DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR QUALITY
Permit Application Analysis
A0001286

September 14, 2015

NAME OF FIRM:	EOG Resources, Inc.
MAILING ADDRESS:	600 17th Street, Suite 1000N Denver, CO 80202
RESPONSIBLE OFFICIAL:	Jason Rauen Environmental Supervisor
TELEPHONE NUMBER:	(303) 262-9946
TYPE OF OPERATION:	multiple well, sweet crude oil and natural gas production facility
FACILITY NAME:	**Crossbow 7-06H and 12-06H PAD**
FACILITY LOCATION:	SE¼ SE¼ of Section 6, T41N, R71W Latitude: 43.55094° Longitude: -105.42421° Campbell County, Wyoming
DATE FACILITY BECAME OPERATIONAL:	2/25/2011, modified 3/25/2013 (addition of Crossbow 12-06H)
REVIEWER:	Heather Bleile, Air Quality Engineer

PURPOSE OF APPLICATION: EOG Resources filed this application to modify the Crossbow 7-06H and 12-06H well sites by combining them into one facility and adding production equipment. This facility is now known as the Crossbow 7-06H and 12-06H PAD.

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

PERMIT HISTORY: The Crossbow 7-06H currently operates under Air Quality Permit, CT-11897, issued on July 6, 2011. A smokeless combustion device was required to control volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions associated with the oil tanks, active produced water tanks and pneumatic pumps.

The Crossbow 12-06H currently operates under Air Quality Permit, CT-15155, issued on October 29, 2013. A smokeless combustion device was required to control VOC and HAP emissions associated with the oil tanks, active produced water tanks and pneumatic pumps

This permit shall supersede CT-11897 for the Crossbow 7-06H well site and CT-15155 for the Crossbow 12-06H well site.

The following equipment operates at the Crossbow 7-06H and 12-06H PAD:

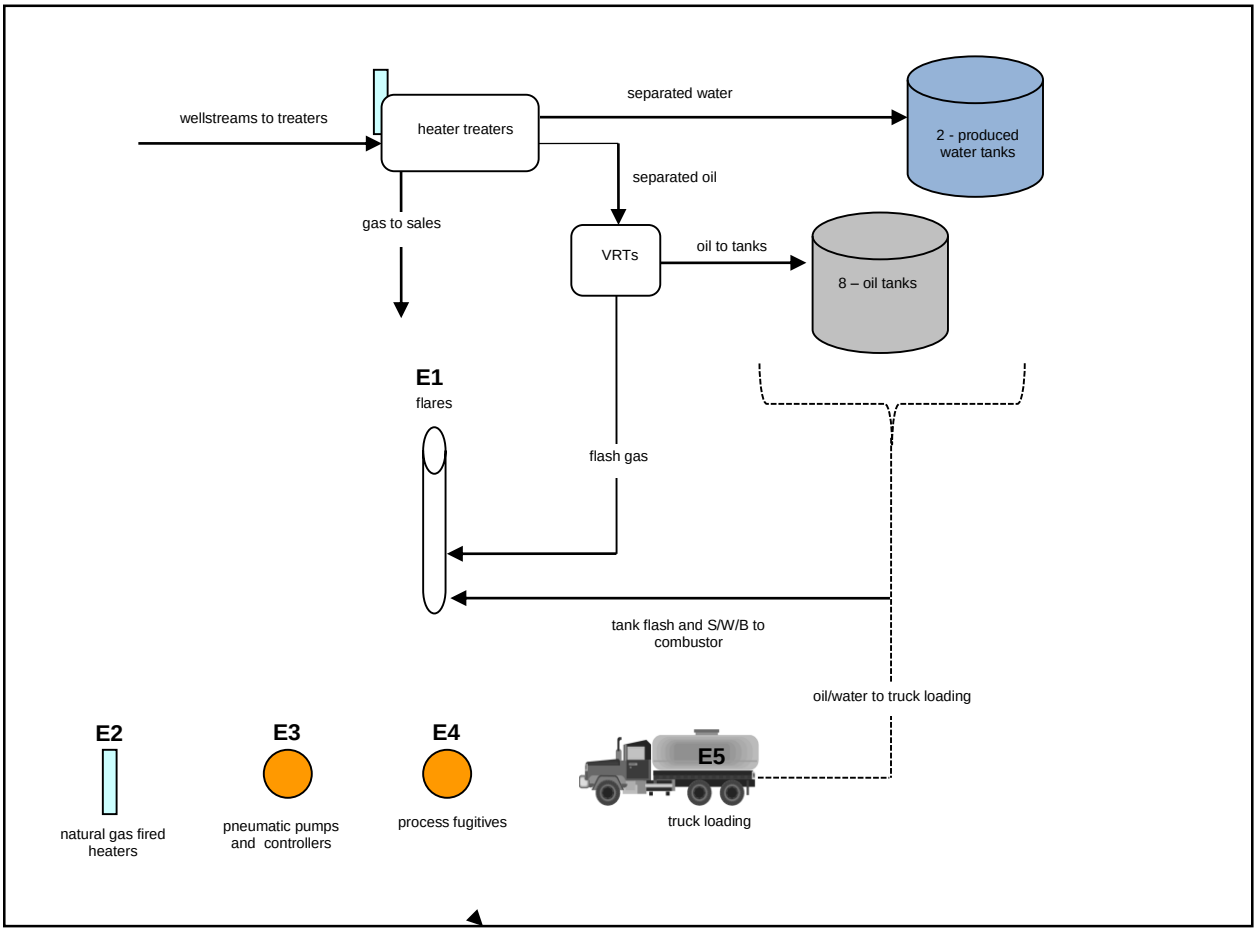
Crossbow 7-06H equipment:

- one (1) heater treater w/ 0.375 million Btu per hour (MMBtu/hr) heater
- one (1) 0.5 MMBtu/hr line heater
- four (4) 400-barrel (bbl) oil tanks
- one (1) 400-bbl produced water tank
- one (1) 400-bbl emergency tank
- one (1) pneumatic combustor scrubber pump
- two (2) electrically-driven pumps (recycle and trace)
- various no-bleed pneumatic controllers
- various gas scrubbers (sales gas, fuel gas and tank vent line)
- one (1) smokeless combustion device w/ continuous pilot monitoring system (oil tank, active produced water tank and pneumatic pump emission control)

Crossbow 12-06H equipment:

- one (1) heater treater w/ 0.375 MMBtu/hr heater
- one (1) 0.5 MMBtu/hr line heater
- four (4) 400-bbl oil tanks
- one (1) 400-bbl produced water tank
- one (1) 400-bbl emergency tank
- one (1) 135-gallon chemical tank
- one (1) vapor recovery tower (VRT)
- two (2) pneumatic pumps (tank combustor scrubber and VRT combustor scrubber)
- three (3) electrically-driven pumps (chemical, recycle and trace)
- various no-bleed pneumatic controllers
- various gas scrubbers (sales gas, fuel gas, VRT vent line and tank vent line)
- one (1) common smokeless combustion device w/ continuous pilot monitoring system (oil tank, active produced water tank, truck loadout, pneumatic pump and VRT flash gas emission 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:

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 combustion devices. Nitrogen oxide (NO_X) and carbon monoxide (CO) emissions are based on 0.14 lb NO_X/MMBtu, 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 tanks are routed to the common combustion devices for 98% control.

VRT flash gas: (**Emission Source E1, Process Flow Diagram**)

Emissions associated with the flash gas from the VRT are accounted for in the oil tank flash emissions.

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.

pneumatic pumps and controllers: (**Emission Source E3, Process Diagram**)

Uncontrolled VOC and HAP emissions are based on pump gas usage/vent rates, the hydrocarbon composition of the motive gas and hours of operation.

Controlled pneumatic pump emissions are based on the reported 98% destruction efficiency of the common combustion devices.

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

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

EOG Resources, Inc. is implementing a leak detection and repair (LDAR) program at this facility to minimize fugitive leaks. Since EOG Resources, Inc. is implementing an LDAR program, VOC and HAP emissions associated with fugitive leaks are considered insignificant.

truck loading: (**Emission Source E5, Process Flow Diagram**)

Uncontrolled VOC and HAP emissions are based on AP-42 EF and the reported 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	N/A, no modification	7/17/2015
Tank / VRT Emission Control	4/25/2011 (within 60-days of startup)	2/25/2011
Pneumatic Pump Control	4/25/2011 (within 60-days of startup)	2/25/2011
Continuous Monitoring	4/25/2011 (within 60-days of startup)	2/25/2011
No-Bleed / Low-Bleed Controllers	2/25/2011 (upon startup)	2/25/2011

Fugitive emissions based on a site specific count at this facility were determined to be greater than eight (8) tons per year. EOG Resources, Inc. has chosen to implement a leak detection and repair (LDAR) program at this facility to minimize fugitive leaks.

The emission control, reporting and monitoring requirements under the 2013 C6 S2 Guidance have 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 Crossbow 7-06H and 12-06H PAD is subject to 40 CFR part 60, subpart OOOO as the facility was modified 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): 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 Crossbow 7-06H and 12-06H 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, 2100 West 5th Street, Sheridan, WY 82801. 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. Notification shall be provided to the Division at least fifteen (15) days prior to each quarterly evaluation under Condition 7.

9. 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.

10. Results of all inspections, evaluations and periodic monitoring shall be documented and maintained for review by the Division upon request.

11. EOG Resources, Inc. shall conduct LDAR inspections as described in the LDAR protocol attached as Appendix A. The LDAR protocol may be revised administratively without reopening the permit. Revised LDAR protocols shall be approved by the Division prior to implementation.

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 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.

13. Flash gas from the vapor recovery towers shall be routed to the common combustion devices 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. The motive gas discharge line on each pneumatic pump shall be routed into a fuel gas supply line or any gas or liquid collection line which is ultimately routed into a closed system or emission control system or each pump shall be replaced with an electric, solar or air-operated pump or other device in order to reduce VOC emissions associated with the pump discharge gas stream by at least ninety-eight percent (98%) by weight.

15. 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.

16. The presence of the combustion device flames shall be monitored using thermocouples and continuous recording devices or 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.

17. The common combustion devices 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.

18. The common flares 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.

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. Effective upon permit issuance, this permit shall supersede Air Quality Permits CT-11897 for the Crossbow 7-06H well site and CT-15155 for the Crossbow 12-06H well site.

Conditions applicable to blowdown/venting operations at the Crossbow 7-06H and 12-06H PAD:

22. 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, 2100 West 5th Street, Sheridan, WY 82801. Submissions may also be done electronically through https://airimpact.wyo.gov to satisfy requirements of this permit.

23. 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.

24. 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.

25. 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.

26. VOC and HAP emission estimates required under Condition 25(G) shall be determined using the spreadsheets illustrated in Appendix B. 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.

27. Within nine (9) months after the date of issuance of this permit, a summary of the information recorded under Condition 25 shall be submitted to the Division. The data required under Condition 25 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 26.

28. 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

Crossbow 7-06H equipment:

- one (1) heater treater w/ 0.375 MMBtu/hr heater
- one (1) 0.5 MMBtu/hr line heater
- four (4) 400-bbl oil tanks
- one (1) 400-bbl produced water tank
- one (1) 400-bbl emergency tank
- one (1) pneumatic combustor scrubber pump
- two (2) electrically-driven pumps (recycle and trace)
- various no-bleed pneumatic controllers
- various gas scrubbers (sales gas, fuel gas and tank vent line)
- one (1) smokeless combustion device w/ continuous pilot monitoring system (oil tank, active produced water tank and pneumatic pump emission control)

Crossbow 12-06H equipment:

- one (1) heater treater w/ 0.375 MMBtu/hr heater
- one (1) 0.5 MMBtu/hr line heater
- four (4) 400-bbl oil tanks
- one (1) 400-bbl produced water tank
- one (1) 400-bbl emergency tank
- one (1) 135-gallon chemical tank
- one (1) vapor recovery tower (VRT)
- two (2) pneumatic pumps (tank combustor scrubber and VRT combustor scrubber)
- three (3) electrically-driven pumps (chemical, recycle and trace)
- various no-bleed pneumatic controllers
- various gas scrubbers (sales gas, fuel gas, VRT vent line and tank vent line)
- one (1) common smokeless combustion device w/ continuous pilot monitoring system (oil tank, active produced water tank, truck loadout, pneumatic pump and VRT flash gas emission control

EMISSIONS SUMMARY

Crossbow 7-06H and 12-06H PAD 225.7 BPD total oil [1]				
SOURCE	EMISSIONS (TPY) [2]			
	VOC	HAP	NO_X	CO
Oil Tanks				
UNCONTROLLED	591.9	8.1		
CONTROLLED	4.5	0.1	2.0	0.5
Pneumatic Pumps				
UNCONTROLLED	40.1	3.2		
CONTROLLED	0.8	0.1	0.5	0.1
Process Heaters	0.1	insig	0.9	0.8
Pneumatic Controllers	insig	insig		
Truck Loading	5.1	0.6		
Fugitives [3]	insig	insig		
Total Uncontrolled Facility Emissions	**637.2**	**11.9**	**0.9**	**0.8**
Total Controlled Facility Emissions	**10.5**	**0.8**	**3.4**	**1.4**

[1] daily rates reported by the applicant
[2] rounded to the nearest 0.1 ton
[3] EOG is implementing a LDAR program; therefore, emissions associated with fugitive leaks are considered insignificant

Appendix A

LDAR Protocol

Fugitive Equipment Leak Inspection and Maintenance Plan

Statement of Dedication and Basis

In order to demonstrate and formally document the effectiveness of the efforts made to minimize emissions from fugitive component leaks, EOG Resources, Inc. (EOG) has committed to monitoring and fixing leaks at exploration and production facilities in the Green River Basin (UGRB) and Powder River Basin (PRB) which are located in the State of Wyoming. The effort is executed as demonstrated by the select implementation of a formal Leak Detection and Repair (LDAR) program. EOG is dedicated to complying with all applicable air quality standards, rules and regulations promulgated by the Wyoming Department of Environmental Quality (WDEQ); including, but not limited, to Chapter 6, Section 2 of the WDEQ air quality standards and regulations (WAQSR). The components and schedule of this program are described in the plan that follows.

EOG applies good operating practices audio, visual and olfactory detection (AVO) and the use of leak detection solutions to identify and repair fugitive emissions from equipment leaks on an on-going basis at all of its facilities in the UGRB and PRB operational area. EOG has implemented a formal LDAR program above and beyond current operating practices. This LDAR program uses an additional monitoring methodology- infrared (IR) camera technology -to identify fugitive volatile organic compound (VOC) emissions from equipment leaks. While the magnitude of the leak cannot be measured using the infrared camera methodology (see 'Technology' section of this Plan), the protocol being followed will allow greater opportunity to reduce overall fugitive emissions even though the value may not be quantified. The IR protocol serves to identify leaks which may only be visible in the infrared spectrum and will ensure proper documentation of the repair of any leak detected using the infrared technology. Use of this monitoring approach allows EOG to demonstrate that its operating practices effectively control fugitive emissions from equipment leaks to insignificant levels.

Technology and Limitations

LDAR inspections will be conducted using IR cameras. IR cameras detect the band of light in the electromagnetic spectrum that extends beyond visible light. Using an IR camera one can identify hydrocarbon vapors which indicate possible sources of fugitive leaks. It should be noted that the intent of this device is solely qualitative; specifically, the IR camera is unable to quantify the magnitude of a leak or the leak rate). However, the objective of this program is to identify and repair any observed leak regardless of its magnitude. As such, the IR camera is the ideal tool to identify these leaks. It should also be noted that all images seen through the infrared camera are not necessarily VOC emissions. It can be difficult to determine whether recordings indicate hydrocarbon vapors or whether the vapors are heat or water vapors. Though, hydrocarbon vapors should typically dissipate slower and "trail-off" longer than heat or water vapors. The design of the camera only allows for detection of vapors and heat emissions and as such the nature of the emissions is not definitive.

Facility Identification

EOG is dedicated to good operating and industry practices at all of its facilities in the UGRB and PRB operational area; however, the application of the EOG LDAR program will be at facilities which have been identified as being subject per condition of the associated air quality permit. A subject facility is defined as exceeding the Air Quality Division (AQD) Best Available Control Technology (BACT) threshold for potential fugitive emissions. The BACT threshold definitions are respective to the effective regulation as follows:

- 15 TPY per AQD Oil and Gas Production Facilities Chapter 6, Section 2 Permitting Guidance, dated OB/W07; or,

- 8 TPY for new and modified facilities after August 1, 2010 per AQD Guidance dated 03/2010.

On a quarterly basis, production equipment at subject facilities will be monitored following the procedure identified in the 'Inspection Protocol' section of this Plan. Wellhead monitoring will be conducted annually during the 3rd quarter inspection.

Inspection Protocol

Modified and newly constructed facilities that are identified in a permit condition as requiring participation in the LDAR program will be inspected; any leaks will be documented; and applicable repair procedures will be followed. These facilities will be incorporated into the LDAR program no later than the next quarterly inspection period. The following scenarios are provided as examples to clarify,

<u>Scenario 1:</u>
Should the quarterly LDAR monitoring occur in May (2nd quarter of the year) and a new facility begins producing the following June (3rd quarter of the year), the fugitive emissions for all sources at this facility will be reviewed as per the AQD's Chapter 6 Section 2 Permitting Guidance. As appropriate and applicable, an application will be submitted prior to the 60 day deadline and the facility monitored under the EOG LDAR program during the next scheduled quarterly inspection.

<u>Scenario 2:</u>
For an existing facililty that began operating in June the fugitive emissions would be reviewed in August. If at that time the fugitive emissions are projected to exceed the 8 TPY VOC threshold this facility will be added to the list of facilities to monitor during the next scheduled quarterly inspection.

Facilities subject to compliance with this Plan and respective permit condition will do so by following the below inspection and maintenance proceedure. The AVO inspection and maintenance procedure follows that which has been approved by Region 8 of the Environmental Protection Agency respective to the Tribal New Source Review program.

1. Conduct AVOs, including IR camera inspection, on a quarterly basis of all pumps, valves, connectors, and pressure relief devices at the facility.

2. For each leak found in the AVO inspection, the leak shall be managed in accordance with the ‘Repair Schedule’ section of this Plan.

3. Re-screen repaired components to determine if the leak is repaired. If the rescreening shows that the leak was not repaired then another attempt to repair the leak will be made as soon as possible, but no later than 15 days after the rescreening.

4. Steps 2 and 3 will be repeated until the rescreening shows no leak.

5. Leaking components will be documented along with the date the leak is detected, date the leak is repaired, and date that the leak is rescreened; see 'Repair Schedule' section of this Plan.

Monitoring and Recordkeeping

Quarterly records and documentation associated with the infrared monitoring inspections performed as part of this LDAR program will be maintained in accordance with the following procedure and consist of the specified informaion. Each quarterly inspection will include a brief discussion of the inspections that were performed, any anomalies in the procedure, and incorporate the following lists:

- List of components screened and associated dates;
- List of currently leaking components;
- List of repaired components along with the repair method and associated repair dates (see 'Repair Schedule' section of this Plan); and
- List of successful repairs, repair delays, and post-repair screenings and associated dates.

The above information will be recorded, maintained and kept for five years electronically and in hardcopy at the nearest EOG field office.

Repair Schedule

Leaks identified through the quarterly inspections will be tagged using a numbered weather resistant tag, documented on a 'IR Camera Inspection' form. Additionally, still photographs of the location of the leak may be taken to assist field personnel in identifying leaking components. All findings (leaks) identified during an inspection with the Infrared camera will be communicated to field personnel so that they may be repaired.

The most common leak types identified during IR inspections are associated with loose fittings, connections and bad seals. These are relatively simple to repair and typically do not require the facility to be shut down. While EOG will be diligent about trying to repair every leak in a timely fashion, a delayed repair schedule will be required in instances where the facility must be shut down or additional time is required to procure parts or equipment in order to repair a leak. For every leak the following schedule should be followed to repair leaks identified with the infrared camera.

Repair Attempt	Timing
1st Attempt	A 1st attempt to repair a leak will be made within 7 days. This will consist of typical basic repairs (i.e., tightening packing, tightening tubing ferrules). After a repair attempt has been made, verification that the leak has been repaired shall consist of observing the component using an IR camera or similar leak detection solutions. Otherwise, visual and/or olfactory inspections shall be conducted to ensure the leak has been repaired. The leak tag may only be removed once repair of the leak has been verified using an Infrared Camera and documented on the respective facility IR Camera Inspection form.
2nd Attempt	If a 1st attempt is not successful, a 2nd attempt will be made within 7 days of the 1st attempt. If the facility must be shut down to repair a leak or if additional time is needed to procure parts or equipment, the leak will be tracked on a delayed repair list. After a repair attempt has been made, verification that the leak has been repaired shall consist of observing the component using an IR camera or similar leak detection solutions. Otherwise, visual and/or olfactory inspections shall be conducted to ensure the leak has been repaired. The leak tag may only be removed once repair of the leak has been verified using an Infrared Camera and documented on the respective facility IR Camera Inspection form. EOG will make a "Best Attempt" at repairing every leak. However, if repairs made during the 2nd attempt are not successful, the leak will be added to the delayed repair list.
Delay Repair	If the facility must be shutdown to attempt the repair of a leak, additional time is needed to procure parts or equipment, or the 2nd repair attempt is not successful, it may be put on a delayed repair list. Repairs will be conducted during the next scheduled shutdown or prior to the next LDAR inspection.

Reporting

EOG will follow reporting protocol specified in the respective air permit for subject facilities. The following will be reported to the WDEQ Staionary Source Permitting Manager and District Engineer for the respective district office upon request to include the following information:

- List of facilities included during the inspection period;
- List of findings and leaks for each inspection; and
- MS Excel Spreadsheet that details leaks, repairs, delay repairs, and LDAR applicable facilities

Appendix B

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/ft³	$\rho_1=(P_1*MW)/R*T_1*Z$
Casing Inside Diameter (**ID**)	3.92	in	Ending Gas Density (ρ_2) 0.0393	lb/ft³	$\rho_2=(P_2*MW)/R*T_2*Z$
Annulus Length (**AL**)	500	ft	4.9128	lb/ft³	$\rho_1 - \rho_2$
			0.0387	ft^3/ft	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		CALCULATED		
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/°R lb-mol			
Starting Pressure (P_1)	600	psig	612	psia	
Starting Temperature (T_1)	600	°F	1060	°R	
Ending Pressure (P_2)	200	psig	212	psia	
Ending Temperature (T_2)	55	°F	515	°R	
Tubing or Casing Inside Diameter (**ID**)	1.875	in	Starting Gas Density (ρ_1) 1.0046	lb/ft³	$\rho_1=(P_1*MW)/R*T_1*Z$
Tubing/Casing Length (**TL**)	15000	ft	Ending Gas Density (ρ_2) 0.7163	lb/ft³	$\rho_2=(P_2*MW)/R*T_2*Z$
			0.2883	lb/ft³	$\rho_1 - \rho_2$
			0.0192	ft^3/ft	Volume per Linear Foot **(TV)**
			Gas Release 83	**lb**	Release = (ρ_1 - ρ_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)

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 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	
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

	CALCULATED	
Total Gas Emitted	0.083	MSCF
VOC Emissions	2.2	lbs
HAP Emissions	1.5	lbs