

**DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR QUALITY
Permit Application Analysis
A0000307**

August 15, 2015

NAME OF FIRM: EOG Resources, Inc.

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Denver, CO 80202

RESPONSIBLE OFFICIAL: Curtis Rice
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TYPE OF OPERATION: multiple well, sweet crude oil and natural gas production facility

FACILITY NAME: **Jubilee 153-1034H PAD**

FACILITY LOCATION: NW¹/₄ NE¹/₄ of Section 10, T13N, R65W
Latitude: 41.115306° Longitude: -104.644744°
Laramie County, Wyoming

DATE FACILITY BECAME OPERATIONAL: 8/27/2014

REVIEWER: Brandi O'Brien, Air Quality Engineer

PURPOSE OF APPLICATION: EOG Resources filed this application to construct a new sweet crude oil and natural gas production facility, known as the Jubilee 153-1034H PAD, consisting of the Jubilee 153-1034H, 154-1034H, 554-1034H and 555-1034H wells.

Production and equipment for the four wells are co-located and/or shared and all associated air emissions are aggregated for permitting determinations.

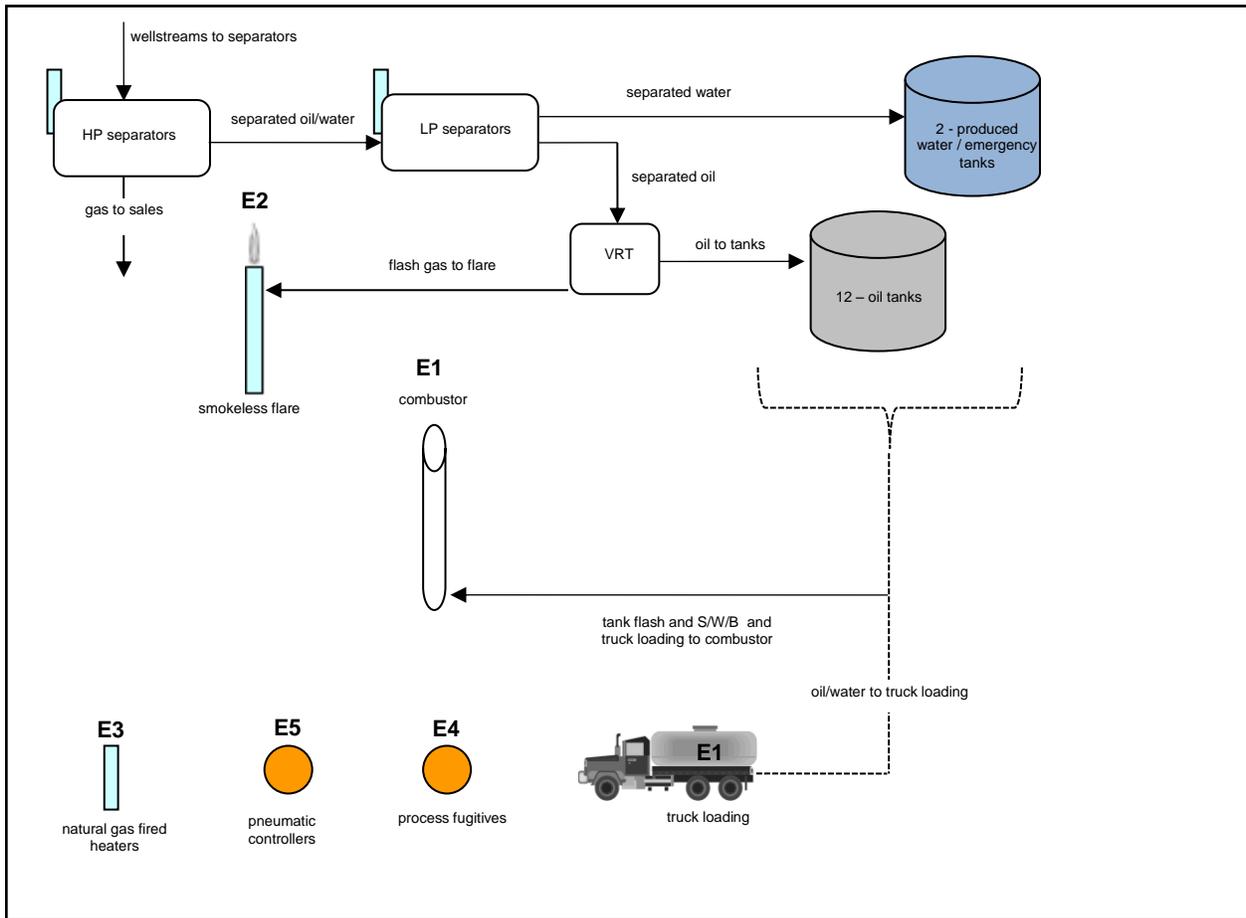
The following equipment operates at the Jubilee 153-1034H PAD:

- four (4) heater treaters w/ 1.0 million Btu per hour (MMBtu/hr) heaters
- two (2) recycle treaters w/ 0.5 MMBtu/hr heaters
- one (1) 0.5 MMBtu/hr line heater
- twelve (12) 500-barrel (bbl) oil tanks
- two (2) 500-bbl produced water / emergency combination tanks
- two (2) vapor recovery towers
- three (3) scrubbers (VRT vent line combustor, tank vent line combustor and fuel gas)
- one (1) common smokeless combustion device w/ continuous pilot monitoring system (oil tank, active produced water tank and truck loadout control)
- various no-bleed pneumatic controllers

Equipment list continued:

- one (1) smokeless tri-tip flare w/ continuous pilot monitoring system (vapor recovery tower control)
- one (1) smokeless emergency tri-tip flare w/ continuous pilot monitoring system (produced gas control during upset conditions)

PROCESS DESCRIPTION: The following is a schematic representation of the production process at this facility. A complete process description is found in the permit application.



ESTIMATED EMISSIONS: (summarized in the attached tables)

oil storage tanks:

tank flash and S/W/B vapors:

Uncontrolled volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions are estimated using Promax software based on the average extended hydrocarbon composition of oil from the wells and the daily oil production rate reported by the applicant.

Controlled VOC and HAP emissions (**Emission Source E1, Process Flow Diagram**) are based on the reported 98% destruction efficiency of the common smokeless combustion device. Nitrogen oxide (NO_x) and carbon monoxide (CO) emissions from combustion of the vapors are based on 0.14 lb NO_x/MMBtu and 0.035 lb CO/MMBtu and the calculated volume of incinerated vapors.

active produced water tank: (Emission Source E1, Process Flow Diagram)

The Division is currently not requiring emission calculations for active produced water tanks. Vapors from the active produced water tank is routed to the common smokeless combustion device for 98% control.

VRT flash gas: (Emission Source E2, Process Flow Diagram)

Uncontrolled VOC and HAP emissions are estimated using Promax software based on the average extended hydrocarbon composition of oil from the wells and the daily oil production rate reported by the applicant.

Controlled VOC and HAP emissions (**Emission Source E1, Process Flow Diagram**) are based on the reported 98% destruction efficiency of the smokeless flare NO_x and CO emissions from combustion of the vapors are based on 0.14 lb NO_x/MMBtu and 0.035 lb CO/MMBtu and the calculated volume of incinerated vapors.

truck loading:

VOC and HAP emissions are based on AP-42 EF and the projected oil production rate.

Controlled VOC and HAP emissions (**Emission Source E1, Process Flow Diagram**) associated with truck loading are based on the reported 98% destruction efficiency of the common combustion device for the vapors recovered (approximately 70%).

natural gas fired heaters: (Emission Source E3, Process Flow Diagram)

NO_x and CO emissions are based on AP-42 EF for fuel boilers and heaters.

fugitive sources: (Emission Source E4, Process Flow Diagram)

VOC and HAP emissions are based on EPA and API EF and the number of fugitive sources at the well site.

pneumatic controllers: (Emission Source E5, Process Diagram)

Pneumatic controllers are no-bleed; therefore, emissions are considered insignificant.

BEST AVAILABLE CONTROL TECHNOLOGY (BACT): The following table summarizes Presumptive BACT notice and control installation requirements under the 2013 Chapter 6, Section 2 Oil and Gas Production Facilities Permitting Guidance (C6 S2 Guidance).

Application, Emissions Controls, Monitoring	Date Due	Date Filed/Installed
Application	11/25/2014 (within 90-days of startup)	11/25/2014
Tank Emission Control	10/25/2014 (within 60-days of startup)	8/27/2014
Active Produced Water Tank	not required	8/27/2014
Produced Gas	10/25/2014 (within 60-days of startup)	8/27/2014
Continuous Monitoring	10/25/2014 (within 60-days of startup)	8/27/2014
No-Bleed / Low-Bleed Controllers	8/27/2014 (upon startup)	8/27/2014

The emission control, reporting and monitoring requirements under the 2013 C6 S2 Guidance have been met.

VOC emissions associated with truck loading are estimated to be 22.4 TPY. The 2013 C6 S2 Guidance requires a BACT analysis for emission sources with greater than 8 TPY VOC. EOG Resources will utilize a vapor collection system for the truck loading operation that is assumed, based on AP-42 Section 5.2, to capture 70% of the truck loading vapors. The captured vapors are routed to a smokeless combustion device with a reported destruction efficiency of 98% which reduces emissions to 6.7 TPY VOC. The Division finds this level of control to satisfy BACT requirements for truck loading operations.

Since this facility is potentially a major source of VOCs, conditions requiring one (1) quarterly inspection per year be done with an optical gas imaging instrument have been incorporated into this proposed permit.

NEW SOURCE PERFORMANCE STANDARDS (NSPS): The oil storage tanks are operated prior to custody transfer and are not subject to Subpart K, K_a or K_b.

40 CFR part 60, subpart OOOO - *Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution* applies to any new, modified or reconstructed emission source installed after August 23, 2011 at oil and gas production and gas processing facilities. The Jubilee 153-1034H PAD is subject to 40 CFR part 60, subpart OOOO as the facility was constructed after the effective date.

PREVENTION OF SIGNIFICANT DETERIORATION (PSD): Under the federally enforceable conditions of this permit, emissions from this facility are less than the major source levels defined in WAQSR Chapter 6, Section 4.

CHAPTER 6, SECTION 3 (Operating Permit): Under the federally enforceable conditions of this permit, emissions from this facility are less than the major source levels defined in WAQSR Chapter 6, Section 3.

NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (MACT): Under the federally enforceable conditions of this permit, emissions from this facility are less than the major source levels of 10 TPY of any individual HAP and 25 TPY of any combination of HAPs; therefore this facility is not subject to 40 CFR part 63, subpart HH requirements for oil and gas production facilities which are major sources of HAP emissions.

PROPOSED PERMIT CONDITIONS: The Division proposes to issue an Air Quality Permit to EOG Resources, Inc. for the Jubilee 153-1034H PAD with the following conditions:

1. Authorized representatives of the Division of Air Quality be given permission to enter and inspect any property, premise or place on or at which an air pollution source is located or is being installed for the purpose of investigating actual or potential sources of air pollution and for determining compliance or non-compliance with any rule, regulation, standard, permit or order.
2. All substantive commitments and descriptions set forth in the application for this permit, unless superseded by a specific condition of this permit, are incorporated herein by this reference and are enforceable as a condition of this permit.
3. A permit to operate in accordance with Chapter 6, Section 2(a)(iii) of the WAQSR is required after a 120-day start-up period in order to operate this facility.
4. All notifications, reports and correspondence required by this permit shall be submitted to the Stationary Source Compliance Program Manager, Air Quality Division, 122 West 25th Street, Cheyenne, WY 82002 and a copy shall be submitted to the District Engineer, Air Quality Division, 122 West 25th Street, Cheyenne, WY 82002. Submissions may also be done electronically through <https://airimpact.wyo.gov> to satisfy the requirements of this permit.
5. All records required under this permit shall be kept for a period of at least five (5) years and shall be made available to the Division upon request.
6. Periodic training on the proper operation of equipment, systems and devices used to contain, control, eliminate or reduce pollution shall be provided to company personnel whose primary job is to regularly ensure that facility production equipment is functional. The training shall provide these personnel with the ability to recognize, correct and report all instances of malfunctioning equipment, systems and devices associated with air pollution control. These equipment, systems and devices include, but are not limited to combustion units, reboiler overheads condensers, hydrocarbons liquids storage tanks, drip tanks, vent lines, connectors, fittings, valves, relief valves, hatches and any other appurtenance employed to, or involved with, eliminating, reducing, containing or collecting vapors and transporting them to a pollution control system or device.
7. Trained personnel shall perform, at a minimum, a quarterly site evaluation of the operation of the air pollution control equipment, systems and devices under Condition 6. The first quarterly site evaluation shall be conducted within the second quarter after issuance of this permit.

8. At least one of the quarterly evaluations per calendar year under Condition 7 shall include an evaluation of the facility for leaks from the equipment, systems and devices under Condition 6 using an optical gas imaging instrument. Monitoring utilizing the no detectable emissions test methods and procedures in 40 CFR §60.5416(b)(1) through (8) may be utilized to satisfy the requirements of this condition for the equipment, systems, and devices under Condition 6 in lieu of using an optical gas imaging instrument.
9. Notification shall be provided to the Division at least fifteen (15) days prior to each quarterly evaluation under Condition 7.
10. An annual preventative maintenance program shall be instituted to inspect and replace equipment, systems and devices under Condition 6 as necessary to ensure their proper operation.
11. Results of all inspections, evaluations and periodic monitoring shall be documented and maintained for review by the Division upon request. Digital files of any optical gas imaging instrument evaluations need not be maintained.
12. Vapors from all oil tanks and all active produced water tanks, including tank flash and S/W/B vapors, shall be routed to the common combustion device to reduce the mass content of VOCs and HAPs in the tank vapors vented to the device by at least ninety-eight percent (98%) by weight.
13. Flash gas from the vapor recovery towers shall be routed to the flare to reduce the mass content of total VOCs and HAPs in the vapors routed to the devices by at least ninety-eight percent (98%) by weight.
14. Truck loading vapors shall be routed to a vapor collection system and the captured vapors shall be routed to the common combustion device to reduce the mass content of VOCs and HAPs in the captured truck loading vapors by at least ninety-eight percent (98%) by weight.
15. The presence of the combustion device and flare pilot flames shall be monitored using thermocouples and continuous recording devices or any other equivalent devices to detect and record the presence of the flames. Records shall be maintained noting periods during active well site operation when any of the pilot flames are not present. The records shall contain a description of the reason(s) for absence of the pilot flames and steps taken to return the pilot flames to proper operation.
16. The enclosed combustion device shall be designed, constructed, operated and maintained to be smokeless, per Chapter 3, Section 6(b)(i) of the WAQSR, with no visible emissions except for periods not to exceed a total of five (5) minutes during any two (2) consecutive hours as determined by 40 CFR part 60, appendix A, Method 22.

17. The flare shall be designed, constructed, operated and maintained to be smokeless, per Chapter 5, Section 2(m) of the WAQSR, with no visible emissions except for periods not to exceed a total of five (5) minutes during any two (2) consecutive hours as determined by 40 CFR part 60, appendix A, Method 22.
18. All natural gas-operated pneumatic process controllers (temperature control, pressure control, level control, flow control, etc.) shall be low or no-bleed controllers, with low bleed defined as less than six (6) cubic feet per hour vent or bleed rate, or the controller discharge streams shall be routed into a closed loop system so there are no volatile organic compound or hazardous air pollutants emitted to the atmosphere.
19. Emission control equipment, including the VOC and HAP emission control systems or devices, reboiler overheads condensers and all vent lines, connections, fittings, valves, relief valves, hatches or any other appurtenance employed to contain and collect vapors and transport them to the emission control system or device, shall be maintained and operated during any time the well is producing such that the emissions are controlled at all times. Records shall be maintained noting dates and durations of times during such operation when any VOC or HAP emissions control system or device or the associated containment and collection equipment is not functioning to control emissions as required by this permit.
20. EOG Resources shall comply with all applicable requirements of 40 CFR part 60, subpart OOOO.
21. Emissions from this facility shall not exceed the major source threshold as defined in Chapter 6, Section 3 of the WAQSR.
22. The emergency flare shall be designed, constructed, operated and maintained to meet the requirements of Chapter 3, Section 6 of the WAQSR.

Conditions applicable to blowdown/venting operations at the Jubilee 153-1034H PAD:

23. All notifications, reports, and correspondence required by this permit shall be submitted to the O&G permitting engineer, 152 North Durbin Street, Suite 100 Casper, WY 82601 and a copy shall be submitted to the District Engineer, Air Quality Division, 122 West 25th Street, Cheyenne, WY 82002. Submissions may be done electronically through <https://airimpact.wyo.gov> to satisfy the requirements of this permit.
24. Emissions of volatile organic compounds (VOC) and hazardous air pollutants (HAP) resulting from episodes of manual and automatic blowdown and venting of hydrocarbon fluids (liquids and gas) associated with liquids unloading, well purging, wellbore depressurization, hydrate clearing, emergency operations, equipment depressurization, etc., shall be minimized to the extent practicable.

25. During manual blowdown and venting episodes, personnel shall remain on site for the duration of the episode to ensure minimal gas venting occurs by ending the episode as soon as possible once the intended purpose for the episode has been accomplished. The requirement for the personnel to remain on site does not apply to automated blowdown and venting episodes and does not apply to any episode where remaining on site might be considered a safety hazard.
26. For all manual and automatic blowdown and venting episodes the following shall be recorded.
 - A. Facility name and legal location (Section, Township, Range, County) and associated Air Quality Permit number;
 - B. Date, duration, start and end time;
 - C. Reason for episode, i.e. unload well by venting well tubing to blowdown tank, relieve annulus pressure, depressurize well for downhole repair, etc.;
 - D. Measure(s) taken to ensure emissions were minimized to the extent practical;
 - E. Name of person(s) remaining on site for the duration of manual blowdown and venting episode;
 - F. Summary of total volumes of hydrocarbon fluids (barrels of oil, condensate, and water and MCF of gas) recovered and vented;
 - G. Estimated pounds of VOC and HAP emissions associated with the vapors vented to the atmosphere.
27. VOC and HAP emission estimates required under Condition 26(G) shall be determined using the spreadsheets illustrated in Appendix A. The spreadsheets are available for download from the DEQ/AQD website or may be obtained upon request. An emission estimation method other than that provided by the Division may be used upon approval.
28. Within nine (9) months after the date of issuance of this permit, a summary of the information recorded under Condition 26 shall be submitted to the Division. The data required under Condition 26 shall be collected for six (6) months after the date of permit issuance and shall include all gas analyses used as sources for the input information in the spreadsheets required under Condition 27.
29. The Division will reopen and revise this permit, as necessary, to add or delete requirements should the Division determine that:
 - A. The practical application of the terms and conditions of the permit are unfeasible or fail to achieve the intent of the permit, or;
 - B. The monitoring, recordkeeping, notification or reporting requirements are inadequate to assure compliance with applicable requirements.

EQUIPMENT LIST

- four (4) heater treaters w/ 1.0 million Btu per hour (MMBtu/hr) heaters
- two (2) recycle treaters w/ 0.5 MMBtu/hr heaters
- one (1) 0.5 MMBtu/hr line heater
- twelve (12) 500-barrel (bbl) oil tanks
- two (2) 500-bbl produced water / emergency combination tanka
- two (2) vapor recovery towers
- three (3) scrubbers (VRT vent line combustor, tank vent line combustor and fuel gas)
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- various no-bleed pneumatic controllers
- one (1) smokeless tri-tip flare w/ continuous pilot monitoring system (vapor recovery tower control)
- one (1) smokeless emergency tri-tip flare w/ continuous pilot monitoring system (produced gas control during upset conditions)

EMISSIONS SUMMARY

Jubilee 153-1034H PAD				
1975 BPD total oil and 94.5 MCFD total VRT flash gas ¹				
SOURCE	EMISSIONS (TPY) ²			
	VOC	HAP	NO _x	CO
Oil Tanks				
UNCONTROLLED	117.6	4.1		
CONTROLLED	2.4	0.1	0.6	0.1
Vapor Recovery Towers				
UNCONTROLLED	1675.3	67.7		
CONTROLLED	33.5	1.4	6.1	1.5
Truck Loading				
UNCONTROLLED	22.4	0.3		
CONTROLLED	6.7	0.1	0.1	insig
Process Heaters				
	0.2	insig	3.6	3.1
Fugitives				
	7.2	0.4		
Total Uncontrolled Facility Emissions				
	1822.7	72.5	3.6	3.1
Total Controlled Facility Emissions				
	50.0	2.0	10.4	4.7

¹ daily rates reported by the applicant

² rounded to the nearest 0.1 ton

Appendix A

Blowdown/Venting Spreadsheets

Spreadsheet for calculating emissions associated with gas vented from ANNULUS when there is an associated pressure drawdown ($P_1 > P_2$).

INPUT		CALCULATED	
Gas HAP Content (wt%)	6		
Gas VOC Content (wt%)	15		
Gas Compressibility (Z)*	0.98		
Gas Molecular Weight	17.74	lb/lbmol	
Universal Gas Constant (R)	10.732	ft ³ psi ² /R lb-mol	
Starting Pressure (P ₁)	1500	psig	1512 psia
Ending Pressure (P ₂)	0	psig	12 psia
Starting Temperature (T ₁)	55	°F	515 °R
Ending Temperature (T ₂)	55	°F	515 °R
Tubing Outside Diameter (OD)	2.875	in	4.9521 lb/ft ³
Casing Inside Diameter (ID)	3.92	in	0.0393 lb/ft ³
Annulus Length (AL)	500	ft	4.9128 lb/ft ³
			0.0387 ft ³ /ft
		Starting Gas Density (ρ ₁)	ρ ₁ =(P ₁ *MW)/R*T ₁ *Z
		Ending Gas Density (ρ ₂)	ρ ₂ =(P ₂ *MW)/R*T ₂ *Z
			ρ ₁ - ρ ₂
			Annular Volume per Linear Foot (AV)
		Gas Release	95 lb
			Pounds of Gas per Linear Foot = (ρ ₁ - ρ ₂) * (AL) * (AV)
		Gas Release	2,032 SCF
			Conversion to SCF = (Gas Release (lb)) * (379 SCF/lb-mol) / (molecular wt of gas (lb/lb-mol))
		VOC Release	14 lb
			VOC release = (Gas Release (lb)) * (Gas VOC Content / 100)
		HAP Release	6 lb
			HAP release = (Gas Release (lb)) * (Gas HAP Content / 100)

Tubing Sizes			Casing Sizes		
nom.	OD inches	ID inches	nom.	OD inches	ID inches
2 3/8	2.375	1.94	4 1/2	4.5	3.92
2 7/8	2.875	2.26	4 3/4	4.75	4.2
3 1/2	3.5	2.76	5	5	4.41
			5 1/2	5.5	4.82

* For the purposes of this spreadsheet, assume the starting Z factor = the ending Z factor.

Spreadsheet for calculating emissions associated with gas vented from tubing or casing when there is an associated pressure drawdown ($P_1 > P_2$)

INPUT	
Gas VOC Content (wt%)	50
Gas HAP Content (wt%)	6
Gas Compressibility (Z)*	0.95
Gas Molecular Weight	17.74 lb/lbmol
Universal Gas Constant (R)	10.732 ft ³ psi/ ^o R lb-mol

CALCULATED

Starting Pressure (P_1)	500 psig	512 psia
Starting Temperature (T_1)	600 °F	1060 °R
Ending Pressure (P_2)	600 psig	612 psia
Ending Temperature (T_2)	55 °F	515 °R

Tubing Sizes			Casing Sizes		
nom.	OD inches	ID inches	nom.	OD inches	ID inches
2 3/8	2.375	1.94	4 1/2	4.5	3.92
2 7/8	2.875	2.26	4 3/4	4.75	4.2
3 1/2	3.5	2.76	5	5	4.41
			5 1/2	5.5	4.82

Tubing or Casing Inside Diameter (ID)	1.875 in	Starting Gas Density (ρ_1)	0.8405 lb/ft ³	$\rho_1 = (P_1 * MW) / (R * T_1 * Z)$
Tubing/Casing Length (TL)	15000 ft	Ending Gas Density (ρ_2)	2.0677 lb/ft ³	$\rho_2 = (P_2 * MW) / (R * T_2 * Z)$
			-1.2273 lb/ft ³	$\rho_1 - \rho_2$
			0.0192 ft ³ /ft	Volume per Linear Foot (TV)

Gas Release	-353 lb	Release = $(\rho_1 - \rho_2) * (TL) * (TV)$
Gas Release	-7541 SCF	Conversion to SCF = (Gas Release (lb)) * (379 SCF/lb-mol) / (molecular wt of gas (lb/lb-mol))
VOC Release	-176 lb	VOC release = (Gas Release (lb)) * (Gas VOC Content / 100)
HAP Release	-21 lb	HAP release = (Gas Release (lb)) * (Gas HAP Content / 100)

* For purposes of these calculations assume starting Z = ending Z.

Spreadsheet for calculating blowdown/venting emissions from tubing, casing or annulus when there is minimal or no pressure differential during the event ($P_1 = P_2$)

	INPUT		CALCULATED
	↓		
Fill in the five parameters below.			
Average Daily Gas Production Rate	1	MSCFD	
Vented Gas VOC Content	50	wt%	
Vented Gas HAP Content	35	wt%	
Vented Gas Molecular Weight	20	lb/lb-mol	
Blowdown Duration	120	minutes	
			↓
		Total Gas Emitted	0.083 MSCF
		VOC Emissions	2.2 lbs
		HAP Emissions	1.5 lbs

Air Quality