157.08 | 59.20 | NO |
| 2600. | .1102 | 4 | 20.0 | 22.3 | 6400.0 | 60.81 | 162.71 | 60.65 | NO |

```
  2700.   .1077        4    15.0   16.7  4800.0   76.61  168.68   63.03    NO
  2800.   .1053        4    15.0   16.7  4800.0   76.61  174.26   64.42    NO
  2900.   .1029        4    15.0   16.7  4800.0   76.61  179.82   65.80    NO
  3000.   .1005        4    15.0   16.7  4800.0   76.61  185.37   67.16    NO
  3500.   .8900E-01    4    15.0   16.7  4800.0   76.61  212.82   73.35    NO
  4000.   .8521E-01    2     1.5    1.6   630.9  629.88  555.31  529.63    NO
  4500.   .8151E-01    5     3.0    3.9 10000.0  133.39  201.68   61.89    NO
  5000.   .8569E-01    5     2.5    3.2 10000.0  140.47  221.53   65.41    NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND     1. M:
  1091.   .1710        1     1.5    1.6   630.9  629.88  284.63  571.82    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         MAX CONC    DIST TO   TERRAIN
  PROCEDURE         (UG/M**3)    MAX (M)    HT (M)
--------------     -----------   -------   -------
SIMPLE TERRAIN       .1710         1091.        0.

*****************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
*****************************************************
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**Oil and Gas Standard Permit and Permit By Rule Refined-Screening Modeling Guidelines**

The modeling tables in the Oil and Gas Standard Permit and Permit by Rule (PBR) are only one tool the applicant may use to demonstrate emissions from Oil and Gas Site (OGS) located in the Barnett Shale are acceptable under the Standard Permit and PBR. The modeling performed to create the modeling tables demonstrates the Standard Permit and PBR are protective anywhere in the Barnett Shale. In order to make the demonstration, the modeling is based on reasonably conservative assumptions and modeling techniques. If the modeling tables are too conservative for a specific OGS, the applicant may use a more refined screening modeling approach to demonstrate acceptable emissions from an OGS under the Standard Permit and PBR. The following information provides the requirements and guidance if an applicant chooses to conduct the refined screening approach. The applicant should follow the approach exactly and should not modify the approach on a case-by-case basis. However, the commission could modify the modeling guidance to resolve technical issues, clarify instructions, or allow the use of other refined dispersion models.

There are two refined screening options for demonstrating acceptable emission impacts. The first is a screening approach using the SCREEN3 model and the second is a refined screening approach using Industrial Source Complex (ISC) model. It is possible, and acceptable, that some sites may utilize a combination of SCREEN3 and ISC when completing the impacts review.

## SCREEN3 Model Setup Guidelines

The information contained in this section will provide guidance for applicants utilizing SCREEN3 in the protectiveness reviews for the Oil and Gas PBR and Standard Permit. If any of the conditions outlined in this guidance cannot be met, then this approach cannot be used.

### Control Options

- The Regulatory default option must be selected.
- The Flat terrain choice must be used.
- Rural or urban dispersion options may be used based on the land use in the vicinity of the sources to be permitted.
- A land use analysis must be conducted to determine the majority land-use type within 3 kilometers (km) of the sources to be permitted.
- If the land-use designation is clear (about 70 percent or more of the total land-use is either urban or rural), then no further refinement is required and the model should be run with the appropriate land-use designation.
- If the land-use designation is not clear, the model should be run twice, once with each option and the higher of the two predicted concentrations should be reported.

### Source Options

- Emissions can be represented as either point sources, point source using pseudo point parameters, area source, or as a flare.
- Use a point source with pseudo-point parameters for individual fugitive sources and for any sources that do not release to the atmosphere through standard stacks (such as stacks or vents with rain caps, horizontal releases).



EFSCOP00009419

- Use area source to characterize emissions from fugitive sources and for any sources that do not release to the atmosphere through standard stacks. The area and release height must represent sources or activities that occur at the same time and height. The ratio of length to width for the area source cannot be greater than 10:1. Multiple area sources can be used as applicable to meet area and release height restrictions.
- Flares may be modeled using the flare source type in SCREEN3 or by calculating the effective stack diameter and using the parameters listed in the ISC model setup guideline. The SCREEN3 flare option assumes an effective stack gas exit velocity (vs) of 20 m/s and an effective stack gas exit temperature (Ts) of 1,273 Kelvin, and calculates an effective stack diameter based on the heat release rate. Enclosed vapor combustion units should not be modeled with the preceding parameters but instead with stack parameters that reflect the physical characteristics of the unit.

### Meteorology

- The SCREEN3 model defaults of full meteorology, 10-meter anemometer height, and regulatory mixing height are required.

### Receptors

- Model receptors should be placed to meet the definitions listed in 30 TAC §106.352(b)(2), 30 TAC §106.352(k), and sections (b)(2) and (k) of the standard permit.
- The distance to the nearest receptor should be used to demonstrate compliance for the health effects analysis.
- The starting receptor for the state property line and NAAQS analyses should be placed at the nearest property line. The ending receptor should be located at a 1/4 mile, 1/2 mile, or 1 mile from a project for PBR level 1, PBR Level 2, or the standard permit, respectively.

### Downwash

- Downwash is generally not applicable for OGS located in rural areas. Downwash may be appropriate for OGS that could be affected by large buildings located in urban areas. Generally, small tanks, storage sheds, and engines are not large enough to cause downwash effects and should not be considered in the analysis.

### Output

- The maximum predicted concentration must be used to compare against the applicable ESL, NAAQS, or state ambient air standard.



EFSCOP00009420

- The following conversion factors can be used to convert 1-hour concentrations from SCREEN3 to averaging times greater than 1-hour:

| Averaging Time | Multiplying Factor |
|---|---|
| 3 hour | 0.9 |
| 24 hour | 0.4 |
| Annual | 0.08 |

## ISC Model Setup Guidelines

The information contained in this section will provide guidance for applicants utilizing ISC in the protectiveness reviews for the Oil and Gas PBR and Standard Permits. The latest version of ISC-Prime must be used in the analysis. If any of the conditions outlined in this guidance cannot be met, then this approach cannot be used.

### Control Options

- The Regulatory default option must be selected.
- The Flat terrain choice must be used.
- Plume depletion and deposition options are not allowed
- Rural or urban dispersion options may be used based on the land use in the vicinity of the sources to be permitted.
- A land use analysis must be conducted to determine the majority land-use type within 3 km of the sources to be permitted.
- If the land-use designation is clear (about 70 percent or more of the total land-use is either urban or rural), then no further refinement is required and the model should be run with the appropriate land-use designation.
- If the land-use designation is not clear, the model should be run twice, once with each option and the higher of the two predicted concentrations should be reported.

### Source Options

- Emissions can be represented as either point sources, point source using pseudo point parameters, area source, or as a flare.
- Use a point source with pseudo-point parameters for individual fugitive sources and for any sources that do not release to the atmosphere through standard stacks (such as stacks or vents with rain caps, horizontal releases).
- Use area source to characterize emissions from fugitive sources and for any sources that do not release to the atmosphere through standard stacks. The area and release height must represent sources or activities that occur at the same time and height. The ratio of length to width for the area source cannot be greater than 10:1. Multiple area sources can be used as applicable to meet area and release height restrictions.



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- Flares should be modeled with the following parameters: effective stack exit velocity of 20 meters per second; effective stack exit temperature of 1273 Kelvin; actual height of the flare tip. The effective stack diameter (in meters) should be calculated using the following equation: $D = \sqrt{(10\text{-}6qn)}$ and $qn = q(1 - 0.048\sqrt{MW})$ Where: q = gross heat release in cal/sec; qn = net heat release in cal/sec; and MW = weighted (by volume) average molecular weight of the compound being flared.

## Meteorology

- The ADMT prepared meteorological data sets available at www.tceq.state.tx.us/permitting/air/modeling/admtmet.html must be used in the modeling analysis.
- The following table lists the meteorological data sets that should be used for projects located in the corresponding County

| Counties | Surface Data | Upper-air Data |
|---|---|---|
| Cooke, Dallas, Denton, Ellis, Hood, Johnson, Parker, Somervell, Tarrant, Wise | Dallas-Fort Worth | Stephenville |
| Archer, Clay, Montague | Wichita Falls | Stephenville |
| Bosque, Coryell, Hill | Waco | Stephenville |
| Comanche, Hamilton | San Angelo | Stephenville |
| Eastland, Erath, Jack, Palo Pinto, Shackelford, Stephens | Abilene | Stephenville |

- The required year is 1988 when using one year of meteorology data,
- Only one year of data is required. However, the entire five year data set may be used for NAAQS pollutants.
- The actual anemometer height must be used for each airport location. Anemometer heights can be found at the following URL: www.tceq.state.tx.us/assets/public/permitting/air/memos/anemom96.pdf

## Receptors

- Model receptors should be placed to meet the definitions listed in 30 TAC §106.352(b)(2), 30 TAC §106.352(k), and sections (b)(2) and (k) of the standard permit.
- Model receptors should be placed at all locations defined as a receptor within a 1/4 mile, 1/2 mile, or 1 mile from a project for PBR level 1, PBR Level 2, or the standard permit, respectively, to demonstrate compliance with the health effects analysis.
- In addition to meeting the requirements in 30 TAC §106.352(b)(2), 30 TAC §106.352(k), and sections (b)(2) and (k) of the standard permit, the following

receptor grid design should be used when conducting a NAAQS or state property line analysis:

**PBR Level 1**

- Tight receptors - receptors beginning at the property line and spaced 50 feet apart extending out to a distance of 1/4 mile (1320 feet) from the property line

**PBR Level 2**

- Tight receptors - receptors beginning at the property line and spaced 50 feet apart extending out to a distance of 1/4 mile (1320 feet) from the property line
- Fine receptors - receptors spaced 300 feet apart beginning at 1/4 mile (1320 feet) from the property line and extending out to a distance of 1/2 mile (2640 feet) from the property line

**Standard Permit**

- Tight receptors - receptors beginning at the property line and spaced 50 feet apart extending out to a distance of 1/4 mile (1320 feet) from the property line
- Fine receptors - receptors spaced 300 feet apart beginning at 1/4 mile (1320 feet) from the property line and extending out to a distance of 1/2 mile (2640 feet) from the property line
- Medium receptors - receptors spaced 1500 feet apart beginning at 1/2 mile (2640 feet) from the property line and extending out to a distance of extending out to a distance of 1 mile (5280 feet)

## Downwash

- Downwash is generally not applicable for OGS located in rural areas. Downwash may be appropriate for OGS that could be affected by large buildings located in urban areas. Generally, small tanks, storage sheds, and engines are not large enough to cause downwash effects and should not be considered in the analysis.
- The latest version of BPIP-Prime should be used to calculate downwash parameters if downwash is appropriate.

## Coordinate System

- Enter receptor locations, source locations, and building location (if necessary) in UTM coordinates
- UTM coordinates in datum NAD27 or NAD83 must be used. Make certain that all of the coordinates originated in, or are converted to, the same horizontal datum. Applicable UTM zone for the Barnett Shale is zone 14 (between 102 and 96 degrees longitude).
- Coordinate systems based on plant coordinates, applicant-developed coordinate systems, or polar grids will not be accepted.



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### Output

- The maximum predicted concentration must be used to compare against the applicable ESL, NAAQS, or state ambient air standard when using one year of meteorological data.
- The *high*, second high may be used when modeling with 5 years of meteorology data for the $SO_2$ 3-hr, $SO_2$ 24-hr, $SO_2$ annual, and $NO_2$ annual NAAQS.
- The form of the standard may be used be used when modeling with 5 years of meteorology data for the $SO_2$ and $NO_2$ 1-hr NAAQS.
- The modeling form of the standard for the 1-hr $NO_2$ NAAQS is based on the 5-year average of the annual 98th percentile of the daily maximum 1-hour concentrations.
- The modeling form of the standard for the 1-hr $SO_2$ is based on the 5-year average of the annual 99th percentile of the daily maximum 1-hour concentrations.

## Review Type Guidelines

The following section contains the required procedures necessary to complete a health effects, NAAQS, and state property line evaluations. The applicant should follow the steps exactly and should not modify the approach on a case-by-case basis. However, the commission could modify the guidance to resolve technical issues, clarify instructions, or allow the use of more refined models.

In addition to following the approaches below, the evaluations must meet the requirements listed in 30 TAC §106.352(k) and section (k) of the standard permit, as appropriate.

### Health Effects Analysis

- Compliance with the hourly ESL for benzene and annual ESL for benzene must be demonstrated at receptors within 1/4 mile, 1/2 mile, or 1 mile of a project for PBR Level 1, PBR Level 2, or the standard permit, respectively
- Model all new and modified sources -- the project.
- If the project's air contaminant maximum predicted concentration is equal to or less than 10% of the appropriate ESL, no further review is required.
- If a project's air contaminant maximum predicted concentration is greater than 10% of the appropriate ESL, compare the project's air contaminant maximum predicted concentration combined with project increases for that contaminant over a 60-month period to 25% of the appropriate ESL. If the resulting concentration is less than 25% of the appropriate ESL, no further review is required.
- A site wide analysis, including all sources emitting the regulated contaminant, must be conducted if the above requirements are not met. Multiple scenarios may be necessary to represent sources that may not operate simultaneously.
- All sources must be modeled at the maximum allowable emission rate.
- The maximum predicted concentration at each receptor should be compared to the ESL and included in the modeling report.



EFSCOP00009424

## State Property Line Analysis

- Compliance with the state ambient air standard for $SO_2$ and $H_2S$ must be demonstrated at any property line within 1/4 mile, 1/2 mile, or 1 mile of a project for PBR level 1, PBR Level 2, or the standard permit, respectively
- Model all new and modified sources-- the project.
- Compare the maximum predicted concentration from the project to the appropriate de minimis level. Compliance with the state property line standards is demonstrated if the maximum predicted concentration from the project is less than or equal to de minimis listed in the following table:

| Pollutant | Averaging Time | Location | De Minimis ($\mu g/m^3$) |
|---|---|---|---|
| $SO_2$ | 1-hr | All locations | 20 |
| $H_2S$ | 1-hr | If property is residential, recreational, business, or commercial | 2 |
| $H_2S$ | 1-hr | If property is other than residential, recreational, business, or commercial | 3 |

- If the maximum predicted concentration from the project is greater than de minimis, a site wide analysis must be conducted.
- Model the allowable emission rate of all sources on site that emit the regulated pollutant.
- Compliance with the state property line standard is demonstrated if the maximum predicted site-wide concentration is less than or equal to the state property line standards listed in the following table:

| Pollutant | Averaging Time | Location | State Property Line Standard ($\mu g/m^3$) |
|---|---|---|---|
| $SO_2$ | 1-hr | All Locations | 1021 |
| $H_2S$ | 1-hr | If property is residential, recreational, business, or commercial | 108 |
| $H_2S$ | 1-hr | If property is other than residential, recreational, business, or commercial | 162 |

## NAAQS Analysis

- Compliance with federal ambient air standards for $NO_2$ and $SO_2$ must be demonstrated at any property line within 1/4 mile, 1/2 mile, or 1 mile of a project for PBR Level 1, PBR Level 2, or the standard permit, respectively
- Model all new and modified sources-- the project.
- Compare the maximum predicted concentration from the project to the appropriate de minimis level. Compliance with the NAAQS is demonstrated if the maximum predicted concentration from the project is less than or equal to the de minimis level listed in the following table:

| Pollutant | Averaging Time | De Minimis ($\mu g/m^3$) |
|---|---|---|
| $SO_2$ | 1-hr | 7.8 |
| $SO_2$ | 3-hr | 25 |
| $SO_2$ | 24-hr | 5 |
| $SO_2$ | Annual | 1 |
| $NO_2$ | 1-hr | 7.5 |
| $NO_2$ | Annual | 1 |

- If the maximum predicted concentration from the project is greater than de minimis, a site wide analysis must be conducted.
- Model the allowable emission rate of all sources on site that emit the regulated pollutant
- The maximum predicted concentration must be used when modeling with one year of meteorology data.
- The *high*, second high may be used when modeling with 5 years of meteorology data for the $SO_2$ 3-hr, $SO_2$ 24-hr, SO2 annual, and $NO_2$ annual NAAQS.
- The form of the standard may be used be used when modeling with 5 years of meteorology data for the $SO_2$ and $NO_2$ 1-hr NAAQS.



EFSCOP00009426

- Add a background concentration to the predicted site wide concentration and compare the total concentration to the NAAQS. Compliance with the NAAQS is demonstrated if the total concentration is less than NAAQS listed in the following table:

| Pollutant | Averaging Time | NAAQS (µg/m$^3$) |
|---|---|---|
| $SO_2$ | 1-hr | 196 |
| $SO_2$ | 3-hr | 1300 |
| $SO_2$ | 24-hr | 365 |
| $SO_2$ | Annual | 80 |
| $NO_2$ | 1-hr | 188 |
| $NO_2$ | Annual | 100 |

- Screening background concentration values can be found at www.tceq.texas.gov/permitting/air/memos/interim_guidance_naaqs.html
- If the screening background concentration values are too conservative, contact the Air Dispersion Modeling Team at 512-239-1250 for further guidance. The applicant should be prepared to present and discuss alternative background concentrations.

## Streamlining Techniques

The following section contains approaches that may be used to streamline the modeling required to demonstrate compliance with the health effects, NAAQS, or state property line analysis. The streamlining techniques are **NOT** required, but may be used to streamline the analyses.

### Controlling Concentrations

Short-term standards are usually the controlling concentrations; that is, if the standard is met for the shortest time period, standards for longer averaging periods will also be met. Therefore, if the predicted concentrations from the maximum 1-hour emissions for a NAAQS or applicable state standard are at or lower than the concentrations from a longer averaging period, the demonstration is complete. For example, if the predicted 1-hour $SO_2$ concentration is 150 µg/m$^3$, the demonstration for all $SO_2$ NAAQS and state standards except the annual NAAQS is complete. However, the screening conversion factor of 0.08 can be used to convert the hourly concentration to an annual concentration, and in this case, the annual NAAQS will not be exceeded. Document the use of this technique in the modeling report.

## Collocation of Emission Points

Collocating stacks may be appropriate for both screening and refined analyses if the individual emission points emit the same pollutant(s); have stack heights, volumetric flow rates, or stack gas exit temperatures that do not differ by more than about 20 percent; and are within about 100 meters of each other.

- Use the following equation to determine the worst-case stack: $M = (h_s V T_s)/Q$
- Where:
  - M = a parameter that accounts for the relative influence of stack height, plume rise, and emission rate on concentrations;
  - $h_s$ = the physical stack height in meters;
  - $V = (\pi/4)d^2 v_s$ = the stack gas flow rate in cubic meters per second.
  - $\Pi$ = pi
  - d = inside stack diameter in meters;
  - $v_s$ = stack gas exit velocity in meters per second;
  - $T_s$ = the stack gas exit temperature in Kelvin;
  - Q = pollutant emission rate in grams per second.
- The stack that has the lowest value of M is used as a representative stack.
- The sum of the emissions from all stacks is assumed to be emitted from the representative stack.

## Generic Modeling Approach

This technique uses a unit emission rate (1 pound per hour ) to determine if the maximum contribution from each permitted source when added together, independent of time and space, could exceed a standard or ESL. This is a conservative procedure since the maximum concentration from all sources modeled concurrently cannot be more than the sum of the maximum concentration from each source modeled separately.

- Determine a generic impact for each source by modeling each source with a unit emission rate of 1 pound per hour; the source's actual location; and the source's proposed stack parameters represented in the permit application.
- In ISC this is done by setting up a separate source group for each source.
- The SCREEN3 model can also be used for this demonstration with a separate SCREEN3 model run for each source.
- Multiply the predicted generic impact by the proposed pollutant specific emission rate for each source to calculate a maximum predicted concentration for each source.
- Sum the maximum predicted concentration for each source to get a total predicted concentration for each pollutant.
- The sum of the maximum concentrations (for each pollutant, independent of time and space) is then compared with the threshold of concern for each pollutant.

## Reporting Requirements

Once the modeling exercise is complete, the modeling approach and results should be summarized in a modeling report. The modeling report should be sent to the TCEQ permit reviewer and include a CD with all modeling input files, plot files, output files and all other files of supporting information used in the modeling demonstration.



EFSCOP00009428

# Interim 1-Hour $NO_2$ NAAQS Guidance for Engines Authorized under §106.512

**Disclaimer: Any actions may be affected by EPA written guidance.**

## Background

EPA has established a new 1-hour National Ambient Air Quality Standard (NAAQS) for $NO_2$ at 188 micrograms per cubic meter (μg/m³) that became effective on Monday, April 12, 2010. Any project application that has new NOx/$NO_2$ emissions or any increases (regardless of decreases also proposed in the project) must demonstrate compliance with both the 1-hour and annual (100 μg/m³) standards. An exception would be if the project is an identical replacement at the same location with the same $NO_2$ emissions and dispersion characteristics.

The oil and gas projects for the following registrations must evaluate compliance with this new hourly standard, because their specific requirements discuss a demonstration of compliance with standards:

- §106.512 Engines and Turbines (not any associated §106.352 small combustion devices or §106.492 Flares at this time)
- §116.620 Oil and Gas Production Standard Permit (only with engines which are using 106.512 per the standard permit requirements)

## Compliance Demonstration

If a 1-hour $NO_2$ NAAQS demonstration for the project needs to be performed, it shall be done using method (A), (B), or (C) of 30 TAC 106.512 Condition 6. If method (A) is used, modeling may be done using one of the following nitrogen dioxide ($NO_2$)/NOx ratios:

- a default value of 0.75, or
- the appropriate value given in Figure 1 of 30 TAC 106.512(6)(A), or
- a ratio derived from actual test data.

If the applicant chooses to use a ratio derived from test data, appropriate documentation shall be provided to demonstrate its validity.

## Modeling Guidance

The applicant may choose to do modeling using SCREEN3 or ISC3-PRIME. Regardless of the method chosen, the applicant should:

1. Model the project increase and compare the result to the de minimis value. The agency will use an interim de minimis value of 10 μg/m³. If the project increase is less than or equal to the de minimis value, no further review is needed.

2. If the project increase exceeds the de minimis value of 10 μg/m³, then add the modeled concentration from the project increase to a conservative background value for the appropriate region/county (contact agency staff to obtain background values) and compare the sum to the hourly standard of 188 μg/m³. Applicants may contact the Air Dispersion Modeling Team at 512-239-1250 to determine if a more representative background value is available, based on the location of the facility.

3. If doing SCREEN3 modeling, either of the following approaches may be employed:

- Combine all facilities together at the closest property line using the facility with the "worst-case" dispersion parameters and run the model using a maximum hourly emission rate to obtain the combined 1-hour concentration; or

- Run the model with "overlapping" receptor grids -- one run for each facility using the maximum hourly emission rate. Sum the predicted concentrations at and beyond the property line and determine the maximum concentration.

4. If the applicant decides to do full scale dispersion modeling, the following procedure should be followed:

- The applicant will have to call the Air Dispersion Modeling Team 512-239-1250 to schedule a pre-modeling meeting. The modeling guidelines checklist can be found at http://www.tceq.state.tx.us/assets/public/permitting/air/Guidance/NewSourceReview/gd_chk.pdf

- During the pre-modeling meeting, all NOx emissions associated with the project will be discussed and a Table 1A will need to be provided.

- After the checklist is approved, the applicant can then submit the modeling results to Rule Registrations Section reviewer and the Air Dispersion Modeling Team.

- Upon acceptance of the modeling results, the applicant may submit (for PBR using Form PI-7-CERT and for Standard Permits Form PI-1S) to **certify** the project and the modeling results.

## Options for Applicants

If an applicant cannot meet the 1-hour standard using one of the methods described above, they have the following options (in order of preference):

1. The applicant can review and revise as appropriate their inputs, emission factors, etc. Example: If an applicant originally used 2.0 g as their NOx factor but later discovered

they could use 0.5 g and revise their calculations to meet the new standard, then they will need to **certify**. An example of an appropriate use of this option would be site-specific testing which demonstrated a lower emission factor than the vendor-supplied value.

2. The applicant can reduce or eliminate the NOx increase by installing controls, increasing stack height, leasing more land to increase the property line distance, etc.

**Interim 1-Hour Nitrogen Dioxide ($NO_2$) NAAQS Implementation Guidance**
**July 22, 2010**

## The New 1-Hour $NO_2$ National Ambient Air Quality Standards (NAAQS)

The U.S. Environmental Protection Agency (EPA) promulgated a new 1-hour National Ambient Air Quality Standard (NAAQS) for $NO_2$ (February 9, 2010) that became effective April 12, 2010. The 1-hour $NO_2$ standard is 100 parts per billion (ppb) or 188 micrograms per cubic meter ($\mu g/m^3$) at 25° Celsius (C) and 760 millimeters of mercury (mm Hg). EPA retained the annual standard (100 $\mu g/m^3$, 53 ppb) and annual increment (25 $\mu g/m^3$).[1] EPA is currently conducting a separate review of the secondary $NO_2$ NAAQS jointly with a review of the secondary $SO_2$ NAAQS.

The EPA retained the annual primary and secondary standards and did not propose a change to the significant emission rate (SER) or significant monitoring concentration (SMC) and did not propose a 1-hour significant impact limit (SIL). The EPA is reviewing secondary standards and plans to propose secondary standards for $NO_2$ in July 2011.

In addition, in the notice EPA explains

- the state's responsibility to develop and implement a state implementation plan (SIP) that contains state measures necessary to achieve the air quality standards in each area (page 6521) and

- that minor new source review (NSR) programs must meet the statutory requirements in section 110(a)(2)(C) of the federal clean air act (CAA) which requires * * * regulation of the modification and construction of any stationary source * * * as necessary to assure that the [NAAQS] are achieved (page 6525).

## TCEQ's General Air Permitting Authority

The TCEQ implements the NSR program through statutory authority for air permitting contained in Chapter 382 of the Texas Health and Safety Code -- the Texas Clean Air Act (TCAA). The current SIP and SIP-approved portions of Title 30, Texas Administrative Code (TAC) Chapters 106 and 116 implement the requirements of the TCAA and provide the basis to regulate 1-hour $NO_2$ for major and minor sources.[2]

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[1] 75Federal Register 6474, Primary National Ambient Air Quality Standards for Nitrogen Dioxide, Final Rule, February 9, 2010.

[2] 30 TAC Section 116.110 requires an authorization to construct or modify a facility. Section 116.111 requires an applicant to demonstrate control technology and protectiveness before a permit can be issued. Computer modeling may be required as part of the demonstration. These rules apply to minor

In addition, the TCAA directs the commission to comply with the federal Clean Air Act (FCAA). The FCAA requires the state to develop a SIP that includes an air permit program. The program must regulate the construction and modification of any stationary source to assure the NAAQS are achieved; bring nonattainment areas into and maintain attainment of the NAAQS; and to prevent significant deterioration of air quality. The EPA has developed a NSR program that encompasses the statutory and regulatory programs that regulate the construction and modification of stationary sources as provided under FCAA section 110(a)(2)(C), FCAA Title I, parts C and D, and 40 Code of Federal Regulations (CFR) Sections 51.160 through 51.166.

- As of April 12, 2010, applicants must demonstrate compliance with the 1-hour NAAQS.
  - Applies to new and modified facilities with increases of nitrogen oxide (NOx)/$NO_2$.Applies to major and minor sources.
  - Any permit and standard permit/PBR registration under technical review that specifically requires a NAAQS or $NO_2$ NAAQS compliance demonstration[3] must demonstrate compliance with the 1-hour $NO_2$ standard.
  - The Air Permits Division (APD) will evaluate all standard permits and permits by rule (PBRs) to determine whether an hourly $NO_2$ NAAQS analysis would be appropriate and needed to confirm claims or amend these permitting tiers.
- Major source applicability is the first part of the permit technical review. The significance level remains at 40 tons per year.
  - If projects "net out" of major NSR review, minor NSR review is still required for facilities with new or increased emissions.

**EPA Guidance**

On June 29, 2010, EPA released guidance concerning implementation of the 1-hour $NO_2$ NAAQS for the NSR PSD program.[4] While the EPA focuses its discussion on the

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and major sources. Additional requirements are contained in Sections 116.150-151 and 116.160-163 for major sources and major modifications. At this time: 30 TAC §106.512.Stationary Engines and Turbines (not any associated §106.352 small combustion devices or §106.492 Flares at this time); 30 TAC §116.617 State Pollution Control Project Standard Permit; 30 TAC §116.620 Installation and/Modification of Oil and Gas Facilities (only with engines which are using §106.512 per the standard permit requirements).

[3] At this time: 30 TAC §106.512.Stationary Engines and Turbines (not any associated §106.352 small combustion devices or §106.492 Flares at this time); 30 TAC §116.617 State Pollution Control Project Standard Permit; 30 TAC §116.620 Installation and/Modification of Oil and Gas Facilities (only with engines which are using §106.512 per the standard permit requirements).

[4] http://www.epa.gov/nsr/documents/20100629no2guidance.pdf

prevention of significant deterioration (PSD) portion of the NSR program, the TCEQ continues to base implementation of the state minor source program on EPA's major source guidance as applicable.

- Stephen D. Page Memorandum, June 29, 2010, Guidance Concerning the Implementation of the 1-hour $NO_2$ NAAQS for the Prevention of Significant Deterioration Program (Page Memo).

- Anna Marie Wood Memorandum, June 28, 2010, General Guidance for Implementing the 1-hour $NO_2$ National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour $NO_2$ Significant Impact Level (Wood Memo.)

- Tyler Fox Memorandum, June 28, 2010, Applicability of Appendix W Modeling Guidance for the 1-hour $NO_2$ National Ambient Air Quality Standard (Fox Memo).

In addition, on July 15, 2010, EPA conducted a webinar that discussed the guidance contained in the memorandum and answered questions e-mailed from participants.[5]

**Air Permits Division (APD) Interpretation of EPA Guidance**

The APD will apply the EPA guidance on a case-by-case basis. There are many areas that require technical judgment and coordination with EPA. Following are some general comments permit reviewers and applicants should be aware of concerning EPA's interim guidance and APD's interim implementation:

Page Memo

Pages 1-2. EPA focuses the discussion on PSD and does not directly refer to minor NSR. To meet TCAA and FCAA requirements and ensure consistency with the current permitting process, the APD continues to consider EPA's major source guidance as applicable to implement the state minor NSR program.

Wood Memo

Page 3. Introduction. The EPA explains that as of April 12, 2010, applicants must demonstrate that proposed emissions increase will not cause or contribute to a NAAQS violation. Applicants and reviewers must evaluate new and increased NOx/ $NO_2$

[5] http://www.epa.gov/apti/webinars/WEBINAR-NO2%20Policy%20Guidance_7-15-2010.pdf and http://www.epa.gov/apti/webinars/WEBINAR-Part2_NO2_ModelingGuidance_15July2010.pdf

emissions associated with a project to satisfy this requirement. Air dispersion modeling may be required as applicable to support the evaluation. Modeling procedures for major or minor projects must be preapproved through development and review of a modeling checklist or protocol with the applicant, permit reviewer and modeling staff. Applicants must send major source (PSD) modeling protocols to EPA Region 6 as well.

Page 5. Air Quality Based Emission Limitations. The TCEQ's three-tier best available control technology (BACT) process is equivalent to EPA's top-down process. APD is currently updating pollution control guidance and will provide a draft to stakeholders for comment.

Pages 5-6.

- Demonstrating Compliance...Cause or Contribute. APD will use the EPA 1-hour interim $NO_2$ SIL to determine when a project would cause or contribute to a modeled NAAQS violation. However, if the model predicts a violation but the project is not significant, the APD may request that the applicant provide the sources that were predicted to cause the violation if this information was not included in the modeling output.

- Mitigating Violations with Air Quality "Offsets." While EPA refers to "offsets" the emission reductions required for PSD in 40 CFR 165(b)(3) are not the same as the mandatory offsets required for nonattainment review. See 30 TAC Section 116.161. Applicants can mitigate modeled adverse impacts by such actions as direct emissions reductions, emission reductions through enhanced control, enforceable permit conditions, and increasing stack height according to Good Engineering Practice.

Pages 10-11. Significant Emissions Rate (SER). The SER is used to determine applicability of major NSR to new or modified sources of $NO_2$. While projects can net out of major NSR, they must be evaluated under TCEQ rules for minor NSR. This would include a BACT and impacts evaluation.

Pages 11-13. Interim 1-hour SIL (also referred to as de minimis impact). The APD will use the EPA interim 1-hour $NO_2$ SIL of 4 ppb. This value equates to 7.5 $\mu g/m^3$ at 25° C and 760 mm Hg. Before EPA provided its SIL, the APD advised applicants to use the SIL developed by NESCAUM (Northeast States for Coordinated Air Use Management). However, any modeling already submitted or in progress based on that SIL (10 $\mu g/m^3$) will not need to be reaccomplished. For the public record applicants can refer to EPA's and APD's guidance in their air quality analysis to justify the use of an interim SIL.

Page 12. Use of the Interim SIL. Results from the SCREEN3 model may be used for major and minor projects. For minor NSR, the applicant may compare the interim de minimis to

- the highest modeled 1-hour $NO_2$ concentration predicted across all receptors based on 1-year of APD designated meteorological dataset for the project, or

- the highest of the 5-year average of the maximum modeled 1-hour $NO_2$ concentration predicted each year at each receptor based on the APD designated 5-year meteorological dataset for the project.

If the project is less than or equal to the de minimis, no further review is needed. If the project concentrations exceed the de minimis value, a site-wide $NO_2$ NAAQS analysis must be performed.

Fox Memo

Page 14. Introduction. EPA provides general guidance in 40 CFR Part 51 Appendix W on how to conduct an air quality analysis. In the Fox memo, EPA clarifies guidance contained in Appendix W that does not specifically address procedures for the 1-hour $NO_2$ NAAQS, and provides selected interim implementation guidance. In general

- For major NSR, follow EPA guidance contained in the referenced EPA memoranda as annotated by APD.

- Do not back calculate from an annual concentration to obtain a 1-hour concentration.

- Design the size of the receptor grid to be large enough to show that concentrations are decreasing from the site.

- Include nearby off-property emissions in the inventory, as applicable. Obtain a short-term 1-hour $NO_2$ retrieval from the PSDB to a maximum distance of 50 kilometers from the site. For PSD, include any technically complete (sent to 2nd Public Notice) or recently issued permits, as applicable.

- Provide air quality data in the area near the proposed facility. The air quality is the ambient background concentration that is added to the maximum predicted

concentration. It is the applicant's burden to determine the air quality data to be used in the air quality analysis and demonstrate its representativeness.

- The division will provide interim background concentrations for screening purposes. Applicants should contact the modeling staff for assistance regarding refined background concentrations.

- Use conservative screening background concentrations for projects that exceed the de minimis concentration.

  - For PBR / standard permit demonstrations, as applicable. Add the screening background concentration for the county/region to the predicted concentration from the project. If the project plus background is less than or equal to 188 µg/m³, the demonstration is complete.

  - For case-by-case minor source permitting. Follow the procedure for PBR / standard permits with prior approval. The applicant must demonstrate that the procedure is appropriate based on factors such as

    - Total $NO_2$ emissions at the site

    - Facility location and dispersion parameters

    - Previous approved modeling results

- Round concentrations to be compared to the NAAQS[6] to the nearest whole number or 1 ppb (decimals 0.5 and greater are rounded up to the nearest whole number, and any decimal lower than 0.5 is rounded down to the nearest whole number).

- Ratio method. Adjust predicted concentrations from site wide 1-hour emissions from other pollutants of combustion. For example, 1-hour $SO_2$ or CO concentrations used as a surrogate for 1-hour $NO_2$ concentrations.

  - Develop appropriate ratios.[7] Example, [$NO_2\ \chi = (NO_2\ Q)\ (SO_2\ \chi) \div (SO_2\ Q)$].

  - Add $NO_2$ background concentrations to the adjusted $SO_2$ or CO maximum surrogate concentration. If the project plus background is less than or equal to 188 µg/m³, the demonstration is complete.

[6] 40 CFR 50 Appendix S, 4.2 Rounding Conventions for the 1-hour Primary $NO_2$ NAAQS
[7] Q = emissions; $\chi$ = concentrations.

- Use of nearby ambient monitored data -- Planned maintenance, startup, shutdown (MSS).
    - The site cannot be new and all facilities must have been operating.
    - Applicants must demonstrate that the hourly $NO_2$ emission rate being requested for the planned MSS maximum allowable emission rate table (MAERT) is a value that actually occurred (within approximately plus or minus 10%).
    - Applicants can identify the closest $NO_2$ ambient air monitor to the site.
        - If a monitor is within approximately 10 kilometers (~ 6 miles), the applicant must obtain and provide the highest 1-hour $NO_2$ concentration within at least the most recent three years of complete data, as well as the period of time the emissions actually occurred.
        - If the highest concentration exceeds the 1-hour $NO_2$ NAAQS, or a monitor is not within approximately 10 kilometers (~ 6 miles), the applicant must coordinate with the permit reviewer to request a modeling meeting or conference call with the permit reviewer and modeling staff to determine an alternative approach to demonstrate compliance. This approach may require refining the monitored data to account for the form of the standard, obtaining representative monitoring data from another location, and/or modeling.
- Uses of nearby ambient monitored data -- PBR/standard permit Production/Operation.
    - The site cannot be new and all facilities must have been operating.
    - Applicants can identify the closest $NO_2$ ambient air monitor to the site.
        - If a monitor is within approximately 10 kilometers (~6 miles), the applicant must obtain and provide the highest 1-hour $NO_2$ concentration within at least the most recent three years of complete data, as well as the period of time the emissions actually occurred.
        - If the highest concentration exceeds the 1-hour $NO_2$ NAAQS, or a monitor is not within approximately 10 kilometers (~ 6 miles), the applicant must coordinate with the air dispersion modeling team to request a modeling meeting or conference call with modeling staff to determine an alternative approach to demonstrate compliance. This approach may require refining the monitored data to account for the form of the standard, obtaining representative monitoring data from another location, and/or modeling.

Page 15. SCREEN3 can be used for major and minor projects. APD must preapprove the use of SCREEN3 for multiple facilities if the applicant proposes non-standard modeling techniques.[8] The Industrial Source Complex model with Plume Rise Model Enhancements (ISC-PRIME) can be used for minor projects.

Page 15. Tier 2. The NOx / $NO_2$ conversion factor of 75% may be used for PSD and minor source screening (SCREEN3) or refined modeling (ISC-PRIME or AERMOD, as applicable).

Page 15. Tier 3. Applicants must submit protocols and APD and EPA must preapprove the use of the ozone limiting method (OLM) or the Plume Volume Molar Ratio Method (PVMRM). This requirement applies to major and minor projects.

Page 18. Emission Inventories. Applicants can obtain 1-hour $NO_2$ emission rates for off-property sources from the Point Source Database (PSDB). Permit reviewers can advise applicants to include emission rates from authorized facilities that are not included in the PSDB as applicable.

[8] Some standard techniques: use the stack with the worst-case dispersion as a representative stack. Assume project maximum emissions are emitted from the representative stack. Or, one run for each facility using the maximum hourly emission rate and 1) sum the predicted concentrations from overlapping grids or 2) sum the highest concentration anywhere on the grid from each run to determine the maximum concentration. Use the following equation to determine the worst-case stack: M = hs V Ts ÷ Q where

M = a parameter that accounts for the relative influence of stack height, plume rise, and emission rate on concentrations;

hs = the physical stack height in meters;

$V = (\pi/4)\, d_s^2\, v_s$ = stack gas flow rate in cubic meters per second;

ds = inside stack diameter in meters;

vs = stack gas exit velocity in meters per second;

Ts = the stack gas exit temperature in Kelvin; and,

Q = pollutant emission rate in grams per second.

The stack that has the lowest value of M is used as a representative stack. The sum of the emissions from all stacks is assumed to be emitted from the representative stack; that is, the stack whose parameters resulted in the lowest value of M.

| *Interim* 1-Hour $NO_2$ Screening Background Concentrations in micrograms per cubic meter ($\mu g/m^3$)[1] | | | |
|---|---|---|---|
| Region / Specific County[2] | Screening Background | Region / Specific County | Screening Background |
| 1 | 70 | 10 | 70 |
| | | Jefferson | 90 |
| | | Orange | 70 |
| 2 | 70 | | |
| | | | |
| 3 | 70 | 11 | 70 |
| | | Travis | 85 |
| | | | |
| 4 | 70 | 12 | 70 |
| Dallas | 104 | Brazoria | 75 |
| Ellis | 85 | Galveston | 75 |
| Tarrant | 107 | Harris | 120 |
| | | Montgomery | 75 |
| | | | |
| 5 | 70 | 13 | 70 |
| Titus | 90 | Bexar | 100 |
| Rusk | 90 | | |
| | | | |
| 6 | 70 | 14 | 70 |
| El Paso | 124 | Nueces | 90 |
| | | | |
| 7 | 70 | 15 | 70 |
| | | Hildalgo | 100 |
| | | | |
| 8 | 70 | 16 | 70 |
| | | Webb | 100 |
| 9 | 70 | | |
| Freestone | 90 | | |
| Limestone | 90 | | |

These values are conservative and based on available ambient monitoring design values (2007-2009) and may change as more research is conducted and/or data obtained.

If a value is too conservative, contact the Air Dispersion Modeling Team to determine if a more refined background concentration is available.

[1] Use the value for the region the project will be located in, or county if listed
[2] NAAQS in 188 $\mu g/m^3$ converted from parts per billion based on standard temperature and pressure

# Texas Natural Resource Conservation Commission

INTEROFFICE MEMORANDUM

**TO:** NSRPD Staff **DATE:** August 3, 1998

**FROM:** Dom Ruggeri, Team Leader
Air Dispersion Modeling Team (ADMT)

**SUBJECT:** Modeling Guidance for Exemption 106.512 (Formerly SE 6)

If an applicant meets the general requirements to claim an exemption under this rule, the applicant must demonstrate that emissions from an exempted source will not cause or contribute to a violation of the $NO_2$ NAAQS [106.512(6)]. One of the methods to show compliance with the $NO_2$ NAAQS involves dispersion modeling [106.512(6)(A)]. The applicant can use the following procedure to conduct the modeling demonstration:

Step 1. *Determine the long-term hourly emission rate for each source.*
Use the applicable $NO_2/NO_x$ ratio in Figure 1: 30 TAC §106.512(6)(A) to adjust the hourly rate for each source.

Step 2. *Determine if the $NO_2$ de minimis is exceeded.*
Use EPA's SCREEN3 or ISCST3 model to determine if the new or modified sources' emissions will exceed the $NO_2$ de minimis of 1 $\mu g/m^3$. If the predicted concentration is $\leq$ 1 $\mu g/m^3$, the demonstration is complete. If not, go to Step 3.

Step 3. *Determine the background concentration from the Screening Background Concentrations table (attached).* If the predicted concentration plus background is $\leq$ 100 $\mu g/m^3$, the demonstration is complete. If not, a full state NAAQS analysis may be required if the screening background concentration cannot be refined to a more representative value. Go to Step 4.

Step 4. *Determine if there is a $NO_2$ monitor in the county.* If not, go to Step 5.
Obtain a background concentration from a representative monitor in the county. Use the most recent annual concentration from the Aerometric Information Retrieval System (AIRS) [www.epa.gov/airsweb/monreps.htm] that is based on at least 6570 hours of observations.

Convert the concentration from ppm to $\mu g/m^3$ by multiplying the AIRS concentration by 1887. If the predicted concentration plus the monitored background concentration is $\leq$ 100 $\mu g/m^3$, the demonstration is complete. If not, a full state NAAQS analysis may be required. Contact the ADMT staff for modeling guidance.

Step 5. *Contact the ADMT staff for assistance in developing a representative background concentration.* If the predicted concentration plus a representative background concentration is $\leq$ 100 $\mu g/m^3$, the demonstration is complete. If not, a full state NAAQS analysis may be required. Contact the ADMT staff for modeling guidance.

Attachment



EFSCOP00009441

# SCREENING BACKGROUND CONCENTRATIONS
# $NO_2$
# August, 1998

Note: Use regional values unless concentrations for a specific county are provided.

| Regional Background / Specific County Background - Annual Concentration ($\mu g/m^3$) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Region 1<br>20 | Region 2 20 | Region3<br>20 | Region 4<br>20 | Region 5<br>20 | Region 6 20 | Region 7<br>20 | Region 8<br>20 |
| Potter<br>25 | Lubbock<br>25 | Wichita<br>25 | Collin<br>25 | Rusk<br>30 | El Paso<br>70 | Ector<br>35 | |
| | | | Dallas<br>55 | Smith<br>25 | | | |
| | | | Denton<br>25 | Titus<br>30 | | | |
| | | | Ellis<br>25 | | | | |
| | | | Tarrant<br>40 | | | | |

| Regional Background / Specific County Background - Annual Concentration ($\mu g/m^3$) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Region 9<br>20 | Region 10<br>20 | Region 11<br>20 | Region 12<br>20 | Region 13<br>20 | Region 14<br>20 | Region 15<br>20 | Region 16<br>20 |
| Bell<br>40 | Jefferson<br>35 | Fayette<br>30 | Brazoria<br>35 | Bexar<br>50 | Nueces<br>35 | Cameron<br>30 | Webb<br>25 |
| Limestone<br>25 | Orange<br>35 | Travis<br>45 | Chambers<br>25 | | Victoria<br>25 | Hidalgo<br>30 | |
| McLennan<br>30 | | Williamson<br>25 | Ft. Bend<br>35 | | | | |
| Robertson<br>35 | | | Galveston<br>30 | | | | |
| | | | Harris<br>60 | | | | |
| | | | Montgomery<br>25 | | | | |



EFSCOP00009442

# Appendix B

## Screening Factors and Ratio Techniques

**Screening Factors**. For averaging times greater than one hour, the maximum concentration will generally be less than the 1-hour value. Use the factors in Table B-1 to convert point and volume source related concentrations (EPA, 1992a and ADMT memo on the ADMT Internet page for lead modeling). Do not use the multiplying factors to obtain concentrations from area sources for averaging times greater than one hour. Concentrations close to an area source will not vary as much as those for point and volume sources in response to varying wind directions, and the meteorological conditions which are likely to give maximum 1-hour concentration can persist for several hours. Therefore, to be conservative, ADMT recommends that the maximum 1-hour concentrations for area sources be assumed to apply for averaging periods out to 24 hours.

**Table B - 1. Multiplying Factors to Convert 1-Hour Point and Volume Source Concentrations to Other Averaging Times**

| Averaging Time | Multiplying Factor |
|---|---|
| 3-Hour | 0.9 |
| 8-Hour | 0.7 |
| 24-Hour | 0.4* |
| Quarterly | 0.2* |
| Annual | 0.08* |

* Can be used for area sources.

**Ratio Technique 1.** This technique uses a unit emission rate (1 pound per hour or 1 gram per second) to determine if the maximum contribution from each permitted source when added together, independent of time and space, could exceed a standard or ESL. This is a conservative procedure since the maximum concentration from all sources modeled concurrently cannot be more than the sum of the maximum concentration from each source modeled separately.

Each source is evaluated separately with a unit emission rate, such as 1 pound per hour or 1 gram per second; the source's actual location; and the source's proposed stack parameters represented in the permit application. In the ISC models this is done by setting up a separate source group for

each source. The SCREEN model can also be used for this demonstration with a separate SCREEN model run for each source.

The maximum predicted concentration for each source is then multiplied by the appropriate emission rate factor for each source and for each pollutant. The emission rate factor is the ratio of the approved emission rate divided by the unit emission rate.

The sum of the maximum concentrations (for each pollutant, independent of time and space) is then compared with the threshold of concern for each pollutant. If the sum for any pollutant is greater than that value, then refined modeling may be required and if so, enter the emission rate for each source for this pollutant into the model for additional evaluation so that time and space are considered.

Determining individual source contributions to the ALL source group maximum concentration in the ISC model is not appropriate unless there is only one source or the pollutants are emitted in exactly the same amount for all sources, or pollutants are emitted in exactly the same ratio for all sources.

**Ratio Technique 2.** One pollutant is modeled for all sources with TNRCC approved emission rates and stack parameters. Other TNRCC approved pollutant emission rates are then compared with the modeled pollutant emission rate to determine the source which has the maximum ratio. This maximum ratio is then multiplied by the predicted maximum off-property concentration for the pollutant modeled. If the resulting maximum concentration exceeds a value of concern, then additional refined modeling may be needed and, if so, enter the emission rate for each source of this pollutant into the model.

**Ambient Ratio Method.** The EPA adopted a new method to predict annual $NO_2$ concentrations [GAQM, Section 6.2.3 (EPA, 1995a)] that can be applied during screening modeling or refined modeling. This method consists of two approaches. One approach applies a conversion factor to the emission rate, and the other applies a conversion factor to the predicted concentration. The process is outlined in the following steps that do not need to be applied in sequence.

***Step 1:*** Assume total conversion of $NO_X$ to $NO_2$. Use the $NO_X$ emission rate as a surrogate for the $NO_2$ emission rate. Conduct screening or refined modeling, as applicable. This approach is conservative but is not realistic. If the concentration exceeds the de minimis or NAAQS (with background concentration added), go to Step 2.

***Step 2:*** Apply a conversion factor to the predicted concentration.

***Step 2a:*** Assume limited conversion of $NO_X$ to $NO_2$. Multiply the predicted annual $NO_X$ concentration by the national default of 0.75. This approach is conservative. If additional refinement is needed, go to Step 2b if applicable.

***Step 2b:*** Obtain a representative factor for conversion of $NO_X$ to $NO_2$. Multiply the predicted annual $NO_X$ concentration by a measured $NO_2 / NO_X$ ratio obtained from a site-specific or representative regional air monitor.

***Step 3:*** Apply a conversion factor to the emission rate.

***Step 3a:*** Assume limited conversion of $NO_X$ to $NO_2$. Multiply the $NO_X$ emission rate by the national default of 0.75. This approach is conservative. Conduct screening or refined modeling, as applicable. If additional refinement is needed, go to Step 3b, if applicable.

***Step 3b:*** Obtain a representative factor for conversion of $NO_X$ to $NO_2$. Multiply the emission rate by a measured $NO_2 / NO_X$ ratio obtained from a site-specific or representative regional monitor. Conduct screening or refined modeling, as applicable.

http://www.epa.gov/air/criteria.html
Last updated on Tuesday, November 08, 2011

Air and Radiation

You are here: EPA Home Air and Radiation National Ambient Air Quality Standards (NAAQS)

# National Ambient Air Quality Standards (NAAQS)

The Clean Air Act, which was last amended in 1990, requires EPA to set National Ambient Air Quality Standards (40 CFR part 50) for pollutants considered harmful to public health and the environment. The Clean Air Act identifies two types of national ambient air quality standards. ***Primary standards*** provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. ***Secondary standards*** provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

EPA has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" pollutants. They are listed below. Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, and micrograms per cubic meter of air (μg/m$^3$).

| Pollutant [final rule cite] | | Primary/ Secondary | Averaging Time | Level | Form |
|---|---|---|---|---|---|
| Carbon Monoxide [76 FR 54294, Aug 31, 2011] | | primary | 8-hour | 9 ppm | Not to be exceeded more than once per year |
| | | | 1-hour | 35 ppm | |
| Lead [73 FR 66964, Nov 12, 2008] | | primary and secondary | Rolling 3 month average | 0.15 μg/m$^3$ (1) | Not to be exceeded |
| Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996] | | primary | 1-hour | 100 ppb | 98th percentile, averaged over 3 years |
| | | primary and secondary | Annual | 53 ppb (2) | Annual Mean |
| Ozone [73 FR 16436, Mar 27, 2008] | | primary and secondary | 8-hour | 0.075 ppm (3) | Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years |
| Particle Pollution [71 FR 61144, Oct 17, 2006] | $PM_{2.5}$ | primary and secondary | Annual | 15 μg/m$^3$ | annual mean, averaged over 3 years |
| | | | 24-hour | 35 μg/m$^3$ | 98th percentile, averaged over 3 years |
| | $PM_{10}$ | primary and secondary | 24-hour | 150 μg/m$^3$ | Not to be exceeded more than once per year on average over 3 years |
| Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973] | | primary | 1-hour | 75 ppb (4) | 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years |
| | | secondary | 3-hour | 0.5 ppm | Not to be exceeded more than once per year |

as of October 2011

(1) Final rule signed October 15, 2008. The 1978 lead standard (1.5 μg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

(2) The official level of the annual NO2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(3) Final rule signed March 12, 2008. The 1997 ozone standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, EPA revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard ("anti-backsliding"). The 1-hour ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.

(4) Final rule signed June 2, 2010. The 1971 annual and 24-hour SO2 standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

See historical tables of NAAQS standards

- Carbon Monoxide
- Lead
- Nitrogen Dioxide
- Ozone
- Particle Pollution
- Sulfur Dioxide

| *Interim* 1-Hour $SO_2$ Screening Background Concentrations in micrograms per cubic meter (µg/m³)[1] | | | |
|---|---|---|---|
| Region/Specific County[2] | Screening Background | Region/Specific County | Screening Background |
| 1 | 50 | 5 | 50 |
| Hutchinson | Cannot be used | Titus | Cannot be used |
| Potter | Cannot be used | Rusk | Cannot be used |
| Gray | Cannot be used | Harrison | Cannot be used |
| Moore | 150 | Smith | 150 |
| Carson | Cannot be used | Cass | 150 |
| Parmer | Cannot be used | Gregg | Cannot be used |
| 2 | 50 | Henderson | Cannot be used |
| Lamb | Cannot be used | Bowie | 150 |
| Hockley | 80 | Anderson | Cannot be used |
| Bailey | Cannot be used | Morris | Cannot be used |
| 3 | 50 | Panola | Cannot be used |
| Wilbarger | 150 | Camp | Cannot be used |
| Wichita | 80 | Franklin | Cannot be used |
| Nolan | 80 | 6 | 50 |
| 4 | 50 | El Paso | 80 |
| Dallas | Cannot be used | 7 | 50 |
| Tarrant | Cannot be used | Howard | 150 |
| Ellis | Cannot be used | Ector | 80 |
| Collin | 80 | Midland | 80 |
| Navarro | Cannot be used | 8 | 50 |
| Denton | 80 | Crockett | 80 |
| Kaufman | 50 | Coke | 80 |

[1] The NAAQS is 196 µg/m³ converted from parts per billion based on standard temperature and pressure
[2] Use the value for the region the project will be located in, or county if listed

| *Interim* 1-Hour $SO_2$ Screening Background Concentrations in micrograms per cubic meter (µg/m³) | | | |
|---|---|---|---|
| Region/Specific County | Screening Background | Region/Specific County | Screening Background |
| 9 | 50 | 12 | 50 |
| Freestone | Cannot be used | Fort Bend | Cannot be used |
| Milam | Cannot be used | Harris | Cannot be used |
| Limestone | Cannot be used | Galveston | 150 |
| Grimes | Cannot be used | Brazoria | 150 |
| Robertson | 150 | Matagorda | 150 |
| McLennan | 80 | Colorado | Cannot be used |
| Brazos | Cannot be used | 13 | 50 |
| Bosque | 80 | Bexar | 150 |
| Leon | Cannot be used | Atascosa | Cannot be used |
| Falls | 150 | Comal | 80 |
| 10 | 50 | Wilson | 150 |
| Jefferson | Cannot be used | 14 | 50 |
| Orange | Cannot be used | Goliad | Cannot be used |
| 11 | 50 | Nueces | Cannot be used |
| Fayette | Cannot be used | Calhoun | 150 |
| Travis | 80 | Aransas | 150 |
| Hays | 80 | Bee | 150 |
| Williamson | 80 | Victoria | Cannot be used |
| Caldwell | 80 | Lavaca | 80 |
| Bastrop | 80 | Live Oak | 80 |
| Lee | Cannot be used | 15 | 50 |
| | | 16 | 50 |
| | | McMullen | Cannot be used |

These values are conservative and based on available ambient monitoring design values (2007-2009), emissions inventory data, and permit allowable rates. However, the screening values cannot be used if more recent data indicates a higher value than in the tables. The values may change as more research is conducted and/or data obtained. It is the applicant's responsibility to determine the appropriate air quality concentrations to use for the source impact and air quality demonstration.

If a value is overly conservative, contact the Air Dispersion Modeling Team to determine if a more refined background concentration is available. For counties where the screening background values cannot be used, if the project's impact is greater than EPA's interim significance value, 7.8 $\mu g/m^3$, then a more refined analysis is required.

# Texas Natural Resource Conservation Commission

INTEROFFICE MEMORANDUM

**TO:** NSRPD Technical Staff **DATE:** September 4, 1998

**FROM:** Dom Ruggeri, Team Leader
Air Dispersion Modeling Team (ADMT)

**SUBJECT:** Screening Background Concentrations

The concentrations in the attached tables were developed for use with the Modeling Request Flowchart. They were determined based on a statewide review of: the highest monitored values during 1992-1997 for sulfur dioxide ($SO_2$), nitrogen dioxide ($NO_2$), particulate matter with an aerodynamic diameter of 10 microns or less ($PM_{10}$), lead (Pb), and carbon monoxide (CO); countywide point source emissions; and population, as a surrogate for non-point source emissions. These concentrations are meant to be conservative, since they were developed for use primarily in the screening modeling process.

The tables contain the highest background concentrations expected within a TNRCC region. For some projects, additional refinement of screening background concentrations may be appropriate, particularly in areas with multiple ambient air monitors. ADMT staff can assist in the determination of more refined screening background concentrations on a case-by-case basis.

Attachments

SCREENING BACKGROUND CONCENTRATIONS ($\mu g/m^3$)
September, 1998

| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Region/ Specific County | Pb Quarter 1.5 | CO 1-Hour 40000 | CO 8-Hour 10000 | $PM_{10}$ 24-Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3-Hour 1300 | $SO_2$ 24-Hour 365 | $SO_2$ Annual 80 |
| 1- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| Carson | | | | 161 | 25 | | 260 | 75 | 12 |
| Gray | | 14000 | 7000 | | | | | | |
| Hutchinson | | 18000 | 9000 | 75 | 25 | | 1040 | 275 | 40 |
| Moore | | 14000 | 7000 | | | | | | |
| Potter | 0.4 | 10000 | 5000 | 90 | 30 | 25 | 975 | 240 | 36 |

| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Region/ Specific County | Pb Quarter 1.5 | CO 1-Hour 40000 | CO 8-Hour 10000 | $PM_{10}$ 24-Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3-Hour 1300 | $SO_2$ 24-Hour 365 | $SO_2$ Annual 80 |
| 2- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| Lamb | 0.4 | | | 75 | 25 | | 975 | 240 | 36 |
| Lubbock | | 10000 | 5000 | 164 | 37 | 25 | 260 | 75 | 12 |

| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Region/ Specific County | Pb Quarter 1.5 | CO 1-Hour 40000 | CO 8-Hour 10000 | $PM_{10}$ 24-Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3-Hour 1300 | $SO_2$ 24-Hour 365 | $SO_2$ Annual 80 |
| 3- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| Mitchell | | | | | | | 520 | 150 | 20 |
| Taylor | | 10000 | 5000 | | | | | | |
| Wichita | | 10000 | 5000 | 90 | 30 | 25 | | | |
| Wilbarger | | | | | | | 520 | 150 | 20 |

| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Region / Specific County | Pb Quarter 1.5 | CO 1 Hour 40000 | CO 8 Hour 10000 | $PM_{10}$ 24 Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3 Hour 1300 | $SO_2$ 24 Hour 365 | $SO_2$ Annual 80 |
| 4- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| Collin | 1.0 | 10000 | 5000 | 90 | 30 | 25 | 260 | 75 | 12 |
| Dallas | 0.4 | 18000 | 9000 | 120 | 40 | 55 | | | |
| Denton | | 10000 | 5000 | 90 | 30 | 25 | | | |
| Ellis | 0.5 | 10000 | 5000 | 116 | 50 | 25 | 975 | 240 | 36 |
| Hood | | | | | | | 260 | 75 | 12 |
| Kaufman | 0.5 | | | | | | | | |
| Navarro | | | | | | | 260 | 75 | 12 |
| Palo Pinto | | | | | | | 260 | 75 | 12 |
| Tarrant | | 16000 | 8000 | 105 | 35 | 40 | | | |
| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |

| Region/ Specific County | Pb Quarter 1.5 | CO 1-Hour 40000 | CO 8-Hour 10000 | $PM_{10}$ 24-Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3-Hour 1300 | $SO_2$ 24-Hour 365 | $SO_2$ Annual 80 |
|---|---|---|---|---|---|---|---|---|---|
| 5- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| Cass | | 10000 | 5000 | | | | 520 | 150 | 20 |
| Gregg | | 10000 | 5000 | | | | | | |
| Harrison | | | | 75 | 25 | | 910 | 220 | 32 |
| Hopkins | | | | | | | 780 | 200 | 24 |
| Morris | 0.4 | | | | | | 260 | 75 | 12 |
| Rusk | | 10000 | 5000 | 105 | 35 | 30 | 1040 | 275 | 40 |
| Smith | | 10000 | 5000 | 75 | 25 | 25 | | | |
| Titus | | | | 98 | 35 | 30 | 1040 | 275 | 40 |

| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Region/ Specific County | Pb Quarter 1.5 | CO 1-Hour 40000 | CO 8-Hour 10000 | $PM_{10}$ 24-Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3-Hour 1300 | $SO_2$ 24-Hour 365 | $SO_2$ Annual 80 |
| 6- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| El Paso | 0.4 | 28000 | 14000 | 256 | 63 | 70 | 910 | 240 | 36 |

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| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Region/ Specific County | Pb Quarter 1.5 | CO 1-Hour 40000 | CO 8-Hour 10000 | $PM_{10}$ 24-Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3-Hour 1300 | $SO_2$ 24-Hour 365 | $SO_2$ Annual 80 |
| 7- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| Crane | | | | | | | 520 | 150 | 20 |
| Ector | | 10000 | 5000 | 126 | 26 | 35 | | | |
| Howard | | 14000 | 7000 | | | | 520 | 150 | 20 |
| Midland | | 10000 | 5000 | | | | | | |
| Pecos | | | | | | | 260 | 75 | 12 |
| Ward | | | | | | | 520 | 150 | 20 |
| Winkler | | | | | | | 780 | 200 | 24 |

| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Region/ Specific County | Pb Quarter 1.5 | CO 1-Hour 40000 | CO 8-Hour 10000 | $PM_{10}$ 24-Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3-Hour 1300 | $SO_2$ 24-Hour 365 | $SO_2$ Annual 80 |
| 8- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| Tom Green | | 10000 | 5000 | | | | | | |

| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Region/ Specific County | Pb Quarter 1.5 | CO 1-Hour 40000 | CO 8-Hour 10000 | $PM_{10}$ 24-Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3-Hour 1300 | $SO_2$ 24-Hour 365 | $SO_2$ Annual 80 |
| 9- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| Bell | | 10000 | 5000 | 75 | 25 | 40 | | | |
| Brazos | | 10000 | 5000 | | | | | | |
| Freestone | | | | 90 | 30 | | | | |
| Grimes | | | | | | | 780 | 200 | 24 |
| Limestone | | | | 75 | 25 | 25 | 1040 | 275 | 40 |
| McClennen | | 10000 | 5000 | 75 | 25 | 30 | 260 | 75 | 12 |
| Milam | | 14000 | 7000 | 75 | 25 | | 1040 | 275 | 40 |
| Robertson | 0.4 | | | 90 | 30 | 35 | 1040 | 275 | 40 |

| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Region/ Specific County | Pb Quarter 1.5 | CO 1-Hour 40000 | CO 8-Hour 10000 | $PM_{10}$ 24-Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3-Hour 1300 | $SO_2$ 24-Hour 365 | $SO_2$ Annual 80 |
| 10- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| Angelina | 0.4 | 10000 | 5000 | 75 | 25 | | | | |
| Hardin | | | | 75 | 25 | | | | |
| Jefferson | 0.1 | 14000 | 7000 | 113 | 33 | 35 | 1040 | 275 | 40 |
| Orange | 0.4 | 14000 | 7000 | 75 | 25 | 35 | 780 | 200 | 24 |

| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Region/ Specific County | Pb Quarter 1.5 | CO 1-Hour 40000 | CO 8-Hour 10000 | $PM_{10}$ 24-Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3-Hour 1300 | $SO_2$ 24-Hour 365 | $SO_2$ Annual 80 |
| 11- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| Fayette | | | | 90 | 30 | 30 | 1040 | 275 | 40 |
| Travis | | 14000 | 8000 | 90 | 30 | 45 | 520 | 150 | 20 |
| Williamson | | 10000 | 5000 | 75 | 25 | 25 | | | |

| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Region/ Specific County | Pb Quarter 1.5 | CO 1-Hour 40000 | CO 8-Hour 10000 | $PM_{10}$ 24-Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3-Hour 1300 | $SO_2$ 24-Hour 365 | $SO_2$ Annual 80 |
| 12- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| Austin | | | | 135 | 45 | | | | |
| Brazoria | | 10000 | 5000 | 98 | 33 | 35 | 1040 | 275 | 40 |
| Chambers | | 10000 | 5000 | | | 25 | 260 | 75 | 12 |
| Fort Bend | | 10000 | 5000 | 98 | 33 | 35 | 1040 | 275 | 40 |
| Galveston | | 14000 | 7000 | 116 | 30 | 30 | 780 | 275 | 40 |
| Harris | | 20000 | 9800 | 143 | 47 | 60 | 1040 | 275 | 40 |
| Montgomery | 0.4 | | | 75 | 25 | 25 | | | |

| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Region/ Specific County | Pb Quarter 1.5 | CO 1-Hour 33400 | CO 8-Hour 10000 | $PM_{10}$ 24-Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3-Hour 1300 | $SO_2$ 24-Hour 365 | $SO_2$ Annual 80 |
| 13- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| Atascosa | | | | | | | 780 | 200 | 24 |
| Bexar | 0.4 | 20000 | 9800 | 120 | 40 | 50 | 1040 | 275 | 40 |
| Comal | | | | 75 | 25 | | | | |

| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Region/ Specific County | Pb Quarter 1.5 | CO 1-Hour 40000 | CO 8-Hour 10000 | $PM_{10}$ 24-Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3-Hour 1300 | $SO_2$ 24-Hour 365 | $SO_2$ Annual 80 |
| 14- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| Aransas | | 10000 | 5000 | | | | 260 | 75 | 12 |
| Calhoun | | | | 75 | 25 | | 260 | 75 | 12 |
| Goliad | | | | | | | 910 | 220 | 32 |
| Nueces | | 14000 | 7000 | 105 | 35 | 35 | 910 | 220 | 32 |
| Victoria | | 10000 | 5000 | | | 25 | | | |

| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Region/ Specific County | Pb Quarter 1.5 | CO 1-Hour 40000 | CO 8-Hour 10000 | $PM_{10}$ 24-Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3-Hour 1300 | $SO_2$ 24-Hour 365 | $SO_2$ Annual 80 |
| 15- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| Cameron | | 14000 | 7000 | 128 | 33 | 30 | | | |
| Hildalgo | | 14000 | 7000 | 128 | 33 | 30 | | | |

| | Pollutant / Averaging Period / Standard / Background Concentration | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pollutant Standard/ Region/ Specific County | Pb Quarter 1.5 | CO 1-Hour 40000 | CO 8-Hour 10000 | $PM_{10}$ 24-Hour 150 | $PM_{10}$ Annual 50 | $NO_2$ Annual 100 | $SO_2$ 3-Hour 1300 | $SO_2$ 24-Hour 365 | $SO_2$ Annual 80 |
| 16- | 0.1 | 4000 | 1000 | 60 | 20 | 20 | 130 | 36 | 8 |
| Maverick | | 10000 | 5000 | 75 | 25 | | | | |
| Val Verde | | 10000 | 5000 | | | | | | |
| Webb | | 16000 | 8000 | 186 | 42 | 25 | | | |

# ATTACHMENT 6
# SUPPORTING DOCUMENTATION

## OIL AND GAS STANDARD PERMIT REGISTRATION

## LACKEY LAND A639 UNIT A1 & B1

## BURLINGTON RESOURCES OIL & GAS COMPANY LP

**Description** **Page**


Air Quality Standard Permit for Oil and Gas Handling and Production Facilities ..... 6-1

30 TAC §116.610: Applicability ..... 6-57

30 TAC §116.611: Registration to Use a Standard Permit ..... 6-58

30 TAC §116.614: Standard Permit Fees ..... 6-60

30 TAC §116.615: General Conditions ..... 6-60

TCEQ Facility/Compound Specific Fugitive Emission Factors Table from Air Permit Technical Guidance for Chemical Sources: Equipment Fugitive Leaks, dated October 2000 ..... 6-63

TCEQ Guidance on Loading Operations ..... 6-66

TCEQ Table 4: Flare Factors from Air Permit Technical Guidance for Chemical Sources: Flares and Vapor Oxidizers, dated June 1998 ..... 6-70

AP-42 Table 1.4-2: Emission Factors for Criteria Pollutants and Greenhouse Gases from Natural Gas Combustion ..... 6-71

AP-42 Table 1.4-3: Emission Factors for Speciated Organic Compounds from Natural Gas Combustion ..... 6-72

Site Data ..... 6-74

Extended Gas Analysis Reports- Representative Sample ..... 6-75

$H_2S$ Representative Reading ..... 6-86

## Air Quality Standard Permit for Oil and Gas Handling and Production Facilities

(a) **Applicability**. This standard permit applies to all stationary facilities, or groups of facilities, at a site which handle gases and liquids associated with the production, conditioning, processing, and pipeline transfer of fluids or gases found in geologic formations on or beneath the earth's surface including, but not limited to, crude oil, natural gas, condensate, and produced water with the following conditions.

(1) The requirements in paragraphs (a)-(k) of this standard permit are applicable in only for new projects and dependent facilities located in the Barnett Shale (Archer, Bosque, Clay, Comanche, Cooke, Coryell, Dallas, Denton, Eastland, Ellis, Erath, Hill, Hood, Jack, Johnson, Montague, Palo Pinto, Parker, Shackelford, Stephens, Somervell, Tarrant, and Wise counties) on or after April 1, 2011. For all other new projects and dependent facilities in all other counties of the state, paragraph (l) of this standard permit is applicable.

(2) Only one Air Quality Standard Permit for Oil and Gas Handling and Production Facilities for an oil and gas site (OGS) may be registered for a combination of dependent facilities and authorizes all facilities in sweet or sour service. This standard permit may not be used if operationally dependent facilities are authorized by the permit by rule in Title 30, Texas Administrative Code (30 TAC) §106.352, Oil and Gas Handling and Production Facilities, or a permit under 30 TAC §116.111,General Application. Existing authorized facilities, or groups of facilities, at an OGS under this standard permit which are not changing certified character or quantity of emissions must only meet subsections (i) and (k) of this standard permit (protectiveness review and planned maintenance, startup, and shutdown (MSS) requirements) and otherwise retain their existing authorization. Other facilities which are not covered under this standard permit may be authorized by other authorizations at an OGS if (b)(6) and (k) of this standard permit are met.

(3) This standard permit does not relieve the owner or operator from complying with any other applicable provision of the Texas Health and Safety Code, Texas Water Code, rules of the Texas Commission on Environmental Quality (TCEQ), or any additional local, state or federal regulations. Emissions that exceed the limits in this standard permit are not authorized and are violations.

(4) Emissions from upsets, emergencies, or malfunctions are not authorized by this standard permit. This standard permit does not regulate methane, ethane, or carbon dioxide.

(b) **Definitions and Scope.**

(1) Facility is a discrete or identifiable structure, device, item, equipment, or enclosure that constitutes or contains a stationary source. Stationary sources associated with a mine, quarry, or well test lasting less than 72 hours are not considered facilities.

(2) Receptor includes any building which is in use as a single or multi-family residence, school, day-care, hospital, business, or place of worship at the time this standard permit is registered. A residence is a structure primarily used as a permanent dwelling. A business is a structure

that is occupied for at least 8 hours a day, 5 days a week, and does not include businesses who are handling or processing materials as described in subsection (a). This term does not include structures occupied or used solely by the owner or operator of the oil and gas facility, or the mineral rights owner of the property upon which the facility is located. All measurements of distance to receptors shall be taken from the emission release point at the oil and gas facility that is nearest to the point on the building that is nearest to the oil and gas facility.

(3) An OGS is defined as all facilities which meet the following:
   (A) Located on contiguous or adjacent properties;
   (B) Under common control of the same person (or persons under common control); and
   (C) Designated under same 2-digit standard industrial classification (SIC) codes.

(4) For purposes of determining applicability of 30 TAC Chapter 122, Federal Operating Permits, the definitions of 30 TAC §122.10, General Definitions, apply.

(5) A project under this standard permit is defined as the following and must meet all requirements of this standard permit prior to construction or implementation of changes.
   (A) Any new facility or new group of operationally dependent facilities at an OGS; or
   (B) Physical changes to existing authorized facilities or group of facilities at an OGS which increase the potential to emit over previously registered emission limits; or
   (C) Operational changes to existing authorized facilities or group of facilities at an OGS which increase the potential to emit over previously registered emission limits.

(6) For purposes of registration under this standard permit, the following facilities shall be included:
   (A) All facilities or groups of facilities at an OGS which are operationally dependent on each other;
   (B) Facilities must be located within a 1/4 mile of a project emission point, vent, or fugitive component, except for those components excluded in (b)(6)(C) of this standard permit;
   (C) If piping or fugitive components are the only connection between facilities and the distance between facilities exceeds 1/4 mile, then the facilities are considered separate for purposes of this registration;
   (D) The boundaries of the registration become fixed at the time this standard permit is registered. No individual facility may be authorized under more than one registration;
   (E) Any facility or group of facilities authorized under an existing standard permit registration which is operationally dependent on a project must be revised to incorporate the project; and
   (F) A registration may include facilities which are claiming 30 TAC § 116.620, Installation and/or Modification of Oil and Gas Facilities as well as projects which are claiming this standard permit. Existing authorized facilities, or group of facilities, at an OGS under this standard permit which are not changing registered and certified character or quantity of emissions must only meet paragraphs (i) and (k) of this standard permit (the protectiveness review and planned maintenance, startup, and shutdown (MSS) requirements) until the registration is renewed after December 31, 2015, after which paragraphs (a) – (k) of this standard permit apply.

(7) For purposes of all previous claims of this standard permit (or any previous version of this standard permit) where no project is occurring:
   (A) Existing authorized facilities, or group of facilities, which have not registered planned MSS activity emissions prior to the effective dates in (a)(1) of this standard permit must

meet paragraph (i) of this standard permit (planned MSS) no later than January 5, 2012; or

(B) Existing authorized facilities, or group of facilities, which have registered planned MSS activity emissions and compliance with 30 TAC § 116.620(a)(1) has been demonstrated prior to the effective dates in (a)(1) of this standard permit, must meet paragraph (i) of this standard permit (planned MSS) no later than the registration renewal submitted after December 31, 2015.

(8) For purposes of ensuring protection of public health and welfare and demonstrating compliance with applicable ambient air standards and effects screening levels, the impacts analysis as specified in paragraph (k) of this standard permit must be completed.

(A) All impacts analysis must be done on a contaminant-by-contaminant basis for any net project increases. If a claim under this standard permit is only for planned MSS under paragraph (i) of this standard permit, the analysis shall evaluate planned MSS scenarios only.

(B) Hourly and annual emissions shall be limited based on the most stringent of paragraphs (h) or (k) of this standard permit.

(c) **Authorized Facilities, Changes and Activities**.

(1) For existing OGS which are authorized by previous versions of this standard permit:

(A) A project requires registration unless otherwise specified.

(B) The following projects do not require registration, but must comply with best management practices in paragraph (e) of this standard permit, compliance demonstrations in paragraphs (i) and (j) of this standard permit and must be incorporated into the registration at the next revision or certification:

(i) Addition of any piping, fugitive components, any other new facilities that increase registered emissions less than or equal to 1.0 tpy volatile organic compounds (VOC), 5.0 tpy nitrogen oxides (NOx), 0.01 tpy benzene, and 0.05 tpy hydrogen sulfide ($H_2S$) over a rolling 12-month period;

(ii) Changes to any existing facilities that increase registered emissions less than or equal to 1.0 tpy VOC, 5.0 tpy nitrogen oxides (NOx), 0.01 tpy benzene, and 0.05 tpy $H_2S$ over a rolling 12-month period; or

(ii) Total increases over a rolling 60-month period that are less than or equal to 5.0 tpy VOC or $NO_X$, 0.05 tpy benzene, or 0.1 tpy $H_2S$; or

(iv) Addition of any new engine rated less than 100 horsepower (hp); or

(v) Replacement of any facility if the new facility does not increase the previous registered emissions.

(C) In lieu of registering proposed changes under this standard permit, incremental emissions increases associated with construction of new facilities or changes to existing facilities may be authorized by 30 TAC §106.261, Facilities (Emission Limitations) or §106.262, Facilities (Emissions and Distance Limitations), if the maximum worst-case emissions also meet the limitations established by paragraphs (b)(8) and (k) of this standard permit for all air contaminants with proposed increases.

(2) All authorizations under this standard permit shall meet the following:

(A) New, changed, or replacement facilities shall not exceed the thresholds for major source or major modification as defined in 30 TAC §116.12, Nonattainment and Prevention of Significant Deterioration Review Definitions, and in Federal Clean Air Act §112(g) or §112(j);

(B) All facilities shall comply with all applicable 40 Code of Federal Regulations (CFR), Parts 60, 61, and 63 requirements for New Source Performance Standards (NSPS), National Emission Standards for Hazardous Air Pollutants (NESHAP), and Maximum Achievable Control Technology (MACT); and

(D) All facilities shall comply with all applicable requirements of 30 TAC Chapters 111, Control of Air Pollution from Visible Emissions and Particulate Matter, 112, Control of Air Pollution from Sulfur Compounds, 113, Standards of Performance for Hazardous Air Pollutants and for Designated Facilities and Pollutants, 115, Control of Air Pollution from Volatile Organic Compounds), and 117, Control of Air Pollution from Nitrogen Compounds.

(3) To be eligible for this standard permit an applicant:

(A) shall meet all applicable requirements as set forth in this standard permit;

(B) shall not misrepresent or fail to fully disclose all relevant facts in obtaining the permit; and

(C) shall not be indebted to the state for failure to make payment of penalties or taxes imposed by the statutes or rules within the commission's jurisdiction.

(6) All facilities related to the operation of any OGS, under any version of this standard permit (or co-located at a site with an OGS standard permit), previously authorized by, and continuing to meet, the conditions of a permit by rule under 30 TAC Chapter 106, Permits by Rule (or any historical version) must:

(A) Be incorporated into this standard permit in any initial registration, revision, or renewal for this standard permit. These facilities will become authorized by this standard permit and previous authorizations will be voided.

(B) Meet all emission limits established by this standard permit and review in accordance with paragraph (b)(8) of this standard permit.

(C) Meet requirements of paragraphs (e), (i), and (j) of this standard permit for Best Management Practices and Minimum Requirements, Planned MSS, and associated Records, Sampling and Monitoring of this standard permit.

(D) Only if facilities or groups of facilities are changed in such a way as to increase the potential to emit, production processing capacity, or registered emission rate, the requirements in paragraph (h) (BACT) of this standard permit are required to be met. In all other cases, these facilities are not required to meet paragraph (h) of this standard permit.

(d) **Facilities and Exclusions**

(1) Only the following specific facilities and groups of facilities have been evaluated for this standard permit, along with supporting infrastructure equipment and facilities, and may be included in a registration:

(A) Fugitive components, including valves, pressure relief valves, pipe flanges and connectors, pumps, compressors, stuffing boxes, instrumentation and meters, natural gas driven pneumatic pumps, and other similar devices with seals that separate process and waste material from the atmosphere and the associated piping;

(B) Separators, including all gas, oil and water physical separation units;

(C) Treatment and processing equipment, including heater-treaters, methanol injection, glycol dehydrators, molecular or mole sieves, amine sweeteners, $H_2S$ scavenger chemical reaction vessels for sulfur removal, and iron sponge units;
(D) Cooling towers and associated heat exchangers;
(E) Gas recovery units, including cryogenic expansion, absorption, adsorption, heat exchangers and refrigeration units;
(F) Combustion units, including engines, turbines, boilers, reboilers, and heaters;
(G) Storage tanks for crude oil, condensate, produced water fuels, treatment chemicals, slop and sump oils and pressure tanks with liquified petroleum gases;
(H) Surface facilities associated with underground storage of gas or liquids;
(I) Truck loading equipment;
(J) Control equipment, including vapor recovery systems, glycol and amine reboiler condensers, flares, vapor combustors, and thermal oxidizers; and
(K) Temporary facilities used for planned maintenance, and temporary control devices for planned start-ups and shutdowns

(2) **Exclusions.** The following are not authorized under this standard permit:
(A) Sour water strippers or sulfur recovery units;
(B) Carbon dioxide hot carbonates processing units;
(C) Water injection facilities (these facilities may otherwise authorized by 30 TAC §106.351, Salt Water Disposal);
(D) Liquefied petroleum gases, crude oil, or condensate transfer or loading into or from railcars, ships, or barges. These facilities may otherwise be authorized by 30 TAC §106.261, Facilities (Emission Limitations)) and §106.262, Facilities (Emissions and Distance Limitations);
(E) Incinerators for solid waste destruction;
(F) Remediation of petroleum contaminated water and soil. These facilities may otherwise authorized by 30 TAC §106.533, Remediation; and
(G) Cooling Towers and heat exchangers with direct contact with gaseous or liquid process streams containing VOC, $H_2S$, halogens or halogen compounds, cyanide compounds, inorganic acids, or acid gases.

(e) **Best Management Practices (BMP) and Best Available Control Technology (BACT) Requirements**. For any project, and any associated emission control equipment registered under this standard permit this paragraph shall be met as applicable. These requirements are not applicable to existing, unchanging facilities until any renewal submitted after December 31, 2015.

(1) All facilities which have the potential to emit air contaminants must be maintained in good working order and operated properly during facility operations. Each operator shall establish and maintain a program to replace, repair, and/or maintain facilities to keep them in good working order. The minimum requirements of this program shall include:
(A) Compliance with manufacturer's specifications and recommended programs applicable to equipment performance and effect on emissions, or alternatively, an owner or operator developed maintenance plan for such equipment that is consistent with good air pollution control practices.
(B) Cleaning and routine inspection of all equipment; and
(C) Replacement and repair of equipment on schedules which prevent equipment failures and maintain performance.

(2) Any OGS facility shall be operated at least 50 feet from any property line or receptor (whichever is closer to the facility). This distance limitation does not apply to the following:
   (A) Any fugitive components that are used for isolation and or safety purposes may be located at one-half of the width of any applicable easement;
   (B) Any facility at a location for which the distance requirements were satisfied at the time this standard permit is registered (provided that the authorization was maintained) regardless of whether a receptor is subsequently built or put to use 50 feet from any OGS facility; or
   (C) Existing facilities which are located less than 50 feet from a property line or receptor when constructed and previously authorized. If modified or replaced, the operator shall consider, to the extent that good engineering practice will permit, moving these facilities to meet the 50 foot requirement. Replacement facilities must meet all other requirements of this standard permit.

(3) Engines and turbines shall meet the emission and performance standards listed in Table 6 in paragraph (m) and the following requirements:
   (A) Liquid fueled engines used for back-up power generation and periodic power needs at the OGS are authorized if the fuel has no more than 0.05% sulfur and the engine is operated less than 876 hours per rolling 12-month period.
   (B) Engines and turbines used for electric generation more than 876 hours per rolling 12-month period are authorized if no reliable electric service is readily available. In all other circumstances, electric generators must meet the technical requirements of the Air Quality Standard Permit for Electric Generating Unit (EGU) (not including the EGU standard permit registration requirements) and the emissions shall be included in the registration under this standard permit;
   (C) All applicable requirements of 30 TAC Chapter 117; and
   (D) All applicable requirements of 40 CFR Part 60 and 40 CFR Part 63.
   (E) Compression ignition engines that are rated less than 225 kW (300 hp) and emit less than or equal to the emission tier for an equivalent sized model year 2008 non-road compression ignition engine located at 40 CFR § 89.112, Table 1 are authorized.

(4) Open-topped tanks or ponds containing VOCs or $H_2S$ are allowed up to a PTE equal to 1 tpy of VOC and 0.1 tpy of $H_2S$.

(5) All process equipment and storage facilities individually must meet the requirements of BACT listed in Table 10 in paragraph (m). Any combination of process equipment and storage facilities with an uncontrolled PTE of equal to or greater than 25 tpy of VOC must also meet the requirements of Table 10, row titled "Combined Control Requirements". All of the following streams and facilities must be included for this site-wide assessment:
   (A) For any gaseous vent stream with a concentration of 1% VOC must be considered for capture and control requirements;
   (B) For any liquid stream with a potential to emit of equal to or greater than 1 tpy VOC for each vessel or storage facility.

(6) The following shall apply to all fugitive components associated with the project:
   (A) All seals and gaskets in VOC or $H_2S$ service shall be installed, checked, and properly maintained to prevent leaking. All components shall be physically inspected quarterly for leaks.

(B) New and replaced fugitive components and instrumentation in gas or liquid service with the uncontrolled potential to emit equal to or greater than 10 tpy VOC or 1 tpy $H_2S$ are subject to a leak detection and repair (LDAR) program as specified in Table 9 in paragraph (m). Additional requirements are applicable where uncontrolled potential to emit equal to or greater than 25 tpy VOC or 5 tpy $H_2S$ as specified in Table 9. Planned MSS from fugitive components must also meet the requirements of Table 9.

(C) All components found to be leaking shall be repaired. Every reasonable effort shall be made to repair a leaking component. All leaks not repaired immediately shall be tagged or noted in a log. At manned sites, leaks shall be repaired no later than 30 days after the leak is found. At unmanned sites, leaks shall be repaired no later than 60 days after the leak is found. If the repair of a component would require a unit shutdown, which would create more emissions than the repair would eliminate, the repair may be delayed until the next shutdown.

(D) Tank hatches, not designed to be completely sealed, shall remain closed (but not completely sealed in order to maintain safe design functionality) except for sampling, gauging, loading, unloading, or planned maintenance activities.

(E) To the extent that good engineering practices will permit, new and reworked valves and piping connections shall be located in a place that is reasonably accessible for leak checking during plant operation and underground process pipelines shall contain no buried valves such that fugitive emission monitoring is rendered impractical.

(7) Tanks and vessels must utilize a paint color that minimizes the effects of solar heating (including, but not limited to, white or aluminum). To meet this requirement the solar absorptance should be 0.43 or less, as referenced in Table 7.1-6 in Compilation of Air Pollutant Emission Factors (AP-42). Paint shall be applied according to paint producers recommended application requirements if provided and in sufficient quantity as to be considered solar resistant. Paint shall be maintained in good condition and will not compromise tank integrity. Minimal amounts of rust may be present not to exceed 10% of the external surface area of the roof or walls of the tank and in no way may compromise tank integrity. Additionally, up to 10% of the external surface area of the roof or walls of the tank or vessel may be painted with other colors to allow for identification and/or aesthetics. For tanks and vessels purposefully darkened to create the process reaction and help condense liquids from being entrained in the vapor or are in an area whereby a local, state, federal law, ordinance, or private contract predating this standard permit's effective date establishes in writing tank and vessel colors other than white, these requirements do not apply.

(8) All emission estimation methods including but not limited to computer programs such as GRI-GLYCalc, AmineCalc, E&P Tanks, and Tanks 4.0, must be used with monitoring data generated in accordance with Table 8 in subsection (m) of this section where monitoring is required. All emission estimation methods must also be used in a way that is consistent with protocols established by the commission or promulgated in federal regulations (NSPS, NESHAPS). Where control of emissions is relied upon to meet subsection (k) of this section, control monitoring is required.

(9) Process reboilers, heaters, and furnaces that are also used for control of waste gas streams may claim 50 to 99% destruction efficiency for VOCs and $H_2S$ depending on the design and level of monitoring applied. The 90% destruction may be claimed where the waste gas is delivered to the flame zone or combustion fire box with basic monitoring as specified in paragraph (j). Any value greater than 90% and up to 99% destruction efficiency may be claimed where

enhanced monitoring and/or testing are applied as specified in paragraph (j). If the waste gas is premixed with the primary fuel gas and used as the primary fuel in the device through the primary fuel burners, 99% destruction may be claimed with basic monitoring as specified in paragraph (j). In systems where the combustion device is designed to cycle on and off to maintain the designed heating parameters, and may not fully utilize the waste gas stream, records of run time and enhanced monitoring is required to claim any run time beyond 50%.

(10) Vapor recovery Systems (VRSs) may claim up to 100% control. The control efficiency is based on whether it is a mechanical VRU (mVRU) or a liquid VRU (lVRU). The VRUs must meet the appropriate design, monitoring and record-keeping in Table 7 and Table 8 in paragraph (m).

(11) Flares used for control of emissions from production, planned MSS, emergency, or upset events may claim design destruction efficiency of 98% for VOCs and $H_2S$ and 99% for VOCs containing no more than three carbon atoms that contain no elements other than carbon and hydrogen. All flares must be designed and operated in accordance with the following:
- (A) Meet specifications for minimum heating values of waste gas, maximum tip velocity, and pilot flame monitoring found in 40 CFR §60.18;
- (B) If necessary to ensure adequate combustion, sufficient gas shall be added to make the gases combustible;
- (C) An infrared monitor is considered equivalent to a thermocouple for flame monitoring purposes;
- (D) An automatic ignition system may be used in lieu of a continuous pilot;
- (E) Flares must be lit at all times when gas streams are present;
- (F) Fuel for all flares shall be sweet gas or liquid petroleum gas except where only field gas is available and it is not sweetened at the site; and
- (G) Flares shall be designed for and operated with no visible emissions, except for periods not to exceed at total of 5 minutes during any 2 consecutive hours. Acid gas flares which must comply with opacity limits and records in accordance with 30 TAC §111.111(a)(4), Requirements for Specified Sources, regarding gas flares, are exempt from this visible emission limitation.
- (H) Flares may be designed with steam or air assist to help reduce visible emissions from the flare but must meet the appropriate requirements in 40 CFR 60.18.
- (I) At no time shall minimum heating values fall below the associated minimum heating value in 60.18

(12) Thermal oxidation and vapor combustion control devices may claim design destruction efficiency from 90 to 99.9% for VOCs and $H_2S$ depending on the design and the level of monitoring and testing applied. A device designed for the variability of the waste gas streams it controls with basic monitoring to indicate oxidation or combustion is occurring when waste gas is directed to the device may claim 90% destruction efficiency. Devices with intermediate monitoring, designed for the variability of the waste gas streams they control, with a fire box or fire tube designed to maintain a temperature above 1,400 degrees Fahrenheit (F) for 0.5 seconds, residence time; or designed to meet the parameters of a flare with minimum heating values of waste gas, maximum tip velocity, and pilot flame monitoring as found in 40 CFR § 60.18, but within a full or partial enclosure may claim a design destruction efficiency of 90 to 98%. Devices with enhanced monitoring and ports and platforms to allow stack testing may

claim a 99% efficiency where the devices are designed for the variability of the waste gas streams they control, with a fire box or fire tube designed to maintain a temperature above 1,400 degrees F for 0.5 seconds, residence time. The devices that can claim 99% destruction efficiency may claim 99.9% destruction efficiency if stack testing is conducted and confirms the efficiency and the enhanced monitoring is adjusted to ensure the continued efficiency. Temperature and residence time requirements may be modified if stack testing is conducted to confirm efficiencies.

(f) **Registration, Revision, and Renewal Requirements**

(1) For all previous claims of this standard permit (or any previous version of this standard permit) existing authorized facilities, or group of facilities, are not required to meet the requirements of this standard permit, with the exception of planned MSS, until a renewal under the standard permit is submitted after December 31, 2015.

(2) If no other changes except for authorizing planned MSS occurs at an existing OGS under this standard permit, or any previous version of this standard permit, (b)(7) applies.
   (A) Records demonstrating compliance with paragraph (i) must be kept;
   (B) If the OGS must certify emissions to establish nonapplicability of prevention of significant deterioration (PSD), nonattainment new source review (NNSR), or the federal operating permit programs, this certification may be filed using Form APD-CERT. No fee is required for this certification.
   (C) Planned MSS shall be incorporated at the next revision or update to a registration under this standard permit after January 5, 2012, and no later than any renewal submitted after December 31, 2015.

(3) Facilities, groups of facilities or planned MSS from facilities registered under this standard permit cannot also be authorized by a permit under 30 TAC §116.111, General Application.

(4) Prior to construction or implementation of changes for any project which meets this standard permit a notification shall be submitted through the e-Permits system. This notification shall include the following:
   (A) Identifying information (Core Data) and a general description of the project must be submitted through e-Permits (or if not available, hard-copy) using the "APD OGS New Project Notification."
   (B) A fee of $25 for small businesses as defined in 30 TAC §106.50, or $50 for all others must be submitted through the commission's e-Pay system.

(5) For any registration which meets the emission limitations of this standard permit must meet the following:
   (A) Within 90 days after start of operation or implemented changes (whichever occurs first), the facilities must be registered with a PI-1S Standard Permit Application.
   (B) This registration shall include a detailed summary of maximum emissions estimates based on: site-specific or defined representative gas and liquid analysis; equipment design specifications and operations; material type and throughput; and other actual parameters essential for accuracy for determining emissions and compliance with all applicable requirements of this standard permit.

(C) The fee for this registration shall be $475 for small businesses, or $850 for all others.

(D) Construction may begin any time after receipt of written notification to the executive director. Operations may continue after receipt of registration if there are no objections or 45 days after receipt by the executive director of the registration, whichever occurs first.

(6) If an OGS emissions increase, either through a change in production or addition of facilities, the site may change authorization (Level 1 or Level 2 PBR in 30 TAC §106.352 or Standard Permit) in the following circumstances:

(A) Within 90 days from the initial notification of construction of an oil and gas facility, a registration can update the authorization mechanism by submitting an initial registration or revision to the PBR or Standard Permit.

(B) Within 90 days of the change of production or installation of additional equipment, by submitting an initial registration or revision to the PBR or Standard Permit.

(7) All registrations, registration revisions, and renewals shall be submitted to the commission through a PI-1S Standard Permit Registration Form. Fee requirements do not apply when there are changes in representations with no increase in emissions within 6-months after a standard permit registration has been issued.

(g) Any claim under this standard permit must comply with all applicable requirements of 30 TAC §116.610; §116.611, Registration to Use a Standard Permit; §116.614, Standard Permit Fees; and §116.615, General Conditions. This standard permit supersedes: the notification requirements of 30 TAC §116.615, General Conditions; and the emission limitations of 30 TAC §116.610(a)(1), Applicability.

(h) **Emission Limitations**. Total maximum estimated registered or certified emissions shall meet the most stringent of the following. All emissions estimates must be based on representative worst-case operations and planned MSS activities.

(1) Total maximum estimated annual emissions of any air contaminant shall not exceed the applicable limits for a major stationary source or major modification for PSD and NNSR as specified in 30 TAC §116.12.

(2) Emissions must meet the limitations established in paragraph (k) of this standard permit.

(3) Maximum emissions are limited to less than the following after any operator limitations or controls:

| Air contaminant | steady-state or < 30 psig periodic releases lb/hr | ≥ 30 psig periodic lb/hr up to 600 hr/yr | Total tpy |
|---|---|---|---|
| Total VOC* | | | 250 |
| Total crude oil or condensate VOC* | 145 | 318 | |
| Total natural gas VOC* | 750 | 1635 | |
| Benzene | 7 | 15.4 | 10.2 |
| Hydrogen sulfide | 10.8 | 9.8 | 47 |
| Sulfur dioxide | 93.2 | | 250 |
| Nitrogen oxides | 121 | | 250 |
| Carbon monoxide | 104 | | 250 |
| PM10 and PM2.5 | 28 | | 15 |

* VOC is defined in 101.1(115) and does not include methane and ethane

(i) **Planned Maintenance, Start-ups and Shutdowns (MSS).** For any facility, group of facilities or site using this standard permit or previous versions of this standard permit, the following shall apply:

(1) Prior to January 5, 2012, representations and registration of planned MSS is voluntary, but if represented must meet the applicable limits of this standard permit. After January 5, 2012, all emissions from planned MSS activities and facilities must be considered for compliance with applicable limits of this standard permit unless otherwise specified in (b)(7). This standard permit may not be used at a site or for facilities authorized under 30 TAC §116.111 if planned MSS has already been authorized under that permit.

(2) As specified, releases of air contaminants during, or as result of, planned MSS must be quantified and meet the emission limits in this standard permit, as applicable. This analysis must include:

(A) Alternate operational scenarios or redirection of vent streams;
(B) Pigging, purging, and blowdowns;
(C) Temporary facilities if used for degassing or purging of tanks, vessels, or other facilities;
(D) Degassing or purging of tanks, vessels, or other facilities; and
(E) Management of sludge from pits, ponds, sumps, and water conveyances.

(3) Other planned MSS activities authorized by this standard permit are limited to the following. These planned MSS activities require only recordkeeping of the activity.

(A) Routine engine component maintenance including filter changes, oxygen sensor replacements, compression checks, overhauls, lubricant changes, spark plug changes, and emission control system maintenance.
(B) Boiler refractory replacements and cleanings.
(C) Heater and heat exchanger cleanings.
(D) Turbine hot standard permit swaps.

(E) Pressure relief valve testing, calibration of analytical equipment; Instrumentation/analyzer maintenance; replacement of analyzer filters and screens.

(4) Engine/compressor start-ups associated with preventative system shutdown activities have the option to be authorized as part of typical operations if:
   (A) Prior to operation, alternative operating scenarios to divert gas or liquid streams are registered and certified with all supporting documentation;
   (B) Engine/compressor shutdowns shall result in no greater than 4 lbs/hr of natural gas emissions; and
   (C) Emissions which result from subsequent compressor start-up activities are controlled to a minimum of 98% efficiency for VOC and $H_2S$.

(j) **Records, Sampling and Monitoring**. The following records shall be maintained at a site in written or electronic form and be readily available to the agency or local air pollution control program with jurisdiction upon request. All required records must be kept at the facility site. If the facility normally operates unattended, records must be maintained at an office within Texas having day-to-day operational control of the plant site. Other requirements, including but not limited to, federal recordkeeping or testing requirements, can be used to demonstrate compliance if the other requirements are at least as stringent as the associated requirements in the table below. Any documentation that is already being kept for other purposes will suffice for demonstrating requirements. If a control or method is not relied upon to meet this standard permit, then the associated sampling, monitoring, and records are not applicable.
   (1) Sampling and demonstrations of compliance shall include the requirements listed in Table 7 in paragraph (m) of this standard permit.
   (2) Monitoring and records for demonstrations of compliance shall include the requirements listed in Table 8 in paragraph (m) of this standard permit.

(k) **Emission Limits Based on Impacts Evaluation**.

(1) All impacts evaluations must be completed on a contaminant-by-contaminant basis for only any net emissions increases resulting from a project and must meet the following as appropriate:
   (A) Compliance with state or federal ambient air standards shall be demonstrated for $NO_2$, $SO_2$, and $H_2S$ at any property-line within 1 mile of a project.
   (B) Compliance with hourly effects screening levels (ESLs) for benzene and annual ESL for benzene, shall be demonstrated at the nearest receptor within 1 mile of a project.

(2) Distance measurements shall be determined using the following:
   (A) For each facility or group of facilities, the shortest corresponding distance from any emission point, vent, or fugitive component to the nearest receptor must be used with the appropriate compliance determination method with the published ESLs as found through the commissioner's internet webpage.
   (B) For each facility or group of facilities, the shortest corresponding distance from any emission point, vent, or fugitive component to the nearest property line must be used with the appropriate compliance determination method with any applicable state or federal ambient air quality standard.

(3) Impacts evaluations are not required under the following cases:
(A) If there is no receptor within 1 mile of a registration no further ESL review is required.
(B) If there is no property line within 1 mile of a registration no further ambient air quality review is required.
(C) If the project total emissions are less than any of the following rates, no additional analysis or demonstration of the specified air contaminant is required:

| **Air contaminant** | **lb/hr** |
|---|---|
| Benzene | 0.039 |
| Hydrogen sulfide | 0.025 |
| Sulfur dioxide | 2 |
| Nitrogen oxides | 4 |

(4) Evaluation of emissions shall meet the following.
(A) For all evaluations of $NO_X$ to $NO_2$ a conversion factor of 0.20 for 4-stroke rich and lean burn engines and 0.50 for 2-stroke engines may be used.
(B) The maximum predicted concentration or rate at the property boundary or receptor, whichever is appropriate, must not exceed a state or federal ambient air standard or ESL.

(5) The impacts analysis shall be based on the following facility emissions:
(A) The following shall be met for ESL reviews:
(i) If a project's air contaminant maximum predicted concentrations are equal to or less than 10% of the appropriate ESL, no further review is required;
(ii) If a project's air contaminant maximum predicted concentrations combined with project increases for that contaminant over a rolling 60-month period after the effective date of this revised standard permit are equal to or less than 25% of the appropriate ESL, no further review is required.
(iii) In all other cases, all facility emissions at an OGS, regardless of authorization type, located within 1 mile of a project requiring registration under this standard permit shall be evaluated.
(B) The following shall be met for state and federal ambient air quality standard reviews:
(i) If a project's air contaminant maximum predicted concentrations are equal to or less than 10% the significant impact level (SIL) (also known as de minimis impact in 30 TAC 101, General Rules), no further review is required;
(ii) In all other cases, all facility emissions at an OGS, regardless of authorization type, located within 1 mile of a project requiring registration under this standard permit shall be evaluated.

(6) Evaluation must comply with one of the methods listed with no changes or exceptions:
(A) Tables.
(i)Emission impact Tables 2 – 5F in paragraph (m) of this standard permit may be used in accordance with the limits and descriptions in Table 1 in paragraph (m).

(ii) Values in Tables 2 - 5F in paragraph (m) of this standard permit may be used with linear interpolation between height and distance points. A distance of less than 50 feet or greater than 5,500 feet may not be used. Release heights may not be extrapolated beyond the limits of any table and instead the minimum or maximum height will be used. If distances and release heights are not interpolated, the next lowest height and lesser distances shall be used for determination of maximum acceptable emissions. All facilities exempted from the distance to the property line restriction in paragraph (e)(2) of this standard permit must use 50 feet as the distance to the property line for those ambient standards based on property line.

(B) **Screening Modeling.** A screening model may be used to demonstrate acceptable emissions from an OGS under this standard permit if all of the parameters in the screening modeling protocol provided by the commission are met.

(C) **Dispersion Modeling**. A refined dispersion model may be used to demonstrate acceptable emissions from an OGS under this standard permit if all of the parameters in the refined dispersion modeling protocol provided by the commission are met.

(l) **Existing, Unchanged Facilities and Projects Before Effective Date.** The requirements in 30 TAC §116.620 are applicable to existing unchanged facilities and new or changing facilities as specified in paragraph (a)(1) of this standard permit.

(m) The following Tables shall be used as required by this standard permit.

Table 1 Emission Impact Tables Limits and Descriptions;
Table 2 Generic Modeling Results for Fugitives & Process Vents;
Table 3 Generic Modeling Results for Flares and Thermal Destruction Devices
Table 4 Generic Modeling Results for Blowdowns, Purging, and Pigging
Table 5A Generic Modeling Results for Engines Less Than or Equal to 250 hp
Table 5B Generic Modeling Results for Engines Greater Than 250 hp to Less Than or Equal to 500 hp
Table 5C Generic Modeling Results for Engines Greater Than 500 hp to Less Than or Equal to 1000 hp
Table 5D Generic Modeling Results for Engines Greater Than 1000 hp to Less Than or Equal to 1500 hp
Table 5E Generic Modeling Results for Engines Greater Than 1500 hp to Less Than or Equal to 2000 hp
Table 5F Generic Modeling Results for Engines Greater Than 2000 hp
Table 6 Engine and Turbine Emission and Operational Standards
Table 7 Sampling and Demonstrations of Compliance;
Table 8 Monitoring and Records Demonstrations;
Table 9 Fugitive Component Leak Detection and Repair (LDAR) Control Program ; and
Table 10 Best Available Control Technology (BACT) Requirements

**Table 1 Emission Impact Tables Limits and Descriptions**

| Topic | Description | Details |
|---|---|---|
| Variables | $E_{MAX\ HOURLY}$ | the maximum acceptable hourly (lb/hr) emissions for a specific air contaminant |
| | $E_{MAX\ ANNUAL}$ | the maximum acceptable annual (tpy) emissions for a specific air contaminant |
| | P | ambient air standard for a specific air contaminant ($\mu g/m^3$) |
| | ESL | current published effects screening level for a specific air contaminant ($\mu g/m^3$) |
| | G | the most stringent of any applicable generic value from the Generic Modeling Results Tables at the emission point's release height and distance to property line ($\mu g/m^3$/lb/hr) |
| | $WR_{EPNx}$= | weighted ratio of emissions of a specific air contaminant for each EPN divided by the sum of total emissions for all EPNs that emit that contaminant or ($E_{EPNx}/E_{total}$) |
| Single releases or co-located groups of similar releases | hourly ambient air standard | emissions are determined by: $E_{MAX\ HOURLY} = P/G$ |
| | hourly health effects review | emissions are determined by: $E_{MAX\ HOURLY} = ESL/G$ |
| | annual ambient air standard | emissions are determined by: $E_{MAX\ ANNUAL} = (8760/2000)\ P/(0.08*G)$ |
| | annual health effects review | emissions are determined by: $E_{MAX\ ANNUAL} = (8760/2000)\ ESL/(0.08*G)$ |
| Multiple release points | Limits | If weighted ratios are not used, the total quantity of emissions shall be assumed to be released from the most conservative applicable G value at the site. |
| | hourly ambient air standard | emissions are determined by: $E_{MAX\ HOURLY} = (WR_{EPN1})\ (P / G_{EPN1}) + (WR_{EPN2})\ (P / G_{EPN2}) + \ldots (WR_{EPNx})\ (P / G_{EPNx})$ |
| | hourly health effects review | emissions are determined by: $E_{MAX\ HOURLY} = (WR_{EPN1})\ (ESL / G_{EPN1}) + (WR_{EPN2})\ (ESL/G_{EPN2}) + \ldots (WR_{EPNx})\ (ESL / G_{EPNx})$ |
| | annual ambient air standard | emissions are determined by: $E_{MAX\ ANNUAL} = (8760/2000)\ [(WR_{EPN1})\ (P / 0.08*G_{EPN1}) + (WR_{EPN2})\ (P / 0.08*G_{EPN2}) + \ldots (WR_{EPNx})\ (P / 0.08*G_{EPNx})]$ |
| | annual health effects review | emissions are determined by: $E_{MAX\ ANNUAL} = (8760/2000)\ [(WR_{EPN1})\ (ESL /0.08*G_{EPN1}]) + (WR_{EPN2})\ (ESL/0.08*G_{EPN2}) + \ldots (WR_{EPNx})\ (ESL / 0.08*G_{EPNx})]$ |

## Table 2 Fugitives and Process Vents Table

| Table 2: Fugitives and Process Vents | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Distance | Fugitive 3ft height | Loading 10 ft height | Tank Vents 20 ft height | Process Vessel 10 ft Vent | Process Vessel 20 ft Vent | Process Vessel 30 ft Vent | Process Vessel 40 ft Vent | Process Vessel 50 ft Vent | Process Vessel 60 ft Vent |
| (ft) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) |
| 50 | 4375 | 1232 | 305 | 469 | 168 | 90 | 70 | 65 | 28 |
| 100 | 4375 | 1232 | 305 | 469 | 168 | 90 | 70 | 65 | 28 |
| 150 | 3907 | 1232 | 305 | 469 | 168 | 90 | 70 | 65 | 28 |
| 200 | 3089 | 1232 | 305 | 440 | 168 | 90 | 70 | 65 | 28 |
| 300 | 1911 | 1193 | 294 | 412 | 168 | 90 | 70 | 65 | 28 |
| 400 | 1269 | 1048 | 291 | 319 | 168 | 90 | 70 | 65 | 28 |
| 500 | 901 | 858 | 274 | 243 | 157 | 90 | 70 | 65 | 28 |
| 600 | 674 | 698 | 271 | 189 | 138 | 89 | 70 | 65 | 28 |
| 700 | 525 | 574 | 271 | 150 | 120 | 88 | 70 | 65 | 28 |
| 800 | 423 | 479 | 261 | 124 | 105 | 85 | 70 | 65 | 28 |
| 900 | 349 | 406 | 244 | 105 | 93 | 81 | 70 | 65 | 28 |
| 1000 | 293 | 348 | 226 | 91 | 84 | 77 | 69 | 65 | 26 |
| 1100 | 250 | 302 | 208 | 90 | 77 | 72 | 67 | 63 | 25 |
| 1200 | 217 | 264 | 191 | 89 | 70 | 68 | 64 | 61 | 24 |
| 1300 | 189 | 233 | 176 | 88 | 65 | 64 | 61 | 58 | 24 |
| 1400 | 167 | 208 | 161 | 87 | 61 | 60 | 58 | 55 | 24 |
| 1500 | 149 | 186 | 149 | 84 | 57 | 57 | 55 | 53 | 24 |
| 1600 | 134 | 168 | 137 | 82 | 54 | 53 | 52 | 50 | 23 |
| 1700 | 121 | 153 | 127 | 79 | 51 | 51 | 49 | 47 | 23 |
| 1800 | 110 | 139 | 117 | 76 | 50 | 48 | 47 | 45 | 22 |
| 1900 | 100 | 128 | 109 | 73 | 49 | 46 | 44 | 43 | 22 |
| 2000 | 92 | 117 | 102 | 70 | 49 | 44 | 42 | 41 | 21 |
| 2100 | 85 | 108 | 95 | 67 | 48 | 42 | 41 | 39 | 21 |
| 2200 | 78 | 101 | 89 | 64 | 47 | 40 | 39 | 38 | 20 |



EFSCOP00009475

**Table 2: Fugitives and Process Vents(continued)**

| Distance | Fugitive 3ft height | Loading 10 ft height | Tank Vents 20 ft height | Process Vessel 10 ft Vent | Process Vessel 20 ft Vent | Process Vessel 30 ft Vent | Process Vessel 40 ft Vent | Process Vessel 50 ft Vent | Process Vessel 60 ft Vent |
|---|---|---|---|---|---|---|---|---|---|
| (ft) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) |
| 2300 | 73 | 94 | 83 | 61 | 46 | 39 | 37 | 36 | 19 |
| 2400 | 68 | 88 | 78 | 59 | 45 | 37 | 36 | 35 | 19 |
| 2500 | 64 | 82 | 74 | 56 | 43 | 36 | 35 | 34 | 18 |
| 2600 | 60 | 77 | 70 | 54 | 42 | 34 | 33 | 32 | 18 |
| 2700 | 56 | 73 | 66 | 52 | 41 | 33 | 32 | 31 | 17 |
| 2800 | 53 | 69 | 63 | 50 | 40 | 32 | 31 | 30 | 17 |
| 2900 | 50 | 65 | 60 | 48 | 39 | 31 | 30 | 29 | 16 |
| 3000 | 48 | 62 | 57 | 46 | 37 | 30 | 29 | 28 | 16 |
| 3500 | 37 | 49 | 46 | 38 | 32 | 26 | 25 | 25 | 14 |
| 4000 | 30 | 40 | 38 | 32 | 28 | 24 | 23 | 22 | 12 |
| 4500 | 25 | 33 | 32 | 28 | 25 | 21 | 20 | 20 | 11 |
| 5000 | 22 | 28 | 27 | 24 | 22 | 19 | 18 | 18 | 10 |
| 5500 | 19 | 25 | 24 | 21 | 19 | 17 | 17 | 16 | 9 |



EFSCOP00009476

## Table 3: Flares and Thermal Destruction Devices Table

| Table 3: Flares and Thermal Destruction Devices | | | | | |
|---|---|---|---|---|---|
| **Generic Modeling Results** | | | | | |
| Distance | 20 ft height | 30 ft height | 40 ft height | 50 ft height | 60 ft height |
| (ft) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) |
| 50 | 58 | 43 | 26 | 25 | 23 |
| 100 | 58 | 43 | 26 | 25 | 23 |
| 150 | 58 | 43 | 26 | 25 | 23 |
| 200 | 58 | 43 | 26 | 25 | 23 |
| 300 | 58 | 43 | 26 | 25 | 23 |
| 400 | 58 | 43 | 26 | 25 | 23 |
| 500 | 58 | 43 | 26 | 25 | 23 |
| 600 | 56 | 43 | 26 | 25 | 23 |
| 700 | 52 | 43 | 26 | 25 | 23 |
| 800 | 47 | 43 | 26 | 25 | 23 |
| 900 | 45 | 43 | 26 | 25 | 23 |
| 1000 | 44 | 43 | 26 | 25 | 23 |
| 1100 | 42 | 41 | 25 | 24 | 23 |
| 1200 | 40 | 40 | 24 | 24 | 22 |
| 1300 | 38 | 38 | 23 | 23 | 21 |
| 1400 | 36 | 36 | 23 | 21 | 21 |
| 1500 | 34 | 34 | 23 | 21 | 20 |
| 1600 | 32 | 32 | 22 | 21 | 20 |
| 1700 | 31 | 31 | 22 | 21 | 20 |
| 1800 | 29 | 29 | 22 | 20 | 20 |
| 1900 | 28 | 28 | 22 | 20 | 20 |
| 2000 | 26 | 26 | 21 | 20 | 19 |
| 2100 | 25 | 25 | 21 | 20 | 19 |
| 2200 | 24 | 24 | 20 | 20 | 19 |



EFSCOP00009477

| Table 3: Flares and Thermal Destruction Devices (continued) | | | | | |
|---|---|---|---|---|---|
| **Generic Modeling Results** | | | | | |
| Distance | 20 ft height | 30 ft height | 40 ft height | 50 ft height | 60 ft height |
| (ft) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) |
| 2300 | 23 | 23 | 20 | 19 | 19 |
| 2400 | 22 | 22 | 20 | 19 | 18 |
| 2500 | 22 | 22 | 19 | 18 | 18 |
| 2600 | 21 | 21 | 19 | 18 | 17 |
| 2700 | 20 | 20 | 18 | 17 | 17 |
| 2800 | 19 | 19 | 18 | 17 | 16 |
| 2900 | 19 | 19 | 17 | 16 | 16 |
| 3000 | 18 | 18 | 17 | 16 | 16 |
| 3500 | 16 | 16 | 15 | 14 | 14 |
| 4000 | 14 | 14 | 13 | 12 | 12 |
| 4500 | 13 | 13 | 12 | 11 | 11 |
| 5000 | 11 | 11 | 11 | 10 | 10 |
| 5500 | 11 | 11 | 10 | 9 | 9 |



EFSCOP00009478

## Table 4: Blowdowns, Purging, and Pigging Generic Modeling Results Table

| Table 4: Blowdowns, Purging, and Pigging Generic Modeling Results | | | | | |
|---|---|---|---|---|---|
| Distance | < 30 psig; 3 ft height | < 30 psig; 10 ft height | < 30 psig; 20 ft height | ≥ 30 psig; 6 ft height | ≥ 30 psig; 10 ft height |
| (ft) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) |
| 50 | 4304 | 791 | 244 | 51 | 25 |
| 100 | 4304 | 791 | 244 | 51 | 25 |
| 150 | 4250 | 777 | 244 | 51 | 25 |
| 200 | 3621 | 763 | 244 | 51 | 25 |
| 300 | 2367 | 750 | 225 | 51 | 25 |
| 400 | 1607 | 737 | 225 | 51 | 25 |
| 500 | 1156 | 671 | 224 | 51 | 25 |
| 600 | 871 | 581 | 218 | 48 | 25 |
| 700 | 682 | 498 | 212 | 44 | 25 |
| 800 | 551 | 427 | 210 | 40 | 24 |
| 900 | 456 | 368 | 204 | 36 | 23 |
| 1000 | 384 | 320 | 194 | 33 | 21 |
| 1100 | 328 | 281 | 182 | 30 | 20 |
| 1200 | 284 | 248 | 170 | 28 | 18 |
| 1300 | 249 | 221 | 159 | 27 | 17 |
| 1400 | 220 | 198 | 147 | 27 | 16 |
| 1500 | 196 | 178 | 137 | 27 | 15 |
| 1600 | 176 | 162 | 127 | 27 | 14 |
| 1700 | 159 | 147 | 118 | 27 | 13 |
| 1800 | 145 | 135 | 110 | 27 | 13 |
| 1900 | 132 | 124 | 103 | 27 | 13 |
| 2000 | 121 | 114 | 96 | 27 | 13 |
| 2100 | 112 | 106 | 90 | 27 | 13 |
| 2200 | 103 | 98 | 85 | 27 | 13 |
| 2300 | 96 | 91 | 80 | 27 | 13 |



EFSCOP00009479

| Table 4: Blowdowns, Purging, and Pigging Generic Modeling Results (continued) | | | | | |
|---|---|---|---|---|---|
| Distance | < 30 psig; 3 ft height | < 30 psig; 10 ft height | < 30 psig; 20 ft height | ≥ 30 psig; 6 ft height | ≥ 30 psig; 10 ft height |
| (ft) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) |
| 2400 | 90 | 86 | 75 | 27 | 13 |
| 2500 | 84 | 81 | 71 | 27 | 13 |
| 2600 | 79 | 76 | 68 | 27 | 13 |
| 2700 | 74 | 72 | 64 | 26 | 13 |
| 2800 | 70 | 68 | 61 | 26 | 13 |
| 2900 | 67 | 64 | 58 | 26 | 13 |
| 3000 | 63 | 61 | 55 | 25 | 13 |
| 3500 | 50 | 48 | 45 | 23 | 13 |
| 4000 | 40 | 39 | 37 | 21 | 13 |
| 4500 | 34 | 33 | 31 | 19 | 13 |
| 5000 | 29 | 28 | 27 | 17 | 12 |
| 5500 | 25 | 24 | 23 | 16 | 11 |



EFSCOP00009480

## Table 5A Engines Less Than or Equal to 250 hp

| Table 5A Engines Less Than or Equal to 250 hp | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Generic Modeling Results** | | | | | | | | | | | |
| Distance | 8 ft height | 10 ft height | 12 ft height | 14 ft height | 16 ft height | 18 ft height | 20 ft height | 25 ft height | 30 ft height | 35 ft height | 40 ft height |
| (ft) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) |
| 50 | 97 | 85 | 83 | 81 | 81 | 71 | 58 | 44 | 43 | 36 | 26 |
| 100 | 97 | 85 | 83 | 81 | 81 | 71 | 58 | 44 | 43 | 36 | 26 |
| 150 | 97 | 85 | 83 | 81 | 81 | 71 | 58 | 44 | 43 | 36 | 26 |
| 200 | 93 | 85 | 83 | 81 | 81 | 71 | 58 | 44 | 43 | 36 | 26 |
| 300 | 92 | 85 | 83 | 81 | 81 | 71 | 58 | 44 | 43 | 36 | 26 |
| 400 | 91 | 85 | 83 | 81 | 81 | 71 | 58 | 44 | 43 | 36 | 26 |
| 500 | 88 | 85 | 83 | 81 | 81 | 71 | 58 | 44 | 43 | 36 | 26 |
| 600 | 80 | 79 | 78 | 78 | 78 | 70 | 56 | 44 | 43 | 36 | 26 |
| 700 | 78 | 77 | 76 | 76 | 71 | 68 | 52 | 44 | 43 | 36 | 26 |
| 800 | 76 | 75 | 74 | 74 | 64 | 63 | 47 | 44 | 43 | 36 | 26 |
| 900 | 74 | 73 | 72 | 72 | 58 | 58 | 45 | 44 | 43 | 36 | 26 |
| 1000 | 72 | 71 | 71 | 71 | 53 | 53 | 44 | 43 | 43 | 36 | 26 |
| 1100 | 69 | 69 | 69 | 69 | 49 | 49 | 42 | 42 | 41 | 35 | 25 |
| 1200 | 66 | 66 | 66 | 65 | 45 | 45 | 40 | 40 | 40 | 35 | 24 |
| 1300 | 62 | 62 | 62 | 62 | 42 | 42 | 38 | 38 | 38 | 33 | 23 |
| 1400 | 59 | 59 | 59 | 59 | 39 | 39 | 36 | 36 | 36 | 32 | 23 |
| 1500 | 56 | 56 | 56 | 56 | 37 | 37 | 34 | 34 | 34 | 30 | 23 |
| 1600 | 53 | 53 | 53 | 53 | 35 | 35 | 32 | 32 | 32 | 29 | 22 |
| 1700 | 50 | 50 | 50 | 50 | 33 | 33 | 31 | 31 | 31 | 28 | 22 |
| 1800 | 48 | 48 | 48 | 48 | 31 | 31 | 29 | 29 | 29 | 26 | 22 |
| 1900 | 46 | 46 | 46 | 46 | 30 | 30 | 28 | 28 | 28 | 25 | 22 |
| 2000 | 44 | 44 | 44 | 44 | 28 | 28 | 26 | 26 | 26 | 24 | 21 |



EFSCOP00009481

| Table 5A Engines Less Than or Equal to 250 hp (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Generic Modeling Results** | | | | | | | | | | | |
| (ft) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) |
| 2100 | 42 | 42 | 42 | 42 | 27 | 27 | 25 | 25 | 25 | 23 | 21 |
| 2200 | 40 | 40 | 40 | 40 | 26 | 26 | 24 | 24 | 24 | 22 | 20 |
| 2300 | 38 | 38 | 38 | 38 | 25 | 25 | 23 | 23 | 23 | 21 | 20 |
| 2400 | 37 | 37 | 37 | 37 | 24 | 24 | 22 | 22 | 22 | 20 | 20 |
| 2500 | 36 | 36 | 36 | 36 | 23 | 23 | 22 | 22 | 22 | 20 | 19 |
| 2600 | 34 | 34 | 34 | 34 | 22 | 22 | 21 | 21 | 21 | 19 | 19 |
| 2700 | 33 | 33 | 33 | 33 | 21 | 21 | 20 | 20 | 20 | 18 | 18 |
| 2800 | 32 | 32 | 32 | 32 | 21 | 21 | 19 | 19 | 19 | 18 | 18 |
| 2900 | 31 | 31 | 31 | 31 | 20 | 20 | 19 | 19 | 19 | 17 | 17 |
| 3000 | 30 | 30 | 30 | 30 | 19 | 19 | 18 | 18 | 18 | 17 | 17 |
| 3500 | 26 | 26 | 26 | 26 | 17 | 17 | 16 | 16 | 16 | 15 | 15 |
| 4000 | 23 | 23 | 23 | 23 | 15 | 15 | 14 | 14 | 14 | 13 | 13 |
| 4500 | 21 | 21 | 21 | 21 | 13 | 13 | 13 | 13 | 13 | 12 | 12 |
| 5000 | 19 | 19 | 19 | 19 | 12 | 12 | 11 | 11 | 11 | 11 | 11 |
| 5500 | 17 | 17 | 17 | 17 | 11 | 11 | 11 | 11 | 11 | 10 | 10 |



EFSCOP00009482

## Table 5B: Engines Greater Than 250 and Less Than or Equal to 500 hp

| Table 5B: Engines Greater Than 250 and Less Than or Equal to 500 hp | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Generic Modeling Results** | | | | | | | | | | | |
| Distance | 8 ft height | 10 ft height | 12 ft height | 14 ft height | 16 ft height | 18 ft height | 20 ft height | 25 ft height | 30 ft height | 35 ft height | 40 ft height |
| (ft) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) |
| 50 | 60 | 59 | 54 | 43 | 43 | 34 | 34 | 24 | 21 | 20 | 17 |
| 100 | 60 | 59 | 54 | 43 | 43 | 34 | 34 | 24 | 21 | 20 | 17 |
| 150 | 60 | 59 | 54 | 43 | 43 | 34 | 34 | 24 | 21 | 20 | 17 |
| 200 | 60 | 59 | 54 | 43 | 43 | 34 | 34 | 24 | 21 | 20 | 17 |
| 300 | 60 | 59 | 54 | 43 | 43 | 34 | 34 | 24 | 21 | 20 | 17 |
| 400 | 60 | 59 | 54 | 43 | 43 | 34 | 34 | 24 | 21 | 20 | 17 |
| 500 | 60 | 59 | 54 | 43 | 43 | 34 | 34 | 24 | 21 | 20 | 17 |
| 600 | 57 | 57 | 52 | 41 | 41 | 34 | 34 | 24 | 21 | 20 | 17 |
| 700 | 52 | 52 | 47 | 38 | 38 | 31 | 31 | 24 | 21 | 20 | 17 |
| 800 | 47 | 47 | 43 | 34 | 34 | 28 | 28 | 24 | 21 | 20 | 17 |
| 900 | 42 | 42 | 39 | 31 | 31 | 26 | 26 | 23 | 20 | 20 | 17 |
| 1000 | 39 | 39 | 35 | 28 | 28 | 23 | 23 | 21 | 20 | 20 | 17 |
| 1100 | 37 | 36 | 32 | 26 | 26 | 23 | 23 | 20 | 20 | 19 | 17 |
| 1200 | 35 | 35 | 30 | 25 | 24 | 23 | 23 | 20 | 20 | 18 | 17 |
| 1300 | 34 | 34 | 28 | 24 | 23 | 23 | 23 | 20 | 20 | 18 | 16 |
| 1400 | 32 | 32 | 26 | 24 | 23 | 23 | 23 | 20 | 20 | 17 | 16 |
| 1500 | 31 | 31 | 24 | 23 | 23 | 23 | 23 | 20 | 20 | 16 | 16 |
| 1600 | 29 | 29 | 23 | 23 | 23 | 23 | 23 | 19 | 19 | 16 | 16 |
| 1700 | 28 | 28 | 23 | 23 | 23 | 23 | 22 | 19 | 19 | 16 | 15 |
| 1800 | 27 | 27 | 22 | 22 | 22 | 22 | 22 | 19 | 19 | 16 | 15 |
| 1900 | 25 | 25 | 22 | 22 | 22 | 21 | 21 | 18 | 18 | 16 | 15 |
| 2000 | 24 | 24 | 22 | 22 | 22 | 21 | 21 | 17 | 17 | 16 | 15 |
| 2100 | 23 | 23 | 21 | 21 | 21 | 20 | 20 | 17 | 17 | 16 | 15 |



EFSCOP00009483

| Table 5B: Engines Greater Than 250 and Less Than or Equal to 500 hp (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Generic Modeling Results** | | | | | | | | | | | |
| Distance | 8 ft height | 10 ft height | 12 ft height | 14 ft height | 16 ft height | 18 ft height | 20 ft height | 25 ft height | 30 ft height | 35 ft height | 40 ft height |
| (ft) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) |
| 2200 | 22 | 22 | 21 | 21 | 21 | 19 | 19 | 17 | 17 | 15 | 15 |
| 2300 | 21 | 21 | 20 | 20 | 20 | 19 | 19 | 17 | 16 | 15 | 14 |
| 2400 | 21 | 21 | 20 | 20 | 20 | 19 | 18 | 16 | 16 | 15 | 14 |
| 2500 | 20 | 20 | 19 | 19 | 19 | 18 | 18 | 16 | 16 | 14 | 14 |
| 2600 | 19 | 19 | 19 | 19 | 19 | 18 | 17 | 16 | 16 | 14 | 13 |
| 2700 | 18 | 18 | 18 | 18 | 18 | 17 | 17 | 15 | 15 | 14 | 13 |
| 2800 | 18 | 18 | 18 | 18 | 18 | 17 | 16 | 15 | 15 | 13 | 13 |
| 2900 | 17 | 17 | 17 | 17 | 17 | 16 | 16 | 15 | 15 | 13 | 13 |
| 3000 | 17 | 17 | 17 | 17 | 17 | 16 | 15 | 15 | 15 | 13 | 13 |
| 3500 | 15 | 15 | 15 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 11 |
| 4000 | 13 | 13 | 13 | 13 | 13 | 13 | 12 | 12 | 12 | 11 | 10 |
| 4500 | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 10 | 10 | 10 | 9 |
| 5000 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 9 | 9 |
| 5500 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 8 | 8 |



EFSCOP00009484

## Table 5C: Engines Greater Than 500 and Less Than or Equal to 1,000 hp

| Table 5C: Engines Greater Than 500 and Less Than or Equal to 1,000 hp | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Generic Modeling Results** | | | | | | | | | | | |
| Distance | 8 ft height | 10 ft height | 12 ft height | 14 ft height | 16 ft height | 18 ft height | 20 ft height | 25 ft height | 30 ft height | 35 ft height | 40 ft height |
| (ft) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) |
| 50 | 26 | 25 | 25 | 25 | 18 | 18 | 17 | 13 | 11 | 11 | 10 |
| 100 | 26 | 25 | 25 | 25 | 18 | 18 | 17 | 13 | 11 | 11 | 10 |
| 150 | 26 | 25 | 25 | 25 | 18 | 18 | 17 | 13 | 11 | 11 | 10 |
| 200 | 26 | 25 | 25 | 25 | 18 | 18 | 17 | 13 | 11 | 11 | 10 |
| 300 | 26 | 25 | 25 | 25 | 18 | 18 | 17 | 13 | 11 | 11 | 10 |
| 400 | 26 | 25 | 25 | 25 | 18 | 18 | 17 | 13 | 11 | 11 | 10 |
| 500 | 26 | 25 | 25 | 25 | 18 | 18 | 17 | 13 | 11 | 11 | 10 |
| 600 | 26 | 25 | 25 | 25 | 18 | 18 | 17 | 13 | 11 | 11 | 10 |
| 700 | 26 | 25 | 25 | 25 | 18 | 18 | 17 | 13 | 11 | 11 | 10 |
| 800 | 24 | 24 | 24 | 24 | 18 | 18 | 17 | 13 | 11 | 11 | 10 |
| 900 | 23 | 23 | 23 | 23 | 18 | 18 | 17 | 13 | 11 | 11 | 10 |
| 1000 | 21 | 21 | 21 | 21 | 17 | 17 | 17 | 13 | 11 | 11 | 10 |
| 1100 | 20 | 20 | 20 | 20 | 17 | 17 | 16 | 13 | 11 | 11 | 10 |
| 1200 | 18 | 18 | 18 | 18 | 16 | 16 | 16 | 12 | 11 | 11 | 10 |
| 1300 | 17 | 17 | 17 | 17 | 15 | 15 | 15 | 12 | 11 | 10 | 10 |
| 1400 | 17 | 17 | 17 | 17 | 14 | 14 | 14 | 11 | 11 | 10 | 10 |
| 1500 | 17 | 17 | 16 | 16 | 13 | 13 | 13 | 11 | 11 | 10 | 9 |
| 1600 | 17 | 17 | 16 | 16 | 13 | 13 | 13 | 11 | 11 | 10 | 9 |
| 1700 | 16 | 16 | 15 | 15 | 13 | 12 | 12 | 11 | 11 | 9 | 9 |
| 1800 | 16 | 16 | 15 | 15 | 13 | 12 | 12 | 11 | 11 | 9 | 9 |
| 1900 | 15 | 15 | 14 | 14 | 13 | 12 | 12 | 11 | 10 | 9 | 9 |
| 2000 | 15 | 15 | 14 | 14 | 13 | 12 | 12 | 11 | 10 | 9 | 9 |



EFSCOP00009485

| Table 5C: Engines Greater Than 500 and Less Than or Equal to 1,000 hp (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Generic Modeling Results** | | | | | | | | | | | |
| Distance | 8 ft height | 10 ft height | 12 ft height | 14 ft height | 16 ft height | 18 ft height | 20 ft height | 25 ft height | 30 ft height | 35 ft height | 40 ft height |
| (ft) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) |
| 2100 | 14 | 14 | 13 | 13 | 12 | 12 | 12 | 11 | 10 | 9 | 9 |
| 2200 | 14 | 14 | 13 | 13 | 12 | 12 | 12 | 10 | 10 | 9 | 9 |
| 2300 | 13 | 13 | 12 | 12 | 12 | 11 | 11 | 10 | 10 | 9 | 8 |
| 2400 | 13 | 13 | 12 | 12 | 12 | 11 | 11 | 10 | 9 | 9 | 8 |
| 2500 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 10 | 9 | 9 | 8 |
| 2600 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 10 | 9 | 9 | 8 |
| 2700 | 12 | 12 | 11 | 11 | 11 | 10 | 10 | 10 | 9 | 8 | 8 |
| 2800 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 9 | 9 | 8 | 8 |
| 2900 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 8 | 8 |
| 3000 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 8 | 8 |
| 3500 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 7 | 7 |
| 4000 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 6 |
| 4500 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 |
| 5000 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 5 |
| 5500 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 |



EFSCOP00009486

## Table 5D: Engines Greater Than 1,000 and Less Than or Equal to 1,500 hp

| Table 5D: Engines Greater Than 1,000 and Less Than or Equal to 1,500 hp | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Generic Modeling Results** | | | | | | | | | | | |
| Distance | 8 ft height | 10 ft height | 12 ft height | 14 ft height | 16 ft height | 18 ft height | 20 ft height | 25 ft height | 30 ft height | 35 ft height | 40 ft height |
| (ft) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) |
| 50 | 17 | 13 | 12 | 10 | 10 | 10 | 10 | 9 | 8 | 8 | 7 |
| 100 | 17 | 13 | 12 | 10 | 10 | 10 | 10 | 9 | 8 | 8 | 7 |
| 150 | 17 | 13 | 12 | 10 | 10 | 10 | 10 | 9 | 8 | 8 | 7 |
| 200 | 17 | 13 | 12 | 10 | 10 | 10 | 10 | 9 | 8 | 8 | 7 |
| 300 | 17 | 13 | 12 | 10 | 10 | 10 | 10 | 9 | 8 | 8 | 7 |
| 400 | 17 | 13 | 11 | 10 | 10 | 10 | 10 | 9 | 8 | 8 | 7 |
| 500 | 17 | 13 | 11 | 10 | 10 | 10 | 10 | 9 | 8 | 8 | 7 |
| 600 | 17 | 12 | 11 | 10 | 10 | 10 | 10 | 9 | 8 | 8 | 7 |
| 700 | 17 | 11 | 11 | 10 | 10 | 10 | 10 | 9 | 8 | 8 | 7 |
| 800 | 17 | 11 | 11 | 10 | 10 | 10 | 10 | 9 | 8 | 8 | 7 |
| 900 | 17 | 11 | 11 | 10 | 10 | 10 | 10 | 9 | 8 | 8 | 7 |
| 1000 | 17 | 11 | 11 | 10 | 10 | 10 | 10 | 9 | 8 | 8 | 7 |
| 1100 | 16 | 11 | 11 | 10 | 10 | 10 | 10 | 9 | 8 | 8 | 7 |
| 1200 | 15 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 8 | 7 | 7 |
| 1300 | 15 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 7 | 7 |
| 1400 | 14 | 10 | 10 | 10 | 9 | 9 | 8 | 8 | 8 | 7 | 7 |
| 1500 | 13 | 10 | 10 | 10 | 8 | 8 | 8 | 8 | 8 | 7 | 6 |
| 1600 | 12 | 10 | 10 | 10 | 8 | 8 | 8 | 8 | 8 | 7 | 6 |
| 1700 | 12 | 10 | 10 | 10 | 8 | 8 | 8 | 8 | 8 | 7 | 6 |
| 1800 | 11 | 10 | 10 | 10 | 8 | 8 | 8 | 8 | 8 | 7 | 6 |
| 1900 | 11 | 10 | 9 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 6 |



EFSCOP00009487

| Table 5D: Engines Greater Than 1,000 and Less Than or Equal to 1,500 hp (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Generic Modeling Results** | | | | | | | | | | | |
| Distance | 8 ft height | 10 ft height | 12 ft height | 14 ft height | 16 ft height | 18 ft height | 20 ft height | 25 ft height | 30 ft height | 35 ft height | 40 ft height |
| (ft) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) |
| 2000 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 6 |
| 2100 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 7 | 7 | 6 | 6 |
| 2200 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 7 | 7 | 6 | 6 |
| 2300 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 6 | 6 |
| 2400 | 9 | 9 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 6 | 6 |
| 2500 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 6 | 5 |
| 2600 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 6 | 5 |
| 2700 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 6 | 5 |
| 2800 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 5 |
| 2900 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 5 |
| 3000 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 5 | 5 |
| 3500 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 |
| 4000 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 4 | 4 |
| 4500 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 5000 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 |
| 5500 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 |



EFSCOP00009488

## Table 5E: Engines Greater Than 1,500 and Less Than or Equal to 2,000 hp

| Table 5E: Engines Greater Than 1,500 and Less Than or Equal to 2,000 hp | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Generic Modeling Results** | | | | | | | | | | | |
| Distance | 8 ft height | 10 ft height | 12 ft height | 14 ft height | 16 ft height | 18 ft height | 20 ft height | 25 ft height | 30 ft height | 35 ft height | 40 ft height |
| (ft) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) | $G_{hourly}$ (μg/m³)/(lb/hr) |
| 50 | 10 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 5 | 5 |
| 100 | 10 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 5 | 5 |
| 150 | 10 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 5 | 5 |
| 200 | 10 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 5 | 5 |
| 300 | 10 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 5 | 5 |
| 400 | 10 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 5 | 5 |
| 500 | 10 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 5 | 5 |
| 600 | 10 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 5 | 5 |
| 700 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 5 | 5 |
| 800 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 5 | 5 |
| 900 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 5 | 5 |
| 1000 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 5 | 5 |
| 1100 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 5 | 5 |
| 1200 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 5 | 5 |
| 1300 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 5 | 5 |
| 1400 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 5 | 5 |
| 1500 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 6 | 5 | 5 | 5 |
| 1600 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 6 | 5 | 5 | 5 |
| 1700 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 6 | 5 | 5 | 5 |
| 1800 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 6 | 5 | 5 | 5 |
| 1900 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 5 | 5 | 5 |
| 2000 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 5 | 5 | 5 |



EFSCOP00009489

| Table 5E: Engines Greater Than 1,500 and Less Than or Equal to 2,000 hp (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Generic Modeling Results** | | | | | | | | | | | |
| Distance | 8 ft height | 10 ft height | 12 ft height | 14 ft height | 16 ft height | 18 ft height | 20 ft height | 25 ft height | 30 ft height | 35 ft height | 40 ft height |
| (ft) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) |
| 2100 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 |
| 2200 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 4 |
| 2300 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 4 |
| 2400 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 4 |
| 2500 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 4 | 4 |
| 2600 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 4 | 4 |
| 2700 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 |
| 2800 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 2900 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 3000 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 3500 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 3 |
| 4000 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 |
| 4500 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 |
| 5000 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 5500 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |



EFSCOP00009490

## Table 5F: Engines Greater Than 2,000 hp

| Table 5F: Engines Greater Than 2,000 hp | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Generic Modeling Results** | | | | | | | | | | | |
| Distance | 8 ft height | 10 ft height | 12 ft height | 14 ft height | 16 ft height | 18 ft height | 20 ft height | 25 ft height | 30 ft height | 35 ft height | 40 ft height |
| (ft) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) |
| 50 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 100 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 150 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 200 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 300 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 400 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 500 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 600 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 700 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 800 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 900 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 1000 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 1100 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 1200 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 1300 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 1400 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 1500 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 1600 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 1700 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 1800 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 1900 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 |
| 2000 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 3 |



EFSCOP00009491

| Table 5F: Engines Greater Than 2,000 hp (continued) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Generic Modeling Results** | | | | | | | | | | | |
| Distance | 8 ft height | 10 ft height | 12 ft height | 14 ft height | 16 ft height | 18 ft height | 20 ft height | 25 ft height | 30 ft height | 35 ft height | 40 ft height |
| (ft) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) | $G_{hourly}$ (µg/m³)/(lb/hr) |
| 2100 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 3 |
| 2200 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 3 |
| 2300 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 3 |
| 2400 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 3 |
| 2500 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 3 |
| 2600 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 3 | 3 |
| 2700 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 3 | 3 |
| 2800 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 |
| 2900 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 |
| 3000 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 |
| 3500 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 |
| 4000 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 4500 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 |
| 5000 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 |
| 5500 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |



EFSCOP00009492

## Table 6 Engine and Turbine Emission and Operational Standards

| Engine Type | Engine Size | Manufacture Date | NOx (g/bhp-hr) | CO (g/bhp-hr) | VOC (g/bhp-hr) |
|---|---|---|---|---|---|
| **Rich Burn, Non-emergency, Spark-ignited** | less than 100 hp | All dates | no standard | no standard | no standard |
| | greater than or equal to 100 hp | Before January 1, 2011 | 2 | 3 | no standard |
| | greater than or equal to 100 hp | After January 1, 2011 | 1 | 3 | 1 |
| | After January 1, 2015, regardless of manufacture date, no rich burn engine greater than or equal to 240 hp authorized by this permit shall emit NOx in excess of 0.5 g/bhp-hr. After January 1, 2018, regardless of manufacture date, no rich burn engine greater than or equal to 100 hp authorized by this permit shall emit NOx in excess of 0.5 g/bhp-hr. If an authorization or authorizations is issued for a spark ignited rich burn engine under this standard permit after the applicable date of January 1, 2015 or January 1, 2018, NOx emissions from that engine shall not exceed 0.5 g/bhp-hr, except that the standard permit holder shall have a one year grace period from the date of the initial authorization under this standard permit to comply with the limit of 0.5 g/bhp-hr for NOx. The commission reserves the right to re-evaluate the upgrade requirement if EPA promulgates any standards for existing engines. | | | | |
| **Lean Burn, 2SLB Non-emergency, Spark-ignited** | less than 500 hp | All dates | no standard | no standard | no standard |
| | greater than or equal to 500 hp | Before September 23, 1982 | 8 | 3 | no standard |
| | | Before June 18, 1992 and rated less than 825 hp | 8 | 3 | no standard |
| | | After September 23, 1982, but prior to June 18, 1992 and rated 825 hp or greater | 5 | 3 | no standard |
| | | After June 18, 1992 but prior to July 1, 2010 | 2.0 except under reduced speed, 80-100% of full torque conditions may be 5.0 | 3 | no standard |
| | | On or after July 1, 2010 | 1 | 3 | 1 |
| **Lean Burn, 4SLB, Non-emergency, Spark-ignited, and Dual-fuel** | less than 500 hp | Before July 1, 2008 | no standard | no standard | no standard |
| | | On or after July 1, 2008 | 2 | 3 | 1 |
| | greater than or equal to 500 hp | Before September 23, 1982 | 5.0 except under reduced speed, 80-100% of full torque conditions may be 8.0 | 3 | no standard |
| | | Before June 18, 1992 and rated less than 825 hp | 5.0 except under reduced speed, 80-100% of full torque conditions may be 8.0 | 3 | no standard |
| | | After September 23, 1982, but prior to June 18, 1992 and rated 825 hp or greater | 5 | 3 | no standard |
| | | After June 18, 1992 but prior to July 1, 2010 | 2.0 except under reduced speed, 80-100% of full torque conditions, may be 5.0 | 3 | no standard |
| | | On or after July 1, 2010 | 1 | 3 | 1 |
| | After January 1, 2020, no spark ignited 4-stroke lean burn engine authorized by this standard permit that existed on-site on January 1, 2012, shall emit NOx in excess of 2.0 g/bhp-hr. If an oil and gas standard permit authorization or authorizations are is issued for a spark ignited 4-stroke lean burn engine after January 1, 2012, NOx emissions from that engine shall not exceed 2.0 g/bhp-hr after January 1, 2015. However, if the date of the initial authorization is after January 1, 2015, the standard permit holder shall have a three year grace period from the date of the initial authorization under the oil and gas standard permit to comply with the limit of 2.0 g/bhp-hr for NOx. The commission reserves the right to re-evaluate the upgrade requirement if EPA promulgates any standards for existing engines. | | | | |
| **Turbines** | Turbines shall not emit greater than 25 ppmvd @ 15% O2 for NOX and 50 ppmvd @ 15% O2 for CO. | | | | |



EFSCOP00009493

## Table 7 Sampling and Demonstrations of Compliance

| Category | Description | Specifications and Expectations |
|---|---|---|
| Exclusions | Control Systems | Control device monitoring and records are required only where the device is necessary for the site to meet emission rate limits |
| Sampling General | When Applicable Ports & Platforms, Methods, Notifications and Timing | (A)If necessary, sampling ports and platforms shall be incorporated into the design of all exhaust stacks according to the specifications set forth in "Chapter 2, Stack Sampling Facilities." Engines and other facilities which are physically incapable of having platforms are excluded from this requirement. For control devices with effectiveness requirements only, appropriate sampling ports shall also be installed upstream of the inlet to control devices or controlled recovery systems with control efficiency requirements. Alternate sampling facility designs may be submitted for written approval by the Texas Commission on Environmental Quality (TCEQ) Regional Director or his designee.<br>(B) Where stack testing is required, Sampling shall be conducted within 180 days of the change that required the registration, in accordance with the appropriate procedures of the TCEQ Sampling Procedures Manual and in accordance with the appropriate EPA Reference Methods. Unless otherwise specified, each performance test shall consist of three separate runs using the applicable test method. Each run shall be conducted for the time and under the conditions specified in the applicable standard. Where appropriate, sampling shall occur as three one-hour test runs and then averaged to demonstrate compliance with the limits of this authorization. Any deviations from those procedures must be approved in writing by the TCEQ Regional Director or his designee prior to sampling.<br>(C) The Regional Office shall be afforded the opportunity to observe all such sampling.<br>(D) The holder of this authorization is responsible for providing sampling and testing facilities and conducting the sampling and testing operations at his expense.<br>(E) The TCEQ Regional Office that has jurisdiction over the site shall be contacted as soon as any testing is scheduled, but not less than 30 days prior to sampling. The region shall have discretion to amend the 30 day prior notification. Except for engine testing and liquid/gas analysis sampling, all other sampling shall include an opportunity for the appropriate regional office to schedule a pretest meeting. The notice shall include:<br>(i) Date for pretest meeting, if required; (ii)Date sampling will occur; (iii) Name of firm conducting sampling; (iv)Type of sampling equipment to be used;<br>(v) Method or procedure to be used in sampling; (vi)Procedure used to determine operating rates or other relevant parameters during the sampling period; (vii) parameters to be documented during the sampling event; (viii) any proposed deviations to the prescribed sampling methods.<br>If held, the purpose of the pretest meeting is to review the necessary sampling and testing procedures, to provide the proper data forms for recording pertinent data, and to review the format procedures for submitting the test reports.<br>(F) Within 60 days after the completion of the testing and sampling required herein, one original and one copy of the sampling reports shall be sent to the Regional Office.<br>(G) When sampling is required, all Quality Assurance/Quality Control shall follow 30 TAC Ch 25 National Environmental Laboratory Accreditation Conference accreditation requirements. |
| Fugitive monitoring and LDAR | Analyzers | An approved gas analyzer or other approved detection monitoring device used for the volatile organic compound fugitive inspection and repair requirement is a device that conforms to the requirements listed in Title 40 CFR §60.485(a) and (b), or is otherwise approved by the Environmental Protection Agency as a device to monitor for VOC fugitive emission leaks. Approved gas analyzers shall conform to requirements listed in Method 21 of 40 CFR Part 60, Appendix A. The gas analyzer shall be calibrated with methane. In addition, the response factor of the instrument for a specific VOC of interest shall be determined and meet the requirements of Standard permit 8 of Method 21. If a mixture of VOCs is being monitored, the response factor shall be calculated for the average composition of the process fluid. If a response factor less than 10 cannot be achieved using methane, then the instrument may be calibrated with one of the VOC to be measured or any other VOC so long as the instrument has a response factor of less than 10 for each of the VOC to be measured.<br>In lieu of using a hydrocarbon gas analyzer and EPA Method 21, the owner or operator may use the Alternative Work Practice in 40 CFR Part 60, §60.18(g) - (i). The optical gas imaging instrument must meet all requirements specified in 40 CFR §60.18(g) - (i), except the annual Test Method 21 requirement in 40 CFR §60.18(h)(7) and the reporting requirement in 40 CFR §60.18(i)(5) do not apply. |



EFSCOP00009494

## Table 7 Sampling and Demonstrations of Compliance (continued)

| Category | Description | Specifications and Expectations |
|---|---|---|
| Verify composition of materials | All site-specific gas or liquid analyses | Reports necessary to verify composition (including hydrogen sulfide ($H_2S$) at any point in the process. All analyses shall be site specific or a representative sample may be used to estimate emissions if all of the parameters in the gas and liquid analysis protocol provided by the commission are met.<br><br>A site-specific or define representative analysis shall be performed within 90 days of initial start of operation or implementation of a change which requires registration. When new streams are added to the site and the character or composition of the streams change and cause an increase in authorized emissions, or upon request of the appropriate Regional office or local air pollution control program with jurisdiction, a new analysis will need to be performed. Analysis techniques may include, but are not limited to, Gas Chromatography (GC), Tutweiler, stain tube analysis, and sales oil/condensate reports. These records will document the following: (A) $H_2S$ content; (B) flow rate; (C) heat content; or (D) other characteristic including, but not limited to: (i) American Petroleum Institute gravity and Reid vapor pressure (RVP);(ii) sales oil throughput; or (iii) condensate throughput.<br><br>Laboratory extended VOC GC analysis at a minimum to C10+ and $H_2S$ analysis for gas and liquids for the following shall be performed and used for emission compliance demonstrations:(A) Separator at the inlet; (B) Dehydration Unit / Glycol Contactor prior to dehydrator;(C) Amine Unit prior to sweetening unit; (D) Separator dumping to gunbarrel or storage tank; (E) Tanks for liquids and vapors; or (F) P |
| Engines & Turbines | Initial Sampling of (i)Any engine greater than 500 horsepower;<br>(ii) Any turbine | Perform stack sampling and other testing as required to establish the actual quantities of air contaminants being emitted into the atmosphere (including but not limited to nitrogen oxide ($NO_X$), carbon monoxide (CO), and oxygen (O2). Each combustion facility shall be tested at a minimum of 50% of the design maximum firing rate of the facility. Each tested firing rate shall be identified in the sampling report. Sampling shall occur within 180 days after initial start-up of each unit. Additional sampling shall occur as requested by the TCEQ Regional Director.<br>If there are multiple engines at an oil and gas sites (OGS) of identical model, year, and control system, sampling may be performed on 50% of the units and used for compliance demonstration of all identical units at the OGS. The remaining 50% of the units not initially tested must be tested during the next biennial testing period.<br>This sampling is not required upon initial installation at any location if the engine or turbine was previously installed and tested at any location in the United States and the test conformed with EPA Reference Methods. Regardless of engine location, records of performance testing, or relied upon sampling reports, must remain with each specific engine for a minimum of five years unless records are unavailable and the permit holder performs the initial sampling on-site. No one may claim records are unavailable for the time period in which an engine is at the site which is authorized by this standard permit. This testing is not required for emergency engines unless requested by the TCEQ Regional Director. Idle engines do not need to be re-started only for the purpose of completing required testing. If biennial testing is required for an engine that is re-started for production purposes, the biennial testing is required within 30 days after re-starting the engine. |



EFSCOP00009495

## Table 7 Sampling and Demonstrations of Compliance (continued)

| Category | Description | Specifications and Expectations |
|---|---|---|
| Engines | Periodic Evaluation | The following is applicable to sites with federal operating permits only: (A) For any engine with a NOx standard under Table 6, conduct evaluations of each engine performance quarterly after initial compliance testing by measuring the $NO_x$ and CO content of the exhaust. Tests shall occur more than 30 days apart. Individual engines shall be subject to the quarterly performance evaluation if they were in operation for 1000 hours or more during the quarter period. If an engine is not operating, the permit holder may delay the test until such time as the engine is expected to run for more than fourteen days. Idled engines do not need to be re-started only for the purpose of completing required testing.<br>(B) The use of portable analyzers specifically designed for measuring the concentration of each contaminant in parts per million by volume is acceptable for these evaluations. The portable analyzer shall be operated at minimum in accordance with the manufacturer's instructions. The operator may modify the procedure if it does not negatively alter the accuracy of the analyzer. Also, colorimetric testing (stain tubes) maybe used in these periodic evaluations. The $NO_x$ and CO emissions then shall be converted into units of grams per horsepower-hour and pounds per hour.<br>(C) Emissions shall be measured and recorded in the as-found operating condition, except no compliance determination shall be established during start-up, shutdown, or under breakdown conditions.<br>(D) In lieu of the above mentioned periodic monitoring for engines and biennial testing, the holder of this permit may install, calibrate, maintain, and operate a continuous emission monitoring system (CEMS) to measure and record the concentrations of $NO_x$ and CO from any engine, turbine, or other external combustion facility. Diluents to be measured include $O_2$ or $CO_2$. Except for system breakdowns, repairs, calibration checks, zero and span adjustments, and other quality assurance tests, the Continuous Emission Monitoring Systems (CEMS) shall be in continuous operation and shall record a minimum of four, and normally 60, approximately equally spaced data points for each full hour. The $NO_x$ and diluents CEMS shall be operated according to the methods and procedures as set out in 40 CFR Part 60, Appendix B, Performance Specifications 2 and 3. The CO CEMS shall be operated according to the methods and procedures as set out in 40 CFR Part 60, Appendix B, Performance Specifications 4, 4A, or 4B. CEMS shall follow the quality assurance requirements of Appendix F except that Cylinder Gas Audits may be conducted in all four calendar quarters in lieu of the annual Relative Accuracy Test Audit. A CEMS with downtime due to breakdown or repair of more than 10% of the facility operating time for any calendar shall be considered as a defective CEMS and the CEMS shall be replaced within 2 weeks. |
| Engines & Turbines | Biennial Testing<br>Any engine greater than 500 horsepower or any turbine | Every two years starting from the completion date of the Initial Compliance Testing, any engine greater than 500 horsepower or any turbine shall be retested according to the procedures of the Initial Compliance Testing.<br>Retesting shall occur within 90 days of the two year anniversary date. If a facility has been operated for less than 2000 hours during the two year period, it may skip the retesting requirement for that period. After biennial testing, any engine retested under the above requirements shall resume periodic evaluations within the next 6 calendar months (January to June or July to December). If biennial testing is required for an engine that is re-started for production purposes, the biennial testing shall be performed within 45 days after re-starting the engine. |



EFSCOP00009496

## Table 7 Sampling and Demonstrations of Compliance (continued)

| Category | Description | Specifications and Expectations |
|---|---|---|
| Oxidation or Combustion Control Device | Initial Sampling and Monitoring for performance for VOC, Benzene, and $H_2S$ | Stack testing, when a company wants to establish efficiencies of 99% or greater, must be coordinated and approved. Sampling is required for VOC, benzene and $H_2S$ at Region's discretion. The thermal oxidizer (TO) must have proper monitoring and sampling ports installed in the vent stream and the exit to the combustion chamber, to monitor and test the unit simultaneously.<br>The temperature and oxygen measurement devices shall reduce the temperature and oxygen concentration readings to an averaging period of 6 minutes or less and record it at that frequency. The temperature measurement device shall be installed, calibrated, and maintained according to accepted practice and the manufacturer's specifications. The device shall have an accuracy of the greater of ±0.75% of the temperature being measured expressed in degrees Celsius or =2.5°C.<br>The oxygen or carbon monoxide analyzer shall be zeroed and spanned daily and corrective action taken when the 24-hour span drift exceeds two times the amounts specified Performance Specification No. 3 or 4A, 40 CFR Part 60, Appendix B. Zero and span is not required on weekends and plant holidays if instrument technicians are not normally scheduled on those days.<br>The oxygen or carbon monoxide analyzer shall be quality-assured at least semiannually using cylinder gas audits (CGAs) in accordance with 40 CFR Part 60, Appendix F, Procedure 1, §5.1.2, with the following exception: a relative accuracy test audit is not required once every four quarters (i.e., two successive semiannual CGAs may be conducted). An equivalent quality-assurance method approved by the TCEQ may also be used. Successive semiannual audits shall occur no closer than four months. Necessary corrective action shall be taken for all CGA exceedances of ±15 percent accuracy and any continuous emissions monitoring system downtime in excess of 5% of the incinerator operating time. These occurrences and corrective actions shall be reported to the appropriate TCEQ Regional Director on a quarterly basis. Supplemental stack concentration measurements may be required at the discretion of the appropriate TCEQ Regional Director. Quality assured or valid data of oxygen or carbon monoxide analyzer must be generated when the TO is operating except during the performance of a daily zero and span check. Loss of valid data due to periods of monitor break down, inaccurate data, repair, maintenance, or calibration may be exempted provided it does not exceed 5% of the time (in minutes) that the oxidizer operated over the previous rolling 12 month period. The measurements missed shall be estimated using engineering judgment and the methods used recorded. |



EFSCOP00009497

## Table 8 Monitoring and Records Demonstrations

| Category | Description | Record Information |
|---|---|---|
| Site Production or Collection | natural gas, oil, condensate, and water production records | Site inlet and outlet gas volume and sulfur concentration, daily gas/liquid production and load-out from tanks |
| Equipment and facility summary | Current process description | Accurate and detailed plot plan with property line, off-site receptors, and all equipment on-site or drawings with sufficient detail to confirm all authorized facilities to confirm emission estimates, impact review, and registration scope |
| Equipment specifications | Process units, tanks, vapor recovery systems; flares; thermal oxidizers; and reboiler control devices | A copy of the registration and emission calculations including the fixed equipment sizes or capacities and manufacturer's specifications and programs to maintain performance, with the plan and records for routine inspection, cleaning, repair and replacement. |
| | Leaks in piping, fugitive components and process vessels | If a leak has been found and determined that there would be less emissions from the repair by delaying repair until the next shutdown, then a record of the calculation showing that the emissions would be less shall be kept. |
| Physical Inspection | Fugitive Component Check | A record of the component count shall be maintained. A record of the date each quarterly inspection was made and the date components found leaking were repaired or the date of the planned shutdown. |



EFSCOP00009498

## Table 8 Monitoring and Records Demonstrations (continued)

| Category | Description | Record Information |
|---|---|---|
| Voluntary LDAR Program | Details of fugitive component monitoring plan, and LDAR results, including QA, QC | The following records are required where a company uses an LDAR program to reduce the potential fugitive emissions from the site to meet emission limitations or certify fugitive emissions.<br>(A) A monitoring program plan must be maintained that contains, at a minimum, the following information:<br>(i) an accounting of all the fugitive components by type and service at the site with the total uncontrolled fugitive potential to emit estimate;<br>(ii) identification of the components at the site that are required to be monitored with an instrument or are exempt with the justification, note the following can be used for this purpose: (a) piping and instrumentation diagram (PID); or (b) a written or electronic database.; (iii) the monitoring schedule for each component at the site with difficult-to-monitor and unsafe-to-monitor valves, as defined by Title 30 Texas Administrative Code Chapter 115 (30 TAC Chapter 115), identified and justified, note if an unsafe-to-monitor component is not considered safe to monitor within a calendar year, then it shall be monitored as soon as possible during safe-to-monitor times and a record of the plan to monitor shall be maintained; and (iv) the monitoring method that will be used (audio, visual, or olfactory (AVO) means; Method 21; the Alternative Work Practice in 40 CFR §60.18(g) - (i)); (v) for components where instrument monitoring is used, information clarifying the adequacy of the instrument response; (vi) the plan for hydraulic or pressure testing or instrument monitoring new and reworked components.<br>(B) Records must be maintained of all monitoring instrument calibrations.<br>(C) Records must be maintained for all monitoring and inspection data collected for each component required to be monitored with a Method 21 portable analyzer that include the type of component and the monitoring results in ppmv regardless if the screening value is above or below the leak definition..<br>(D) Leaking components must be tagged and a leaking-components monitoring log must be maintained for all leaks greater than the applicable leak definition (i.e.10,000 ppmv, 2000 ppmv, or 500 ppmv) of VOC detected using Method 21, all leaks detected by AVO inspection, and all leaks found using Alternative Work Practice specified in 40 CFR §60.18(g)-(i). The log must contain, at a minimum, the following:<br>(i) the method used to monitor the leaking component (audio, visual, or olfactory inspection; Method 21; or the Alternative Work Practice in 40 CFR §60.18(g) - (i)); (ii) the name of the process unit or other appropriate identifier where the component is located; (iii) the type (e.g., valve or seal) and tag identification of component; (iv) the results of the monitoring (in ppmv if a Method 21 portable analyzer was used); (v) the date the leaking component was discovered;(vi) the date that a first attempt at repair was made to a leaking component; (vii) the date that a leaking component is repaired; (viii) the date and instrument reading of the recheck procedure after a leaking component is repaired; and (ix) the leaks that cannot be repaired until turnaround and the date that the leaking component is placed on the shutdown list.<br>(E) If the owner or operator is using the Alternative Work Practice specified in 40 CFR §60.18(g) - (i), the records required by 40 CFR §60.18(i)(4).<br>(F) A record of the monitored value any open-ended line or valve for which is a repair or replacement is not completed within 72 hours and monitoring in lieu of covering is chosen.<br>(G) Any open-ended line or valve caused by a repair or replacement not completed within 72 hours shall be monitored as specified in table 10 and the checks and any corrective actions taken shall be recorded.<br>(H) Weekly audio, visual and olfactory inspections shall be noted in a log<br>(I) A check of the reading for any pressure-sensing device to verify rupture disc integrity shall be performed weekly and noted in a log. |
| Minor Changes | Additions, changes or replacement | Records showing all replacements and additions, including summary of emission type and quantities, for a rolling 6-month period of time. |
| Equipment Replacement | Like-Kind replacement | Records on equipment specifications and operations, including summary of emissions type and quantity. |



EFSCOP00009499

## Table 8 Monitoring and Records Demonstrations (continued)

| Category | Description | Record Information |
|---|---|---|
| Process Units | Glycol Dehydration Units | For emission estimates, the worst-case combination of parameters resulting in the greatest emission rates must be used. If worst-case parameters are not used, then glycol dehydrator unit monitoring records include dry gas flow rate, absorber pressure and temperature, glycol type, and circulation rate recorded weekly. If worst-case parameters are not used, then in addition to weekly unit monitoring, where control of flash tank or reboiler emissions are required to meet the emission limitations of the section and emissions are certified, the following control monitoring requirements apply weekly: flash tank temperature and pressure, any reboiler stripping gas flow rate, and condenser outlet temperature. VRU, flare, or thermal oxidizer control or reboiler fire box used for control must comply with the monitoring and recordkeeping for those devices. Where all emissions from the flash tank and the reboiler or reboiler condenser vent are directed to a VRU, flare, or thermal oxidizer designed to be on-line at all times the glycol dehydrator is in operation, the control system monitoring for the glycol dehydrator is not required. |
| | Amine Units | Amine units may simply retain site production or inlet gas records if all sulfur compounds in the inlet are assumed to be emitted. Where only partial removal of the inlet sulfur is assumed, for emission estimates, the worst-case combination of parameters resulting in the greatest emission rates must be used. If worst-case parameters are not used, then records of the amine solution, contactor pressure, temperature and pump rate shall be maintained. Where the waste gas is vented to combustion control, the requirements of the control device utilized should be noted. |
| Boilers, Reboilers, Heater-Treaters, and<br>and Process Heaters | Combustion | Records of Operational Monitoring and Testing Records<br>Records of the hours of operation of every combustion device of any size by the use of a process monitor such as a run time meter, fuel flow meter, or other process variable that indicates a unit is running unless, in the registration for the facility, the emissions from the facility were calculated using full year operation at maximum design capacity in which case no hours of operation records must be kept. |
| Internal Combustion Engines | Combustion | Records of Appropriate Operational Monitoring and Testing Records<br>Records of the hours of operation of every combustion device and engine of any size by the use of a process monitor such as a run time meter, fuel flow meter, or other process variable that indicates a unit is running. The owner or operator may test and retest at the most frequent intervals identified in Table 7 in lieu of installing a process monitor and recording the hours of operation. If an engine has no testing requirements in Table 7, no records of the hours of operation must be kept.<br>See fuel records below |
| Gas Fired Turbines | Combustion | Records of Appropriate Operational Monitoring and Testing Records<br>Records of the hours of operation of every turbine greater than 500 hp by the use of a process monitor such as a run time meter, fuel flow meter, or other process variable that indicates a unit is running unless the permit holder determined emissions from the facility assuming full year operation at maximum design capacity in which case no hours of operation records must be kept. |
| Fuel Records | VOC and Sulfur Content | A fuel flow meter is not required if emissions are based on maximum fuel usage for 8,760 hr/yr. There are no specific requirements for allowable VOC content of fuel. If field gas contains more than 1.5 grains (24 ppmv) of H2S or 30 grains total sulfur compounds per 100 dry standard cubic feet, the operator shall maintain records, including at least quarterly measurements of fuel H2S and total sulfur content, which demonstrate that the annual SO2 emissions do not exceed limitations |
| Tanks/Vessels | Color/Exterior | Records demonstrating design, inspection, and maintenance of paint color and vessel integrity. |
| Tanks/Vessels | Emission and emission potential | Maintain a record of the material stored in each tank/vessel that vents to the atmosphere and the maximum vapor pressure used to establish the maximum potential short-term emission rate. Where pressurized liquids can flash in the tank/vessel monitor and record weekly the maximum fluid pressure that can enter the tank / vessel.<br>Records that tank / vessel hatches and relief valves are properly sealed when tank /vessel is directed to control and after loading events (as needed). |



EFSCOP00009500

## Table 8 Monitoring and Records Demonstrations (continued)

| Category | Description | Record Information |
|---|---|---|
| Truck Loading | All Types | Records indicating type of material loaded, amount transferred, method of transfer, condition of tank truck before loading. |
| | Vacuum Trucks | Note loading with an air mover or vacuum. No additional record is needed where a vacuum truck uses only an on-board or portable pump to push material into the truck. |
| | Controlled Loading | Where control is required note the control that is utilized. |
| Control Devices | Vapor Capture and Recovery | Records of hours of use are required for all units and on-line time must be considered when emission estimates and actual emissions inventories are calculated.<br><br>mVRU<br>Basic Design Function Record: Record demonstrating the unit captures vapor and includes a sensing device set to capture this vapor at peak intervals.<br><br>Additional Design Parameter Record: Record demonstrating additional design parameters are utilized such as additional sensing equipment, a properly designed bypass system, an appropriate gas blanket, an adequate compressor selection, and the ability to vary the drive speed for units utilizing electric driven compressors<br>mVRUs that are used at oil and gas sites to control emissions may claim up to 100% control efficiency provided records of basic and additional design functions and parameters of a VRU along with appropriate records listed in Table 8 are satisfied.<br><br>mVRUs may claim up to 99% control efficiency for units where records of basic and additional design functions are satisfied and parameters listed in Table 8 are not satisfied.<br><br>mVRUs may claim up to 95% control efficiency for units where records listed in Table 8 are not satisfied.<br><br>IVRU<br>The record of proper design must be kept to demonstrate how the unit was designed and for what capacity. The record of liquid replacement must be kept, along with the calculations for demonstrating that the VOC to liquid ratio has been maintained. Additionally, the system must be tested to demonstrate the efficiency. This testing needs to be performed and results recorded to receive 95% control efficiency no longer than: vacuum truck emissions: after 20 loads have been pulled through the IVRU, for tanks: Produced Water – Monthly, Crude – Bi-Monthly, Condensate – Weekly. This testing needs to be performed and results recorded to receive 98% control efficiency no longer than: vacuum truck emissions: after 15 loads have been pulled through the IVRU, for tanks: Produced Water – 3 weeks, Crude – 10 days, Condensate – 5 days.<br><br>All valves must be designed and maintained to prevent leaks. All hatches and openings must be properly gasketed and sealed with the unit properly connected.<br><br>Downtime is limited to a rolling 12 month average of 5% or 432 hr/per rolling 12 months and waste vents shall be redirected to an appropriate control device if possible during down time unless otherwise registered for alternate operating hours. |



EFSCOP00009501

## Table 8 Monitoring and Records Demonstrations (continued)

| Category | Description | Record Information |
|---|---|---|
| Cooling Tower | Design data | Records shall be kept of maximum cooling water circulation rate and basis, maximum total dissolved solids allowed as maintained through blowdown, and towers design drift rate. These records are only required if the cooling system is used to cool process VOC streams or control from drift eliminators or minimizing solids content is needed to meet particulate matter emission limits. |
| | VOC Leak Monitoring, Maintenance and Repair | Cooling tower heat exchanger systems cooling process VOC streams are assumed to have potential uncontrolled leaks repaired when obviated by process problems. If controlled emissions (systems monitored for leaks) are required to meet emission rate limits then the cooling tower water shall be monitored monthly for VOC leakage from heat exchangers in accordance with the requirements of the TCEQ Sampling Procedures Manual, Appendix P (dated January 2003 or a later edition) or another air stripping method approved by the TCEQ Executive Director.<br>Cooling water VOC concentrations above 0.08 parts per million by volume (ppmv) indicate faulty equipment. Equipment shall be maintained so as to minimize VOC emissions into the cooling water. Faulty equipment shall be repaired at the earliest opportunity but no later than the next scheduled shutdown of the process unit in which the leak occurs. Records must be maintained of all monitoring data and equipment repairs. |
| | Particulate Monitoring, Maintenance and Repair. | Inspect and record integrity of drift eliminators annually, repairing as necessary. If a maximum solids content must be maintained through blowdowns to meet particulate emission rate limits, cooling water shall be sampled for total dissolved solids (TDS) once a month at prior to any periodic blow downs and maintain records of the monitoring results and all corrective actions. |
| Planned Maintenance, Start-up, and Shutdown (MSS) | Alternate Operational Scenarios and Redirection of Vent Streams | Records of redirection of vent streams during primary operational unit or control downtime, including associated alternate controls, releases and compliance with emission limitations. |
| Planned MSS | Pigging, Purging and Blowdowns | Pigging records, including catcher design, date, emission estimate to atmosphere and to control, and when controlled, the control device. Note where a control device is necessary to meet emission limitations the device is subject to the requirements of standard permit (e) and record requirements of this table.<br>Purging and blowdown records, including the volume and pressure and a description of the piping and equipment involved, the date, emission estimate to atmosphere and to control, and when controlled, the control device. Where purging to control to meet a lower concentration before purging to atmosphere is conducted the concentrations of VOC, BTEX or H2S as appropriate must be measured and recorded prior to purging to atmosphere. Note where a control device is necessary to meet emission limitations the device is subject to the requirements of standard permit (c) and record requirements of this table. |
| Planned MSS | Temporary Facilities for Bypass, and Degassing and Purging | Temporary facility records, including a description and estimate of potential fugitive emissions from temporary piping, size and design of facilities (eg. tanks or pan volume, fill method, and throughput; engine horse power, fuel and usage time, flare tip area, ignition method, and heating value assurance method; etc.) and the date and emission estimate to atmosphere and to control for their use |
| Planned MSS | Management of Sludge from Pits, Ponds, Sumps and Water Conveyances | Records including the source identification, removal plan, emission estimate direct to atmosphere and through control. Note where a control device is necessary to meet emission limitations the device is subject to the requirements of standard permit (e) and record requirements of this table. |
| Planned MSS | Degassing or Purging of Tanks, Vessels, or Other Facilities | Records including:<br>a) the EPN and description of vessels and equipment degassed or purged;<br>b) the material, volume and pressure (if applicable);<br>c) the volume of purge gas used;<br>d) a description of the piping and equipment involved;<br>e) clarifying estimates for a coated surface or heel;<br>f) the date;<br>g) emission estimate to atmosphere and to control;<br>h) when controlled, the control device; and<br>i) where purging to a control device to reduce concentrations before purging to atmosphere, the concentrations of VOC, BTEX or $H_2S$ as appropriate must be measured and recorded prior to purging to atmosphere. |



EFSCOP00009502

## Table 8 Monitoring and Records Demonstrations (continued)

| Category | Description | Record Information |
|---|---|---|
| Planned MSS | Records | Records or copies of work orders, contracts, or billing by contractors for the following activities shall be kept at the site, or nearest manned site, and made available upon request:<br>• Routine engine component maintenance including filter changes, oxygen sensor replacements, compression checks, overhauls, lubricant changes, spark plug changes, and emission control system maintenance;<br>• Boiler refractory replacements and cleanings;<br>• Heater and heat exchanger cleanings;<br>• Turbine hot standard permit swaps;<br>• Pressure relief valve testing, calibration of analytical equipment; instrumentation/analyzer maintenance; replacement of analyzer filters and screens. |
| Control Devices | Flare Monitoring | Basic monitoring requires the flare and pilot flame to be continuously monitored by a thermocouple or an infrared monitor. Where an automatic ignition system is employed, the system shall ensure ignition when waste gas is present. The time, date, and duration of any loss of flare, pilot flame, or auto-ignition shall be recorded. Each monitoring device shall be accurate to, and shall be calibrated at a frequency in accordance with, the manufacturer's specifications.<br>A temporary, portable or backup flare used less than 480 hours per year is not required to be monitored.<br>Records of hours of use are required for all units and on-line time must be considered when emission estimates and actual emissions inventories are calculated. |
| Control Devices | Thermal Oxidation and Vapor Combustion Performance Monitoring Basic | Control device monitoring and records are required only where the device is necessary for the site to meet emission rate limits.<br>Basic monitoring is a thermocouple or infrared monitor that indicates the device is working.<br>Records of hours of use are required for all units and on-line time must be considered when emission estimates and actual emissions inventories are calculated. |
| | Intermediate | Intermediate monitoring and records include continuously monitoring and recording temperature to insure the control device is working when waste gas can be directed to the device and showing compliance with the 1400 degrees Fahrenheit if applicable. |
| | Enhanced | Enhanced monitoring requires continuous temperature and oxygen or carbon monoxide monitoring on the exhaust with six minute averages recorded to show compliance with the temperature requirement and the design oxygen range or a CO limit of 100 ppmv. Some indication of waste gas flow to the control device, like a differential pressure, flow monitoring or valve position indicator, must also be continuously recorded, if the flow to the control device can be intermittent. |
| | Alternate Monitoring | Records of stack testing and the monitored parameters during the testing shall be maintained to allow alternate monitoring parameters and limits. |



EFSCOP00009503

## Table 8 Monitoring and Records Demonstrations (continued)

| Category | Description | Record Information |
|---|---|---|
| Control Devices | Control with process combustion or heating devices (e.g. reboilers, heaters & furnaces) | Basic monitoring is any continuous monitor that indicates when the flame in the device is on or off (other than partial operational use). The following are effective basic options: a fire box temperature monitor, rising or steady process temperature monitor, CO monitor, primary fuel flow monitor, fire box pressure monitor or equivalent.<br>Enhanced monitoring for 91 to 99% control, where waste gas is not introduced as the primary fuel, must include the following monitors: continuous fire box or fire box exhaust temperature, and CO and $O_2$ monitoring, with at least 6 minute averages recorded. Additionally, enhanced monitoring where the waste gas may be flowing when the control device is not firing must show continuous disposition of the waste gas streams, including continuous monitoring of flow or valve position through any potential by-pass to the control where more than 50% run time of control is claimed..<br>Basic monitoring is any continuous monitor that indicates when the flame in the device is on or off (other than partial operational use). The following are effective basic options: a fire box temperature monitor, rising or steady process temperature monitor, CO monitor, primary fuel flow monitor, fire box pressure monitor or equivalent.<br>Enhanced monitoring for 91 to 99% control, where waste gas is not the primary fuel, must include the following monitors: continuous fire box or fire box exhaust temperature monitoring; and CO and $O_2$ monitoring, with at least 6 minute averages recorded. Additionally, enhanced monitoring where the waste gas may be flowing when the control device is not firing must show continuous disposition of the waste gas streams. This includes continuous monitoring of flow or valve position through any potential by-pass to the control where more than 50% run time of the control is claimed. |



EFSCOP00009504

## Table 9 Fugitive Component LDAR BACT Table

| FUGITIVE COMPONENT LEAK DETECTION AND REPAIR (LDAR) BEST AVAILABLE CONTROL TECHNOLOGY REQUIREMENTS TABLE | |
|---|---|
| **Exceptions** *All fugitive components must meet the minimum design, monitoring, control and other emissions techniques listed in this Table unless the component's service meets one of the following exceptions:* | **Additional Details** *Compliance with these requirements does not assure compliance with requirements of NSPS, NESHAPS or MACT, and does not constitute approval of alternate standards for these regulations.* |
| Total uncontrolled potential to emit from all components ≤ 10 tpy | |
| Nitrogen lines | No expectation to estimate emissions. Note this exemption does not include lines with nitrogen that has been used as a sweep gas. |
| Steam lines (non contact) | No expectation to estimate emissions. |
| Flexible plastic tubing ≤ 0.5 inches in diameter, unless it is subject to monitoring by other state or federal regulations. | No expectation to estimate emissions, unless it is subject to monitoring by other state or federal regulations. |
| The operating pressure is at least 5 kilopascals (0.725 psi) below ambient pressure | No expectation to estimate emissions. |
| Mixtures in streams where the VOC has an aggregate partial pressure of less than 0.002 psia at 68°F. | No expectation to estimate emissions. |
| Components containing only noble gases, inserts such as $CO_2$ and water or air contaminants not typically listed on a MAERT such as methane, ethane, and Freon. | No expectation to estimate emissions. |
| Instrument monitoring is not required for pipeline quality sweet natural gas | Uncontrolled Emissions should be estimated. Must meet pipeline quality specifications |
| Instrument monitoring is not required when the aggregate partial pressure or vapor pressure is less than 0.044 psia at 68 °F or at maximum process operating temperature. | Uncontrolled Emissions should be estimated. This applies at all times, unless a control efficiency is being claimed for instrument monitoring, in which case there must be a record supporting that the instrument could detect a leak. |
| Instrument monitoring is not required for waste water lines containing less than 1% VOC by weight and operated at ≤ 1 psig | Uncontrolled Emissions should be estimated. |
| Instrument monitoring is not required for cooling water line components | Emissions are estimated and associated with the cooling tower |
| Instrument monitoring is not required for $CO_2$ lines after VOC is removed. This is referred to as Dry Gas lines in 40 CFR Part 60 Subpart KKK, and defined as a stream having a VOC weight percentage less than 4 %; a weighted average Effects Screening Level (ESL) of the combined VOC stream is > 3,500 $\mu g/m^3$; and total uncontrolled emissions for all such sources is < 1 ton per year at any OGS. | Uncontrolled Emissions should be estimated.<br>The weighted average $ESL_x$ for process stream, X, with multiple VOC species will be determined by:<br>$ESL_x = fa/ESL_a + f_b/ESL_b + f_c/ESL_c + ..... + fn/ESL_n$<br>Where:<br>n =total number of VOC species in process stream;<br>$ESL_n$ = the effects screening level in $\mu g/m^3$ for the contaminant being evaluated (published in the most recent edition of the TCEQ ESL list);<br>$f_n$=the weight fraction of the appropriate VOC species in relation to all other VOC in process stream. |
| At OGS sites where the total uncontrolled potential to emit from all components < 25 tpy, instrument monitoring is not required on components where the aggregate partial pressure or vapor pressure is less than 0.5 psia at 100 F or at maximum process operating temperature, unless the components are subject to monitoring by other state or federal regulations. | Uncontrolled Emissions should be estimated. |
| **Minimum Design, Monitoring, Technique or Control for all fugitive components with uncontrolled potential to emit of ≥ 10 tpy VOC or ≥ 1 tpy H2S** | |



EFSCOP00009505

## Table 9 Fugitive Component LDAR BACT Table (continued)

| FUGITIVE COMPONENT LEAK DETECTION AND REPAIR (LDAR) BEST AVAILABLE CONTROL TECHNOLOGY REQUIREMENTS TABLE | |
|---|---|
| **Requirements** | **Additional Details** |
| Construction of new and reworked piping, valves, pump systems, and compressor systems shall conform to applicable American National Standards Institute (ANSI), American Petroleum Institute (API), American Society of Mechanical Engineers (ASME), or equivalent codes. | To the extent that good engineering practice will permit, new and reworked valves and piping connections shall be so located to be reasonably accessible for leak-checking during plant operation. |
| *New and reworked underground process pipelines shall contain no buried valves such that fugitive emission monitoring is rendered impractical. New and reworked piping connections shall be welded or flanged. Screwed connections are permissible only on piping smaller than two-inch diameter.*<br>Gas or hydraulic testing of the new and reworked piping connections at no less than operating pressure shall be performed prior to returning the components to service or they shall be monitored for leaks using an approved gas analyzer within 15 days of the components being returned to service. Where technically feasible new and reworked components may be screened for leaks with a soap bubble test within 8 hours of being returned to service in lieu of instrument testing. Adjustments shall be made as necessary to obtain leak-free performance. | |
| Each open-ended valve or line shall be equipped with an appropriately sized cap, blind flange, plug, or a second valve to seal the line so that no leakage occurs. Except during sampling, both valves shall be closed. | If the removal of a component for repair or replacement results in an open ended line or valve, it is exempt from the requirement to install a cap, blind flange, plug, or second valve for 72 hours. If the repair or replacement is not completed within 72 hours, the permit holder must complete either of the following actions within that time period: the line or valve must have a cap, blind flange, plug, or second valve installed; or the open-ended valve or line shall be monitored once for leaks above background for a plant or unit turnaround lasting up to 45 days with an approved gas analyzer and the results recorded. For all other situations, the open-ended valve or line shall be monitored once at the end of the 72 hour period following the creation of the open ended line and monthly thereafter with an approved gas analyzer and the results recorded. For turnarounds and all other situations, leaks are indicated by readings 20 ppmv above background and must be repaired within 24 hours or a cap, blind flange, plug, or second valve must be installed on the line or valve. |
| Components shall be inspected by visual, audible, and/or olfactory means at least weekly by operating personnel walk-through. | |
| Accessible valves shall be monitored by leak-checking for fugitive emissions quarterly using an approved gas analyzer. Sealless/leakless valves (including, but not limited to, welded bonnet bellows and diaphragm valves) and relief valves equipped with a rupture disc upstream or venting to a control device are not required to be monitored.<br><br>If an unsafe-to-monitor valve is not considered safe to monitor within a calendar year, then it shall be monitored as soon as possible during safe-to-monitor times. A difficult-to-monitor component for which quarterly monitoring is specified may instead be monitored annually. | Sealless/leakless valves and relief valves equipped with rupture disc or venting to a control device and exempted from instrument monitoring are not counted in the fugitive emissions estimates. See Table 7 Sampling and Demonstrations of Compliance for Fugitive and LDAR Analyzer requirements. See Table 8, Monitoring and Records Demonstrations to identify Difficult-to-monitor and unsafe-to-monitor valves. |
| For valves equipped with rupture discs, a pressure-sensing device shall be installed between the relief valve and rupture disc to monitor disc integrity. | All leaking discs shall be replaced at the earliest opportunity but no later than the next process shutdown. |



EFSCOP00009506

## Table 9 Fugitive Component LDAR BACT Table (continued)

| FUGITIVE COMPONENT LEAK DETECTION AND REPAIR (LDAR) BEST AVAILABLE CONTROL TECHNOLOGY REQUIREMENTS TABLE | |
|---|---|
| **Requirements** | **Additional Details** |
| All pump, compressor and agitator seals shall be monitored quarterly with an approved gas analyzer or be equipped with a shaft sealing system that prevents or detects emissions of VOC from the seal. Seal systems designed and operated to prevent emissions or seals equipped with an automatic seal failure detection and alarm system need not be instrument monitored. Seal systems that prevent emissions may include (but are not limited to) dual pump seals with barrier fluid at higher pressure than process pressure or seals degassing to vent control systems kept in good working order. Submerged pumps or sealless pumps (including, but not limited to, diaphragm, canned, or magnetic-driven pumps) may be used to satisfy the requirements of this condition and need not be monitored. | Pumps compressor and agitator seals that prevent leaks or direct emissions from the seals to control and are exempt from instrument monitoring are not counted in the fugitive emissions estimates. Equipment equipped with alarms would still be counted. See Table 7 Sampling and Demonstrations of Compliance for Fugitive and LDAR Analyzer requirements. |
| For a site where the total uncontrolled potential to emit from all components is **< 25 tpy**; Components found to be emitting VOC in excess of 10,000 parts per million by volume (ppmv) using EPA Method 21, found by visual inspection to be leaking (e.g. whistling, dripping or blowing process fluids or emitting hydrocarbon or $H_2S$ odors) or found leaking using the Alternative Work Practice in 40 CFR §60.18(g) - (i) shall be considered to be leaking and shall be repaired, replaced, or tagged as specified. A first attempt to repair the leak must be made within 5 days. A leaking component shall be repaired as soon as practicable, but no later than 15 days after the leak is found. If the repair of a component would require a unit shutdown, the repair may be delayed until the next scheduled shutdown. All leaking components which cannot be repaired until a scheduled shutdown shall be identified for such repair by tagging. | Components subject to routine instrument monitoring with an approved gas analyzer under this leak definition my claim a 75% emission reduction credit when evaluating controlled fugitive emission estimates. This reduction credit does not apply when evaluating uncontrolled emission or to any component not measured with an instrument quarterly, but is allowed for all components monitored by the Alternative Work Practice. See Table 7 Sampling and Demonstrations of Compliance for Fugitive and LDAR Analyzer requirements |
| Components **not** subject to a instrument monitoring program but found to be emitting VOC in excess of 10,000 ppmv using EPA Method 21, found by audio, visual or olfactory inspection to be leaking (e.g. whistling, dripping or blowing process fluids or emitting hydrocarbon or $H_2S$ odors) shall be considered to be leaking and shall be repaired, replaced, or tagged as specified. All components are subject to monitoring when using the Alternative Work Practice in 40 CFR §60.18(g) - (i). | At the discretion of the TCEQ Executive Director or designated representative, early unit shutdown or other appropriate action may be required based on the number and severity of tagged leaks awaiting shutdown. |
| Minimum Design, Monitoring, Technique or Control for all fugitive components with uncontrolled potential to emit of ≥ 25 tpy or ≥ 5 tpy H2S | |
| For a site where the total uncontrolled potential to emit from all components is **≥ 25 tpy**; All the requirements for < 25tpy VOC above apply, except valves found to be emitting VOC in excess of 500 ppmv using EPA Method 21, found by audio, visual or olfactory inspection to be leaking (e.g. whistling, dripping or blowing process fluids or emitting hydrocarbon or $H_2S$ odors) or found leaking using the Alternative Work Practice in 40 CFR §60.18(g) - (i) shall be considered to be leaking and shall be repaired, replaced, or tagged as specified and Pump, compressor, and agitator seals found to be emitting VOC in excess of 2,000 ppmv using EPA Method 21, found by audio, visual or olfactory inspection to be leaking (e.g. whistling, dripping or blowing process fluids or emitting hydrocarbon or $H_2S$ odors) or found leaking using the Alternative Work Practice in 40 CFR §60.18(g) - (i) shall be considered to be leaking and shall be repaired, replaced, or tagged as specified. | Components subject to routine instrument monitoring under this leak definition my claim a 97% emission reduction credit for valves and an 85% emission reduction credit for pump, compressor and agitator seals when evaluating controlled fugitive emission estimates. This reduction credit does not apply when evaluating uncontrolled emission or to any component not measured with an instrument quarterly. See Table 7 Sampling and Demonstrations of Compliance for Fugitive and LDAR Analyzer requirements. |



EFSCOP00009507

## Table 9 Fugitive Component LDAR BACT Table (continued)

| FUGITIVE COMPONENT LEAK DETECTION AND REPAIR (LDAR) BEST AVAILABLE CONTROL TECHNOLOGY REQUIREMENTS TABLE | |
|---|---|
| **Requirements** | **Additional Details** |
| LDAR **Monitoring Options** | |
| Any site may reduce the controlled fugitive emission estimates by including components not required to be monitored in the quarterly instrument monitoring program or applying the lower leak definition of the more stringent program as appropriate. | Quarterly monitoring at a leak definition of 10,000 ppmv would equate to a 75% emission reduction credit when evaluating controlled fugitive emission estimates for the component. Quarterly monitoring at a leak definition of 500 ppmv would equate to a 97% emission reduction credit for valves, flanges and connectors, a 93% emission reduction credit for pumps, and a 95% emission reduction credit for compressor, agitator seals and other component groups when evaluating controlled fugitive emission estimates. This reduction credit does not apply when evaluating uncontrolled emission or to any component not measured with an instrument quarterly. See Table 7 Sampling and Demonstrations of Compliance for Fugitive and LDAR Analyzer requirements. |
| After completion of the required quarterly inspections for a period of at least two years, the operator of the OGS facility may change the monitoring schedule as follows:(i)After two consecutive quarterly leak detection periods with the percent of valves leaking equal to or less than 2.0%, an owner or operator may begin to skip one of the quarterly leak detection periods for the valves in gas/vapor and light liquid service.(ii)After five consecutive quarterly leak detection periods with the percent of valves leaking equal to or less than 2.0%, an owner or operator may begin to skip three of the quarterly leak detection periods for the valves in gas/vapor and light liquid service.<br>If the owner or operator is using the Alternative Work Practice in 40 CFR §60.18(g) - (i), the alternative frequencies specified in this standard permit are not allowed. | |
| **Shutdown prior to Maintenance of Fugitive Components** | **Start-up after Maintenance of components** |
| All components shall be kept in good repair. During repair or replacement, emission releases from the emptying of associated piping, equipment, and vessels must meet the emission limits and control requirements listed under pipeline or compressor blowdowns. | When returning associated equipment and piping to service after repair or replacement of fugitive components, appropriate leak detection shall occur and correction, maintenance or repair shall be immediately performed if fugitive components are not in good working order. |



EFSCOP00009508

## Table 10 Best Available Control Technology Requirements

| Source or Facility | Air Contaminant | Minimum Acceptable Design, Control or Technique, Control Efficiencies, and Other Details during Production Operations |
|---|---|---|
| Combined Control Requirements | < 25 tpy VOC | No add on control is required if the continuous and periodic vents from all units, vessels and equipment (including normal operation process blow downs) is less than 25 tons of VOC per year. |
| | ≥ 25 tpy VOC | All continuous and periodic vents on process vessels and equipment with potential emissions containing ≥ 1% VOC at any time must be captured and directed to a control device listed in the Control Device BACT Table with a minimum design control efficiency of at least 95%, if the sum of the uncontrolled PTE of the vents at the site will equal or exceed 25 tons of VOC per year. A site total potential to emit of 1 tpy of VOC from vent gas streams may be exempted from this control requirement. |
| Glycol Dehydration Unit | Uncontrolled PTE < 10 tpy VOC VOC, BTEX, $H_2S$ | No control is required. Condensers included in the equipment constructed must be maintained and operated as specified by the manufacturer or design engineering. |
| | Uncontrolled PTE ≥ 10 tpy and < 50 tpy VOC<br><br>VOC, BTEX, $H_2S$ | All non-combustion VOC emissions shall be routed to a vapor recovery unit (VRU), the unit reboiler, or to an appropriate control device listed in the Control Device BACT Table. This includes the emissions from the condenser vent.<br>Liquid waste or product material captured by a condenser must be enclosed and transferred to a unit compliant with the requirements of this table and the condenser must meet the requirements listed in the Control Device BACT Table with a minimum design control efficiency of 80%. For condensers, greater efficiencies may be claimed where enhanced monitoring and testing are applied following Table 7.<br>If the unit reboiler is used to control the VOC emissions from the dehydrator (e.g. to control the condenser vent and the flash tank if one is present) the unit must be designed to efficiently combust those vented VOCs at least 50% of the time the unit is operated. |
| | Uncontrolled PTE ≥ 50 tpy VOC VOC, BTEX, $H_2S$ | All non-combustion VOC emissions shall be captured and directed to an appropriate control device listed in the Control Device BACT Table with a minimum design control efficiency of at least 95%. |
| Atmospheric Oil/Water separators | VOC with partial pressure < 0.5 psia at maximum liquid temperature or 95 F whichever is greater. VOC, BTEX, $H_2S$ | May vent to atmosphere through vent no larger than 3 inch diameter.<br>If $H_2S$ can exceed 24 ppmv in the vapor space the separator vent shall be captured and directed to a control device listed in the Control Device BACT Table with a minimum design control efficiency of at least 95%. |
| | VOC with partial pressure ≥ 0.5 psia at maximum liquid surface temperature or 95 F whichever is greater, VOC, BTEX, $H_2S$ | The oil layer must have a floating cover over the entire liquid surface with a conservation vent to atmosphere or the vents must be captured and directed to a control device listed in the Control Device BACT Table with a minimum design control efficiency of at least 95%.<br><br>If $H_2S$ can exceed 24 ppmv in the vapor space the separator vent shall be captured and directed to a control device listed in the Control Device BACT Table with a minimum design control efficiency of at least 95%.<br><br>If the separator operates with more than 25,000 gallons (595 barrels) of liquid contained or is used as an oil storage tank, it shall be treated as a storage tank and meet those requirements. |
| | Oil water separators where the material entering the separator may flash. VOC, BTEX, $H_2S$ | These separators must be treated as process separators with a gas stream and follow those requirements. |
| Fuel Combustion Units including auxiliary fuel for combustion control devices | $H_2S$ | Fuel for all combustion units at the site shall be sweet natural gas or liquid petroleum gas, fuel gas containing no more than ten grains of total sulfur per 100 dry standard cubic feet (dscf), or field gas. |



EFSCOP00009509

## Table 10 Best Available Control Technology Requirements (continued)

| Source or Facility | Air Contaminant | Minimum Acceptable Design, Control or Technique, Control Efficiencies, and Other Details during Production Operations |
|---|---|---|
| Boilers, Reboilers, Heater-Treaters, and Process Heaters | NOx, CO, $PM_{10/2.5}$, VOC, HCHO, $SO_2$ | If any unit has a designed maximum firing rate of < 40 MMBTU/hr and greater than 10 MMBtu/hr, it must be designed and operated for good combustion and meet 0.10 lb/MMBtu for $NO_X$. For boilers and reboilers greater than or equal to 40 MMBtu/hr, emission shall not exceed 0.036 lb/MMBtu for NOx. For heaters and heater treaters greater than or equal to 40 MMBtu/hr but less than 100 MBtu/hr, emissions shall not exceed 0.06 lb/MMBtu for NOx. Heaters and heater treaters greater than or equal to 100 MMBtu/hr shall not exceed 0.036 lb/MMBtu for NOx.<br><br>For boilers, reboilers, process heaters, and heater treaters with heat inputs equal to or greater than 10 MMBtu/hr, the emission limit for CO is 0.074 lb CO/MMBtu |
| GasFired Turbines | NOx, CO, $PM_{10/2.5}$, VOC, HCHO, $SO_2$ | Units shall be designed and operate with low NOx combustors and meet 25 ppmvd @ 15% $O_2$ for $NO_X$ and 50 ppmvd @ 15% $O_2$ for CO. |
| All Tanks | Uncontrolled PTE of < 1.0 tpy VOC or < 0.1 tpy H2S | Open-topped tanks or ponds containing VOCs or $H_2S$ are allowed |
| All Tanks | Uncontrolled PTE of ≥ 1.0 tpy VOC or ≥ 0.1 tpy H2S | Open-topped tanks or ponds containing VOCs or $H_2S$ are not allowed.<br>Tank hatches and valves, which emit to the atmosphere, shall remain closed except for sampling or planned maintenance activities. All pressure relief devices (PRD) shall be designed and operated to ensure that proper pressure in the vessel is maintained and shall stay closed except in upset or malfunction conditions. If the PRD does not automatically reset, it must be reset within 24 hours at a manned site and within one week if located at an unmanned site. |
| Process Separators, Crude oil, Condensate, Treatment chemicals, Produced water, Fuel, Slop/Sump Oil and any other storage tanks or vessels that contain a VOC or a film of VOC on the surface of water. | VOC with partial pressure < 0.5 psia at maximum liquid surface temperature or 95 F whichever is greater, or with uncontrolled PTE of < 5 tpy VOC from working and breathing losses, including flash emissions<br>VOC, BTEX, $H_2S$ | All storage tanks with a storage capacity greater than 500 gallons must be submerged fill.<br>Existing tanks and vessels (including temporary liquid storage tanks) which are not increasing emissions at an OGS shall also meet this requirement no later than 180 days after a registration renewal as of January 1, 2016 |
| | VOC with partial pressure ≥ 0.5 psia at maximum liquid surface temperature or 95 F (whichever is greater), and with uncontrolled PTE of < 5 tpy from working and breathing losses, including flash emissions<br><br>VOC, BTEX, $H_2S$ | All storage tanks with a storage capacity greater than 500 gallons must be submerged fill.<br>Un-insulated tank exterior surfaces exposed to the sun shall be of a color that minimizes the effects of solar heating (including, but not limited to, white or aluminum). To meet this requirement the solar absorptance should be 0.43 or less, as referenced in Table 7.1-6 in AP-42. Paint shall be maintained in good condition. If a new or modified tank cannot be painted white or other reflective color, then another control device may be used to control emissions. Exceptions to the color requirement include the following:<br>(A) Up to 10% of the external surface area of the roof or walls of the tank or vessel may be painted with other colors to allow for identifying information or aesthetic purposes; and<br>(B) If a local, state or federal law or ordinance or private contract which predates this standard permit's effective date establishes in writing tank and vessel colors other than white. If applicable, a copy of this documentation must be provided to the commission upon registration.<br>(C) Tanks and vessels purposefully darkened to create the process reaction and help condense liquids from being entrained in the vapor.<br>Existing tanks and vessels (including temporary liquid storage tanks) which are not increasing emissions at an OGS using shall also meet this requirement no later than 180 days after a registration renewal as of January 1, 2016. |



EFSCOP00009510

## Table 10 Best Available Control Technology Requirements (continued)

| Source or Facility | Air Contaminant | Minimum Acceptable Design, Control or Technique, Control Efficiencies, and Other Details during Production Operations |
|---|---|---|
| Process Separators, Crude oil, Condensate, Treatment chemicals, Produced water, Fuel, Slop/Sump Oil and any other storage tanks or vessels that contain a VOC or a film of VOC on the surface of water. | VOC with uncontrolled PTE of ≥ 5 tpy | Vents shall be captured and directed to an appropriate control device as listed in standard permit (e) BMP and BACT.<br>Un-insulated tank exterior surfaces exposed to the sun shall be of a color that minimizes the effects of solar heating (including, but not limited to, white or aluminum). To meet this requirement the solar absorptance should be 0.43 or less, as referenced in Table 7.1-6 in AP-42. Paint shall be maintained in good condition. Exceptions to the color requirement include the following:<br>(A) Up to 10% of the external surface area of the roof or walls of the tank or vessel may be painted with other colors to allow for identifying information or aesthetic purposes; and<br>(B) If a local, state or federal law or ordinance or private contract which predates this standard permit's effective date establishes in writing tank and vessel colors other than white. If applicable, a copy of this documentation must be provided to the commission upon registration.<br>(C) Tanks and vessels purposefully darkened to create the process reaction and help condense liquids from being entrained in the vapor.<br>Existing tanks and vessels (including temporary liquid storage tanks) which are not increasing emissions at an OGS using shall also meet this requirement no later than 180 days after a registration renewal as of January 1, 2016. |
| Truck Loading | VOC with partial pressure < 0.5 psia at maximum liquid surface temperature or 95 F whichever is greater, or with uncontrolled PTE of < 5 tpy VOC<br>VOC, BTEX, $H_2S$ | Loading is recommended to be performed with submerged filling, or vapor balancing back to the tank and any subsequent recovery or control device. |
| | VOC with partial pressure ≥ 0.5 psia at maximum liquid surface temperature or 95 F whichever is greater<br>VOC, BTEX, $H_2S$ | Splash loading and uncontrolled vacuum truck loading is not allowed. Loading shall be performed with a control effectiveness of at least 42% as compared to splash loading. Loading may occur by submerged filling or equivalent prevention or recovery technique as listed in Table 10. |
| | VOC with uncontrolled PTE of ≥ 5 tpy VOC<br>VOC, BTEX, $H_2S$ | Loading vapors shall be captured and directed to an appropriate control device listed in the Control Device BACT Table with a minimum design control efficiency of at least 98%, routed to a vapor recovery unit (VRU) with a control effectiveness of at least 95%, or vapor balanced back to the delivering storage tank equipped with a VRU, or connected to a control device listed in the Control Device BACT Table with a minimum design control efficiency of at least 95%. |
| | Controlled Loading | Where loading control is required, the collection or capture system must be connected to the tank truck so all displaced vapors are directed to the control device and the control device is operational before loading is commenced. When properly connected the capture efficiency will be assumed to be 70% efficient at capturing the displaced truck vapors. The capture efficiency may be assumed to be 98.7 percent efficient when the tanker truck has certification that the tank has passed vapor-tightness testing within the last 12 months using the methods described in 40 CFR 60, Subpart XX. The capture efficiency may be assumed to be 99.2 percent efficient when the tanker truck has certification that the tank has passed vapor-tightness testing within the last 12 months using the methods described in 40 CFR 63, Subpart R. Loading shall be discontinued when liquid or gas leaks from the loading or collection system are observed. |



EFSCOP00009511

## Table 10 Best Available Control Technology Requirements (continued)

| Source or Facility | Air Contaminant | Minimum Acceptable Design, Control or Technique, Control Efficiencies, and Other Details during Production Operations |
|---|---|---|
| Cooling Tower Heat Exchange System | VOC, BTEX, $PM_{10/2.5}$ | Heat exchange systems must be non-contact design (i.e. designed and operated to avoid direct contact with gaseous or liquid process streams containing VOC, H2S, halogens or halogen compounds, cyanide compounds, inorganic acids, or acid gases).<br><br>Systems with heat exchangers that cool a fluid with VOC shall meet the following:<br>The cooling water must be at a higher pressure than the process fluid in the heat exchangers or the cooling tower water must be monitored monthly for VOC emissions using TCEQ Sampling Procedures Manual, Appendix P dated January 2003 or a later edition. Equipment shall be maintained so as to minimize VOC emissions into the cooling water. Cooling water VOC concentrations greater than 0.08 ppmw indicate faulty equipment. If the repair of a heat exchanger would require a unit shutdown that would create more emissions than the repair would eliminate, the repair may be delayed until the next planned shutdown or 180 days if no shutdowns are scheduled. Cooling towers shall be designed and operated with properly functioning drift eliminators. New cooling towers shall be designed with drift eliminators designed to meet ≤ 0.001% drift. |



EFSCOP00009512

## List of Acronyms

| | |
|---|---|
| °C | Degrees Celsius |
| °F | Degrees Fahrenheit |
| $\mu g/m^3$ | Micrograms per cubic meter |
| acfm | Actual cubic feet per minute |
| ADMT | Air Dispersion Modeling Team |
| AMINECalc | Amine Unit Air Emissions Model Ver 1.0 |
| AP-42 | Air Pollutant Emission Factors, 5th ed |
| APD | Air Permits Division |
| API | American Petroleum Institute |
| APWL | Air Pollutant Watch List |
| AREACIRC | Co-located circular area source from the EPA AERMOD Modeling System |
| AWP | Alternative Work Practices |
| BACT | Best Available Control Technology |
| bbl | Barrel |
| bbl/day | Barrels per day |
| BMP | Best Management Practices (includes equipment manufacturer's guidelines and specifications) |
| BTEX | Benzene, Toluene, Ethylbenzene, Xylene |
| Btu/scf | British thermal units per standard cubic feet |
| CEMS | Continuous Emissions Monitoring System |
| cf/day | Cubic feet per day |
| cfm | Cubic feet per minute |
| CFR | Code of Federal Regulations |
| $CO_2$ | Carbon dioxide |
| COS | Carbonyl sulfide |
| CPR | Considerable personnel and resources |
| $CS_2$ | Carbon disulfide |
| CT | Cooling towers |
| DEA | Diethanolamine |
| DGA | Diglycolamine |
| DIPA | Di-isopropylamine |
| DOT | Department of Transportation |
| DRE | Destruction rate efficiency |
| dscf | Dry standard cubic feet |
| DV | Designated value |
| E | Maximum acceptable emission rate (lb/hr) |
| EF | Emission factor |
| EFR | External floating roof tank |
| $E_{max}$ | Maximum acceptable emission rate (lb/hr) |
| EPA | Environmental Protection Agency |
| EPN | Emission point number |
| ESL | Effects screening level |
| FR | Federal Register |
| ft | Feet |
| ft/sec | Feet per second |
| gal/wk | Gallons per week |
| gal/yr | Gallons per year |
| $GLC_{max}$ | Max predicted ground-level concentration |
| GOP | General Operating Permit |

## List of Acronyms (continued)

| | |
|---|---|
| $H_2S$ | Hydrogen sulfide |
| HAP | Hazardous air pollutant |
| HB | House Bill |
| HCl | Hydrogen chloride |
| hp | Horsepower |
| hr | Hour |
| HRVOC | Highly reactive volatile organic compounds |
| HYSIM® | Hydrologic Simulation Model computer program |
| HYSIS® | Process simulator computer program |
| ICE | Internal combustion engine |
| IFR | Internal floating roof tank |
| IR | Infrared |
| ISCST3 | Industrial Source Complex Short-term Model V02035 |
| LACT | Lease automatic custody transfer unit |
| lb | Pound |
| lb/hr | Pounds per hour |
| lb/MMBtu | Pounds per million British thermal units |
| lbs/day | Pounds per day |
| LDAR | Leak detection and repair |
| $L_L$ | Loading losses |
| LPG | Liquid petroleum gas |
| LT/D | Long ton per day |
| m/sec | Meters per second |
| MACT | Maximum Available Control Technology |
| MDEA | Methyl-diethanolamine |
| MEA | Monoethanol amine |
| MERA | Modeling and Effects Review Applicability |
| MMBtu | Million British thermal units |
| MMBtu/hr | Million British thermal units per hour |
| MMCFD | Million cubic feet per day |
| MSS | Maintenance, start-up, and shutdown |
| NAAQS | National Ambient Air Quality Standards |
| NESHAP | National Emission Standards for Hazardous Air Pollutants |
| NGL | Natural gas liquids |
| NNSR | Nonattainment New Source Review |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | Oxides of nitrogen |
| NSPS | New Source Performance Standards |
| NSR | New Source Review |
| $O_2$ | Oxygen (molecular form) |
| OGS | Oil and gas site |
| PBR | Permit by Rule |
| $PM_{10}$ | Particulate matter less than or equal to 10 microns |
| POC | Products of combustion |
| ppm | Parts per million |
| Ppmvd | Parts per million by volume, dry |
| PROSIM® | DOS based process simulator computer program |

## List of Acronyms (continued)

| | |
|---|---|
| PSD | Prevention of Significant Deterioration |
| psi | Pounds per square inch |
| psia | Pounds per square inch, absolute |
| psig | Pounds per square inch, gage |
| | |
| RICE | Reciprocating internal combustion engine |
| RVP | Reid vapor pressure |
| | |
| scfh | Standard cubic feet per hour |
| scfm | Standard cubic feet per minute |
| scmd | Standard cubic feet per day |
| SCREEN3 | Air dispersion modeling computer program for windows, Version 5.0. BEE-line Software c1998-2002 |
| SE | Standard Exemption |
| SIC | Standard Industrial Classification System |
| $SO_2$ | Sulfur dioxide |
| SOP | Site Operating Permit |
| Standard permit | Standard Permit |
| SRU | Sulfur recovery unit |
| | |
| T&S | Transfer and storage |
| TAC | Texas Administrative Code |
| TCAA | Texas Clean Air Act |
| TCEQ | Texas Commission on Environmental Quality |
| TEA | Triethanolamine |
| THSC | Texas Health and Safety Code |
| tpy | Tons per year |
| | |
| V-B | Vasquez-Beggs correlation equation |
| VOC | Volatile organic compounds |
| VRU | Vapor recovery unit or system |
| | |
| WINSIM® | Windows process simulator computer program |

standard permit in accordance with the requirements of §116.611 of this title (relating to Registration to Use a Standard Permit).

(f) If the commission revokes a standard permit, it will provide written notice to affected registrants prior to the revocation of the standard permit. The notice will advise registrants that they must apply for a permit under this chapter or qualify for an authorization under Chapter 106 of this title (relating to Exemptions from Permitting).

(g) The issuance, amendment, or revocation of a standard permit or the issuance, renewal, or revocation of a registration to use a standard permit is not subject to Texas Government Code, Chapter 2001.

Adopted December 16, 1999 Effective January 11, 2000

**§116.606. Delegation.**

The commission may delegate to the executive director any authority in this subchapter.

Adopted December 16, 1999 Effective January 11, 2000

**§116.610. Applicability.**

(a) Under the Texas Clean Air Act, §382.051, a project that meets the requirements for a standard permit listed in this subchapter or issued by the commission is hereby entitled to the standard permit, provided the following conditions listed in this section are met. For the purposes of this subchapter, project means the construction or modification of a facility or a group of facilities submitted under the same registration.

(1) Any project that results in a net increase in emissions of air contaminants from the project other than carbon dioxide, water, nitrogen, methane, ethane, hydrogen, oxygen, or those for which a national ambient air quality standard has been established must meet the emission limitations of §106.261 of this title (relating to Facilities (Emission Limitations), unless otherwise specified by a particular standard permit.

(2) Construction or operation of the project must be commenced prior to the effective date of a revision to this subchapter under which the project would no longer meet the requirements for a standard permit.

(3) The proposed project must comply with the applicable provisions of the Federal Clean Air Act (FCAA), §111 (concerning New Source Performance Standards) as listed under 40 Code of Federal Regulations (CFR) Part 60, promulgated by the United States Environmental Protection Agency (EPA).

(4) The proposed project must comply with the applicable provisions of FCAA, §112 (concerning Hazardous Air Pollutants) as listed under 40 CFR Part 61, promulgated by the EPA.

(5) The proposed project must comply with the applicable maximum achievable control technology standards as listed under 40 CFR Part 63, promulgated by the EPA under FCAA, §112 or as listed under Chapter 113, Subchapter C of this title (relating to National Emissions Standards for Hazardous Air Pollutants for Source Categories (FCAA, §112, 40 CFR Part 63)).

(6) If subject to Chapter 101, Subchapter H, Division 3 of this title (relating to Mass Emissions Cap and Trade Program) the proposed facility, group of facilities, or account must obtain allocations to operate.

(b) Any project that constitutes a new major stationary source or major modification as defined in §116.12 of this title (relating to Nonattainment and Prevention of Significant Deterioration Review Definitions) is subject to the requirements of §116.110 of this title (relating to Applicability) rather than this subchapter.

(c) Persons may not circumvent by artificial limitations the requirements of §116.110 of this title.

(d) Any project involving a proposed affected source (as defined in §116.15(1) of this title (relating to Section 112(g) Definitions)) shall comply with all applicable requirements under Subchapter E of this chapter (relating to Hazardous Air Pollutants: Regulations Governing Constructed or Reconstructed Major Sources (FCAA, §112(g), 40 CFR Part 63)). Affected sources subject to Subchapter E of this chapter may use a standard permit under this subchapter only if the terms and conditions of the specific standard permit meet the requirements of Subchapter E of this chapter.

Adopted January 11, 2006 Effective February 1, 2006

**§116.611. Registration to Use a Standard Permit.**

(a) If required, registration to use a standard permit shall be sent by certified mail, return receipt requested, or hand delivered to the executive director, the appropriate commission regional office, and any local air pollution program with jurisdiction, before a standard permit can be used. The registration must be submitted on the required form and must document compliance with the requirements of this section, including, but not limited to:

(1) the basis of emission estimates;

(2) quantification of all emission increases and decreases associated with the project being registered;

(3) sufficient information as may be necessary to demonstrate that the project will comply with §116.610(b) of this title (relating to Applicability);

(4) information that describes efforts to be taken to minimize any collateral emissions increases that will result from the project;

(5) a description of the project and related process; and

(6) a description of any equipment being installed.

(b) Construction may begin any time after receipt of written notification from the executive director that there are no objections or 45 days after receipt by the executive director of the registration, whichever occurs first, except where a different time period is specified for a particular standard permit.

(c) In order to avoid applicability of Chapter 122 of this title (relating to Federal Operating Permits), a certified registration shall be submitted. The certified registration must state the maximum allowable emission rates and must include documentation of the basis of emission estimates and a written statement by the registrant certifying that the maximum emission rates listed on the registration reflect the reasonably anticipated maximums for operation of the facility. The certified registration shall be amended if the basis of the emission estimates changes or the maximum emission rates listed on the registration no longer reflect the reasonably anticipated maximums for operation of the facility. The certified registration shall be submitted to the executive director; to the appropriate commission regional office; and to all local air pollution control agencies having jurisdiction over the site. Certified registrations must also be maintained in accordance with the requirements of §116.115 of this title (relating to General and Special Conditions).

(1) Certified registrations established prior to the effective date of this rule shall be submitted on or before February 3, 2003.

(2) Certified registrations established on or after the effective date of this rule shall be submitted no later than the date of operation.

Adopted November 20, 2002 Effective December 11, 2002

**§116.614. Standard Permit Fees.**

Any person who registers to use a standard permit or an amended standard permit, or to renew a registration to use a standard permit shall remit, at the time of registration, a flat fee of $900 for each standard permit being registered, unless otherwise specified in a particular standard permit. No fee is required if a registration is automatically renewed by the commission. All standard permit fees will be remitted in the form of a check, certified check, electronic funds transfer, or money order made payable to the Texas Commission on Environmental Quality (TCEQ) and delivered with the permit registration to the TCEQ, P.O. Box 13088, MC 214, Austin, Texas 78711-3087. No fees will be refunded.

Adopted September 25, 2002 Effective October 20, 2002

**§116.615. General Conditions.**

The following general conditions are applicable to holders of standard permits, but will not necessarily be specifically stated within the standard permit document.

(1) Protection of public health and welfare. The emissions from the facility, including dockside vessel emissions, must comply with all applicable rules and regulations of the commission adopted under Texas Health and Safety Code, Chapter 382, and with the intent of the Texas Clean Air Act (TCAA), including protection of health and property of the public.

(2) Standard permit representations. All representations with regard to construction plans, operating procedures, and maximum emission rates in any registration for a standard permit become conditions upon which the facility or changes thereto, must be constructed and operated. It is unlawful for any person to vary from such representations if the change will affect that person's right to claim a standard permit under this section. Any change in condition such that a person is no longer eligible to claim a standard permit under this section requires proper authorization under §116.110 of this title (relating to Applicability). If the facility remains eligible for a standard permit, the owner or operator of the facility shall notify the executive director of any change in conditions which will result in a change in the method of control of emissions, a change in the character of the emissions, or an increase in the discharge of the various emissions as compared to the representations in the original registration or any previous notification of a change in representations. Notice of changes in representations must be received by the executive director no later than 30 days after the change.

(3) Standard permit in lieu of permit amendment. All changes authorized by standard permit to a facility previously permitted under §116.110 of this title shall be administratively incorporated into that facility's permit at such time as the permit is amended or renewed.

(4) Construction progress. Start of construction, construction interruptions exceeding 45 days, and completion of construction shall be reported to the appropriate regional office not later than 15 working days after occurrence of the event, except where a different time period is specified for a particular standard permit.

(5) Start-up notification.

(A) The appropriate air program regional office of the commission and any other air pollution control agency having jurisdiction shall be notified prior to the commencement of operations of the facilities authorized by a standard permit in such a manner that a representative of the executive director may be present.

(B) For phased construction, which may involve a series of units commencing operations at different times, the owner or operator of the facility shall provide separate notification for the commencement of operations for each unit.

(C) Prior to beginning operations of the facilities authorized by the permit, the permit holder shall identify to the Office of Permitting, Remediation, and Registration, the source or sources of allowances to be utilized for compliance with Chapter 101, Subchapter H, Division 3 of this title (relating to Mass Emissions Cap and Trade Program).

(D) A particular standard permit may modify start-up notification requirements.

(6) Sampling requirements. If sampling of stacks or process vents is required, the standard permit holder shall contact the commission's appropriate regional office and any other air pollution control agency having jurisdiction prior to sampling to obtain the proper data forms and procedures. All sampling and testing procedures must be approved by the executive director and coordinated with the regional representatives of the commission. The standard permit holder is also responsible for providing sampling facilities and conducting the sampling operations or contracting with an independent sampling consultant.

(7) Equivalency of methods. The standard permit holder shall demonstrate or otherwise justify the equivalency of emission control methods, sampling or other emission testing methods, and monitoring methods proposed as alternatives to methods indicated in the conditions of the standard permit. Alternative methods must be applied for in writing and must be reviewed and approved by the executive director prior to their use in fulfilling any requirements of the standard permit.

(8) Recordkeeping. A copy of the standard permit along with information and data sufficient to demonstrate applicability of and compliance with the standard permit shall be maintained in a file at the plant site and made available at the request of representatives of the executive director, the United States Environmental Protection Agency, or any air pollution control agency having jurisdiction. For facilities that normally operate unattended, this information shall be maintained at the nearest staffed location within Texas specified by the standard permit holder in the standard permit registration. This information must include, but is not limited to, production records and operating hours. Additional recordkeeping requirements may be specified in the conditions of the standard permit. Information and data sufficient to demonstrate applicability of and compliance with the standard permit must be retained for at least two years following the date that the information or data is obtained. The copy of the standard permit must be maintained as a permanent record.

(9) Maintenance of emission control. The facilities covered by the standard permit may not be operated unless all air pollution emission capture and abatement equipment is maintained in good

working order and operating properly during normal facility operations. Notification for emissions events and scheduled maintenance shall be made in accordance with §101.201 and §101.211 of this title (relating to Emissions Event Reporting and Recordkeeping Requirements; and Scheduled Maintenance, Startup, and Shutdown Reporting and Recordkeeping Requirements).

(10) Compliance with rules. Registration of a standard permit by a standard permit applicant constitutes an acknowledgment and agreement that the holder will comply with all rules, regulations, and orders of the commission issued in conformity with the TCAA and the conditions precedent to the claiming of the standard permit. If more than one state or federal rule or regulation or permit condition are applicable, the most stringent limit or condition shall govern. Acceptance includes consent to the entrance of commission employees and designated representatives of any air pollution control agency having jurisdiction into the permitted premises at reasonable times to investigate conditions relating to the emission or concentration of air contaminants, including compliance with the standard permit.

(11) Distance limitations, setbacks, and buffer zones. Notwithstanding any requirement in any standard permit, if a standard permit for a facility requires a distance, setback, or buffer from other property or structures as a condition of the permit, the determination of whether the distance, setback, or buffer is satisfied shall be made on the basis of conditions existing at the earlier of:

(A) the date new construction, expansion, or modification of a facility begins; or

(B) the date any application or notice of intent is first filed with the commission to obtain approval for the construction or operation of the facility.

Adopted February 21, 2007 Effective March 15, 2007

**§116.617. State Pollution Control Project Standard Permit.**

(a) Scope and applicability.

(1) This standard permit applies to pollution control projects undertaken voluntarily or as required by any governmental standard, that reduce or maintain currently authorized emission rates for facilities authorized by a permit, standard permit, or permit by rule.

(2) The project may include:

(A) the installation or replacement of emissions control equipment;

(B) the implementation or change to control techniques; or

(C) the substitution of compounds used in manufacturing processes.

(3) This standard permit must not be used to authorize the installation of emission control equipment or the implementation of a control technique that:

## Facility/Compound Specific Fugitive Emission Factors

| Equipment/ Service | Ethylene Oxide [1] | Phosgene [2] | Butadiene [3] | Petroleum Marketing Terminal [4] | Oil and Gas Production Operations [5] | | | | Refinery [6] |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Gas | Heavy Oil <20° API | Light Oil >20° | Water/Light Oil | |
| Valves | | | | | 0.00992 | 0.0000185 | 0.0055 | 0.000216 | |
| Gas/Vapor | 0.000444 | 0.00000216 | 0.001105 | 0.0000287 | | | | | 0.059 |
| Light Liquid | 0.00055 | 0.00000199 | 0.00314 | 0.0000948 | | | | | 0.024 |
| Heavy Liquid | | | | 0.0000948 | | | | | 0.00051 |
| Pumps | 0.042651 | 0.0000201 | 0.05634 | | 0.00529 | 0.00113 [10] | 0.02866 | 0.000052 | |
| Light Liquid | | | | 0.00119 | | | | | 0.251 |
| Heavy Liquid | | | | 0.00119 | | | | | 0.046 |
| Flanges/Connectors | 0.000555 | 0.00000011 | 0.000307 | | 0.00086 | 0.00000086 | 0.000243 | 0.000006 | 0.00055 |
| Gas/Vapor | | | | 0.000092604 | | | | | |
| Light Liquid | | | | 0.00001762 | | | | | |
| Heavy Liquid | | | | 0.0000176 | | | | | |
| Compressors | 0.000767 | | 0.000004 | | 0.0194 | 0.0000683 | 0.0165 | 0.0309 | 1.399 |
| Relief Valve | 0.000165 | 0.0000162 | 0.02996 | | 0.0194 | 0.0000683 | 0.0165 | 0.0309 | 0.35 |
| Open-ended Lines [7] | 0.001078 | 0.00000007 | 0.00012 | | 0.00441 | 0.000309 | 0.00309 | 0.00055 | 0.0051 |
| Sampling | 0.000088 | | 0.00012 | | | | | | 0.033 |
| Connectors | | | | | 0.00044 | 0.0000165 | 0.000463 | 0.000243 | |
| Other [9] | | | | | 0.0194 | 0.0000683 | 0.0165 | 0.0309 | |
| Gas/Vapor | | | | 0.000265 | | | | | |
| Light/Heavy Liquid | | | | 0.000287 | | | | | |
| Process Drains | | | | | 0.0194 | 0.0000683 | 0.0165 | 0.0309 | 0.07 |



EFSCOP00009522

Table Notes: All factors are in units of (lb/hr)/component.

1. Monitoring must occur at a leak definition of 500 ppmv. No additional control credit can be applied to these factors. Emission factors are from EOIC Fugitive Emission Study, Summer 1988.

2. Monitoring must occur at a leak definition of 50 ppmv. No additional control credit can be applied to these factors. Emission factors are from Phosgene Panel Study, Summer 1988.

3. Monitoring must occur at a leak definition of 100 ppmv. No additional control credit can be applied to these factors. Emission factors are from Randall, J. L., et al., Radian Corporation. Fugitive Emissions from the 1,3-butadiene Production Industry: A Field Study. Final Report. Prepared for the 1,3-Butadiene Panel of the Chemical Manufacturers Association. April 1989.

4. Control credit is included in the factor; no additional control credit can be applied to these factors. Monthly AVO inspection required.

5. Factors give the total organic compound emission rate. Multiply by the weight percent of non-methane, non-ethane organics to get the VOC emission rate.

6. Factors are taken from EPA Document EPA-453/R-95-017, November 1995, Page 2-13.

7. The 28 Series quarterly LDAR programs require open-ended lines to equipped with a cap, blind flange, plug, or a second valve. If so equipped, open-ended lines may be given a 100% control credit.

8. Emission factor for Sampling Connections is in terms of pounds per hour per sample taken.

9. For Petroleum Marketing Terminals"Other" includes any component excluding fittings, pumps, and valves. For Oil and Gas Production Operations, "Other" includes diaphragms, dump arms, hatches, instruments, meters, polished rods, and vents.

10. No Heavy Oil - Pump factor was derived during the API study. The factor is the SOCMI without $C_2$ Heavy Liquid - Pump factor with a 93% reduction credit for the physical inspection.

# Tank Truck Loading of Crude Oil or Condensate

**Scope:** Tank Truck Loading activities at loading terminals

The transportation and marketing of petroleum liquids involve many distinct operations, each of which represents a potential source of evaporation loss. Crude oil or condensate is transported from oil and gas sites to a refinery or other refining operations by tankers, barges, rail tank cars, tank trucks, and pipelines.

Loading losses are the primary source of evaporative emissions from rail tank car, tank truck, and marine vessel operations (for marine loading please review Marine Loading of Crude Oil and Condensate Guidance Document). Loading losses occur as organic vapors in "empty" cargo tanks are displaced to the atmosphere by the liquid being loaded into the tanks. These vapors are a composite of (1) vapors formed in the empty tank by evaporation of residual product from previous loads, (2) vapors transferred to the tank in vapor balance systems as product is being unloaded, and (3) vapors generated in the tank as the new product is being loaded. The quantity of evaporative losses from loading operations is, therefore, a function of the following parameters:

- Physical and chemical characteristics of the previous cargo;
- Method of unloading the previous cargo;
- Operations to transport the empty carrier to a loading terminal;
- Method of loading the new cargo; and
- Physical and chemical characteristics of the new cargo.

Tank truck loading operations can be divided into three general categories: A) atmospheric trucks, B) pressure trucks used in atmospheric service, and C) pressure trucks. The type of connection that is used in the loading procedure will be considered to determine the collection efficiency. "Quick connects" are clamp type connections that are not bolted or flanged. "Quick connects" can be used with atmospheric trucks. Hard-piped connections are bolted or flanged to the receiving vessel. Hard-piped connections should be used with pressure trucks to achieve its maximum collection efficiency. Atmospheric trucks must be leak checked according to NSPS Subpart XX to achieve its maximum collection efficiency.

## Tank Truck Loading Authorizations

All stationary facilities, or groups of facilities, at a site which handle gases and liquids associated with the production, conditioning, processing, and pipeline transfer of fluids or gases found in geologic formations on or beneath the earth's surface including, but not limited to, crude oil, natural gas, condensate, and produced water that satisfy the general conditions of Title 30, Texas Administrative Code (30 TAC), Section 106.4, and the specific conditions of 30 TAC Section 106.352 are permitted by rule. The commission also has available rule language in an easy-to-read format for the permit by rule.

For all new projects and dependent facilities not located in the Barnett Shale counties, the current 106.352 subsection (l) is applicable, which contains the previous requirements of 106.352.

For projects located in one of the Barnett Shale counties which are constructed or modified on or after April 1, 2011 subsections (a)-(k) apply.

Other permit by rules which may be used for tank truck loading but are not commonly seen are 106.261, 106.262, 106.472, and 106.473.

If a site does not qualify for a PBR, it may be authorized by a standard permit. Sites constructed prior to April 1, 2011 may be authorized using the Oil and Gas Standard Permit (30 TAC 116.620, effective January 11, 2000). For sites in one of the Barnett Shale counties constructed or modified on or after April 1, 2011, the site is subject to the requirements of the Air Quality Standard Permit for Oil and Gas Handling and Production Facilities.

**Emission Calculations**

Loading calculations are listed in AP-42, Chapter 5, Section 5.2: Transportation and Marketing of Petroleum Liquids.

Submerged tank truck loading is the minimum level of control required. The two types of submerge loading are the submerged fill pipe method and the bottom loading method. In the submerged fill pipe method, the fill pipe extends almost to the bottom of the cargo tank. In the bottom loading method, a permanent fill pipe is attached to the cargo tank bottom. During most of submerged loading by both methods, the fill pipe opening is below the liquid surface level. Liquid turbulence is controlled significantly during submerged loading, resulting in much lower vapor generation than encountered during splash loading.

The saturation factor, S, represents the expelled vapor's fractional approach to saturation, and it accounts for the variations observed in emission rates from the different unloading and loading methods. The loading calculation requires the use of a Saturation Factor (S factor) listed in Table 5.2-1, Saturation (S) Factors for Calculating Petroleum Liquid Loading Losses.

<u>Submerged loading: dedicated normal service, S factor = 0.6</u>

The S factor of 0.6 should be used if the tank truck is in "dedicated normal service". Dedicated normal service means the tank truck is used to transport only one product or products with similar characteristics (petroleum products with similar API gravity, molecular weight, vapor pressure).

<u>Submerged Loading: dedicated vapor balance, S factor = 1.0</u>

The S factor of 1.0 should be used if the loading vapors are returned back to the tank truck when it is unloaded to a storage tank or other vessel.

Emissions from loading petroleum liquid can be estimated using the following expression:

Where:

$$L_L = 12.46 \frac{SPM}{T}$$

- LL= loading loss, pounds per 1000 gallons (lb/103 gal) of liquid loaded
- S = a saturation factor (see Table 5.2-1)

- P = true vapor pressure of liquid loaded, pounds per square inch absolute (psia) (see Section 7.1, "Organic Liquid Storage Tanks")
- M = molecular weight of vapors, pounds per pound-mole (lb/lb-mole) (see Section 7.1, "Organic Liquid Storage Tanks")
- T = temperature of bulk liquid loaded, °R (°F + 460)

Emissions are broken down into short-term emissions (lb/hr) and annual emissions (tons/year). Short-term emissions should be estimated by using the maximum expected vapor pressure and temperature of the compound being loaded and the maximum expected pumping rate being used to fill the container (loading tank truck). Annual emissions should be estimated by using the average annual temperature and corresponding vapor pressure of the compound and the expected annual throughput of the compound.

**Capture/Collection techniques and efficiency**

The overall reduction efficiency should account for the capture efficiency of the collection system as well as both the control efficiency and any downtime of the control device. Measures to reduce loading emissions include selection of alternate loading methods and application of vapor recovery equipment.

Please note,not all of the displaced vapors reach the control device, because of leakage from both the tank truck and collection system. The collection efficiency should be assumed to be 98.7 percent for tanker trucks passing an annual leak test per EPA standards. A collection efficiency of 70 percent should be assumed for trucks which are not leak tested.

- 70% capture/collection efficiency if not leak tested
- 98.7% capture/collection efficiency if leak tested based on EPA standards (NSPS Subpart XX)
- 100% capture/collection efficiency if a blower system is installed which will produce a vacuum in the tank truck during all loading operations. A pressure/vacuum gauge shall be installed on the suction side of the loading rack blower system adjacent to the truck being loaded to verify a vacuum in that vessel. Loading shall not occur unless there is a vacuum of at least 1.5 inch water column being maintained by the vacuum-assist vapor collection system when loading trucks. The vacuum shall be recorded every 15 minutes during loading.

**Uncollected Loading Emissions**

Uncollected loading emissions are referred to as loading fugitives and are listed as a separate emission point or source. Uncollected loading emissions (LLF) can be estimated using the following expression:

$$L_{LF} = (L_L) \frac{(1 - \text{Collection Efficiency})}{100}$$

**Control techniques and control efficiencies**

Emissions from controlled loading operations can be calculated by multiplying the uncontrolled emission rate calculated in the loading loss equation (LL) by an overall reduction efficiency term:

$$\text{Emissions} = (L_L)\left(\frac{\text{Collection Efficiency}}{100}\right)\left(1 - \frac{\text{Control Efficiency}}{100}\right)$$

- Flares – Flares must meet 40 CFR 60.18 requirements of minimum heating value of waste gas and a maximum flare tip velocity. Flares can have a control efficiency of 98% or 99% for the following compounds: methanol, ethanol, propanol, ethylene oxide, and propylene oxide. The agency highly encourages the consideration of variable speed blowers when a control efficiency of > 98% is claimed for a steam – assisted flare to reduce over steaming of the flare which could affect the control efficiency.
- Thermal oxidizers – must be designed for the variability of the waste gas stream and basic monitoring which consists of thermocouple or infrared monitor that indicates the device is working. Control efficiencies range from 95% - <99%.
- Carbon Systems – Can claim up to a 98% control efficiency. The carbon system must have an alarm system that will prevent break through.
- Vapor Recovery Units (VRU) – Can claim up to 100% control. Designed systems claiming 100% control must submit the requirements found in the Vapor Recovery Unit Capture/Control Guidance.

Note: Loading cannot occur while the control system is off-line.

Vapor balancing is NOT a form of control; it is only a capture technique.

## Flare Emission Factors

The usual flare destruction efficiencies and emission factors are provided in Table 4. The high-Btu waste streams referred to in the table have a heating value greater than 1,000 Btu/scf.

## Flare Destruction Efficiencies

Claims for destruction efficiencies greater than those listed in Table 4 will be considered on a case-by-case basis. The applicant may make one of the three following demonstrations to justify the higher destruction efficiency: (1) general method, (2) 99.5 percent justification, or (3) flare stack sampling.

**Table 4. Flare Factors**

| Waste Stream | Destruction/Removal Efficiency (DRE) | | |
|---|---|---|---|
| VOC | 98 percent (generic) | | |
| | 99 percent for compounds containing no more than 3 carbons that contain no elements other than carbon and hydrogen in addition to the following compounds: methanol, ethanol, propanol, ethylene oxide and propylene oxide | | |
| $H_2S$ | 98 percent | | |
| $NH_3$ | case by case | | |
| CO | case by case | | |
| **Air Contaminants** | **Emission Factors** | | |
| thermal $NO_x$ | steam-assist: | high Btu | 0.0485 lb/MMBtu |
| | | low Btu | 0.068 lb/MMBtu |
| | other: | high Btu | 0.138 lb/MMBtu |
| | | low Btu | 0.0641 lb/MMBtu |
| fuel $NO_x$ | $NO_x$ is 0.5 wt percent of inlet $NH_3$, other fuels case by case | | |
| CO | steam-assist: | high Btu | 0.3503 lb/MMBtu |
| | | low Btu | 0.3465 lb/MMBtu |
| | other: | high Btu | 0.2755 lb/MMBtu |
| | | low Btu | 0.5496 lb/MMBtu |
| PM | none, required to be smokeless | | |
| $SO_2$ | 100 percent S in fuel to $SO_2$ | | |



EFSCOP00009529

TABLE 1.4-2. EMISSION FACTORS FOR CRITERIA POLLUTANTS AND GREENHOUSE GASES FROM NATURAL GAS COMBUSTION[a]

| Pollutant | Emission Factor ($lb/10^6$ scf) | Emission Factor Rating |
|---|---|---|
| $CO_2$[b] | 120,000 | A |
| Lead | 0.0005 | D |
| $N_2O$ (Uncontrolled) | 2.2 | E |
| $N_2O$ (Controlled-low-$NO_X$ burner) | 0.64 | E |
| PM (Total)[c] | 7.6 | D |
| PM (Condensable)[c] | 5.7 | D |
| PM (Filterable)[c] | 1.9 | B |
| $SO_2$[d] | 0.6 | A |
| TOC | 11 | B |
| Methane | 2.3 | B |
| VOC | 5.5 | C |

[a] Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. Data are for all natural gas combustion sources. To convert from $lb/10^6$ scf to $kg/10^6$ $m^3$, multiply by 16. To convert from $lb/10^6$ scf to lb/MMBtu, divide by 1,020. The emission factors in this table may be converted to other natural gas heating values by multiplying the given emission factor by the ratio of the specified heating value to this average heating value. TOC = Total Organic Compounds. VOC = Volatile Organic Compounds.

[b] Based on approximately 100% conversion of fuel carbon to $CO_2$. $CO_2[lb/10^6 scf] = (3.67)(CON)(C)(D)$, where CON = fractional conversion of fuel carbon to $CO_2$, C = carbon content of fuel by weight (0.76), and D = density of fuel, $4.2 \times 10^4$ $lb/10^6$ scf.

[c] All PM (total, condensible, and filterable) is assumed to be less than 1.0 micrometer in diameter. Therefore, the PM emission factors presented here may be used to estimate $PM_{10}$, $PM_{2.5}$ or $PM_1$ emissions. Total PM is the sum of the filterable PM and condensible PM. Condensible PM is the particulate matter collected using EPA Method 202 (or equivalent). Filterable PM is the particulate matter collected on, or prior to, the filter of an EPA Method 5 (or equivalent) sampling train.

[d] Based on 100% conversion of fuel sulfur to $SO_2$. Assumes sulfur content is natural gas of 2,000 grains/$10^6$ scf. The $SO_2$ emission factor in this table can be converted to other natural gas sulfur contents by multiplying the $SO_2$ emission factor by the ratio of the site-specific sulfur content (grains/$10^6$ scf) to 2,000 grains/$10^6$ scf.



EFSCOP00009530

TABLE 1.4-3. EMISSION FACTORS FOR SPECIATED ORGANIC COMPOUNDS FROM NATURAL GAS COMBUSTION[a]

| CAS No. | Pollutant | Emission Factor ($lb/10^6$ scf) | Emission Factor Rating |
|---|---|---|---|
| 91-57-6 | 2-Methylnaphthalene[b, c] | 2.4E-05 | D |
| 56-49-5 | 3-Methylchloranthrene[b, c] | <1.8E-06 | E |
| | 7,12-Dimethylbenz(a)anthracene[b,c] | <1.6E-05 | E |
| 83-32-9 | Acenaphthene[b,c] | <1.8E-06 | E |
| 203-96-8 | Acenaphthylene[b,c] | <1.8E-06 | E |
| 120-12-7 | Anthracene[b,c] | <2.4E-06 | E |
| 56-55-3 | Benz(a)anthracene[b,c] | <1.8E-06 | E |
| 71-43-2 | Benzene[b] | 2.1E-03 | B |
| 50-32-8 | Benzo(a)pyrene[b,c] | <1.2E-06 | E |
| 205-99-2 | Benzo(b)fluoranthene[b,c] | <1.8E-06 | E |
| 191-24-2 | Benzo(g,h,i)perylene[b,c] | <1.2E-06 | E |
| 205-82-3 | Benzo(k)fluoranthene[b,c] | <1.8E-06 | E |
| 106-97-8 | Butane | 2.1E+00 | E |
| 218-01-9 | Chrysene[b,c] | <1.8E-06 | E |
| 53-70-3 | Dibenzo(a,h)anthracene[b,c] | <1.2E-06 | E |
| 25321-22-6 | Dichlorobenzene[b] | 1.2E-03 | E |
| 74-84-0 | Ethane | 3.1E+00 | E |
| 206-44-0 | Fluoranthene[b,c] | 3.0E-06 | E |
| 86-73-7 | Fluorene[b,c] | 2.8E-06 | E |
| 50-00-0 | Formaldehyde[b] | 7.5E-02 | B |
| 110-54-3 | Hexane[b] | 1.8E+00 | E |
| 193-39-5 | Indeno(1,2,3-cd)pyrene[b,c] | <1.8E-06 | E |
| 91-20-3 | Naphthalene[b] | 6.1E-04 | E |
| 109-66-0 | Pentane | 2.6E+00 | E |
| 85-01-8 | Phenanathrene[b,c] | 1.7E-05 | D |



EFSCOP00009531

TABLE 1.4-3. EMISSION FACTORS FOR SPECIATED ORGANIC COMPOUNDS FROM NATURAL GAS COMBUSTION (Continued)

| CAS No. | Pollutant | Emission Factor ($lb/10^6$ scf) | Emission Factor Rating |
|---|---|---|---|
| 74-98-6 | Propane | 1.6E+00 | E |
| 129-00-0 | Pyrene[b, c] | 5.0E-06 | E |
| 108-88-3 | Toluene[b] | 3.4E-03 | C |

[a] Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. Data are for all natural gas combustion sources. To convert from $lb/10^6$ scf to $kg/10^6$ $m^3$, multiply by 16. To convert from $1b/10^6$ scf to lb/MMBtu, divide by 1,020. Emission Factors preceeded with a less-than symbol are based on method detection limits.

[b] Hazardous Air Pollutant (HAP) as defined by Section 112(b) of the Clean Air Act.

[c] HAP because it is Polycyclic Organic Matter (POM). POM is a HAP as defined by Section 112(b) of the Clean Air Act.

[d] The sum of individual organic compounds may exceed the VOC and TOC emission factors due to differences in test methods and the availability of test data for each pollutant.



EFSCOP00009532

**SITE DATA**

**OIL & GAS STANDARD PERMIT REGISTRATION**

**LACKEY LAND A639 UNIT A1 & B1**

**BURLINGTON RESOURCES OIL & GAS COMPANY LP**

**Representative Analyses:**
**Schendel 189**
**and Laird B1**

Stream Compositions:

| | Stream 1 | | Stream 2 | | Stream 3 | | Stream 4 | |
|---|---|---|---|---|---|---|---|---|
| | Inlet Gas | | Flare Assist Gas | | LP Condensate | | Produced Water | |
| Component | mole % | wgt. % | mole % | wgt. % | mole % | wgt. % | mole % | wgt % |
| Nitrogen | 0.082% | 0.091% | 0.164% | 0.202% | 0.042% | 0.011% | 0.000% | 0.000% |
| Carbon Dioxide | 1.123% | 1.948% | 2.163% | 4.183% | 0.031% | 0.012% | 0.000% | 0.000% |
| Water | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 99.000% | 94.140% |
| Hydrogen Sulfide | 0.020% | 0.027% | 0.020% | 0.030% | 0.000% | 0.000% | 0.000% | 0.000% |
| Methane | 68.789% | 43.508% | 75.685% | 53.360% | 1.891% | 0.274% | 0.019% | 0.016% |
| Ethane | 13.087% | 15.515% | 11.765% | 15.547% | 1.556% | 0.422% | 0.016% | 0.025% |
| Propane | 6.871% | 11.945% | 4.689% | 9.087% | 2.564% | 1.020% | 0.026% | 0.061% |
| I-Butane | 1.829% | 4.191% | 0.899% | 2.296% | 1.401% | 0.735% | 0.014% | 0.043% |
| N-Butane | 3.330% | 7.631% | 1.663% | 4.248% | 3.577% | 1.876% | 0.036% | 0.110% |
| I-Pentane | 1.593% | 4.531% | 0.652% | 2.067% | 3.554% | 2.313% | 0.036% | 0.137% |
| N-Pentane | 1.375% | 3.911% | 0.623% | 1.975% | 4.111% | 2.676% | 0.041% | 0.156% |
| Cyclopentane | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% | 0.000% |
| n-Hexane | 0.441% | 1.498% | 0.279% | 1.057% | 3.204% | 2.491% | 0.032% | 0.146% |
| Cyclohexane | 0.130% | 0.442% | 0.137% | 0.519% | 0.789% | 0.613% | 0.008% | 0.036% |
| Other Hexanes | 0.963% | 3.272% | 0.517% | 1.958% | 4.221% | 3.282% | 0.042% | 0.191% |
| Heptanes | 0.227% | 0.897% | 0.347% | 1.528% | 10.202% | 9.223% | 0.102% | 0.539% |
| Octanes | 0.025% | 0.113% | 0.109% | 0.547% | 8.851% | 9.121% | 0.089% | 0.537% |
| Nonanes | 0.010% | 0.051% | 0.058% | 0.327% | 6.295% | 7.284% | 0.063% | 0.426% |
| Decanes Plus | 0.000% | 0.000% | 0.014% | 0.088% | 40.790% | 52.365% | 0.408% | 3.064% |
| Benzene | 0.050% | 0.154% | 0.034% | 0.117% | 0.294% | 0.207% | 0.003% | 0.012% |
| Toluene | 0.061% | 0.222% | 0.132% | 0.534% | 2.163% | 1.798% | 0.022% | 0.107% |
| Ethylbenzene | 0.001% | 0.004% | 0.006% | 0.028% | 0.671% | 0.643% | 0.007% | 0.039% |
| Xylene | 0.012% | 0.050% | 0.065% | 0.303% | 3.794% | 3.634% | 0.038% | 0.213% |
| Totals | 100.02% | 100.00% | 100.02% | 100.00% | 100.001% | 100.00% | 100.002% | 100.00% |
| Totals (C3+) | | 38.91% | | 26.68% | | 99.28% | | 5.82% |
| VOC max (%) | | 40.00% | | 30.00% | | 100.00% | | 10.00% |
| Benzene Max (%) | | 0.23% | | 0.18% | | 0.31% | | 0.02% |
| Higher Heating Value (Btu/scf) | 1486 | | 1315 | | | | | |
| Lower Heating Value (Btu/scf) | 1461 | | 1292 | | | | | |
| Specific Gravity | 0.8794 | | | | 0.7598 | | | |

SGS LABORATORY REFERENCE NUMBER : **6890-250891**

**Conoco Phillips**

| | | | |
|---|---|---|---|
| ID: | **Schendel A-189 Unit 1** | LINE PRESSURE: | **46 PSI** |
| AREA: | **Eagleford** | LINE TEMPERATURE: | **85 F** |
| METER: | **Low Pressure Separator** | CYLINDER NUMBER: | **0097** |
| LEASE: | | EFFECTIVE DATE: | |
| OPERATOR: | | SAMPLED BY: | **Robert Hester** |
| STATION: | | ANALYZED BY: | **Kerry Quave** |
| SAMPLE DATE: | **12/20/2011** | ANALYZED DATE: | **12/24/2011** |
| SAMPLE OF: | **Gas** | SAMPLE TYPE: | **Spot** |

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Physical Properties per GPA 2145-09 — Calculations per GPA 2286-03

Note: Zero = Less than detection limit

| | MOL% | WEIGHT% | GPM @ 14.696 |
|---|---|---|---|
| NITROGEN | 0.082 | 0.091 | |
| CARBON DIOXIDE | 1.123 | 1.949 | |
| METHANE | 68.789 | 43.528 | |
| ETHANE | 13.087 | 15.522 | 3.509 |
| PROPANE | 6.871 | 11.951 | 1.898 |
| ISOBUTANE | 1.829 | 4.193 | 0.600 |
| N-BUTANE | 3.330 | 7.634 | 1.053 |
| ISOPENTANE | 1.593 | 4.534 | 0.584 |
| N-PENTANE | 1.375 | 3.913 | 0.500 |
| HEXANES | 1.329 | 4.517 | 0.549 |
| HEPTANES PLUS | 0.592 | 2.168 | 0.227 |
| | 100.000 | 100.000 | 8.920 |

| BTU | Vol. IDEAL Gas Fuel | Vol. Real Gas Fuel |
|---|---|---|
| BTU @ 14.696 PSIA ( DRY ) | 1478.4 | 1485.9 |
| BTU @ 14.696 PSIA ( SAT. ) | 1452.6 | 1460.7 |
| Specific Gravity | 0.8753 | 0.8794 |
| Compressibility ( Z ) | 0.9949 | |

Gasoline Content ( Gallons Per Thousand - GPM )

| | |
|---|---|
| Ethane & Heavier | 8.693 |
| Propane & Heavier | 5.184 |
| Butane & Heavier | 3.286 |
| Pentane & Heavier | 1.633 |
| Total 26 psi Reid V.P. Gasoline GPM | 2.720 |

| Secondary BTU Psia Base | Vol. IDEAL Gas Fuel | Vol. Real Gas Fuel |
|---|---|---|
| BTU @ 15.025 PSIA ( DRY ) | 1511.5 | 1519.4 |
| BTU @ 15.025 PSIA ( SAT. ) | 1485.1 | 1493.6 |

Compressibility ( Z ) at 15.025 = 0.9948

**Remarks:**
**Remarks:**

Precision parameters apply in the determination of above test results. Also refer to ASTM D 3244-97/02, IP 367/96 and appendix E of IP standard methods for analysis and testing for utilization of test data to determine conformance with specifications.

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SGS LABORATORY REFERENCE NUMBER : **6890-250891**

**COMPANY: Conoco Phillips** **SAMPLE DATE: ########**
**AREA / FIELD: Eagleford**
**LEASE:**

| | MOL% | WEIGHT% | GPM @ 14.696 |
|---|---|---|---|
| NITROGEN | 0.082 | 0.091 | 0.009 |
| CARBON DIOXIDE | 1.123 | 1.949 | 0.192 |
| METHANE | 68.789 | 43.528 | 11.692 |
| ETHANE | 13.087 | 15.522 | 3.509 |
| PROPANE | 6.871 | 11.951 | 1.898 |
| ISOBUTANE | 1.829 | 4.193 | 0.600 |
| N-BUTANE | 3.330 | 7.634 | 1.053 |
| ISOPENTANE | 1.593 | 4.534 | 0.584 |
| N-PENTANE | 1.375 | 3.913 | 0.500 |
| 2,2-Dimethylbutane | 0.076 | 0.260 | 0.032 |
| 2,3-Dimethylbutane & Cyclopentane | 0.000 | 0.000 | 0.000 |
| 2-Methylpentane | 0.517 | 1.757 | 0.215 |
| 3-Methylpentane | 0.294 | 1.001 | 0.120 |
| n-Hexane | 0.441 | 1.499 | 0.182 |
| 2,2-Dimethylpentane | 0.013 | 0.051 | 0.006 |
| Methylcyclopentane | 0.076 | 0.252 | 0.027 |
| 2,4-Dimethylpentane | 0.001 | 0.004 | 0.000 |
| 2,2,3- Trimethylbutane | 0.000 | 0.000 | 0.000 |
| Benzene | 0.050 | 0.154 | 0.014 |
| 3,3-Dimethylpentane | 0.000 | 0.000 | 0.000 |
| Cyclohexane | 0.130 | 0.432 | 0.044 |
| 2-Methylhexane | 0.009 | 0.036 | 0.004 |
| 2,3-Dimethylpentane | 0.058 | 0.229 | 0.026 |
| 1,1-Dimethylcyclopentane | 0.000 | 0.000 | 0.000 |
| 3-Methylhexane | 0.008 | 0.032 | 0.004 |
| l,t-3-Dimethylcyclopentane | 0.000 | 0.000 | 0.000 |
| 1,c-3-Dimethylcyclopentane & 3-Ethylpentane | 0.007 | 0.027 | 0.003 |
| l,t-2-Dimethylcyclopentane & 2,2,4- Trimethylpentane | 0.000 | 0.000 | 0.000 |
| n-Heptane | 0.073 | 0.289 | 0.034 |
| Methylcyclohexane | 0.057 | 0.221 | 0.023 |
| 1,1,3- Trimethylcyclopentane & 2,2-Dimethylhexane | 0.001 | 0.004 | 0.000 |
| 2,5-Dimethylhexane & 2,4-Dimethylhexane | 0.000 | 0.000 | 0.000 |
| Ethylcyclopentane | 0.001 | 0.004 | 0.000 |
| 2,2,3- Trimethylpentane & 1,t-2,c-4- Trimethylcyclopentane | 0.000 | 0.000 | 0.000 |
| 3,3-Dimethylhexane & 1,t-2,c-3- Trimethylcyclopentane | 0.000 | 0.000 | 0.000 |
| 2,3,4- Trimethylpentane & 2,3.Dimethylhexane | 0.000 | 0.000 | 0.000 |
| Toluene | 0.061 | 0.222 | 0.020 |
| 1,1,2- Trimethylcyclopentane | 0.000 | 0.000 | 0.000 |
| 3,4-Dimethylhexane | 0.000 | 0.000 | 0.000 |
| 2-Methylheptane | 0.009 | 0.041 | 0.005 |
| 4-Methylheptane | 0.000 | 0.000 | 0.000 |
| 1,c-2,t-4- Trimethylcyclopentane | 0.000 | 0.000 | 0.000 |
| 3-Methylheptane & 3,4-Dimethylhexane | 0.001 | 0.005 | 0.001 |

Precision parameters apply in the determination of above test results. Also refer to ASTM D 3244-97/02, IP 367/96 and appendix E of IP standard methods for analysis and testing for utilization of test data to determine conformance with specifications.

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SGS LABORATORY REFERENCE NUMBER : **6890-250891**

**COMPANY: Conoco Phillips**
**AREA / FIELD: Eagleford**
**LEASE:**

**SAMPLE DATE: ########**

| | MOL% | WEIGHT% | GPM @ 14.696 |
|---|---|---|---|
| 1,c-3-Dimethylcyclohexane & 3-Ethylhexane | 0.000 | 0.000 | 0.000 |
| l,t-4-Dimethylcyclohexane & 1,c2,t3- Trimethylcyclopentane | 0.000 | 0.000 | 0.000 |
| 2,2,5-Trimethylhexane & 1,1-Dimethylcyclohexane | 0.000 | 0.000 | 0.000 |
| Methyl-Ethylcyclopentane's & 2,2,4- Trimethylhexane | 0.005 | 0.022 | 0.002 |
| n-Octane | 0.012 | 0.054 | 0.006 |
| 1,t2 Dimethylcyclohexane & 2,2,4,4- Tetramethylpentane | 0.000 | 0.000 | 0.000 |
| 1,t-3-Dimethylcyclohexane & 1,c-4-Dimethylcyclohexane | 0.001 | 0.004 | 0.000 |
| Dimethylheptanes & 1 ,c-2,c-3- Trimethylcyclopentane | 0.001 | 0.005 | 0.000 |
| Isopropylcyclopentane | 0.000 | 0.000 | 0.000 |
| Dimethylheptanes & Trimethylhexanes | 0.001 | 0.005 | 0.001 |
| 1,c-2-Dimethylcyclohexane | 0.000 | 0.000 | 0.000 |
| Dimethylheptanes | 0.001 | 0.005 | 0.001 |
| Ethylcyclohexane | 0.000 | 0.000 | 0.000 |
| n-Propylcyclopentane | 0.000 | 0.000 | 0.000 |
| Trimethylcyclohexanes | 0.000 | 0.000 | 0.000 |
| Ethylbenzene | 0.001 | 0.004 | 0.000 |
| Dimethylheptanes & Trimethylhexanes | 0.000 | 0.000 | 0.000 |
| m-Xylene & p-Xylene | 0.003 | 0.013 | 0.001 |
| 2 & 4 Methyloctane & 3,4-Dimethylheptane | 0.000 | 0.000 | 0.000 |
| Trimethylcyclohexanes | 0.000 | 0.000 | 0.000 |
| 3-Methyloctane | 0.000 | 0.000 | 0.000 |
| Trimethylcyclohexanes | 0.000 | 0.000 | 0.000 |
| o-Xylene | 0.009 | 0.038 | 0.003 |
| Trimethylcyclohexanes & Isobutylcyclopentane | 0.000 | 0.000 | 0.000 |
| n-Nonane | 0.003 | 0.015 | 0.002 |
| C9 Naphthenes & C10 Paraffins & Trimethylcyclohexanes | 0.000 | 0.000 | 0.000 |
| Isopropylbenzene & Trimethylcyclohexanes | 0.000 | 0.000 | 0.000 |
| C9 Naphthenes & C10 Paraffins | 0.000 | 0.000 | 0.000 |
| Isopropylcyclohexane | 0.000 | 0.000 | 0.000 |
| C9 Naphthenes & C10 Paraffins & Cyclooctane | 0.000 | 0.000 | 0.000 |
| N-Propylcyclohexane | 0.000 | 0.000 | 0.000 |
| C9 Naphthenes & C10 Paraffins & n-Butylcyclopentane | 0.000 | 0.000 | 0.000 |
| n-Propylbenzene | 0.000 | 0.000 | 0.000 |
| C9 Naphthenes & C10 Paraffins & EthylBenzenes | 0.000 | 0.000 | 0.000 |
| m-Ethyltoluene | 0.000 | 0.000 | 0.000 |
| p-Ethyltoluene | 0.000 | 0.000 | 0.000 |
| 1,3,5- Trimethylbenzene & 4 & 5 Methylnonane | 0.000 | 0.000 | 0.000 |
| 2-Methylnonane & 3-Ethyloctane | 0.000 | 0.000 | 0.000 |
| C9 Naphthenes & C10 Paraffins | 0.000 | 0.000 | 0.000 |
| O-Ethyltoluene & 3-Methylnonane | 0.000 | 0.000 | 0.000 |
| C9 Naphthenes & C10 Paraffins | 0.000 | 0.000 | 0.000 |
| tert-Butylbenzene | 0.000 | 0.000 | 0.000 |
| 1,2,4 Trimethylbenzene & Methylcyclooctane | 0.000 | 0.000 | 0.000 |
| Isobutylcyclohexane & tert- Butylcyclohexane | 0.000 | 0.000 | 0.000 |
| n-Decane Plus | 0.000 | 0.000 | 0.000 |
| | 100.000 | 100.000 | 20.813 |

Precision parameters apply in the determination of above test results. Also refer to ASTM D 3244-97/02, IP 367/96 and appendix E of IP standard methods for analysis and testing for utilization of test data to determine conformance with specifications.

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SGS LABORATORY REFERENCE NUMBER : **6890-250891**

**COMPANY:** Conoco Phillips
**AREA / FIELD:** Eagleford
**LEASE:**

**SAMPLE DATE:** ########

| Calculated Value | Total Sample | Heptanes Plus |
|---|---|---|
| Molecular Weight | 25.352 | 92.759 |
| Relative Density | 0.3870 | 0.7605 |
| Liquid Density ( lbs/gal Absolute Density) | 3.226 | 6.340 |
| Liquid Density ( lbs/gal Weight in Air ) | 3.223 | 6.334 |
| Cu.Ft./Vapor / Gal. @ 14.696 | 48.289 | 25.937 |
| Vapor Pressure @ 100° F | 3560.800 | 0.750 |
| API Gravity at 60° F | 234.1 | 54.6 |
| BTU / LB | 22129 | 6505 |
| BTU / GAL. | 71390 | 37487 |
| BTU / Cu. FT. ( Vol. IDEAL Gas Fuel @ 14.696 ) | 1478.4 | 4902.8 |
| Specific Gravity as a Vapor @ 14.696 | 0.8753 | 0.9871 |

**Heavy End Grouping Breakdown**

| | | |
|---|---|---|
| HEXANES | C6 | 1.329 |
| HEPTANES | C7 | 0.425 |
| OCTANES | C8 | 0.147 |
| NONANES | C9 | 0.020 |
| DECANES+ | C10 | 0.000 |
| | Total | 1.921 Mol% |

**BTEX BREAKDOWN**

| | Mol% | WT.% |
|---|---|---|
| BENZENE | 0.050 | 0.154 |
| TOLUENE | 0.061 | 0.222 |
| ETHYLBENZENE | 0.001 | 0.004 |
| XYLENES | 0.012 | 0.051 |
| **Total BTEX** | **0.124** | **0.431** |

Precision parameters apply in the determination of above test results. Also refer to ASTM D 3244-97/02, IP 367/96 and appendix E of IP standard methods for analysis and testing for utilization of test data to determine conformance with specifications.

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SGS LABORATORY REFERENCE NUMBER : **6890-250891**

**Conoco Phillips**

| | | | |
|---|---|---|---|
| ID: | **Schendel A-189 Unit 1** | LINE PRESSURE: | **46 PSI** |
| AREA: | **Eagleford** | LINE TEMPERATURE: | **85 F** |
| METER: | **Low Pressure Separator** | CYLINDER NUMBER: | **0097** |
| LEASE: | | EFFECTIVE DATE: | |
| OPERATOR: | | SAMPLED BY: | **Robert Hester** |
| STATION: | | ANALYZED BY: | **Kerry Quave** |
| SAMPLE DATE: | **12/20/2011** | ANALYZED DATE: | **12/24/2011** |
| SAMPLE OF: | **Gas** | SAMPLE TYPE: | **Spot** |

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Physical Properties per GPA 2145-09 — Calculations per GPA 2286-03

Note: Zero = Less than detection limit

| | MOL% | WEIGHT% | GPM @ 14.696 |
|---|---|---|---|
| NITROGEN | 0.082 | 0.091 | |
| CARBON DIOXIDE | 1.123 | 1.949 | |
| METHANE | 68.789 | 43.528 | |
| ETHANE | 13.087 | 15.522 | 3.509 |
| PROPANE | 6.871 | 11.951 | 1.898 |
| ISOBUTANE | 1.829 | 4.193 | 0.600 |
| N-BUTANE | 3.330 | 7.634 | 1.053 |
| ISOPENTANE | 1.593 | 4.534 | 0.584 |
| N-PENTANE | 1.375 | 3.913 | 0.500 |
| HEXANE | 1.329 | 4.517 | 0.549 |
| HEPTANE | 0.425 | 1.506 | 0.162 |
| OCTANE | 0.147 | 0.573 | 0.057 |
| NONANE | 0.020 | 0.089 | 0.008 |
| DECANE+ | 0.000 | 0.000 | 0.000 |
| | 100.000 | 100.000 | 8.920 |

| **BTU** | **Vol. IDEAL Gas Fuel** | **Vol. Real Gas Fuel** |
|---|---|---|
| BTU @ 14.696 PSIA ( DRY ) | 1478.4 | 1485.9 |
| BTU @ 14.696 PSIA ( SAT. ) | 1452.6 | 1460.7 |
| Specific Gravity | 0.8753 | 0.8794 |
| Compressibility ( Z ) | 0.9949 | |

Gasoline Content ( Gallons Per Thousand - GPM )

| | |
|---|---|
| Ethane & Heavier | 8.693 |
| Propane & Heavier | 5.184 |
| Butane & Heavier | 3.286 |
| Pentane & Heavier | 1.633 |
| Total 26 psi Reid V.P. Gasoline GPM | 2.720 |

| **Secondary BTU Psia Base** | **Vol. IDEAL Gas Fuel** | **Vol. Real Gas Fuel** |
|---|---|---|
| BTU @ 15.025 PSIA ( DRY ) | 1511.5 | 1519.4 |
| BTU @ 15.025 PSIA ( SAT. ) | 1485.1 | 1493.6 |
| Compressibility ( Z ) at 15.025 = | 0.9948 | |

**Remarks:**

Precision parameters apply to the determination of above test results. Also refer to ASTM D 3244-97/02, IP 367/96 and appendix E of IP standard methods for analysis and testing for utilization of test data to determine conformance with specifications.

**Remarks:**

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**SGS** LABORATORY

COMPANY: Conoco Phillips
AREA / FIELD: Eagleford

| Sample Container<br>Cylinder Type/No.or Bottle | Sample Description<br>Field/Locations.Well | Sample Point<br>Date, hours | Sample Time<br>Date, hours | Matrix | RVP by D<br>5191 | Sample<br>Pressure,psi | Sample<br>Temp, F |
|---|---|---|---|---|---|---|---|
| Station No. 74143 (7) | Schendel A-189 | LP Separator before Dump Valve | 12-20-2011 @ 5:00 PM | Condensate | 8.60 psi | 84 | 85 |

**Chromatographic Extended Analysis - Summation Report**

| Component | Mol% | Liq Vol% | Wt% |
|---|---|---|---|
| Nitrogen | 0.042 | 0.008 | 0.008 |
| Carbon Dioxide | 0.031 | 0.009 | 0.010 |
| Methane | 1.891 | 0.553 | 0.218 |
| Ethane | 1.556 | 0.718 | 0.337 |
| Propane | 2.564 | 1.219 | 0.814 |
| Isobutane | 1.401 | 0.791 | 0.586 |
| N-Butane | 3.577 | 1.946 | 1.496 |
| 2,2 Dimethylpropane | 0.029 | 0.019 | 0.015 |
| IsoPentane | 3.554 | 2.243 | 1.846 |
| n-Pentane | 4.082 | 2.554 | 2.120 |
| 2,2 Dimethylbutane | 0.164 | 0.118 | 0.101 |
| Cyclopentane | 0.000 | 0.000 | 0.000 |
| 2,3 Dimethylbutane | 0.326 | 0.230 | 0.202 |
| 2 Methylpentane | 1.935 | 1.386 | 1.201 |
| 3 Methylpentane | 1.266 | 0.892 | 0.785 |
| n-Hexane | 3.204 | 2.274 | 1.988 |
| Heptanes Plus | 74.380 | 85.039 | 88.273 |
| Total | 100.000 | 100.000 | 100.000 |

**Characteristics of Heptanes Plus**

| | | |
|---|---|---|
| Specific Gravity | 0.7866 | (Water = 1) |
| API Gravity | 47.92 | @60 F |
| Molecular Weight | 164.9 | |
| Vapor Volume | 15.18 | CF/Gal |
| Weight | 6.57 | Lbs/Gal |

**Characteristics of Total Sample**

| | | |
|---|---|---|
| Specific Gravity | 0.7598 | (Water = 1) |
| API Gravity | 54.74 | @60 F |
| Molecular Weight | 138.9 | |
| Vapor Volume | 17.36 | CF/Gal |
| Weight | 6.33 | Lbs/Gal |

**Total Extended Report**

| Component | Mol% | Liq Vol% | Wt% |
|---|---|---|---|
| Nitrogen | 0.042 | 0.008 | 0.008 |
| Carbon Dioxide | 0.031 | 0.009 | 0.010 |
| Methane | 1.891 | 0.553 | 0.218 |
| Ethane | 1.556 | 0.718 | 0.337 |
| Propane | 2.564 | 1.219 | 0.814 |
| Isobutane | 1.401 | 0.791 | 0.586 |
| N-Butane | 3.577 | 1.946 | 1.496 |
| 2,2 Dimethylpropane | 0.029 | 0.019 | 0.015 |
| IsoPentane | 3.554 | 2.243 | 1.846 |
| n-Pentane | 4.082 | 2.554 | 2.120 |
| 2,2 Dimethylbutane | 0.164 | 0.118 | 0.101 |
| Cyclopentane | 0.000 | 0.000 | 0.000 |
| 2,3 Dimethylbutane | 0.326 | 0.230 | 0.202 |
| 2 Methylpentane | 1.935 | 1.386 | 1.201 |
| 3 Methylpentane | 1.266 | 0.892 | 0.785 |
| n-Hexane | 3.204 | 2.274 | 1.988 |
| Methylcyclopentane | 0.530 | 0.324 | 0.321 |
| Benzene | 0.294 | 0.142 | 0.165 |
| Cyclohexane | 0.789 | 0.463 | 0.478 |
| 2-Methylhexane | 1.617 | 1.298 | 1.166 |
| 3-Methylhexane | 1.549 | 1.227 | 1.117 |
| 2,2,4 Trimethylpentane | 0.000 | 0.000 | 0.000 |
| Other C-7's | 1.416 | 1.102 | 1.011 |
| n-Heptane | 3.338 | 2.658 | 2.407 |
| Methylcyclohexane | 2.282 | 1.583 | 1.613 |
| Toluene | 2.163 | 1.250 | 1.434 |
| Other C-8's | 5.852 | 4.901 | 4.643 |
| n-Octane | 2.999 | 2.652 | 2.466 |
| E-Benzene | 0.671 | 0.447 | 0.513 |
| M & P Xylenes | 2.871 | 1.923 | 2.194 |
| O-Xylene | 0.923 | 0.606 | 0.705 |
| Other C-9's | 3.880 | 3.630 | 3.526 |
| n-Nonane | 2.415 | 2.345 | 2.229 |
| Other C-10's | 5.480 | 5.634 | 5.573 |
| n-Decane | 2.039 | 2.160 | 2.088 |
| Undecanes (11) | 5.794 | 6.112 | 6.131 |
| Dodecanes (12) | 4.337 | 4.941 | 5.026 |
| Tridecanes (13) | 3.971 | 4.852 | 5.002 |
| Tetradecanes (14) | 3.179 | 4.160 | 4.348 |
| Pentadecanes (15) | 2.664 | 3.734 | 3.950 |
| Hexadecanes (16) | 2.069 | 3.100 | 3.307 |
| Heptadecanes (17) | 1.760 | 2.788 | 3.002 |
| Octadecanes (18) | 1.534 | 2.558 | 2.771 |
| Nonadecanes (19) | 1.328 | 2.308 | 2.514 |
| Eicosanes (20) | 0.985 | 1.779 | 1.950 |
| Heneicosanes (21) | 0.803 | 1.526 | 1.682 |
| Docosanes (22) | 0.679 | 1.345 | 1.491 |
| Tricosanes (23) | 0.550 | 1.128 | 1.258 |
| Tetracosanes (24) | 0.441 | 0.939 | 1.052 |
| Pentacosanes (25) | 0.334 | 0.737 | 0.829 |
| Hexacosanes (26) | 0.266 | 0.607 | 0.686 |
| Heptacosanes (27) | 0.228 | 0.541 | 0.615 |
| Octacosanes (28) | 0.203 | 0.498 | 0.568 |
| Nonacosanes (29) | 0.193 | 0.489 | 0.559 |
| Triacontanes (30) | 0.177 | 0.461 | 0.529 |
| Hentriacontanes Plus (31+) | 1.776 | 6.090 | 7.351 |
| Total | 100.000 | 100.000 | 100.000 |

SGS LABORATORY REFERENCE NUMBER : **6894-250891**

**Conoco Phillips**

| | | | |
|---|---|---|---|
| ID: | **Laird B1** | LINE PRESSURE: | **1060 PSI** |
| AREA: | **Eagleford** | LINE TEMPERATURE: | **112 F** |
| METER: | **High Pressure Separator** | CYLINDER NUMBER: | **0110** |
| LEASE: | | EFFECTIVE DATE: | |
| OPERATOR: | | SAMPLED BY: | **Robert Hester** |
| STATION: | | ANALYZED BY: | **Kerry Quave** |
| SAMPLE DATE: | **12/20/2011** | ANALYZED DATE: | **12/24/2011** |
| SAMPLE OF: | **Gas** | SAMPLE TYPE: | **Spot** |

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Physical Properties per GPA 2145-09 — Calculations per GPA 2286-03

Note: Zero = Less than detection limit

| | MOL% | WEIGHT% | GPM @ 14.696 |
|---|---|---|---|
| NITROGEN | 0.164 | 0.202 | |
| CARBON DIOXIDE | 2.163 | 4.187 | |
| METHANE | 75.685 | 53.403 | |
| ETHANE | 11.765 | 15.559 | 3.151 |
| PROPANE | 4.689 | 9.094 | 1.294 |
| ISOBUTANE | 0.899 | 2.298 | 0.295 |
| N-BUTANE | 1.663 | 4.251 | 0.525 |
| ISOPENTANE | 0.652 | 2.069 | 0.239 |
| N-PENTANE | 0.623 | 1.977 | 0.226 |
| HEXANES | 0.733 | 2.778 | 0.302 |
| HEPTANES PLUS | 0.964 | 4.182 | 0.396 |
| | 100.000 | 100.000 | 6.428 |

| **BTU** | **Vol. IDEAL Gas Fuel** | **Vol. Real Gas Fuel** |
|---|---|---|
| BTU @ 14.696 PSIA ( DRY ) | 1310.2 | 1315.3 |
| BTU @ 14.696 PSIA ( SAT. ) | 1287.3 | 1292.9 |
| Specific Gravity | 0.7850 | 0.7878 |
| Compressibility ( Z ) | 0.9961 | |

Gasoline Content ( Gallons Per Thousand - GPM )

| | |
|---|---|
| Ethane & Heavier | 6.032 |
| Propane & Heavier | 2.881 |
| Butane & Heavier | 1.587 |
| Pentane & Heavier | 0.767 |
| Total 26 psi Reid V.P. Gasoline GPM | 1.791 |

| **Secondary BTU Psia Base** | **Vol. IDEAL Gas Fuel** | **Vol. Real Gas Fuel** |
|---|---|---|
| BTU @ 15.025 PSIA ( DRY ) | 1339.5 | 1344.8 |
| BTU @ 15.025 PSIA ( SAT. ) | 1316.1 | 1321.9 |

Compressibility ( Z ) at 15.025 = 0.9960

**Remarks:**
**Remarks:**

Precision parameters apply in the determination of above test results. Also refer to ASTM D 3244-97/02, IP 367/96 and appendix E of IP standard methods for analysis and testing for utilization of test data to determine conformance with specifications.

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SGS LABORATORY REFERENCE NUMBER : **6894-250891**

**COMPANY: Conoco Phillips** **SAMPLE DATE: ########**
**AREA / FIELD: Eagleford**
**LEASE:**

| | MOL% | WEIGHT% | GPM @ 14.696 |
|---|---|---|---|
| NITROGEN | 0.164 | 0.202 | 0.018 |
| CARBON DIOXIDE | 2.163 | 4.187 | 0.370 |
| METHANE | 75.685 | 53.403 | 12.848 |
| ETHANE | 11.765 | 15.559 | 3.151 |
| PROPANE | 4.689 | 9.094 | 1.294 |
| ISOBUTANE | 0.899 | 2.298 | 0.295 |
| N-BUTANE | 1.663 | 4.251 | 0.525 |
| ISOPENTANE | 0.652 | 2.069 | 0.239 |
| N-PENTANE | 0.623 | 1.977 | 0.226 |
| 2,2-Dimethylbutane | 0.025 | 0.093 | 0.010 |
| 2,3-Dimethylbutane & Cyclopentane | 0.000 | 0.000 | 0.000 |
| 2-Methylpentane | 0.248 | 0.940 | 0.103 |
| 3-Methylpentane | 0.182 | 0.688 | 0.074 |
| n-Hexane | 0.279 | 1.057 | 0.115 |
| 2,2-Dimethylpentane | 0.009 | 0.040 | 0.004 |
| Methylcyclopentane | 0.062 | 0.229 | 0.022 |
| 2,4-Dimethylpentane | 0.001 | 0.004 | 0.000 |
| 2,2,3- Trimethylbutane | 0.000 | 0.000 | 0.000 |
| Benzene | 0.034 | 0.117 | 0.010 |
| 3,3-Dimethylpentane | 0.000 | 0.000 | 0.000 |
| Cyclohexane | 0.137 | 0.507 | 0.047 |
| 2-Methylhexane | 0.012 | 0.053 | 0.006 |
| 2,3-Dimethylpentane | 0.071 | 0.313 | 0.032 |
| 1,1-Dimethylcyclopentane | 0.000 | 0.000 | 0.000 |
| 3-Methylhexane | 0.010 | 0.044 | 0.005 |
| l,t-3-Dimethylcyclopentane | 0.006 | 0.026 | 0.002 |
| 1,c-3-Dimethylcyclopentane & 3-Ethylpentane | 0.009 | 0.039 | 0.004 |
| l,t-2-Dimethylcyclopentane & 2,2,4- Trimethylpentane | 0.000 | 0.000 | 0.000 |
| n-Heptane | 0.135 | 0.595 | 0.062 |
| Methylcyclohexane | 0.092 | 0.397 | 0.037 |
| 1,1,3- Trimethylcyclopentane & 2,2-Dimethylhexane | 0.003 | 0.015 | 0.001 |
| 2,5-Dimethylhexane & 2,4-Dimethylhexane | 0.005 | 0.025 | 0.003 |
| Ethylcyclopentane | 0.002 | 0.009 | 0.001 |
| 2,2,3- Trimethylpentane & 1,t-2,c-4- Trimethylcyclopentane | 0.000 | 0.000 | 0.000 |
| 3,3-Dimethylhexane & 1,t-2,c-3- Trimethylcyclopentane | 0.000 | 0.000 | 0.000 |
| 2,3,4- Trimethylpentane & 2,3.Dimethylhexane | 0.000 | 0.000 | 0.000 |
| Toluene | 0.132 | 0.535 | 0.044 |
| 1,1,2- Trimethylcyclopentane | 0.000 | 0.000 | 0.000 |
| 3,4-Dimethylhexane | 0.000 | 0.000 | 0.000 |
| 2-Methylheptane | 0.033 | 0.166 | 0.017 |
| 4-Methylheptane | 0.000 | 0.000 | 0.000 |
| 1,c-2,t-4- Trimethylcyclopentane | 0.000 | 0.000 | 0.000 |
| 3-Methylheptane & 3,4-Dimethylhexane | 0.002 | 0.010 | 0.001 |

Precision parameters apply in the determination of above test results. Also refer to ASTM D 3244-97/02, IP 367/96 and appendix E of IP standard methods for analysis and testing for utilization of test data to determine conformance with specifications.

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SGS LABORATORY REFERENCE NUMBER : **6894-250891**

**COMPANY: Conoco Phillips**
**AREA / FIELD: Eagleford**
**LEASE:**

**SAMPLE DATE: ########**

| | MOL% | WEIGHT% | GPM @ 14.696 |
|---|---|---|---|
| 1,c-3-Dimethylcyclohexane & 3-Ethylhexane | 0.000 | 0.000 | 0.000 |
| l,t-4-Dimethylcyclohexane & 1,c2,t3- Trimethylcyclopentane | 0.000 | 0.000 | 0.000 |
| 2,2,5-Trimethylhexane & 1,1-Dimethylcyclohexane | 0.000 | 0.000 | 0.000 |
| Methyl-Ethylcyclopentane's & 2,2,4- Trimethylhexane | 0.017 | 0.084 | 0.008 |
| n-Octane | 0.057 | 0.286 | 0.029 |
| 1,t2 Dimethylcyclohexane & 2,2,4,4- Tetramethylpentane | 0.000 | 0.000 | 0.000 |
| 1,t-3-Dimethylcyclohexane & 1,c-4-Dimethylcyclohexane | 0.004 | 0.020 | 0.002 |
| Dimethylheptanes & 1 ,c-2,c-3- Trimethylcyclopentane | 0.002 | 0.010 | 0.001 |
| Isopropylcyclopentane | 0.003 | 0.015 | 0.001 |
| Dimethylheptanes & Trimethylhexanes | 0.006 | 0.033 | 0.003 |
| 1,c-2-Dimethylcyclohexane | 0.000 | 0.000 | 0.000 |
| Dimethylheptanes | 0.007 | 0.039 | 0.004 |
| Ethylcyclohexane | 0.000 | 0.000 | 0.000 |
| n-Propylcyclopentane | 0.000 | 0.000 | 0.000 |
| Trimethylcyclohexanes | 0.000 | 0.000 | 0.000 |
| Ethylbenzene | 0.006 | 0.028 | 0.002 |
| Dimethylheptanes & Trimethylhexanes | 0.002 | 0.011 | 0.001 |
| m-Xylene & p-Xylene | 0.019 | 0.089 | 0.007 |
| 2 & 4 Methyloctane & 3,4-Dimethylheptane | 0.000 | 0.000 | 0.000 |
| Trimethylcyclohexanes | 0.000 | 0.000 | 0.000 |
| 3-Methyloctane | 0.002 | 0.011 | 0.001 |
| Trimethylcyclohexanes | 0.000 | 0.000 | 0.000 |
| o-Xylene | 0.046 | 0.215 | 0.018 |
| Trimethylcyclohexanes & Isobutylcyclopentane | 0.000 | 0.000 | 0.000 |
| n-Nonane | 0.020 | 0.113 | 0.011 |
| C9 Naphthenes & C10 Paraffins & Trimethylcyclohexanes | 0.001 | 0.006 | 0.001 |
| Isopropylbenzene & Trimethylcyclohexanes | 0.001 | 0.005 | 0.000 |
| C9 Naphthenes & C10 Paraffins | 0.001 | 0.006 | 0.001 |
| Isopropylcyclohexane | 0.002 | 0.011 | 0.001 |
| C9 Naphthenes & C10 Paraffins & Cyclooctane | 0.002 | 0.010 | 0.001 |
| N-Propylcyclohexane | 0.001 | 0.006 | 0.001 |
| C9 Naphthenes & C10 Paraffins & n-Butylcyclopentane | 0.003 | 0.019 | 0.002 |
| n-Propylbenzene | 0.003 | 0.016 | 0.001 |
| C9 Naphthenes & C10 Paraffins & EthylBenzenes | 0.000 | 0.000 | 0.000 |
| m-Ethyltoluene | 0.000 | 0.000 | 0.000 |
| p-Ethyltoluene | 0.000 | 0.000 | 0.000 |
| 1,3,5- Trimethylbenzene & 4 & 5 Methylnonane | 0.000 | 0.000 | 0.000 |
| 2-Methylnonane & 3-Ethyloctane | 0.000 | 0.000 | 0.000 |
| C9 Naphthenes & C10 Paraffins | 0.000 | 0.000 | 0.000 |
| O-Ethyltoluene & 3-Methylnonane | 0.000 | 0.000 | 0.000 |
| C9 Naphthenes & C10 Paraffins | 0.000 | 0.000 | 0.000 |
| tert-Butylbenzene | 0.000 | 0.000 | 0.000 |
| 1,2,4 Trimethylbenzene & Methylcyclooctane | 0.000 | 0.000 | 0.000 |
| Isobutylcyclohexane & tert- Butylcyclohexane | 0.000 | 0.000 | 0.000 |
| n-Decane Plus | 0.004 | 0.025 | 0.002 |
| | 100.000 | 100.000 | 19.664 |

Precision parameters apply in the determination of above test results. Also refer to ASTM D 3244-97/02, IP 367/96 and appendix E of IP standard methods for analysis and testing for utilization of test data to determine conformance with specifications.

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SGS LABORATORY REFERENCE NUMBER : **6894-250891**

**COMPANY:** Conoco Phillips
**AREA / FIELD:** Eagleford
**LEASE:**

**SAMPLE DATE:** ########

| Calculated Value | Total Sample | Heptanes Plus |
|---|---|---|
| Molecular Weight | 22.736 | 98.624 |
| Relative Density | 0.3670 | 0.7618 |
| Liquid Density ( lbs/gal Absolute Density) | 3.060 | 6.351 |
| Liquid Density ( lbs/gal Weight in Air ) | 3.057 | 6.345 |
| Cu.Ft./Vapor / Gal. @ 14.696 | 51.074 | 24.437 |
| Vapor Pressure @ 100° F | 3889.010 | 1.010 |
| API Gravity at 60° F | 254.1 | 54.2 |
| BTU / LB | 21868 | 12034 |
| BTU / GAL. | 66890 | 72131 |
| BTU / Cu. FT. ( Vol. IDEAL Gas Fuel @ 14.696 ) | 1310.2 | 5205.2 |
| Specific Gravity as a Vapor @ 14.696 | 0.7850 | 1.9341 |

**Heavy End Grouping Breakdown**

| | | |
|---|---|---|
| HEXANES | C6 | 0.733 |
| HEPTANES | C7 | 0.486 |
| OCTANES | C8 | 0.343 |
| NONANES | C9 | 0.117 |
| DECANES+ | C10 | 0.018 |
| | Total | 1.697 Mol% |

**BTEX BREAKDOWN**

| | Mol% | WT.% |
|---|---|---|
| BENZENE | 0.034 | 0.117 |
| TOLUENE | 0.132 | 0.535 |
| ETHYLBENZENE | 0.006 | 0.028 |
| XYLENES | 0.065 | 0.304 |
| **Total BTEX** | **0.237** | **0.984** |

Precision parameters apply in the determination of above test results. Also refer to ASTM D 3244-97/02, IP 367/96 and appendix E of IP standard methods for analysis and testing for utilization of test data to determine conformance with specifications.

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SGS LABORATORY REFERENCE NUMBER : **6894-250891**

**Conoco Phillips**

| | | | |
|---|---|---|---|
| ID: | **Laird B1** | LINE PRESSURE: | **1060 PSI** |
| AREA: | **Eagleford** | LINE TEMPERATURE: | **112 F** |
| METER: | **High Pressure Separator** | CYLINDER NUMBER: | **0110** |
| LEASE: | | EFFECTIVE DATE: | |
| OPERATOR: | | SAMPLED BY: | **Robert Hester** |
| STATION: | | ANALYZED BY: | **Kerry Quave** |
| SAMPLE DATE: | **12/20/2011** | ANALYZED DATE: | **12/24/2011** |
| SAMPLE OF: | **Gas** | SAMPLE TYPE: | **Spot** |

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Physical Properties per GPA 2145-09 — Calculations per GPA 2286-03

Note: Zero = Less than detection limit

| | MOL% | WEIGHT% | GPM @ 14.696 |
|---|---|---|---|
| NITROGEN | 0.164 | 0.202 | |
| CARBON DIOXIDE | 2.163 | 4.187 | |
| METHANE | 75.685 | 53.403 | |
| ETHANE | 11.765 | 15.559 | 3.151 |
| PROPANE | 4.689 | 9.094 | 1.294 |
| ISOBUTANE | 0.899 | 2.298 | 0.295 |
| N-BUTANE | 1.663 | 4.251 | 0.525 |
| ISOPENTANE | 0.652 | 2.069 | 0.239 |
| N-PENTANE | 0.623 | 1.977 | 0.226 |
| HEXANE | 0.733 | 2.778 | 0.302 |
| HEPTANE | 0.486 | 1.967 | 0.194 |
| OCTANE | 0.343 | 1.527 | 0.141 |
| NONANE | 0.117 | 0.584 | 0.051 |
| DECANE+ | 0.018 | 0.104 | 0.010 |
| | 100.000 | 100.000 | 6.428 |

| **BTU** | **Vol. IDEAL Gas Fuel** | **Vol. Real Gas Fuel** |
|---|---|---|
| BTU @ 14.696 PSIA ( DRY ) | 1310.2 | 1315.3 |
| BTU @ 14.696 PSIA ( SAT. ) | 1287.3 | 1292.9 |
| Specific Gravity | 0.7850 | 0.7878 |
| Compressibility ( Z ) | 0.9961 | |

Gasoline Content ( Gallons Per Thousand - GPM )

| | |
|---|---|
| Ethane & Heavier | 6.032 |
| Propane & Heavier | 2.881 |
| Butane & Heavier | 1.587 |
| Pentane & Heavier | 0.767 |
| Total 26 psi Reid V.P. Gasoline GPM | 1.791 |

| **Secondary BTU Psia Base** | **Vol. IDEAL Gas Fuel** | **Vol. Real Gas Fuel** |
|---|---|---|
| BTU @ 15.025 PSIA ( DRY ) | 1339.5 | 1344.8 |
| BTU @ 15.025 PSIA ( SAT. ) | 1316.1 | 1321.9 |
| Compressibility ( Z ) at 15.025 = | 0.9960 | |

**Remarks:**

Precision parameters apply to the determination of above test results. Also refer to ASTM D 3244-97/02, IP 367/96 and appendix E of IP standard methods for analysis and testing for utilization of test data to determine conformance with specifications.

**Remarks:**

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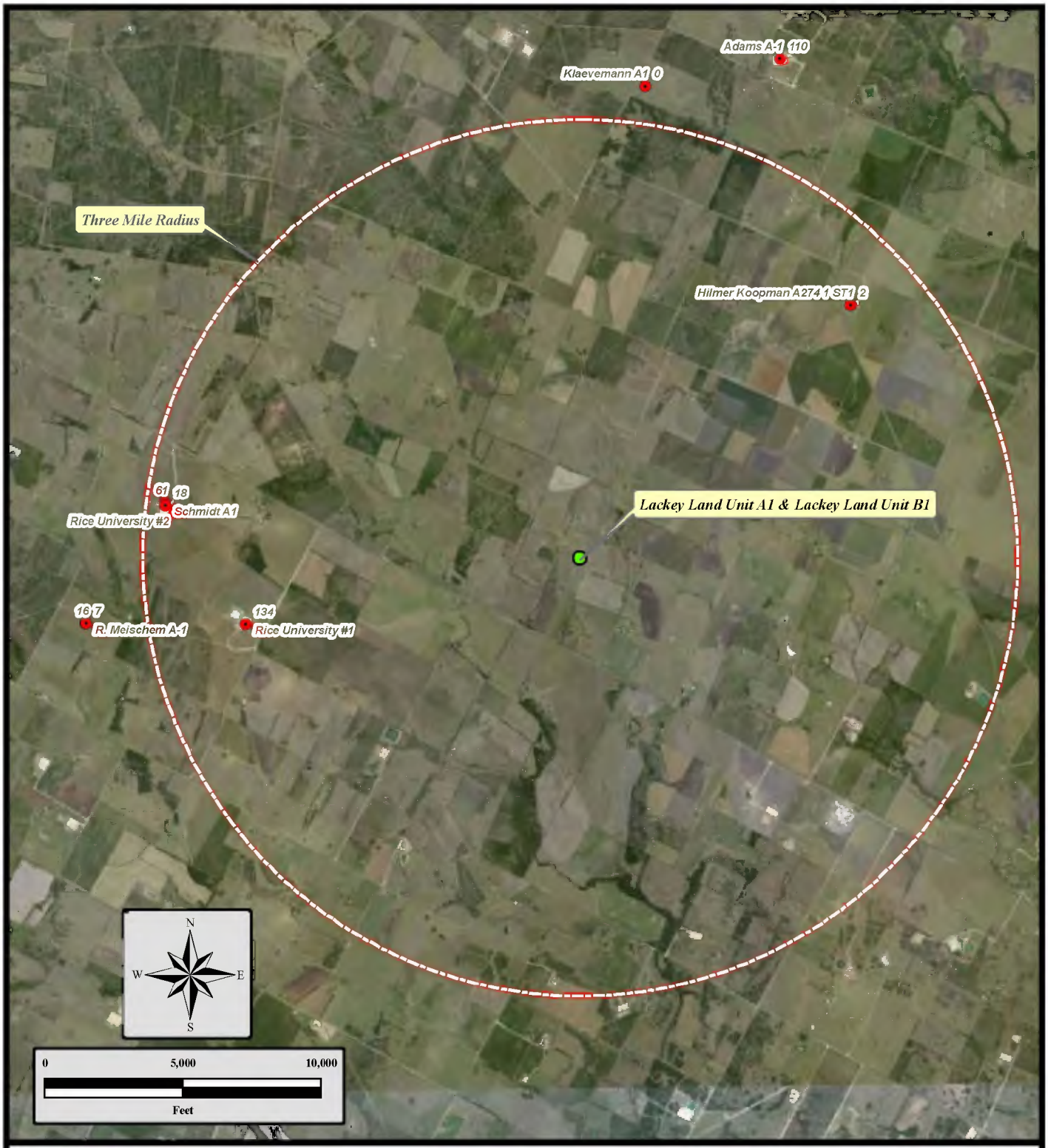


**FIGURE 6-1**
**H2S RESPRESENTATIVE READING**
**Burlington Resources Oil & Gas Company LP**
**Standard Permit Registration**
**Lackey Land A639 Unit A1 & B1**
**TITAN Project No. 84800507-72.009**
**August 2012**

*from USGS Quadrangle New Davy, Texas*
*Ground Condition Depicted October 2011*
*Digital Data Courtesy of ESRI Online Datasets*

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