

**DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR QUALITY
Permit Application Analysis
A0001144**

August 24, 2015

NAME OF FIRM: Bear Oil and Gas, Inc.

MAILING ADDRESS: 730 17th Street, Suite 450
Denver, CO 80202

RESPONSIBLE OFFICIAL: John Kelly
Landman

TELEPHONE NUMBER: (720) 946-6700

TYPE OF OPERATION: multiple well, sweet crude oil and natural gas production facility

FACILITY NAME: **Armour Tank Battery**

FACILITY LOCATION: NE¼ NE¼ Section 16, T16N, R60W
Latitude: 41.35716° Longitude: -104.10012°
Laramie County, Wyoming

DATE FACILITY BECAME OPERATIONAL: 9/23/2014

REVIEWER: Heather Bleile, Air Quality Engineer

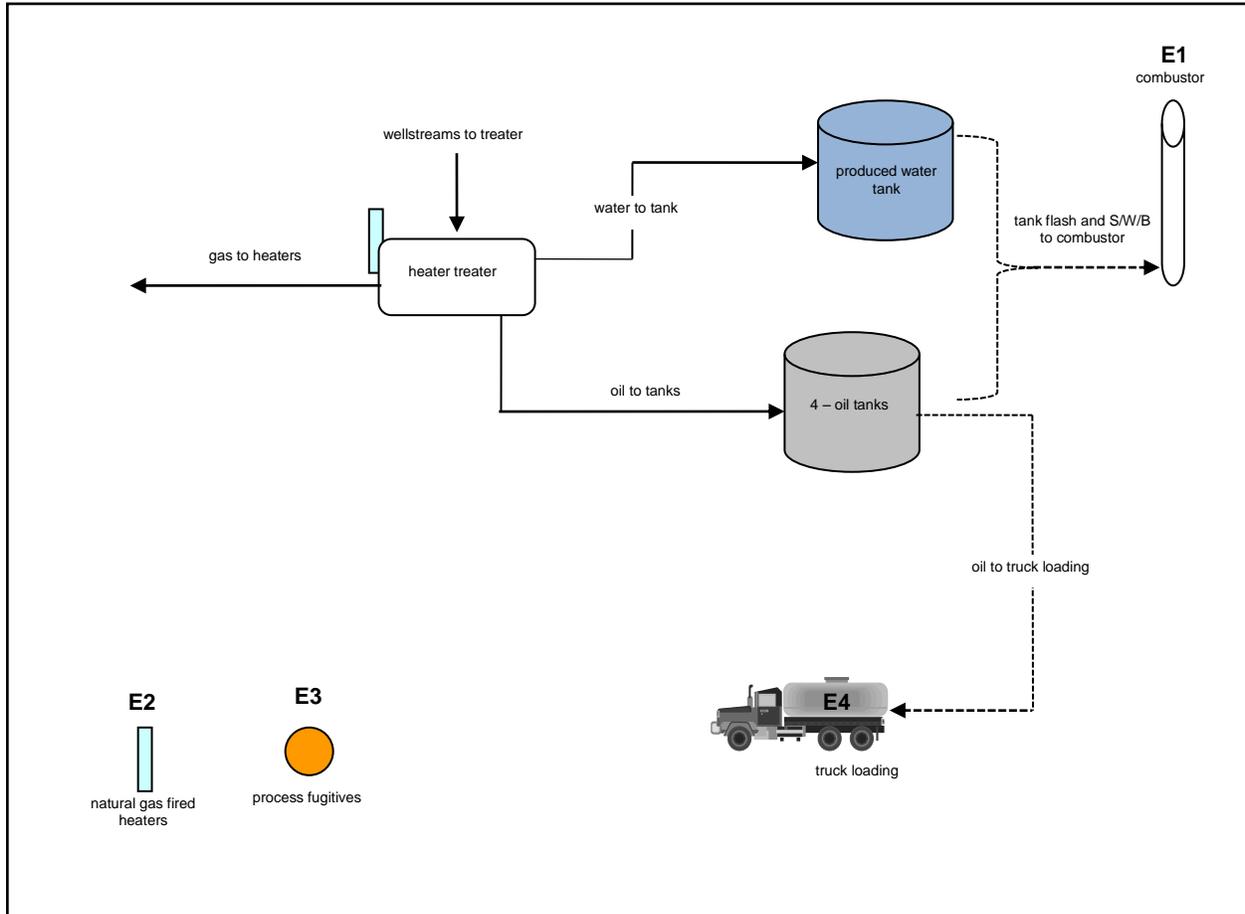
PURPOSE OF APPLICATION: Bear Oil & Gas, Inc. filed this application to construct a new sweet crude oil and natural gas production facility, known as the Armour Tank Battery, consisting of the Armour 41-17 and 42-17 wells.

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

The following equipment operates at the Armour Tank Battery:

- one (1) heater treater w/ 0.75 million Btu per hour (MMBtu/hr) heater
- one (1) 0.5 MMBtu/hr tank heater
- four (4) 400-barrel (bbl) oil storage tanks
- one (1) 400-bbl produced water tank
- one (1) smokeless emergency flare (produced gas control when not routed to equipment as fuel)
- one (1) smokeless combustion device w/ continuous pilot monitoring system (oil tank and active produced water tank control)

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:

flashing and standing/working/breathing (S/W/B) losses:

Uncontrolled volatile organic (VOC) and hazardous air pollutant (HAP) emissions were estimated by the Division using the E&P Tank V2.0 software based on composite extended hydrocarbon analysis of pressurized oil from the J-Sand Formation and the projected oil production reported by the applicant.

Controlled VOC and HAP emissions (**Emission Source E1, Process Flow Diagram**) associated with flashing and S/W/B losses are based on the reported 98% destruction efficiency of the combustion device. Nitrogen oxide (NO_x) and carbon monoxide (CO) emissions are based on 0.14 lb NO_x/MMBtu and 0.035 lb CO/MMBtu and the volume of vapors calculated with the E&P Tanks software.

active produced water tanks: (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 tanks are routed to the combustion device for 98% control.

natural gas fired heaters: (Emission Source E2, Process Flow Diagram)

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

fugitive sources: (Emission Source E3, Process Flow Diagram)

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

truck loading: (Emission Source E4, Process Flow Diagram)

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

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 | 12/23/2014 (within 90-days of startup) | 6/15/2015 |
| Oil Tank Emission Control | 11/23/2014 (within 60-days of startup) | 9/23/2014 |
| Water Tank Emission Control | not required | 9/23/2014 |
| Continuous Monitoring | 11/23/2014 (within 60-days of startup) | 9/23/2014 |

The application was received approximately fifteen (15) weeks late; therefore, the emission reporting requirements under the 2013 C6 S2 Guidance have not been met.

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 Armour Tank Battery is subject to 40 CFR part 60, subpart OOOO as the facility was constructed after the effective date.

PREVENTION OF SIGNIFICANT DETERIORATION (PSD): Emissions from this facility are less than the major source levels defined in WAQSR Chapter 6, Section 4.

CHAPTER 6, SECTION 3 (Operating 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): 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 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 Bear Oil and Gas, Inc. for the Armour Tank Battery 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 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 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. 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.
9. Results of all inspections, evaluations and periodic monitoring shall be documented and maintained for review by the Division upon request.

10. Vapors from all condensate tanks and all active produced water tanks, including tank flash and S/W/B vapors, shall be routed to the combustion devices to reduce the mass content of VOCs and HAPs in the tank vapors vented to the devices by at least ninety-eight percent (98%) by weight for at least one (1) year following the date of installation of the control devices, after which time the devices may be removed upon Division approval without permit modification provided it can be demonstrated that the current, uncontrolled, annualized VOC emission rate from the condensate tanks is less than, and will remain less than eight (8) tons per year.
11. The presence of the combustion device pilot flame shall be monitored using a thermocouple and continuous recording device or any other equivalent device to detect and record the presence of the flame. Records shall be maintained noting periods during active well site operation when the pilot flame is not present. The records shall contain a description of the reason(s) for absence of the pilot flame and steps taken to return the pilot flame to proper operation.
12. The 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.
13. Emission control equipment, including the VOC and HAP emission control system or device, 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.
14. Bear Oil and Gas, Inc. shall comply with all applicable requirements of 40 CFR part 60, subpart OOOO.

Conditions applicable to blowdown/venting operations at the Armour Tank Battery:

15. 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 also be done electronically through <https://airimpact.wyo.gov> to satisfy requirements of this permit.
16. 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.

17. 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.
18. 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.
19. VOC and HAP emission estimates required under Condition 18(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.
20. Within nine (9) months after the date of issuance of this permit, a summary of the information recorded under Condition 18 shall be submitted to the Division. The data required under Condition 18 shall be collected for a minimum of 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 19.
21. 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

- one (1) heater treater w/ 0.75 MMBtu/hr heater
- one (1) 0.5 MMBtu/hr tank heater
- four (4) 400-bbl oil storage tanks
- one (1) 400-bbl produced water tank
- one (1) smokeless emergency flare (produced gas control when not routed to equipment as fuel)
- one (1) smokeless combustion device w/ continuous pilot monitoring system (oil tank and active produced water tank control)

EMISSIONS SUMMARY

| Armour Tank Battery 60 BPD total oil ¹ | | | | |
|---|------------------------------|------------|-----------------|------------|
| SOURCE | EMISSIONS (TPY) ² | | | |
| | VOC | HAP | NO _x | CO |
| Oil Tanks (flashing and S/W/B) | | | | |
| UNCONTROLLED | 20.4 | 0.1 | | |
| CONTROLLED | 0.4 | insig | 0.1 | insig |
| Process Heaters | | | | |
| | insig | insig | 1.1 | 0.9 |
| Fugitives | | | | |
| | 1.9 | 0.3 | | |
| Truck Loading | | | | |
| | 0.8 | 0.1 | | |
| Total Uncontrolled Facility Emissions | | | | |
| | 23.1 | 0.5 | 1.1 | 0.9 |
| Total Controlled Facility Emissions | | | | |
| | 3.1 | 0.4 | 1.2 | 0.9 |

¹ projected oil production reported by applicant

² rounded to the nearest 0.1 ton

Appendix A

Blowdown/Venting Spreadsheet

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/°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 | Starting Gas Density (ρ ₁) 4.9521 lb/ft ³ |
| Casing Inside Diameter (ID) | 3.92 | in | Ending Gas Density (ρ ₂) 0.0393 lb/ft ³ |
| Annulus Length (AL) | 500 | ft | 4.9128 lb/ft ³ |
| | | | 0.0387 ft ³ /ft |
| | | | Annular Volume per Linear Foot (AV) |
| | | | ρ ₁ =(P ₁ *MW)/R*T ₁ *Z |
| | | | ρ ₂ =(P ₂ *MW)/R*T ₂ *Z |
| | | | ρ ₁ - ρ ₂ |
| | | | Pounds of Gas per Linear Foot = (ρ ₁ - ρ ₂) * (AL) * (AV) |
| | | | Conversion to SCF = (Gas Release (lb)) * (379 SCF/lb-mol) / (molecular wt of gas (lb/lb-mol)) |
| | | | VOC release = (Gas Release (lb)) * (Gas VOC Content / 100) |
| | | | 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 |

| | | | |
|--------------------|--------------|------------|--|
| Gas Release | 95 | lb | |
| Gas Release | 2,032 | SCF | |
| VOC Release | 14 | lb | |
| HAP Release | 6 | lb | |

* 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) | 612 psia |
| Starting Temperature (T_1) | 1060 ^o R |
| Ending Pressure (P_2) | 212 psia |
| Ending Temperature (T_2) | 515 ^o 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) | 1.0046 lb/ft ³ | $\rho_1 = (P_1 * MW) / (R * T_1 * Z)$ |
| Tubing/Casing Length (TL) | 15000 ft | Ending Gas Density (ρ_2) | 0.7163 lb/ft ³ | $\rho_2 = (P_2 * MW) / (R * T_2 * Z)$ |
| | | | 0.2883 lb/ft ³ | $\rho_1 - \rho_2$ |
| | | | 0.0192 ft ³ /ft | Volume per Linear Foot (TV) |

| | | |
|--------------------|-----------------|---|
| Gas Release | 83 lb | Release = $(\rho_1 - \rho_2) * (TL) * (TV)$ |
| Gas Release | 1772 SCF | Conversion to SCF = (Gas Release (lb)) * (379 SCF/lb-mol) / (molecular wt of gas (lb/lb-mol)) |
| VOC Release | 41 lb | VOC release = (Gas Release (lb)) * (Gas VOC Content / 100) |
| HAP Release | 5 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 |