OIL AND GAS PRODUCTION FACILITIES
CHAPTER 6, SECTION 2
PERMITTING GUIDANCE

WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

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EFFECTIVE for all wells spudded on/after September 1, 2007 and for all modifications to existing facilities occurring on/after September 1, 2007

This document applies to oil and gas production operations where oil and gas fluids are produced, processed and treated prior to lease custody transfer.

Throughout this Guidance, Statewide refers to all O&G Production Facilities other than those located in the Jonah and Pinedale Anticline Development Area (JPAD) defined as:

R109W & R110W in T34N
R109W & R110W in T33N
R108W, R109W & R110W in T32N
R108W, R109W & R110W in T31N
R107W, R108W & R109W in T30N
R107W, R108W & R109W in T29N
R108W & R109W in T28N
R107W, R108W & R109W in T27N

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B L A N K

ACRONYMS & ABBREVIATIONS

AQD	Air Quality Division
API	American Petroleum Institute
BACT	Best Available Control Technology
BBL	barrel
BPD	barrels per day
BTEX	Benzene/Toluene/ethyl-Benzene/Xylenes
Btu	British Thermal Unit
MMBtu	one million BTUs
C6 S2	Chapter 6 Section 2 (of the WAQSR)
CAA	Clean Air Act Amendments of 1990
CO	carbon monoxide
EPA	Environmental Protection Agency
gpm	gallons per minute
H_2S	Hydrogen Sulfide
HAP	Hazardous Air Pollutants
HP	high pressure
Hp	horse pressure
JPAD	Jonah & Pinedale Area Development
lb	pound
LP	low pressure
NOI	Notice of Installation
NOV	Notice of Violation
NO_X	Nitrogen Oxides
NESHAP	National Emission Standards for Hazardous Air Pollutants
NSPS	New Source Performance Standards
NSR	New Source Review
pph	pounds per hour
PPMV	parts per million by volume
PSD	Prevention of Significant Deterioration
psi	pounds per square inch
SCF	standard cubic foot
MSCF	one thousand standard cubic feet (SCF × 1000) (MSCFD = 1000 SCF per day)
MMSCF	one million standard cubic feet (SCF × 10^6) (MMSCFD = 1,000,000 SCF per day)
SO_2	Sulfur Dioxide
S/W/B	Standing/Working/Breathing losses
TPY	Tons per Year
TEG	Tri-Ethylene Glycol
VOC	Volatile Organic Compounds
WAQD	Wyoming Air Quality Division
WAQSR	Wyoming Air Quality Standards and Regulations
WDEQ	Wyoming Department of Environmental Quality

Introduction

The purpose of the Chapter 6 Section 2 Oil and Gas Production Facilities Permitting Guidance (C6 S2 Guidance) document is to serve as a supplement to the **Wyoming Air Quality Standards and Regulations** (**WAQSR**) Chapter 6 Section 2 **New Source Review** (**NSR**) permitting program, as it applies to oil and gas production facilities.

To obtain a copy of the C6 S2 Guidance contact the Wyoming Air Quality Division at:

(307) 777-7391 or (307) 473-3475

Download the C6 S2 Guidance at:

http://deq.state.wy.us/aqd/

Applicability

If **ANY** regulated air contaminant will be released to the atmosphere from a new facility, that facility is subject to **Wyoming Air Quality Standards and Regulations** (**WAQSR**) and the Wyoming Environmental Quality Act.

Regulated air contaminants commonly associated with O&G production facilities are:

Volatile Organic Compounds (**VOC**): These are hydrocarbon compounds excluding methane and ethane. VOC are also referred to as C_3^+ compounds – propane, butane, pentane, hexane, etc.

Hazardous Air Pollutants (**HAP**): Section 112(b) of the Clean Air Act lists 188 hazardous air pollutants. HAPs commonly associated with O&G production are BTEX and n-hexane (benzene, toluene, ethyl-benzene, xylenes and n-C_6).

Nitrogen Oxides (**NO_X**): NO_X emissions are the result of natural gas combustion.

Carbon Monoxide (**CO**): CO emissions are the result of natural gas combustion.

Hydrogen Sulfide (**H_2S**): Sour gas.

Sulfur Dioxide (**SO_2**): SO_2 is formed when sour gas is combusted.

Owners/operators of **ALL** regulated air emission sources constructed or modified after May 29, 1974 must comply with the WAQSR Chapter 6, Section 2 permitting requirements.

Failure to comply with Wyoming air quality regulations may result in an enforcement action in the form of a "Notice of Violation" and penalties of up to $10,000.00 per day.

To obtain a copy of the WAQSR contact the Wyoming Air Quality Division at:

(307) 777-7391

Download the WAQSR at:

http://deq.state.wy.us/aqd/

Wyoming Air Quality Regulation Overview

This is a brief overview of some WAQSR which may impact O&G production operations. This overview is not all inclusive. Other regulations or interpretations not listed here may impact O&G production operations and you should refer to the actual regulations for more complete information.

Chapter 6, Section 2 (C6 S2) Permit Requirements for Construction, Modification and Operation

C6 S2 is Wyoming's **NEW SOURCE REVIEW** regulation, in effect since May 29, 1974. Facilities in operation before this date may have **grandfathered status** and may be exempt from C6 S2 permitting requirements.

C6 S2 applies to virtually every situation where regulated air contaminants are discharged to the atmosphere. If a site, piece of equipment, source, facility, or process, which may cause or increase the emissions of a regulated air contaminant into the atmosphere, is constructed, modified or operated, then it is subject to NSR regulation. The C6 S2 permitting process and its potential impacts on a project should be considered in the early stages of the project development in order to avoid delays.

> **Grandfathered status:** A facility, installation or site which was built or in service before May 29, 1974 that has not been physically or operationally changed, causing an increase in any regulated pollutant (to which any state standard applies) or causing the emission of a new regulated pollutant. Modifications which could eliminate grandfather status are increasing production rate by fracturing, acidizing, recompletion, change in artificial lift method, bringing new wells into a central battery, a waterflood response, installing compression or increasing horsepower.

Chapter 6, Section 3 (C6 S3) Operating Permits

C6 S3 is Wyoming's **OPERATING PERMIT PROGRAM**. C6 S3 permits incorporate requirements of, and ensure compliance with applicable regulations and construction permit conditions for:

- major sources - one that emits or has the potential to emit any of the following:
  100 tons per year (TPY) or more of any regulated air pollutant (NO_X, SO_2, VOC, PM_{10})
  10 TPY or more of any individual Hazardous Air Pollutant (HAP)
  25 TPY or more of any combination of HAP's
- sources subject to New Source Performance Standards (**NSPS**)
- sources subject to National Emission Standards for Hazardous Air Pollutants (**NESHAP**), except that not all sources subject to a NESHAP are required to obtain a C6 S3 operating permit
- sources subject to **acid rain** provisions of the Environmental Quality Act
- sources subject to preconstruction review requirements under Prevention of Significant Deterioration (**PSD**)

All **major** sources are subject to C6 S3 permitting requirements regardless of when the source was constructed or modified. There is no grandfather status provision under C6 S3. Major sources commencing operation after November 15, 1995 have one year after commencing operation to submit the required C6 S3 application, comply with the synthetic minor exemption as provided by C6 S3 or limit emissions to less than major source levels under the conditions of a federally enforceable permit.

Wyoming Air Quality Regulation Overview, cont'd.

Chapter 6, Section 4 (C6 S4) Prevention of Significant Deterioration (PSD)

C6 S4 is applicable to any facility which is considered a "PSD major emitting facility", one that emits or has the potential to emit 250 tons per year (TPY) or more of a regulated air pollutant.

Sources subject to C6 S4 must adhere to specific permit application requirements such as air quality modeling, emissions monitoring and strict use of BACT.

Chapter 5 (C5) National Emissions Standards

C5 incorporates emission control regulations developed by the EPA for specific source categories. Standards included in Chapter 5 have been adopted by the State of Wyoming in order to maintain administrative authority with regard to the standards.

Chapter 5, Section 2 (C5 S2) New Source Performance Standards (NSPS)

This section contains performance standards for criteria pollutant emissions from specific categories of new sources. NSPS which may be applicable to O&G production facilities are **40 CFR part 60, Subparts K, K_a and K_b** for Storage Vessels for Petroleum Liquids, depending on when a storage vessel was constructed, reconstructed or modified and what is stored in the vessel.

Chapter 5, Section 3 (C5 S3) National Emission Standards for Hazardous Air Pollutants (NESHAP)

This section contains emission standards regulating specific categories of stationary sources that emit, or have the potential to emit, one or more of the hazardous air pollutants listed pursuant to section 112(b) of the Clean Air Act Amendments of 1990.

A NESHAP applicable to O&G production facilities is 40 CFR part 63, Subpart HH, promulgated June 17, 1999. The rule targets O&G production facilities which are **major** sources of HAP, with major defined as 10 TPY or more of any single HAP or 25 TPY or more of any combination of HAP.

Final action under Subpart HH with respect to O&G production **area** source facilities was deferred until **December 21, 2006.** The final rule, **effective January 3, 2007**, affects **area** source oil and natural gas production facilities, with area sources being those facilities emitting less than major source levels of HAPs.

Wyoming Air Quality Regulation Overview, cont'd.

The following is for informational purposes only to help operators understand the new NESHAP affecting O&G area source production facilities, Subpart HH. Until this rule is adopted by the State of Wyoming, EPA maintains administrative authority with regard to the standards.

The final rule, **effective January 3, 2007**, affects area source oil and natural gas production facilities.

> **Area source:** stationary source that emits or has the potential to emit, considering controls, less than 10 TPY of any single HAP and less than 25 TPY of any combination of HAP.
>
> **Oil and natural gas production facility**: one that processes, upgrades or stores (1) hydrocarbon liquids (except those that exclusively handle black oil) to the point of custody transfer and (2) natural gas from the well up to and including the natural gas processing plant.
>
> **Black oil**: hydrocarbon (petroleum) liquid with an initial producing gas-to-oil ratio (GOR) less than 1,750 SCF/bbl and an API gravity less than 40 degrees.
>
> **Affected source:** each TEG dehydration unit located at an area source oil and natural gas production facility with an actual annual average natural gas flow rate equal to or greater than 3.0 MMSCFD **and** with benzene emissions equal to or greater than 1.0 ton per year.

Requirements for affected sources vary, depending upon one of two locations with regard to areas of higher population densities:

1) areas inside UA plus offset and UC boundaries
2) areas outside UA plus offset and UC boundaries

These boundaries are described on the Internet site at http://www.epa.gov/ttn/atw/oilgas/oilgaspg.html, or you can generate a map based on the location of a TEG dehydration unit relative to UA plus offset and UC boundaries at http://factfinder.census.gov.

For affected sources located inside the UA plus offset and UC boundaries, those units must: (1) be connected, through a closed vent system, to one or more emission control devices to reduce HAP emissions by 95% or more, (2) reduce HAP emissions to an outlet concentration of 20 parts per million by volume (PPMV) or less or (3) reduce benzene emissions to a level less than 1.0 TPY.

For affected sources located outside the UA plus offset and UC boundaries, those units must reduce emissions by lowering the glycol circulation rate to be less than or equal to an optimum rate determined by the following equation:

$$L_{OPT} = 1.15 * [3.0 \text{ gallons TEG / lb } H_2O] * [F * (I-O)/24 \text{ hr/day}]$$

Where:
L_{OPT} = optimal circulation rate (gal/hr)
F = gas flowrate (MMSCFD)
I = inlet water content (lb/MMSCFD)
O = outlet water content (lb/MMSCF)

Wyoming Air Quality Regulation Overview, cont'd.

Natural gas flowrates of a TEG dehydration unit must be determined using either a flow measurement device or another method approved by the Administrator.

To demonstrate the unit emits less than 1.0 TPY of benzene, emissions must be determined using either GRI-GLYCalc V3.0 or higher or direct measurement.

For affected units located within the Urban Area (UA)[1] plus offset and Urban Cluster (UC)[2] boundaries, the source must submit Notification of Compliance Status Reports, inspect/test the closed-vent system and control device(s) and establish monitoring parameter values. Notifications are to be submitted to the EPA with a copy forwarded to the Stationary Source Compliance Program Manager, Air Quality Division, 122 West 25th Street, Cheyenne, WY 82002.

For affected units located outside the UA plus offset and UC boundaries, the source only has to submit an Initial Notification which must include a certified statement of future compliance. Notifications are to be submitted to the EPA with a copy forwarded to the Stationary Source Compliance Program Manager, Air Quality Division, 122 West 25th Street, Cheyenne, WY 82002.

Affected units located within the UA plus offset and UC boundaries are required to submit periodic reports, perform annual inspections of closed-vent systems, repair leaks and defects, conduct required monitoring and maintain records.

Affected units located outside the urbanized areas (UA) plus offset and urban clusters (UC)[3] boundaries must maintain a record of the glycol circulation rate determination.

Compliance deadlines vary depending on location and start up of the affected unit. The soonest compliance date is January 3, 2007 for certain new sources. After that, the next compliance date is January 5, 2009 for certain existing sources.

Operators of TEG dehydration units are encouraged to review the final rule which can be downloaded from the internet at http://www.epa.gov/ttn/oarpg/t3/fr_notices/ongfinalrule122106.pdf.

[1] Urbanized area (UA) refers to Census 2000 Urbanized Area, which is defined in the Urban Area Criteria for Census 2000, 67 FR 11663, 11667 (March 15, 2002). Essentially, a UA consists of a densely settled territory with a population of at least 50,000 people.

[2] Urban cluster (US) refers to Census 2000 Urban Cluster, which is defined in the Urban Area Criteria for Census 2000, 67 FR 11667. Essentially, a UC consists of a densely settled territory with at least 2,500 people, but fewer than 50,000 people.

[3] The final rule does not cover all UC areas, but only those UC areas that contain 10,000 people or more, which are used to construct Census 2000 core-based statistical areas (65 FR 82233). We determined the 2-mile offset distance by reviewing maps of different UA areas and measuring the distance across the largest pockets or holes within the UA footprint. Since our evaluations showed that the largest distance was just under 4 miles across, we decided to use one half of that distance, i.e., 2 miles, as the offset distance. This would ensure that any sources located within a pocket or hole would be controlled as part of the UA source-group. Since we did not find the presence of holes in UC's, no offset is provided.

Wyoming Air Quality Regulation Overview, cont'd.

Chapter 2, Section 7 (C2 S7) Hydrogen Sulfide

C2 S7 is the State ambient air standard for hydrogen sulfide (H_2S). In order to comply with this regulation controls may be required to ensure ambient sulfur dioxide or H_2S standards are not exceeded.

As a minimum the Division prefers that process gas streams containing H_2S be flared instead of discharging to atmosphere.

Caution: Flaring H_2S creates Sulfur Dioxide (SO_2), a regulated pollutant, and is likely to result in other control and permitting requirements.

Operators wanting to construct new O&G production facilities which will have associated H_2S or SO_2 emissions should contact division staff prior to construction of such facilities for permitting guidance.

Chapter 3, Section 6 (C3 S6) Volatile Organic Compounds

C6 S3 refers to the definition of "volatile organic compounds", specifies that Best Available Control Technology (BACT) shall be applied to limit VOC emissions, defines "smokeless" operation of flares and specifies a 20% opacity limit for flares used to control VOC emissions from various activities, including those generated during certain oil and gas development, production and processing operations.

C6 S2 O&G Production Facilities Permitting Program

Why and How the Program Works

C6 S2 requires all new or modified sources or facilities which may generate regulated air emissions to obtain a construction permit prior to start up/modification and that **Best Available Control Technology (BACT)** be applied to reduce or eliminate emissions from a facility with consideration given for technical feasibility and economical reasonableness. **BACT** is a process, not an emission limit. Regulation does not set a minimum emission threshold below which **BACT** does not need to be considered.

Generally, emissions associated with production equipment and processes at new or modified O&G production facilities can not be determined until after start up/modification. To accommodate this, the AQD has tailored a permitting program specific to O&G production operations, allowing start up or modification to occur prior to obtaining a construction permit, provided the operators of such facilities meet certain emission control requirements which have been established through the BACT process. This permitting process for O&G production facilities is called **Presumptive BACT.**

Presumptive BACT requirements have been established for flashing emissions, emissions from dehydration units, emissions from certain pneumatic equipment and emissions associated with well completion operations in specific areas of the State. **BACT** for emissions associated with other processes and equipment may be evaluated on a case by case basis.

For O&G production facilities where emissions from proposed equipment **are** known prior to construction or modification, the C6 S2 permit must be obtained **PRIOR TO CONSTRUCTION or MODIFICATION** and **BACT** must be considered at the time of application review. Examples of O&G production facilities where emissions are known prior to construction or modification are a central tank battery designed for collecting and processing production from multiple existing oil wells, a central dehydration unit installation for drying gas from multiple existing gas wells or perhaps a single dehydration unit for processing gas from one existing well.

In this guidance, the C6 S2 O&G Production Facilities permitting process is divided into two sections. One section applies to O&G production facilities located within the **JONAH AND PINEDALE ANTICLINE DEVELOPMENT (JPAD) AREA.** The other applies to all other **STATEWIDE** areas.

The **JPAD** area is legally defined as:

R109W & R110W in T34N
R109W & R110W in T33N
R108W, R109W & R110W in T32N
R108W, R109W & R110W in T31N
R107W, R108W & R109W in T30N
R107W, R108W & R109W in T29N
R108W & R109W in T28N
R107W, R108W & R109W in T27N

C6 S2 O&G Production Facilities Permitting Program

Regulated Air Pollutant Sources, Equipment & Processes at O&G Production Facilities

When permitting an O&G production facility all emission sources must be considered. Generally the three most common and significant sources of regulated air pollutants are:

Hydrocarbon Liquid Storage Tanks: Vapors containing regulated pollutants are released from solution in hydrocarbon liquids as the liquids are transferred from higher to lower pressure, such as from a separator to an atmospheric storage tank. These vapors are called **flashing losses**.

Vapors escaping from hydrocarbon liquids while they are stored in atmospheric tanks are called **standing/working/breathing (S/W/B) losses**. Standing losses are essentially evaporation losses. Working losses are those caused by decreased tank vapor space occurring as the tank is filled. Breathing losses are those promoted by ambient changes such as increased air temperatures.

Dehydration Units: Glycol, usually tri-ethylene glycol (TEG), is used in dehydration units to absorb water from wet produced gas. "Lean" TEG contacts the wet gas and absorbs water. The TEG is then considered "rich". As the rich TEG is passed through a flash separator and/or reboiler for regeneration, steam containing hydrocarbon vapors are released from it. These are then vented from the dehydration unit flash separator and/or reboiler still vent.

Pressurized Process Vessels: Vapors vented from separators, treaters, water knockouts, gas boots, drip pots, etc. usually consist of hydrocarbon vapors containing regulated pollutants. Unless these vents streams are not routed into a sales line or other closed loop collection system, they are emission points for regulated air pollutants. Sometimes there are several pressurized vessels operating in series, such as a 2-phase high pressure (HP) separator dumping into a 3-phase low pressure (LP) separator. In this case, in addition to the flash that occurs from the separator to the storage tanks, flashing losses also occur as fluids dump from the 2-phase to the 3-phase vessel. All vents from these units must be considered when determining which are emission sources.

Less common or significant sources are:

Gun Barrels: Regulated air pollutants are associated with the natural gas released from these types of separation tanks.

Natural Gas-Fired Combustion Units: Some of the byproducts of natural gas combustion in process heaters, boilers, burners, flares, engines, etc. are regulated air pollutants.

Fugitives: Fugitive emissions are those associated with equipment and process component leaks. There are always leaks, no matter how minimal, from pipe connectors, flanges, fittings, gaskets, pump packing, hammer unions, tank hatches, pneumatic controllers, etc.

Pneumatic Pumps: Normally, the motive gas used to operate pneumatic pumps is vented from the pumps. If the motive gas is natural gas, it probably contains regulated air pollutants.

Truck Loading: When oil and condensate are loaded into tank trucks the hydrocarbon vapors released from the tanker lines as the truck is filling contain regulated air pollutants.

C6 S2 O&G Production Facilities Permitting Program

Presumptive BACT

STATEWIDE

There are two steps to the C6 S2 Presumptive BACT permitting process for O&G production facilities. Applying Presumptive BACT is the first step. Filing a complete C6 S2 application is the second step.

Presumptive BACT requirements must be considered for

1) dehydration unit emissions and
2) storage tanks and pressurized vessels with flashing emissions.

Dehydration unit emissions

Dehydration units use glycol (TEG, DEG or EG) to absorb water from produced gas before it is introduced into gas sales or collection lines. Upon contact with wet gas, "lean" glycol absorbs water and other liquids. It is then considered "rich". To remove impurities, or regenerate, the rich glycol is routed through a glycol flash separator and/or a reboiler. During flash separation and reboiling, water and hydrocarbon vapors containing VOC and HAP pollutants are released from the rich glycol. These are then discharged to the atmosphere from the dehydration unit process vents.

How are dehydration unit VOC and HAP emissions determined for the Presumptive BACT permitting process?

STEP 1: Within 30-days after the First Date of Production or modification calculate the **average daily gas production**.

Example:
Well produced 100 MMCF during the first 30-days after the First Date of Production
average daily gas production = 100 MMCF ÷ 30 days = 3.3 MMCFD

STEP 2: Calculate the **projected first year average daily gas production** rate by multiplying the initial average 30-day rate times 0.6. This effectively results in determining a first year, average daily gas production rate which is 80% than the initial production rate. In other words, the well's initial production is projected to decline by 80% by the end of the first year of operation. First year, projected emissions are then calculated using this decline, average, daily rate for the first year of operation. (see page 42)

Example:
projected first year average daily gas production = 3.3 MMCFD × 0.6 = 2.0 MMCFD

STEP 3: Use GRI-GLYCalc V3.0 or higher to determine **potential uncontrolled VOC and HAP emissions** from the **process vents** of the dehydration unit associated with the projected first year average daily gas production rate. **Process vents** include reboiler still vents, glycol flash separators and still vent condensers.

C6 S2 O&G Production Facilities Permitting Program

Presumptive BACT

STATEWIDE

Input to the GLYCalc model must include:

1) An extended hydrocarbon analysis of wet gas sampled upstream of the reboiler contact tower. Or, a composite extended hydrocarbon analysis may be used. The composite analysis must be the average wet gas composition from at least five nearby wells producing from the same formation as the new well and under the same or very similar pressure and temperature conditions. The five samples used for the composite must be no older than five years.
2) The projected first year average daily gas production rate (MMCFD).
3) Average operational parameters, including wet gas temperature and pressure, dry gas water content, glycol flash separator temperature and pressure, stripping gas source and rate and average operating parameters of emission control equipment.
4) The **maximum lean glycol circulation rate** (gpm) for the glycol circulation pump in use. Maximum circulation rates for the most commonly used Kimray Model pumps are listed in **TABLE 1**. If different pump makes are used, contact the manufacturer for the maximum rates.

TABLE 1

KIMRAY GLYCOL PUMP RATES				
Model #	Capacity (gpm)		Working Pressure (psi)	
	min	max	min	max
3154 PV	0.05	0.22	100	1500
1715 PV	0.13	0.67	300	1500
4015 PV	0.2	0.67	300	1500
9015 PV	0.45	1.5	300	1500
21015 PV	1.1	3.5	400	1500
45015 PV	2.77	7.5	400	1500
4015 LP	0.13	0.33	100	500
2015 SC	0.13	0.33	100	500
5015 SC	0.2	0.83	100	500
10015 SC	0.37	1.67	100	500
20015 SC	1	3.33	100	500

Manufacturer data from Kimray - 1983

C6 S2 O&G Production Facilities Permitting Program

Presumptive BACT
STATEWIDE

When do dehydration unit VOC and HAP emissions require control?

If projected, first year emissions thresholds will be met or exceeded, dehydration unit process vents must be controlled according to BACT requirements **within 60-days** of the First Date of Production and prior to the emission of major source levels of any regulated air pollutants. The thresholds, rounded to the nearest 0.1 ton, are:

≥ 5.0 TPY of any combination of HAPs, or ≥ 15.0 TPY any combination of VOCs

REMINDER: If actual throughput to the unit is ≥ 3.0 MMCFD **and** actual benzene emissions from the unit are ≥ 1.0 TPY, the unit is an affected unit under the new NESHAP for O&G area source production facilities, Subpart HH (see Page 6). It is the operator's responsibility to comply with requirements of the rule.

CAUTION: Total emissions from any facility or source must not exceed major source levels prior to emission control installation. Major source levels are 10 TPY of any single HAP, 25 TPY of any combination of HAP or 100 TPY of any regulated pollutant. Dehydration unit emissions occurring prior to the installation of required controls will be determined using the GRI-GLYCalc model based on the maximum lean glycol circulation rate, the actual reported gas production rate including that reported during well completion operations and other actual operating parameters.

CAUTION: Emissions may ultimately exceed the projected levels rather than decline according to projections. Operators should be mindful of this since emission controls will be required through permitting if the controllable Presumptive BACT levels are exceeded. Compliance actions may be taken when these levels are exceeded.

What are Presumptive BACT requirements for dehydration unit VOC and HAP emissions?

The following control systems or devices are considered by the Division as meeting BACT for emissions from dehydration unit process vents (reboiler still vents and vents from glycol flash separators or glycol flash tanks):

1) Vapor recovery device (e.g. condenser, BTEX control system) that is designed and operated and may be demonstrated to reduce the mass content of total HAP and VOC in the process gases vented to the device by at least 98% by weight.
2) Enclosed smokeless combustion device or smokeless flare that is designed and operated and may be demonstrated to reduce the mass content of total HAP and VOC in the process vapors vented to the device by at least 98% by weight.
3) Any other control device or configuration that can be demonstrated to reduce the mass content of total HAP and VOC in the process gases vented to the device or configuration by at least 98% by weight.

Emissions control equipment, systems or devices, all vent lines, connections, fitting, valves, relief valves, hatches or any other appurtenance employed to contain and collect vapors and transport them to the emission control system or device, must be maintained and operated during any time a well is producing such that the emissions are controlled at all times.

C6 S2 O&G Production Facilities Permitting Program

When projected, uncontrolled emissions exceed major source levels, monitoring and recordkeeping which will demonstrate continuous and effective emission control are required upon start up of the control system. For combustion devices this may be a thermocouple and continuous recording device for the pilot flame or any other equivalent device to detect and record the presence of the pilot flame. A temperature recorder/monitor might be used to demonstrate sufficient heat of combustion or a continuous, wind-up chart recorder might be used to demonstrate continual operation by measuring and recording temperature or pressure parameters.

Storage tanks and pressurized vessels with flashing emissions

As produced liquids are exposed to temperature and pressure changes (i.e., liquids at separator pressure & temperature are dumped to atmospheric storage tanks or condensate is dumped from a HP to a LP separator), gas entrained in the liquids is released from solution. For purposes of this guidance, the term "**flashing emissions**" refers to the VOC and HAP pollutants associated with vapors released to the atmosphere from hydrocarbon liquids storage tanks and with vapors released to the atmosphere from pressurized process vessels during times other than emergency or upset conditions (i.e., HP separator to LP separator flash gas not collected for sales) and with standing/working/breathing (S/W/B) losses. S/W/B losses refers to vapors displaced from hydrocarbon storage tanks during filling and to vapors displaced from tanks during expansion and contraction of the tank vapor space, caused by changing ambient conditions.

How are flashing emissions determined for the Presumptive BACT process?

STEP 1: 30-days after the First Date of Production calculate the **average daily condensate or oil production**.

Example:
Well produced 600 BBL during the first 30-days after the First Date of Production.
average daily condensate/oil production = 600 BBL ÷ 30 days = 20 BPD

STEP 2: Calculate the **projected first year average daily condensate/oil production** rate by multiplying the average daily rate times 0.6. This equates to an 80% decline in condensate/oil production from the well during the first year of production. If the expected decline rate is less than 80%, then the expected decline rate should be used. Using an expected decline rate > 80% requires pre-approval from the Division.

Example:
projected first year average daily production = 20 BPD × 0.6 = 12 BPD

STEP 3: Use an approved flashing emissions model or actual measurements to determine **projected first year VOC and HAP emissions associated with the projected first year average daily production rate**.

C6 S2 O&G Production Facilities Permitting Program

Presumptive BACT
STATEWIDE

Flashing emission models generally require:

1) an extended hydrocarbon analysis of pressurized condensate/oil sampled at the outlet of the separator or treater and upstream of the atmospheric storage tanks, at the operating conditions of the separator or treater. In other words, the sample should be that of "unflashed" condensate/oil. Or, a composite extended hydrocarbon analysis may be used. The composite analysis must be the average condensate/oil composition from at least five nearby wells producing from the same formation as the new well and under the same, or very similar, pressure and temperature conditions. The five samples as the basis for the composite must be no older than three years.
2) the actual operational parameters of the separation and storage equipment

The names of some common flashing models are API E&P TANK V2, Prosim, Hysim, Hysys, ProMax, KFlash. All are simulation software based on known properties of hydrocarbon liquids and vapors and accepted chemical equations of state. Using a known composition of hydrocarbon liquids at certain conditions, the models predict the volumes and compositions of vapors that will be released from that liquid as it is exposed to changing temperatures and pressures.

Sometimes it is not possible to get an extended hydrocarbon analysis of heavier crudes due to properties of the crude. When this is the case the Vasquez-Beggs GOR (VB) correlation may be used to estimate flashing emissions from hydrocarbon storage tanks. The correlation is basically intended to be used as an indicator of relative volumes of vapors which might be released from stored crudes and should not be used when the API gravity of the crude exceeds 35 degrees since the accuracy of the correlation decreases with increased gravity. Contact the Division for an excel copy of the VB correlation or it may be downloaded from the AQD website at http://deq.state.wy.us/aqd/sec21/bflash.xls

Flashing emissions, especially those from pressurized vessels, may also be determined through direct measurement and analysis of the vapors. This requires careful isolation of the flash vessel so that the only route of vapor release is through a calibrated meter.

Alternate methods for determining flash emissions must receive prior approval from the Division.

When do flashing emissions require control?

When projected, uncontrolled emissions associated with flashing, rounded to the nearest 0.1 ton, are ≥**20 TPY VOC**, flashing emissions must be controlled according to BACT requirements **within 60-days** of the First Date of Production and prior to the emission of major source levels of any regulated air pollutants.

CAUTION: Total emissions from any facility or source must not exceed major source levels prior to emission control installation. Major source levels are 10 TPY of any single HAP, 25 TPY of any combination of HAP or 100 TPY of any regulated pollutant. Flashing emissions prior to control installation will be determined using approved emission models or methods based on actual reported production and operating conditions. Reported production includes that sold during well completion activities which are reported to the WOGCC. Flashing emissions are directly proportional to production

C6 S2 O&G Production Facilities Permitting Program

rates, provided operational parameters remain consistent, so it is acceptable to prorate emissions based on production.

CAUTION: Emissions may ultimately exceed the projected levels rather than decline according to projections. Operators should be mindful of this since emission controls will be required through permitting if the controllable levels are exceeded. Compliance actions may be taken when emissions thresholds are exceeded.

What are Presumptive BACT requirements for flashing emissions?

The following control systems or devices are accepted by the Division as meeting BACT for flashing emissions:

1) A vapor recovery device that is designed and operated and may be demonstrated to reduce the mass content of VOC and total HAP emissions in the vapors vented to the device by at least 98% by weight.
2) An enclosed, smokeless combustion device or flare that is designed and operated and may be demonstrated to reduce the mass content of VOC and total HAP emissions in the vapors vented to the device by at least 98% by weight.
3) Any other control device or configuration that can be demonstrated to reduce the mass content of total HAP and VOC in the process gases vented to the device or configuration by at least 98% by weight.

Emissions control equipment, systems or devices, all vent lines, connections, fitting, valves, relief valves, hatches or any other appurtenance employed to contain and collect vapors and transport them to the emission control system or device, must be maintained and operated during any time a well is producing such that the emissions are controlled at all times.

When projected, uncontrolled emissions exceed major source levels, monitoring and recordkeeping which will demonstrate continuous and effective emission control are required upon start up of the control system. For a combustion device this may be a thermocouple and continuous recording device or any other equivalent device to detect and record the presence of the pilot flame, or a combustion chamber temperature recorder/monitor. The monitoring/recording requirements become enforceable permit conditions.

Flashing emission controls may be removed after one year of operation provided VOC flashing emissions have declined to less than 15 TPY. This provision will be included in the final permit, when applicable.

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C6 S2 Permit Application

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C6 S2 Application

Unless a permit was required prior to construction, the C6 S2 application is the second step in the Presumptive BACT permitting process. It is an application for a permit to construct a new facility or to modify an existing one.

The C6 S2 application must be **FILED WITHIN 90-DAYS of the FIRST DATE of PRODUCTION** after construction or modification. The application notifies the AQD that the new or modified facility has begun operation. It describes the current process, equipment and associated emissions/emissions controls and serves as a form of certification by the owner that the Presumptive BACT requirements have been met.

Whether the application is being filed after construction under the Presumptive BACT process or prior to construction, the appropriate application forms depend upon the facility equipment and operating scenario. A complete application includes the following applicable forms:

- **A cover letter stating the purpose of the application**

- **A process description and process diagram for the facility including each air emission source and the operational parameters of each source** (see examples on pages 18 & 19)

- **The appropriate application forms**

  AQD-OG0 Identification of application type (application or NOI = application)
  AQD-OG00 Completeness checklist
  AQD-OG1 Application Cover Sheet
  AQD-OG2 Equipment List
  AQD-OG3 Storage Tanks, Pressurized Vessels & Pneumatic Pumps
  AQD-OG4 Dehydration Units
  AQD-OG5 Pumping Unit Engines
  AQD-OG6 Emission Summary
  AQD-OG7 Notice of Installation
  AQD-OG8 Multiple Facilities
  AQD-OG10 BACT cost analysis

- Explanations or demonstrations of all methods used to calculate or estimate emissions for each emission source, including controlled and uncontrolled sources. Emission calculation methods are described later.

- All applicable and required attachments noted on the forms, including

  Input and output for emission models/software/process simulations

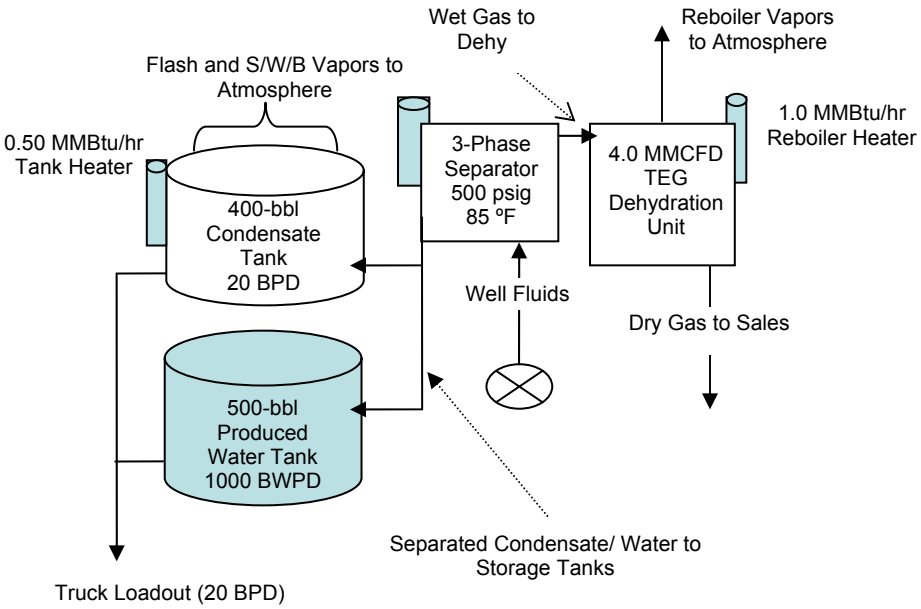
C6 S2 O&G Production Facilities Permitting Program

Equipment manufacturer's emissions information

Laboratory analyses used for emission models/software/process simulations or calculations including a description of sampling procedures and handling, sampling locations, sampling location parameters (i.e., pressure and temperature at sampling port)

- Any additional attachments or information necessary for complete review of the application

Example Process Diagram and Description



EXAMPLE: Air emission sources in the diagram are the condensate storage tank from which vapors are vented to the atmosphere, the dehydration unit reboiler still vent and the three natural gas-fired process heaters. Produced fluids are directed to the 3-phase separator for separation of condensate/water/gas. Wet gas is directed to the TEG dehydration unit for drying. Separated condensate and water are routed to the appropriate tanks for storage prior to being hauled from location via truck. Produced gas is used as burner fuel. Reboiler vapors and flash emissions are vented to the atmosphere along with S/W/B losses from the condensate tank.

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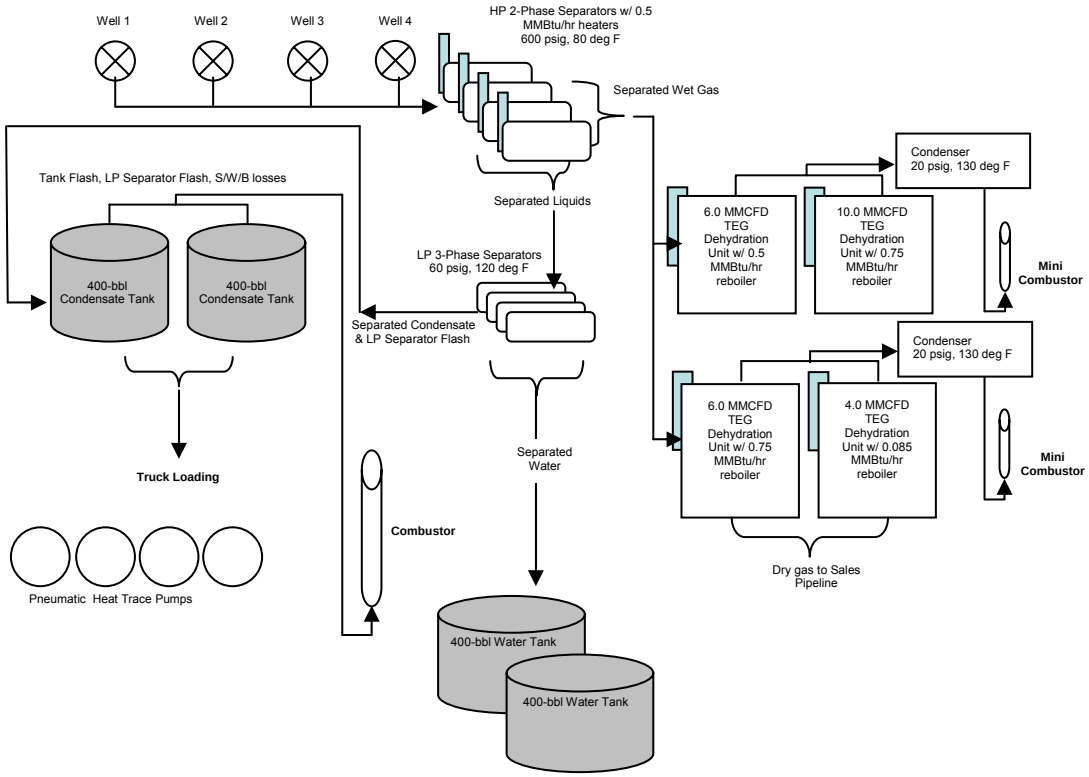
Example Process Diagram & Description



EXAMPLE: Total well fluids from four wells flow to the 2-ph HP separators. Wet gas from the HP separators flows to the four dehydration units. Separated fluids from the 2-ph HP separators flows to the 3-ph LP separators. Separated condensate and water flows from the 3-ph LP separators to the storage tanks. Gas released in the 3-ph separators is routed to the condensate storage tanks. Tank vapors, including tank flash, gas from the 3-ph LP separators and S/W/B vapors are collected and directed to a 30-foot smokeless combustor. The temperature of the combustor is continually monitored and recorded using a SCADA system. Reboiler still vents vapors flow through condensers. Condensed liquids are pumped to the condensate storage tanks. Non-condensible vapors flow to the 20-foot Mini-Combustors. The temperature of the Mini-combustors is continually monitored and recorded using a SCADA system. Pneumatic heat trace pumps operate 6 months per year using produced gas from the HP separators to operate. Vent lines from the pumps are routed into the condensate dump lines from the LP separators.

The process diagram does not need to be computer generated. A simple hand sketch will work as long as the required information is included. The diagram does not need to be drawn to scale and does not need to represent the exact position of production equipment at the facility as long as the process description and operating scenario are clearly defined.

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Emissions reported in the application must be based on current average production rates at the time of application filing. Higher production rates may be used if the applicant wants to allow for expected production increases.

For facilities requiring a permit prior to start up of operations, emissions reported in the application must be based on expected production rates. Higher production rates may be used if the applicant wants to allow for production increases.

Both controlled and uncontrolled emissions must be reported in the application.

How are dehydration unit emissions determined for the C6 S2 application?

Use GRI-GLYCalc V3.0 or higher to determine **potential uncontrolled and controlled VOC and HAP emissions** from the dehydration unit process vents. Process vents include reboiler still vents and glycol flash separators.

Potential uncontrolled and controlled VOC and HAP emissions are based on the maximum lean glycol circulation rate for the glycol circulation pump in use (see TABLE 1 on page 12), appropriate daily dry gas production rate (discussed above), an extended hydrocarbon analysis of the wet gas from a sample taken upstream of the dehydration unit contact tower or an average of five wet gas analyses sampled upstream of the dehydration unit contact towers at nearby wells producing from the same formation and under very similar conditions, average operational parameters including wet gas temperature and pressure, dry gas water content, glycol flash separator temperature and pressure and stripping gas source and rate if applicable.

When do dehydration unit emissions require control?

If potential uncontrolled emissions as determined under the Presumptive BACT process were:

≥ 5.0 TPY of any combination of HAP, or
≥ 15.0 TPY any combination of VOC, or

Then, dehydration unit emissions should already have been controlled within 60-days of FDP.

If dehydration unit emissions did not require control under the Presumptive BACT process, but did not decline as projected and now exceed the 5 TPY/10 TPY thresholds at the time of application filing, controls meeting BACT requirements described earlier must be installed. The applicant must identify the date controls were or will be installed in the application.

For facilities requiring permitting prior to startup, the same emission thresholds listed above apply for determining whether or not controls will be required in order to meet BACT requirements.

C6 S2 O&G Production Facilities Permitting Program

How are VOC and HAP flashing emissions determined for the C6 S2 application?

Use an approved emissions model, process simulator or actual measurements to determine **uncontrolled VOC and HAP emissions** associated with flashing vapors from hydrocarbon storage tanks and from any pressurized vessels which vent to the atmosphere during times other than upset or emergency conditions.

Uncontrolled VOC and HAP emissions should be based on the appropriate average daily production rates (discussed above), appropriate extended hydrocarbon lab analyses of produced condensate or oil and actual operating parameters of production vessels. **Controlled emissions** depend upon the emission control device or system used or proposed.

When do flashing emissions require control?

If potential uncontrolled flashing emissions determined under the Presumptive BACT process were:

≥ 20 TPY of any combination of VOCs

Then, flashing emissions should already have been controlled within 60-days of FDP.

If flashing emissions did not require control under the Presumptive BACT process, but did not decline as projected and now exceed the 20 TPY threshold at the time of application filing, controls meeting BACT requirements described earlier must be installed. The applicant must identify the date controls were or will be installed in the application.

For facilities requiring permitting prior to startup, the same emission threshold listed above applies for determining whether or not controls will be required in order to meet BACT requirements.

How are emissions from other sources determined for the C6 S2 Application?

Calculation methods for other sources such as pneumatic pumps, truck loading, fugitives, natural gas-fired burners, etc. are described in Appendix B.

How is BACT addressed for equipment other than dehydration units and flashing sources for the C6 S2 Application?

BACT must be considered for:

sources with ≥ 15 TPY VOC emissions,

sources with ≥ 5 TPY total HAP emissions and

pumping unit engines site rated at ≥ 50 Hp OR with ≥ 5 TPY NO_X emissions.

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For these sources **EITHER** the emission source will be controlled using BACT **OR** a BACT cost analysis will be performed and submitted with the application showing either:

control is not technically feasible (i.e., due to physical constraints the emissions can not be controlled)

OR

control is not economically reasonable (i.e., based on a control cost analysis the "cost to control per ton of pollutant reduced" is uneconomical).

CAUTION: **BACT** may be required at lower levels and for other emissions and emission sources than those stated in this guidance, but as a minimum, **BACT** must be considered when equal to or above these guidance emission levels.

Multiple pieces of the same type of equipment are considered one emission source for permitting purposes. For example, there are five pneumatic heat trace pumps at a facility so emissions from the five pumps must aggregated for permitting purposes. If total emissions from the five heat trace pumps are 10 TPY VOCs and 4 TPY total HAPs, BACT requirements are met with no control. If total emissions from the five heat trace pumps are 10 TPY VOCs and 6 TPY total HAPs, emissions from all five pumps must be reduced to less than 5 TPY total HAPs to meet BACT requirements or the applicant must demonstrate controlling the emissions is not economically reasonable or technically feasible.

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How to obtain C6 S2 application forms

Download forms from the AQD website at

http://deq.state.wy.us/aqd/oilgas.asp

Contact the Wyoming Air Quality Division at **(307) 777-7391 or (307) 473-3475**

Make written request to

Wyoming Department of Environmental Quality
Air Quality Division
Herschler Building, 2-E
122 west 25th Street
Cheyenne, WY 82002
attn: O&G NSR Permitting

or

Wyoming Department of Environmental Quality
Air Quality Division
152 North Durbin Street, Suite 100
Casper, WY 82601
attn: O&G NSR Permitting

When/where to file a C6 S2 permit application

For facilities where emissions are known prior to construction submit **EITHER** 1 paper copy w/ original signature and 1 electronic copy **OR** 3 paper copies (one w/ original signature) of the complete C6 S2 application **prior** to construction to the address below.

For facilities constructed or modified under the Presumptive BACT process submit **EITHER** 1 paper copy w/ original signature and 1 electronic copy **OR** 3 paper copies (one w/ original signature) of the complete C6 S2 application within **90-days** of the **First Date of Production** to the address below.

NSR Program Manager / attn: O&G Production Facilities
Department of Environmental Quality
Air Quality Division
Herschler Building, 2-E
122 west 25th Street
Cheyenne, WY 82002

The preferred method for filing the application is 1 paper copy w/ 1 electronic copy.

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Upon receiving the application, the AQD sends a receipt letter to the applicant. The application is logged into the AQD tracking system and assigned a reviewing engineer. The engineer has up to 30-days to perform a completeness review to ensure adequate and correct information has been filed. If the application is deemed incomplete the engineer will notify the applicant and request further information. Upon completeness the engineer has 60-days to complete a technical review, write an application analysis and make any recommendations. During this process the decision to issue a permit or waiver takes place. If the decision is to issue a permit, the proposed permit, including compliance requirements, is published for a mandatory 30-day public comment period. If no comments are received the permit is issued once the public comment period ends. If comments are received these are addressed by the AQD. It is possible comments will warrant a public hearing. When this is the case, a final permit may be denied or delayed.

An hourly fee will be assessed for the time it takes AQD personnel to process the application. A bill will be sent to the applicant when the process is complete. Billing is handled as follows:

> **Initial billing** is assessed when a proposed permit is sent to public notice. Initial billing must be paid prior to issuance of the final permit.
>
> **Final billing** is assessed for waivers and permits after these are issued.

Contact the Division for the current hourly rate.

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NOTE: **The Presumptive BACT permitting process may not be used for sour gas (H_2S) production facilities unless the only emissions of H_2S will be those associated with fugitive losses from valves, fittings, surface piping and pneumatic devices, etc**. If there will be H_2S emissions associated with vented gas or tank vapors or if sour gas will be flared the applicant must contact the Division for permitting guidance **prior to construction**.

NOTE: NO internal combustion compressor engines or generator engines may be installed under the Presumptive BACT process. No pumping unit engines greater than 50-Hp or with nitrogen oxide (NO_X) emissions greater than 5 TPY may be installed under the Presumptive BACT permitting process.

Such engines must be permitted prior to installation.

NOTICE of INSTALLATION (NOI)

For some O&G production facilities or equipment, associated air emissions are considered relatively insignificant by the AQD. In these cases the NOI form, **FORM AQD-OG7**, serves as a complete C6 S2 permit application.

The NOI can be used for facilities such as single wellsites, consisting of only a wellhead or perhaps a separation unit, where no produced fluids are stored or dehydrated. Instead, the produced fluids are routed directly from the wellhead or separation vessels into a sales line, collection system or to a separate facility for treatment, storage and sales. The only emissions at this type of facility would be fugitive emissions from equipment leaks and fittings, or NO_X and CO emissions associated with small natural gas fired process heaters.

The NOI may be used as a complete permit application **ONLY** if **ALL** of the following apply to the facility owner:

- There are no hydrocarbon liquids storage tanks.
- There are no dehydration units.
- There are no pressurized vessels from which hydrocarbon vapors are vented to the atmosphere other than during upset or emergency conditions.
- There are no internal combustion pumping unit engines ≥ 50 HP or with ≥ 5 TPY NO_X emissions.
- There are no H_2S emissions from the facility other than those associated with fugitive leaks from process components and surface piping.
- There are no SO_2 emissions associated with the combustion of sour gas.

C6 S2 O&G Production Facilities Permitting Program

Using the NOI as notification of equipment replacements and changes

The NOI may be used for notification of equipment change outs or replacements, provided the changes will not significantly increase permitted emissions, if at all. For example, use the NOI as notification of replacement of a TEG dehydration unit with one having a higher design rating but with the same model glycol pump as previously permitted, or higher rated reboiler burner. Increased emissions associated with the larger burner would be considered insignificant and there would be no emissions increase associated with the larger dehy as long as there is no change in the glycol pump model or wet gas throughput.

Another example would be to use the NOI as notification of the installation of additional production tanks at a previously permitted facility provided throughput to the current and additional tanks is the same as or less than the previously permitted throughput and provided the vent lines of the new tanks are tied into emission control devices if such was required for the existing tanks.

The NOI may be used as notification of the installation of different process heater, such as replacing a 0.5 MMBtu/hr line heater with a 0.75 MMBtu/hr line heater.

Examples are illustrated below.

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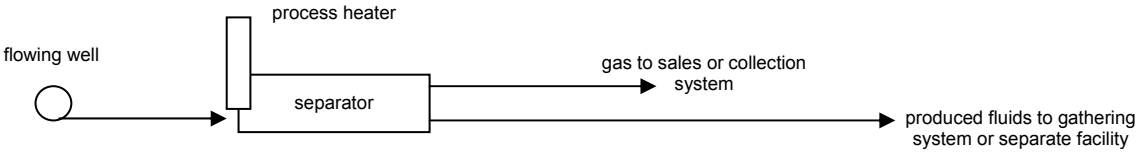
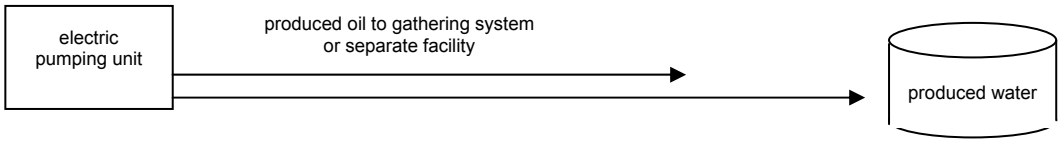
Examples of cases where the NOI may be used as a complete C6 S2 permit application or as notification of equipment changes

1



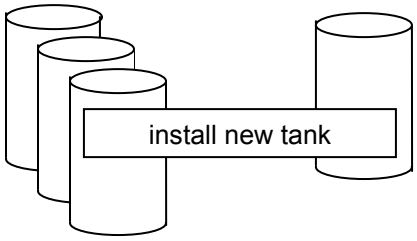
2



3

<50 Hp & <5 TPY NOx

4



A storage tank is added to an existing facility. Tank throughput at the facility is no greater than previously permitted throughput. If existing tanks are connected to an emission control device, the new tank must also be connected to the control device.

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How to obtain NOI Form AQD-OG7

The link to electronic forms on the AQD website is

http://deq.state.wy.us/aqd/oilgas.asp

Contact the Wyoming Air Quality Division at **(307) 777-7391 or (307) 473-3475**

Make written request to: Wyoming Department of Environmental Quality
Air Quality Division
Herschler Building, 2-E
122 west 25th Street
Cheyenne, WY 82002

When/where to file a NOI

Within **60-days** of the **First Date of Production**, equipment change out, equipment replacement or equipment addition submit **EITHER** 1 paper copy w/ original signature and 1 electronic copy **OR** 3 paper copies (one w/ original signature) of the NOI form to:

NSR Program Manager / attn: O&G Production Facilities
Department of Environmental Quality
Air Quality Division
Herschler Building, 2-E
122 West 25th Street
Cheyenne, WY 82002

The preferred method for filing the NOI is 1 paper copy w/ 1 electronic copy.

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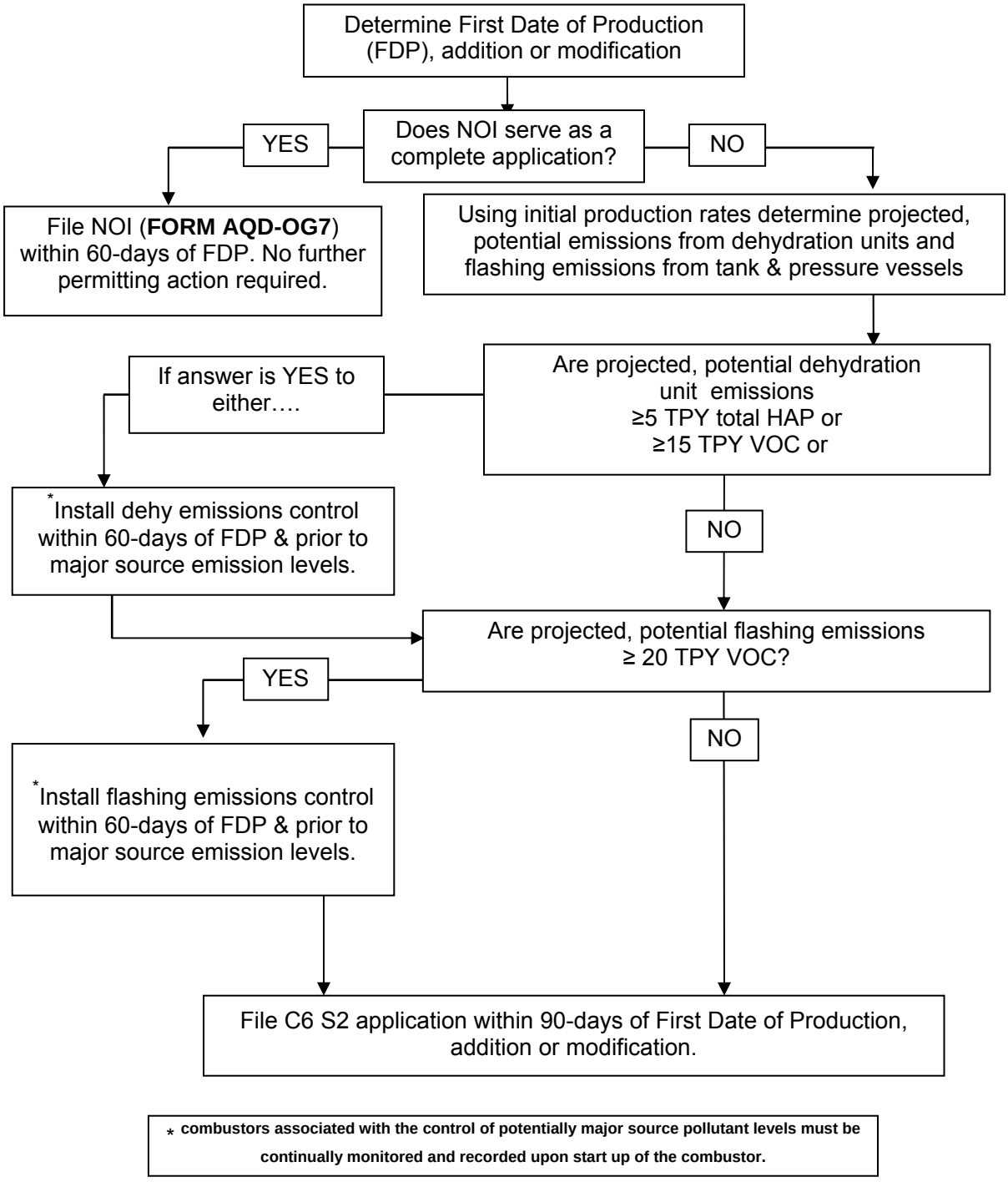
PRESUMPTIVE BACT PERMITTING PROCESS



*** combustors associated with the control of potentially major source pollutant levels must be continually monitored and recorded upon start up of the combustor.**

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JPAD Area

The Jonah and Pinedale Anticline Development Area is currently defined as:

R109W & R110W in T34N
R109W & R110W in T33N
R108W, R109W & R110W in T32N
R108W, R109W & R110W in T31N
R107W, R108W & R109W in T30N
R107W, R108W & R109W in T29N
R108W & R109W in T28N
R107W, R108W & R109W in T27N

For JPAD, the Presumptive BACT permitting process varies from that for all other statewide areas.

For the purposes of this guidance:

A PAD facility is a location where more than one well and/or associated production equipment are located, where some or all production equipment is shared by more than one well or where well streams from more than one well are routed through individual production trains located at the same or contiguous and adjacent location. If the production streams or production equipment associated with one or more wells is added to an existing single well facility, that location is then considered to be a PAD facility.

A single well facility is one where production equipment is associated with only one well.

A single well becomes a multiple well or PAD facility upon the First Date of Production of an additional well at the location or on the day production streams associated with an additional well or wells from separate locations are routed to the single well facility.

An existing facility becomes modified once production streams or production equipment associated with another well or wells is added to or tied into it. The date modification occurs to an existing facility is the First Date of Production for the added well or the date the production streams associated with an additional well or wells are tied into equipment at the existing facility.

Examples of modified facilities not involving new wells or added production from other wells are:

An existing well facility is completed in additional production zones resulting in increased production and/or emissions at the facility greater than those previously permitted.

Existing production equipment is replaced with larger equipment, resulting in increased potential or actual emissions.

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Presumptive BACT permitting process

Unlike the Presumptive BACT permitting process for statewide facilities, the permitting process for JPAD facilities does not require the determination of projected, potential emissions prior to application filing. Instead, emissions meeting the BACT requirements described later must be in place upon the First Date of Production at all new and modified facilities. A C6 S2 application is filed to notify the AQD of the start up of a new facility or the modification to an existing facility. The application describes new, modified and future well/equipment installations along with the associated, controlled and uncontrolled emissions and serves as a form of certification by the owner that Presumptive BACT requirements for emission controls and control device monitoring have been and will be met.

The C6 S2 Application

A complete C6 S2 application, including all appropriate forms, must be filed for within sixty-days of the First Date of Production or modification for:

all new single well facilities
all new PAD facilities
modifications to existing single or PAD facilities

If a facility has been previously permitted and the permit contains conditions authorizing additional equipment and wells to be added according to the July 28, 2004 Guidance Addendum, a complete application made be submitted using the **AQD Pinedale-1 Form**.

For all applications other than those filed on the **AQD Pinedale-1 Form**, a complete C6 S2 application includes the following applicable forms and information:

- **A cover letter stating the purpose of the application**

- **A process description and process diagram for the facility including each planned air emission source and the operational parameters of each source** (see pages 19 & 20)

- **The appropriate application forms**

AQD-OG0	Identification of application type (application or NOI = application)
AQD-OG00	Completeness checklist
AQD-OG1	Application Cover Sheet
AQD-OG2	Equipment List
AQD-OG3	Storage Tanks, Pressurized Vessels & Pneumatic Pumps
AQD-OG4	Dehydration Units
AQD-OG5	Pumping Unit Engines
AQD-OG6	Emission Summary
AQD-OG7	Notice of Installation
AQD-OG8	Multiple Facilities
AQD-OG10	BACT cost analysis

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- Explanations or demonstrations of all methods used to calculate or estimate emissions for each emission source, including controlled and uncontrolled sources. (Emission calculation methods are described later.)

- Required attachments including:
  input and output for emission models/software/process simulations,
  equipment manufacturer's emissions information,
  laboratory analyses used for emission models/software/process simulations or calculations, and
  a description of sampling and handling procedures, sampling locations, sampling parameters (i.e., pressure and temperature at sampling port).

- Any additional attachments or information necessary for complete review of the application

Emissions reported in the application must be based on projected rates for new wells and current average production rates at the time of application filing for existing wells. Higher production rates may be used if the applicant wants to permit for production/emission increases.

NOTE: At facilities with a permit authorizing the addition of future wells, the authorization becomes invalid if no wells are added to the facility within 24 months after receipt of the permit or if the addition of the planned wells is discontinued for a period of 24 months or more. The permit for the existing wells remains valid.

For facilities requiring a permit prior to start up of operations, emissions reported in the application should be based on expected production rates. Higher production rates may be used if the applicant wants to permit for production/emissions increases.

Using the NOI as a complete C6 S2 application or as notification of equipment replacements and changes

When air emissions associated with certain sources or situations qualify as those considered relatively insignificant by the AQD, the NOI form, **FORM AQD-OG7**, serves as a complete C6 S2 permit application. For complete instructions see the discussion and examples on pages 26 through 28.

C6 S2 O&G Production Facilities Permitting Program

How are dehydration unit emissions determined?

STEP 1: Within 30-days after the First Date of Production or modification, calculate the **average daily gas production**.

Example:
Well produced 100 MMCF during the first 30-days after the First Date of Production
average daily gas production = 100 MMCF ÷ 30 days = 3.3 MMCFD

STEP 2: Calculate the **projected first year average daily gas production** rate by multiplying the initial average 30-day rate times 0.6. This effectively results in determining a first year, average daily gas production rate which is 80% than the initial production rate. In other words, the well's initial production is projected to decline by 80% by the end of the first year of operation. First year, projected emissions are then calculated using this decline, average, daily rate for the first year of operation. (see page 42)

Example:
projected first year average daily gas production = 3.3 MMCFD × 0.6 = 2.0 MMCFD

STEP 3: Use GRI-GLYCalc V3.0 or higher to determine **potential uncontrolled and controlled VOC and HAP emissions** from the **process vents** of the dehydration unit associated with the projected first year average daily gas production rate. **Process vents** include reboiler still vents, glycol flash separators and still vent condensers.

NO_X and CO emissions associated with emission control combustion devices are to be calculated using the volumes of waste gas from the process vents, as predicted by the GLYCalc model, and the AP-42 flare emission factors listed in this guidance.

Input to the GLYCalc model must include:

1) An extended hydrocarbon analysis of wet gas sampled upstream of the reboiler contact tower. Or, a composite extended hydrocarbon analysis may be used. The composite analysis must be the average wet gas composition from at least five nearby wells producing from the same formation as the new well and under the same or very similar pressure and temperature conditions. The five samples used for the composite must be no older than five years.
2) The projected first year average daily gas production rate (MMCFD).
3) Average operational parameters, including wet gas temperature and pressure, dry gas water content, glycol flash separator temperature and pressure, stripping gas source and rate and average operating parameters of emission control equipment.
4) The **maximum lean glycol circulation rate** (gpm) for the glycol circulation pump in use. Maximum circulation rates for the most commonly used Kimray Model pumps are listed in **TABLE 1** on page 12. If different pump makes are used, contact the manufacturer for the maximum rates.

C6 S2 O&G Production Facilities Permitting Program

When do dehydration unit emissions require control?

Emissions from the process vents of all new and existing dehydration units must be controlled upon the First Date of Production at a new facility and upon the First Date of Production after a modification to a facility. Process vents include reboiler still vents, glycol flash separators and still vent condensers.

Emissions from the process vents of temporary TEG dehydration units which are associated with skid mounted "green completion" separation equipment, do not require emission control equipment, although emission control for these units is encouraged.

Emissions from temporary dehydration units in place to accommodate initial high production rates must be controlled. These units are not considered to be associated with "green completion" equipment.

What are the Presumptive BACT control requirements for dehydration unit emissions?

The following control systems or devices are accepted by the Division as meeting BACT for emissions from dehydration unit process vents (reboiler still vents and vents from glycol flash separators or glycol flash tanks):

1) Vapor recovery device (e.g. condenser, BTEX control system) that is designed and operated and may be demonstrated to reduce the mass content of total HAP and VOC in the process gases vented to the device by at least 98% by weight.
2) Enclosed smokeless combustion device or smokeless flare that is designed and operated and may be demonstrated to reduce the mass content of total HAP and VOC in the process vapors vented to the device by at least 98% by weight.
(3) Any other control device or configuration that can be demonstrated to reduce the mass content of total HAP and VOC in the process gases vented to the device or configuration by at least 98% by weight.

Emissions control equipment, systems or devices, all vent lines, connections, fitting, valves, relief valves, hatches or any other appurtenance employed to contain and collect vapors and transport them to the emission control system or device, must be maintained and operated during any time a well is producing such that the emissions are controlled at all times.

Upon the First Date of Production at a new facility and the First Date of Production after modification to an existing facility the Division requires continuous monitoring and recording of emission control components in order demonstrate continual operation and effectiveness. For a combustion device this may be a thermocouple and continuous recording device or any other equivalent device to detect and record the presence of the flame, or a combustion chamber temperature recorder/monitor. The monitoring/recording requirements become enforceable permit conditions.

C6 S2 O&G Production Facilities Permitting Program

How are flashing emissions determined?

STEP 1: 30-days after the First Date of Production calculate the **average daily condensate or oil production**.

Example:
Well produced 600 BBL during the first 30-days after the First Date of Production.
average daily condensate/oil production = 600 BBL ÷ 30 days = 20 BPD

STEP 2: Calculate the **projected first year average daily condensate/oil production** rate by multiplying the average daily rate times 0.6. This equates to an 80% decline in condensate/oil production from the well during the first year of production. If the expected decline rate is less than 80%, then the expected decline rate should be used. Using an expected decline rate > 80% requires pre-approval from the Division.

Example:
projected first year average daily production = 20 BPD × 0.6 = 12 BPD

STEP 3: Use an approved flashing emissions model or actual measurements to determine **uncontrolled and controlled first year VOC and HAP emissions associated with the projected first year average daily production rate**.

Flashing emission models generally require:

1) an extended hydrocarbon analysis of pressurized condensate/oil sampled at the outlet of the separator or treater and upstream of the atmospheric storage tanks, at the operating conditions of the separator or treater. In other words, the sample should be that of "unflashed" condensate/oil. Or, a composite extended hydrocarbon analysis may be used. The composite analysis must be the average condensate/oil composition from at least five nearby wells producing from the same formation as the new well and under the same, or very similar, pressure and temperature conditions. The five samples as the basis for the composite must be no older than three years.
2) the actual operational parameters of the separation and storage equipment

Some commonly used flashing models are API E&P TANK V2, Prosim, Hysim, Hysys, ProMax, KFlash. All are simulation software based on known properties of hydrocarbon liquids and vapors and accepted chemical equations of state. Using a known composition of hydrocarbon liquids at certain conditions, the models predict the volumes and compositions of vapors that will be released from that liquid as it is exposed to changing temperatures and pressures.

Flashing emissions, especially those from pressurized vessels, may also be determined through direct measurement and analysis of the vapors. This requires careful isolation of the flash vessel so that the only route of vapor release is through a calibrated meter.

Alternate methods for determining flash emissions must receive prior approval from the Division.

C6 S2 O&G Production Facilities Permitting Program

When do flashing emissions require control?

Flashing emissions at all new or facilities must be controlled upon the First Date of Production.

Flashing emissions from all new and existing sources at modified facilities must be controlled upon the First Date of Production after the modification.

Flashing emissions associated with skid mounted "green completion" separation equipment do not require emission control, although control is encouraged.

What are Presumptive BACT requirements for flashing emissions?

The following control systems or devices are accepted by the Division as meeting BACT for flashing emissions:

1) A vapor recovery device that is designed and operated and may be demonstrated to reduce the mass content of VOC and total HAP emissions in the vapors vented to the device by at least 98% by weight.
2) An enclosed, smokeless combustion device or flare that is designed and operated and may be demonstrated to reduce the mass content of VOC and total HAP emissions in the vapors vented to the device by at least 98% by weight.
3) Any other control device or configuration that can be demonstrated to reduce the mass content of total HAP and VOC in the process gases vented to the device or configuration by at least 98% by weight.

Emissions control equipment, systems or devices, all vent lines, connections, fitting, valves, relief valves, hatches or any other appurtenance employed to contain and collect vapors and transport them to the emission control system or device, must be maintained and operated during any time a well is producing such that the emissions are controlled at all times.

Upon the First Date of Production at a new facility and the First Date of Production after modification to an existing facility the Division requires continuous monitoring and recording of emission control components in order demonstrate continual operation and effectiveness. For a combustion device this may be a thermocouple and continuous recording device or any other equivalent device to detect and record the presence of the flame, or a combustion chamber temperature recorder/monitor. The monitoring/recording requirements become enforceable permit conditions.

What are pneumatic pump emissions?

All gas used to motivate a pneumatic pump is ultimately discharged by the pump. If the motive gas is natural gas, as opposed to air, the vented gas contains VOC and HAP pollutants.

C6 S2 O&G Production Facilities Permitting Program

When do pneumatic pump emissions require control?

VOC and HAP emissions associated with pneumatic heat trace, heat medium or hot glycol circulation pumps must be controlled upon the First Date of Production at all new facilities and upon the First Date of Production after modification to an existing facility.

What are Presumptive BACT requirements for pneumatic pump emissions?

The motive gas discharge lines from the affected pumps should be tied into fuel gas supply lines or any other gas or liquid collection line which is ultimately tied into a closed system or emission control system, such as a tank vapor combustion device. If there are no such available lines with low enough operating pressure to accommodate the pump discharge gas, the pump should be replaced with an electric pump, solar operated pump, air operated pump or other such device which will eliminate the emissions. If none of these replacements is possible, BACT requirements for pneumatic pump emissions are met with no control.

How is BACT addressed for equipment other than dehydration units, flashing and pneumatic heat trace pump emissions?

BACT must be considered for:

sources with ≥ 15 TPY VOC emissions,
sources with ≥ 5 TPY total HAP emissions and
pumping unit engines site rated at ≥ 50 Hp OR with ≥ 5 TPY NO_X emissions.

EITHER the emission source will be controlled using BACT **OR** a BACT cost analysis will be performed and submitted with the application showing either: control is not technically feasible (i.e., due to physical constraints the emissions can not be controlled) **OR** control is not economically reasonable (i.e., based on a control cost analysis the "cost to control per ton of pollutant reduced" is uneconomical).

CAUTION: BACT may be required at lower levels and for other emission sources than stated in this guidance, but as a minimum, **BACT** must be considered when equal to or above these guidance emission levels.

FORM AQD-OG10 is the BACT cost analysis worksheet.

C6 S2 O&G Production Facilities Permitting Program

Presumptive BACT, C6 S2 Permitting Process

JPAD Area

How to obtain C6 S2 application, AQD Pinedale-1 and NOI forms

Download electronic forms from the AQD website at:

http://deq.state.wy.us/aqd/oilgas.asp

Contact the Wyoming Air Quality Division at **(307) 777-7391 or (307) 473-3475**

Make written request to:

Wyoming Department of Environmental Quality
Air Quality Division
Herschler Building, 2-E
122 west 25th Street
Cheyenne, WY 82002
attn: O&G NSR Permitting

When/where to file C6 S2 permit applications, AQD Pinedale-1 and NOI forms

For facilities where emissions are known prior to construction submit **EITHER** 1 paper copy w/ original signature and 1 electronic copy **OR** 3 paper copies (one w/ original signature) of the complete C6 S2 application **PRIOR** to construction to the address below.

For facilities constructed or modified under the Presumptive BACT process submit **EITHER** 1 paper copy w/ original signature and 1 electronic copy **OR** 3 paper copies (one w/ original signature) of the complete C6 S2 application within **60-days** of the First Date of Production to the address below.

For facilities with additions authorized under the July 28, 2004 Guidance Addendum, use the **AQD Pinedale-1 Form.** Submit **EITHER** one electronic and one paper copy w/ original signature **OR** three paper copies (one w/ original signature) within **60-days** of the First Date of Production to:

NSR Program Manager / attn: O&G Production Facilities
Department of Environmental Quality
Air Quality Division
Herschler Building, 2-E
122 west 25th Street
Cheyenne, WY 82002

The preferred method for filing the application is 1 paper copy w/ 1 electronic copy.

C6 S2 O&G Production Facilities Permitting Program

Presumptive BACT, C6 S2 Permitting Process

JPAD Area

Upon receiving the application the AQD sends a receipt letter to the applicant. The application is logged into the AQD tracking system and assigned a reviewing engineer. The engineer has up to 30-days to perform a completeness review to ensure adequate and correct information has been filed. If the application is deemed incomplete the engineer will notify the applicant and request further information. Upon completeness the engineer has 60-days to complete a technical review, write an application analysis and make any recommendations. During this process the decision to issue a permit or waiver takes place. If the decision is to issue a permit, the proposed permit, including compliance requirements, is published for a mandatory 30-day public comment period. If no comments are received the permit is issued once the public comment period ends. If comments are received these are addressed by the AQD. It is possible comments will warrant a public hearing. When this is the case, a final permit may be denied or delayed.

An hourly fee will be assessed for the time it takes AQD personnel to process the application. A bill will be sent to the applicant when the process is complete. Billing is handled as follows:

> **Initial billing** is assessed when a proposed permit is sent to public notice. Initial billing must be paid prior to issuance of the final permit.
>
> **Final billing** is assessed for waivers and permits after these are issued.

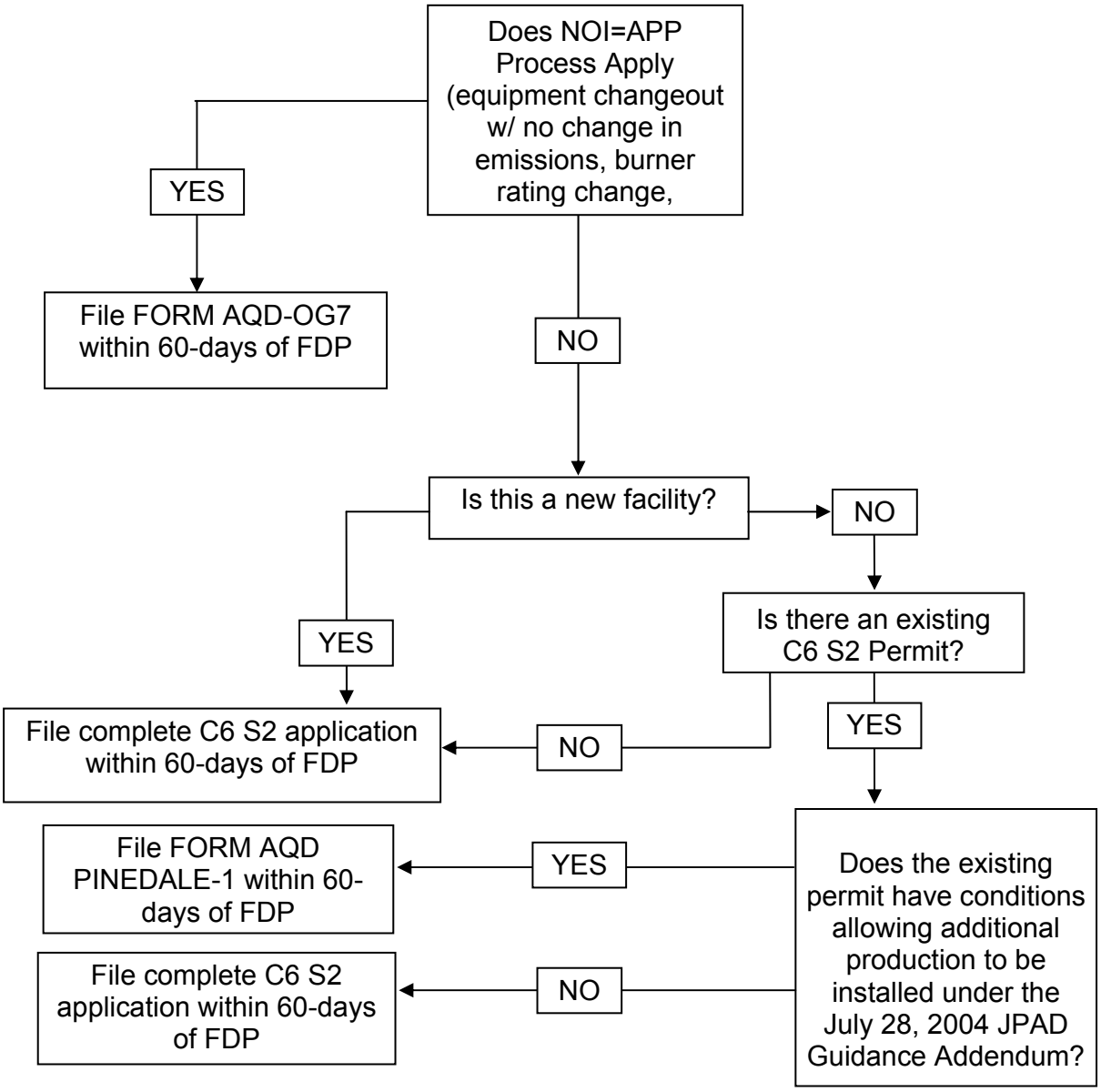
Contact the Division for the current hourly rate.

C6 S2 O&G Production Facilities Permitting Program

Presumptive BACT, C6 S2 Permitting Process

JPAD Area

PERMITTING FLOWCHART

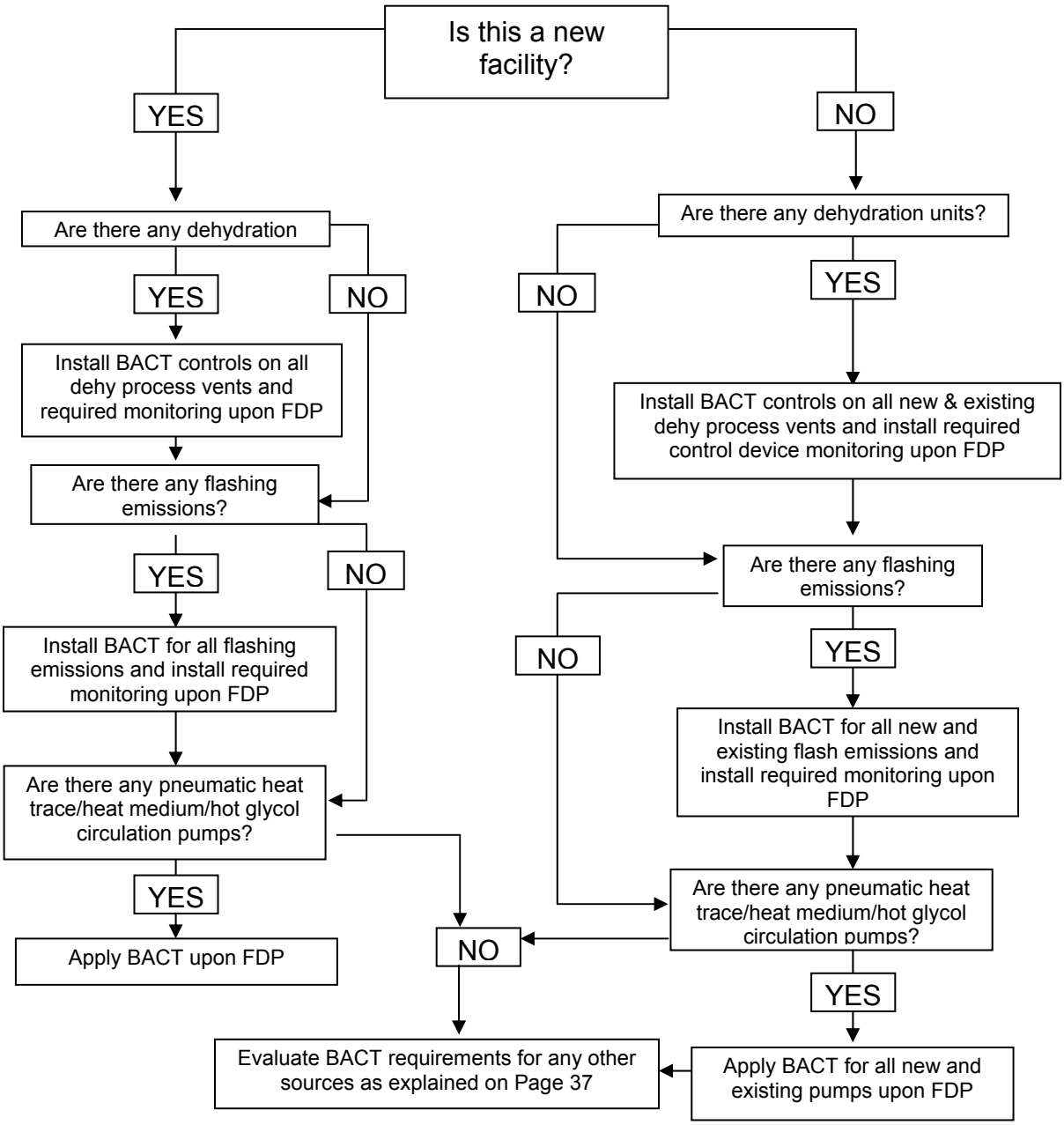


C6 S2 O&G Production Facilities Permitting Program

Presumptive BACT, C6 S2 Permitting Process

JPAD Area

EMISSION CONTROL FLOWCHART

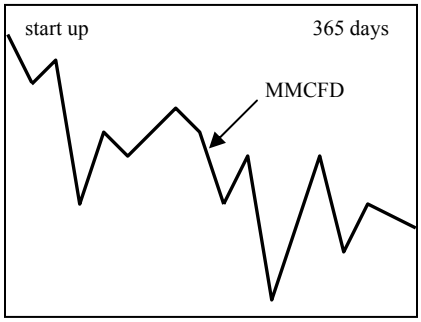


C6 S2 O&G Production Facilities Permitting Program

The Basis for the 0.6 Factor

The first year daily production rates are represented by the jagged line **BOX 1**. The area under the line represents the total actual production volume for the first year. It is difficult to calculate the total volume under the jagged line so it is smoothed out **BOX 2** using statistical methods.

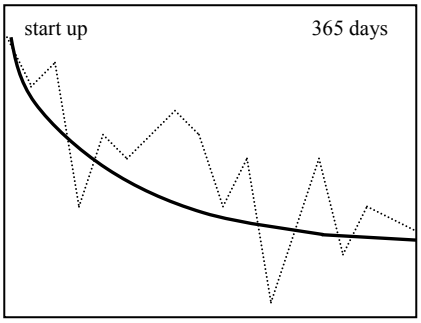
BOX 1



EXAMPLE - actual daily gas production rate vs time

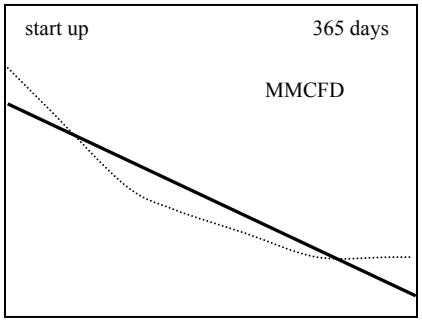
Actual production during the first year is represented by the area under the jagged line which ultimately turns out to be ≈ 730 MMCF.

BOX 2



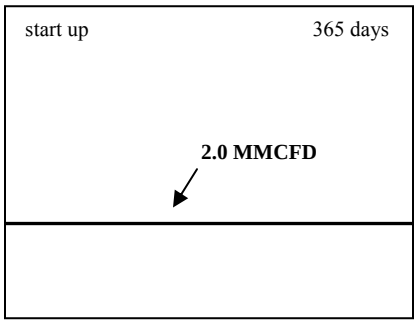
The jagged line representing daily production is "smoothed" out using statistical methods.

BOX 3



The "smoothed" curve in BOX 2 is "straightened" out using mathematical methods.

BOX 4



"leveled" out, projected daily gas production rate vs time

Total projected production for the first year is represented by the area under the straight line
2 MMCFD × 365 days = 730 MMCF

First year projected emissions are based on 730 MMCF of produced gas.

The smoothed curve is "straightened" out in **BOX 3**, then "leveled" out in **BOX 4**. Now the total production for the first year is represented by the area under the line in **BOX 4** which is easily calculated. Production curves from a large sampling of Wyoming wells indicate the average well declines by 80% during the first year. That 80% decline is represented by the level line in **BOX 4** after the first 30-day average production rate is multiplied by 0.6.

For the first month the well makes an average 3.333 MMCFD. With 80% decline during the first year, the well will make 0.667 MMCFD at the end of the first year (3.333 - 0.8(3.333) = 0.667). Then the average daily production rate over 365 days is (3.333 + 0.667)/2 = 2.0 MMCFD which is the same as 3.333 × 0.6 = 2.0.

C6 S2 O&G Production Facilities Permitting Program

STATEWIDE & JPAD Area

APPENDIX A

F O R M S

B L A N K

Form AQD-OG0 Application

Identifies the submittal as a C6 S2 O&G Production Facilities Permit Application

STATE OF WYOMING

Department of Environmental Quality - Air Quality Division

Oil & Gas Production Facilities C6 S2 Permit Application

Company Name: _____

Facility Name: _____

To Be Completed by WDEQ-AQD

Reviewer _____
Copy to _____
Cynthia _____
D.E. _____

File: _____

AQD-OG0 Application AUGUST 2007

Form AQD-OG0 NOI

Identifies the submittal as a C6 S2 O&G Production Facilities Notice of Installation = Application

STATE OF WYOMING

Department of Environmental Quality - Air Quality Division

Oil & Gas Production Facilities C6 S2 Notice of Installation

Company Name: _____

Facility Name: _____

To Be Completed by WDEQ-AQD

Reviewer _____
Copy to _____
Cynthia _____
D.E. _____

File: _____

AQD-OG0 NOI AUGUST 2007

Form AQD-OG00 Completedness Checklist

STATE OF WYOMING

Department of Environmental Quality - Air Quality Division

Oil & Gas Production Facilities

Checklist for Complete Application

INDUSTRY		DEQ-AQD
☐	Company Name/Contact Information	☐
☐	Well/Facility Name and API #	☐
☐	Legal Locations	☐
☐	Existing Permit/Waiver #'s	☐
☐	List of Equipment Onsite	☐
☐	Plot Plan	☐
☐	Process Description	☐
☐	Current Production Rates	☐
☐	Gas/Condensate Analyses	☐
☐	All Pertinent Dates (date of first production, control installation date)	☐
☐	Emission Models (Input/Output)	☐
☐	Other Calculations (heaters, pneumatic equipment, truck loading, etc.)	☐
☐	All Applicable Application Forms	☐
☐	DEQ Application Cover Sheet	☐

Form AQD-OG1 Application Coversheet

STATE OF WYOMING
Department of Environmental Quality - Air Quality Division
Oil and Gas Production Facilities C6 S2 Permit Application
Application Cover Sheet

submit (1) one signed original copy AND (1) one electronic copy of the application OR (3) paper copies, one w/ original signature

Company Name _____

Facility Name _____

API Number _____

For more than one well, list additional wells & associated API numbers on page 2 of this form.

OFFICIAL CONTACT PERSON

Name _____ Title _____

Address _____

Telephone _____ Fax _____ E-mail _____

LOCATION

County _____

Legal Description 1/4 1/4 _____ Section _____ T _____ R _____

Latitude _____ Longitude _____

FACILITY INFORMATION

Type of Facility: Single Well _____ PAD _____ Central Tank Battery _____

Type of Application: New Construction _____ Modified Facility _____

First Date of Production _____ Date of Modification _____

Producing Field Name _____

Producing Formation(s) _____

Existing Air Quality Permit / Waiver Numbers _____

Pending Air Quality Permit Application Numbers _____

I, _____
Responsible Official **Title**

state 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 certify that the emission rates listed on this certification reflect the anticipated emissions due to t

Signature _____ **Date** _____

Signature Required

FORM AQD-OG1 Application Coversheet AUGUST 2007

Form AQD-OG2 Equipment List

STATE OF WYOMING
Department of Environmental Quality - Air Quality Division
Oil and Gas Production Facilities C6 S2 Permit Application

Equipment List

Company Name _____

Facility Name _____

List all production equipment at the site including all pressurized vessels with the potential for flash emissions, all hydrocarbon liquids and produced water storage tanks, all dehydration units, all pneumatic pumps, all natural gas-fired burners and heaters and all emission control equipment and devices. Pressurized vessels with the potential for flash emissions are all vessels that vent vapors to the atmosphere during times other than upset or emergency conditions (water knockouts, 2-phase and 3-phase separators, heater treaters, gun barrels, scrubber pots, etc). Provide design ratings for dehys (MMCFD), process heaters, burners and pilots (MMBtu/hr, SCFH). Provide size of production & water storage tanks (BPD). For dehydration units indicate if the unit includes a glycol flash separator or reboiler still vent condenser. For emission control combustors/flares indicate design rating (MMBtu/hr, SCFD) and combustor/flare height (ft). Provide pneumatic pump motive gas useage (SCFH).

If more space is required, continue on page 2 of this sheet.

PROVIDE INSTALLATION DATES OF ALL EMISSION CONTROL EQUIPMENT & MONITORING DEVICES/SYSTEMS !!!

Example:

1 2-phase high pressure separator (unheated)

1 3-phase low pressure separator w/ 0.5 MMBtu/hr heater

2 0.5 MMBtu/hr line heaters

1 5 MMCFD TEG dehydration unit w/ 0.5 MMBtu/hr reboiler heater, glycol flash separator(0.5 MMBtu/hr heater) and overheads condenser

2 400-bbl condensate tanks

1 400-bbl produced water tank

1 30-ft enclosed combustor (3.0 MMBtu/hr, 5 MCFD) for flashing & reboiler vent/glycol flash separator emissions control installed 1/1/2007

Form AQD-OG2 Equipment List Page 2

STATE OF WYOMING
Department of Environmental Quality - Air Quality Division
Oil and Gas Production Facilities C6 S2 Permit Application

Equipment List - continued

Company Name _____

Facility Name _____

Form AQD-OG3 Storage Tanks, Pressurized Vessels & Pneumatic Pumps

STATE OF WYOMING

Department of Environmental Quality - Air Quality Division
Oil and Gas Production Facilities C6 S2 Permit Application
Storage Tanks, Pressurized Vessels & Pneumatic Pumps

Use as many copies of this form as necessary to include all tanks, vessels and pumps.

Company Name _____

Facility Name _____

STORAGE TANKS

Below, list all atmospheric tanks used to store liquids transferred from an upstream vessel or wellhead. Upstream vessels include separators, treaters, flash tanks, FWKOs, gun barrels, tanks, etc. If more than one tank of the same size is used for the same purpose, receiving fluids from the same upstream vessel, those tanks may be combined on one line.

E X A M P L E S				
2-400	condensate	100	2-phase separator	600
1-1000	produced water, skim oil	1000 water, 5 oil	treater	30
1-300	bad oil tank	5 oil	run tank	atmospheric
size (bbl)	use (condensate / oil / H_2O)	total throughput (bpd)	upstream vessel	upstream vessel pressure (psig)

PRESSURIZED VESSELS List each vessel separately.

Pressurized vessels include FWKO's, heater-treaters, separators (2-phase & 3-phase), gas boots, gun barrels, flash tanks, etc…

E X A M P L E S			
HP 2-phase separator	600	well	1000
LP 3-phase separator	300	HP separator	600
3-phase heater treater	30	well	40
vessel	operating pressure (psig)	upstream vessel	upstream vessel pressure (psig)

What is the API gravity of the SALES oil or condensate at this facility? _____

Does this facility handle sour oil / gas? YES _____ NO _____

EMISSION CONTROL DEVICES & SYSTEMS for FLASH VAPORS & PRESSURE VESSEL PROCESS STREAMS

Identify each emission control system or device and the date(s) of installation for each.

E X A M P L E: 30-foot ACME smokeless combustor for tank vapor emissions control, installed 1/1/2008

Combustion Device Emission Controls (if applicable)

Date of Installation _____

Manufacturer _____

Smokeless Design? Yes _____ No _____

Excess Oxygen (%) _____

VOC Destruction Effeciency (%) _____ HAP Destruction Efficiency (%) _____

Maximum Design Throughput (SCFD) _____ Minimum Design throughput (SCFD) _____

Actual Waste Gas Volume (SCFD) _____ Waste Gas Heat Content (Btu/SCF) _____

Burner Rating (MMBtu/hr) _____

Ignition System: Pilot _____ Electric Spark _____ Other _____

Continuous Pilot? Yes _____ No _____

Pilot Gas Volume (SCFM) _____

Is the Combustion Device Monitored? Yes _____ No _____ How? _____

PNEUMATIC PUMPS

Describe each pneumatic pump using natural gas as the motive gas. Indicate where motive gas is vented (atmosphere or other).

E X A M P L E: 50 SCFH Acme brand heat trace circulation pump operated w/ produced gas, vented to gas collection system.

Form AQD-OG4 Dehydration Units

STATE OF WYOMING
Department of Environmental Quality - Air Quality Division
Oil and Gas Production Facilities C6 S2 Permit Application
Dehydration Units

Use multiple copies of this form to provide the required information for each dehydration unit at the facility.

Company Name _____

Facility Name _____

Fill in all information below for each dehydration unit.

Design Rating (MMSCFD) _____
Type of Glycol: TEG ____ DEG ____ EG ____ other _____
Reboiler Heater Rating (MMBtu/hr) _____

Wet Gas (Upstream of Contact Tower)

Temperature (ºF) _____ Pressure (psig) _____
Is the Wet Gas Saturated? YES ____ NO ____
If NO, Wet Gas Water Content (lbs H_2O/MMSCF) _____

Dry Gas (Upstream of Contact Tower)

Flowrate (MMSCFD) _____ Water Content (lbs H_2O/MMSCF) _____

Glycol Circulation Pump

Manfacturer _____
Model _____
Gas Operated Pump? _____ Electric Pump? _____
Maximum LEAN Glycol Circulation Rate (gpm) _____ Actual LEAN Glycol Circulation Rate (gpm) _____
Limited LEAN Glycol Pump Rate (gpm) (if applicable) _____
Source of Motive Gas for Pump _____
Pump Volume Ratio (ACFM/gpm) _____

Glycol Flash Separator (if applicable)

Operating Temperature (ºF) _____ Operating Pressure (psig) _____
Indirect Heater Rating (MMBtu/hr) _____
Where are Flash Vapors Routed? _____

Stripping Gas (if applicable)

Source of Stripping Gas: Dry Gas _____ Flash Gas _____ Nitrogen _____
Stripping Gas Rate (scfm) _____

Process Vent Emissions Control System / Device

Reboiler Still Vent Condenser (if applicable)

Operating Temperature (ºF) _____ Operating Pressure (psia) _____
Where are Non-Condensible Vapors Routed? _____

Combustion Device (if applicable)

Date of Installation _____
Manufacturer _____
Smokeless Design? Yes ____ No ____
Excess Oxygen (%) _____
VOC Destruction Effeciency (%) _____ HAP Destruction Efficiency (%) _____
Maximum Design Throughput (SCFD) _____ Minimum Design throughput (SCFD) _____
Actual Waste Gas Volume (SCFD) _____ Waste Gas Heat Content (Btu/SCF) _____
Burner Rating (MMBtu/hr) _____
Ignition System: Pilot ____ Electric Spark ____ Other ____
Continuous Pilot? Yes ____ No ____
Pilot Gas Volume (SCFM) _____
Is the Combustion Device Monitored? Yes ____ No ____ How? _____

Describe any process vent emission control devices or systems not described above.

_____
_____
_____

Form AQD-OG4 Dehydration Units AUGUST 2007

Form AQD-OG5 Pumping Unit Engines

STATE OF WYOMING

Department of Environmental Quality - Air Quality Division
Oil and Gas Production Facilities C6 S2 Permit Application
Pumping Unit Engines

This form is to be used for PUMPING UNIT ENGINES ONLY

Company Name _____

Facility Name _____

Engine Manufacturer _____

Model _____

Site Rated Horsepower _____

Number of Cylinders _____

Date of Installation _____

Fuel Type

Natural Gas _____ LP _____

Diesel _____ Gasoline _____

Emissions

Nitrogen Oxides (NO_X) (grams / Hp-hr) _____

Carbon Monoxide (CO) (grams / Hp-hr) _____

Formaldehyde (grams / Hp-hr) _____

Voltile Organic Compounds (VOC) (grams / Hp-hr) _____

Annual Operating Hours (continual - 8760 hr/yr) _____

Emission Control Equipment

Lean Burn Technology _____

Oxidation Catalyst _____

NSCR Catalyst _____

SCR Catalyst _____

Other _____

BEST AVAILABLE CONTROL TECHNOLOGY (B A C T)

Is a BACT analysis attached? YES _____ NO _____

Form AQD-OG6 Emission Summary

STATE OF WYOMING

Department of Environmental Quality - Air Quality Division
Oil and Gas Production Facilities C6 S2 Permit Application

EMISSION SUMMARY

Company Name _____

Facility Name _____

This form must be completed for each emission source at the facility. A list of the emission sources which must be considered is found in Appendix B of the C6 S2 O&G Production Facilities Permitting Guidance.

UNCONTROLLED EMISSIONS (Tons Per Year)

These are the total uncontrolled, potential emissions from each source.

EMISSION SOURCE (i.e., tank, natural gas-fired heater, reboiler still vent, glycol flash separator, pneumatic pump, separator gas vent, water knockout vent, etc.)	**VOCs**	**total HAPs**	**NOX**	**CO**	**SO2**	**H2S**

CONTROLLED EMISSIONS (Tons Per Year)

These are the total emissions from each source. Include controlled emissions from each controlled source and uncontrolled emissions from each source which does not require control, such as process equipment burners.

EMISSION SOURCE	**VOCs**	**total HAPs**	**NOX**	**CO**	**SO2**	**H2S**

HAZARDOUS AIR POLLUTANT SUMMARY (Tons Per Year)

Complete this section for each emissions source if TOTAL HAPs from that source are 9 TPY or greater.					
SOURCE	**Benzene**	**Toluene**	**Ethyl-Benzene**	**Xylenes**	**Other**

Form AQD-OG7 Notice of Installation

STATE OF WYOMING
Department of Environmental Quality - Air Quality Division
Oil and Gas Production Facilities C6 S2 Permit Application
NOTICE of INSTALLATION

Company Name _____
Facility Name _____

Appropriate use of this form is described on Pages 26 - 28 of the C6 S2 O&G Production Facilities Permitting Guidance.
Submit one (1) signed original copy and one (1) electronic copy of the NOI
OR
three (3) paper copies of the Notice of Installation - one (1) with an original signature.

Contact
Name _____ Title _____
Address _____
Telephone _____ Fax _____ E-Mail _____

Location
County _____
¼ ¼ Section _____ Section _____ Township _____ Range _____
Latitude _____ Longitude _____

Date of Installation _____

Facility Information
API number, if applicable _____
Well field name _____
Producing formation, if applicable _____

Is this NOI being filed for new equipment at a new location? YES ____ NO ____
Is this NOI being filed for new or replacement equipment at an existing location? YES ____ NO ____
If YES, list existing Air Quality Permit or Waiver numbers. _____
List any pending Air Quality Permit application numbers. _____

Below, list the equipment to be installed under this NOI.

EXAMPLES	
(1) 0.5 MMBut/hr line heater	(1) 25-Hp AJAX pumping unit engine, 2 TPY NO_X emissions
replace 400-bbl condensate tank with like kind	wellhead only @ new sour well facility
(1) 400-bbl cond. tank, vent line routed to existing combustor	(1) unheated 2-phase separator, dumps to collection system

Attach any information demonstrating equipment installed under this NOI complies with the conditions described on Pages 26 - 28 of the C6 S2 O&G Production Facilities Permitting Guidance. For example, provide manufacturer's engine emission factors indicating emissions from a new pumping unit engine will be less than 5 TPY NO_X.

I, _____ _____
Responsible Official Title

state that I have knkowledge of the facts herein set forth and that the same are true and correct to the best of my knowledge and belief. I further certify that the emission rates listed on this certification reflect the anticipated emissions due to the operation of this facility. The facility will operate in compliance with all Wyoming Air Quality Standards and Regulations.

Signature _____ Date _____
Signature Required

Form AQD-OG7 NOTICE of INSTALLATION AUGUST 2007

Form AQD-OG8 Multiple Facilities

STATE OF WYOMING

Department of Environmental Quality - Air Quality Division
Oil and Gas Production Facilities C6 S2 Permit Application

Multiple Facilities

Provide the following information for each site included with a multiple facility application. You may use this form or provide the required information on a spreadsheet or complete as many copies of this form as necessary to include all sites.

Company Name _____

Site Name _____
API Number _____
Production Field Name _____ Producing Formation _____

First Date of Production _____

LOCATION

County _____
Legal Description ¼ ¼ Section _____ Section _____ T _____ R _____
Latitude _____ Longitude _____

CURRENT PRODUCTION RATES

gas (MMCFD) _____ oil / condensate (BPD) _____

EQUIPMENT

List tanks, separators, treaters, pneumatic pumps, dehys, flares, burners, etc. Include sizes & design ratings.

_____ _____
_____ _____
_____ _____
_____ _____

Site Name _____
API Number _____
Production Field Name _____ Producing Formation _____

First Date of Production _____

LOCATION

County _____
Legal Description ¼ ¼ Section _____ Section _____ T _____ R _____
Latitude _____ Longitude _____

CURRENT PRODUCTION RATES

gas (MMCFD) _____ oil / condensate (BPD) _____

EQUIPMENT

List tanks, separators, treaters, pneumatic pumps, dehys, flares, burners, etc. Include sizes & design ratings.

_____ _____
_____ _____
_____ _____
_____ _____

Form AQD-OG9 Change of Ownership

STATE OF WYOMING

Department of Environmental Quality - Air Quality Division

Change of Ownership Form

NEW OWNER

Company Name _____

Mailing Address _____

City _____ State _____ Zip Code _____

Owner or Company Official to contact regarding air pollution matters:

Name _____ Title _____

Address _____

Telephone _____ Fax _____ E-mail _____

PREVIOUS OWNER

Company Name _____

Mailing Address _____ _____

City _____ State _____ Zip Code _____

Telephone _____ Fax _____ E-Mail _____

FACILITY INFORMATION

Facility Name _____ County _____

Date of Ownership Change _____

Legal Description ¼ ¼ Section _____ Section _____ T _____ R _____

Lat/Long Coordinates Latitude _____ Longitude _____

Type of Facility Tank Battery ____ Wellsite Facility ____ Dehydration Unit ____

Compressor Station ____ Gas Plant ____ Other ____

Describe if other _____

_____

FOR MULTIPLE SITES...

On a separate piece of paper continue the list of the facility names, counties, location descriptions and facility types for each site for which ownership has changed.

Form AQD-OG10 BACT Cost Analysis

Company Name: _____
Facility Name: _____

Wyoming Air Quality Standards and Regulations - Chapter 6, Section 2(c)(v)

Best Available Control Technology Control Cost Analysis Worksheet

(Based on Office of Air Quality Planning and Standards, EPA, OAQPS Control Cost Manual, Fourth Edition, EPA 450/3-90-006, January 1990, Section 2.3.2)

Reference No.	Site Rating (units)	Manufacturer	Model	Control Method	Controlled or Targeted Emission	Typical BACT (units)	Targeted Emission without Control (TPY)	Targeted Emission with Control (TPY)
Example	1500	Waukesha	L7042GSI	Catalitic/AFR	NOx	2 g/hp-hr	144.7	28.9

Reference No.	Interest Rate (i)	Control System Life (n)	Capital Recovery Factor (CRF)	Capital Investment (P)	Annual Maintenance Cost	Capital Recovery Cost (CRC)	Realized Economic Benefit
Example	0.1	10	0.163	$14,000	$4,000	$2,278	$0
0			#DIV/0!			#DIV/0!	
0			#DIV/0!			#DIV/0!	

"n" is the control system economic life, typically thought to be 10-20 years.
"i" is the considered the annual pretax marginal rate of return on private investment (i.e., what it may cost you to borrow the money).
"P" is the capital investment required to install the controls (i.e., equipment purchase cost, installation/retrofit cost, engineering, etc.).
Annual Maintenance Cost is the yearly costs to maintain the control effectiveness (i.e., cleaning, testing, etc).

CRC = CRF * P

CRC = Capital Recovery Cost (Annualized cost of control over the life of the control)
CRF = Capital recovery Factor
P = Capital Investment

CRF = i(1+i)n/(1+i)n-1

i = Annual Interest Rate
n = Economic life of the control

Total Annual Cost (TAC) = Annual Maintenance Cost + Capital Recovery Cost - Realized Economic Benefit

Cost to Control = TAC / (Targeted Emission Volume Without Control - Targeted Emission Volumn with Control)

Reference Number	TAC ($)	Cost to Control ($/Ton)
Example	$6,278	**$54**
0	#DIV/0!	**#DIV/0!**
0	#DIV/0!	**#DIV/0!**

Does the control have "Economic Reasonableness" and "Technical Practicability"? _____

APPENDIX B

EMISSION CALCULATIONS

B L A N K

C6 S2 O&G Production Facilities Permitting Program

EMISSIO ESTIMATIONS & CALCULATIONS

STATEWIDE & JPAD Area

Emissions from processes and equipment which must be accounted for and reported by applicants FOR ALL O&G PRODUCTION FACILITIES are:

Emission Unit or Process	Associated Emissions [1]
storage tanks (flashing & S/W/B losses)	VOC HAP H_2S
pressurized vessels (flashing losses)	VOC HAP H_2S
dehydration units (reboiler still vents & glycol flash tanks)	VOC HAP
natural gas fired burners, heaters, flares	NO_X CO SO_2
natural gas operated pneumatic pumps	VOC HAP H_2S
fugitives	VOC HAP H_2S
natural gas fired engines	NO_X CO SO_2
truck load out	VOC HAP H_2S

AP-42 EMISSION FACTORS

Throughout this Guidance reference is made to AP-42 emission factors. These factors are compiled and approved by the EPA. An emissions factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kilograms of particulate emitted per megagram of coal burned). Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all facilities in the source category (i.e., a population average).

The complete AP-42 compilation may be downloaded from http://www.epa.gov/ttn/chief/ap42/index.html

STORAGE TANK EMISSIONS

Flashing and Standing/Working/Breathing (S/W/B) losses are the terms for emissions which occur when hydrocarbon liquids are exposed to temperature and pressure changes (ie, from separator pressure and temperature to storage tank pressure and temperature) causing hydrocarbon vapors to be released from the liquids. The vapors may contain VOCs, HAPs and H_2S.

Software is available for modeling these emissions. Models accepted by the Air Quality Division are those using Peng-Robinson or S-R-K methods based on widely accepted principals of behavior for hydrocarbon vapors and liquids. Some common software programs for estimating these emissions are HYSIM, HYSYS, K-FLASH, PROSIM and API E&P TANKS v2.0. The models require input detailing chemical properties of the fluids handled and physical operating parameters of the system(s) and production equipment. Output from the models includes volumes, rates and chemical components of the individual process streams from tanks and pressurized vessels.

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EMISSION ESTIMATIONS & CALCULATIONS

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Emissions from storage tanks may also be physically measured. In order to do so all tank valves, hatches, relief devices, leaks, etc. must be sealed. Tank vapors must only be allowed to exit the tank through a metered outlet. Usually this requires a meter capable of measuring low volumes. The measurement period must last long enough to capture a representative tank vapor volume. An extended hydrocarbon analysis of the vapors must be obtained along with the vapor volume.

MEASURED TANK FLASH EMISSIONS - EXAMPLE CALCULATION

Vapors from a condensate tank are measured at 1000 SCF per day. An extended hydrocarbon analysis of the vapors indicates the vapors consist of 20% by weight VOCs and 5% by weight HAPs and that the molecular weight of the vapors is 20 lb/lb-mol. The tons per year of VOC and HAP emissions are calculated as follows:

TPY total flash emissions
= 1000 SCF/day × (1 lb-mol/379 SCF) × (20 lb/lb-mol) × (ton/2000 lb) × (365 days/year)
= 9.6 TPY
9.6 TPY × (20 weight % VOC / 100) = 1.9 TPY VOC
9.6 TPY × (5 weight % HAP / 100) = 0.5 TPY HAP

S/W/B losses

Not all software programs include tools for estimating S/W/B losses. There is free software available from the EPA named EPA TANKS. The most recent available version of EPA TANKS is ver. 4.09D. The software may be downloaded from the EPA website at http://www.epa.gov/ttn/chief/software/tanks/index.html

VASQUEZ-BEGGS GAS-OIL (GOR) CORRELATION

For flashing losses from lower gravity crude oil storage tanks, a mathematic correlation called the Vasquez-Beggs Gas-Oil Ratio (GOR) Correlation may sometimes be used. Caution should be used along with the V-B Correlation since it provides only a very rough estimate of potential tank vapors. If the correlation indicates emissions close to controllable levels, a more precise method should be used to more accurately estimate tank emissions.

The parameters necessary for input to the V-B Correlation are:

1) API gravity of the stock tank sales oil (ºAPI)
2) operating pressure of the separator or treater upstream of the stock tank (psig)
3) operating temperature of the separator or treater upstream of the stock tank (ºF)
4) specific gravity of the gas inside the separator or treater upstream of the stock tank (no units)
5) stock tank throughput (BOPD)
6) molecular weight of the stock tank vapors (lb/lb-mol)
7) various weight fractions of individual constituents of the stock tank vapors, ie wt% VOC, wt% HAPs, wt% H_2S

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Parameters 4, 6 and 7 must be obtained from extended lab analyses of the separator gas and tank vapors. If gas from a particular facility is sold, parameter 4 is usually known and can be found in a sales contract or other records.

The AQD has set the following constraints for use with the V-B Correlation. If your facility does not fall within these constraints, the V-B Correlation is not an acceptable method for estimating flash emissions:

V-B Constraints: crude oil gravity < 40 ºAPI
separator operating pressure < 5250 psia
separator operating temperature < 295 ºF
separator specific gravity between 0.56 and 1.18
stock tank gas molecular weight between 14 and 125 lb/lb-mol
weight percent of constituent to be estimated (ie 0.5 for 50% by weight)

You may download the V-B Correlation, an EXCEL spreadsheet, at http://deq.state.wy.us/aqd/miscforms.asp

PRESSURIZED VESSELS

Whenever vapors from a pressurized vessel (separator, treater, FWKO, flash separator, gunbarrel, gas boot, etc) are released to the atmosphere, other than during times of emergency or upset conditions, emissions associated with those vapors must be accounted for.

The same flashing emission models mentioned above, for tank flashing emissions, are often used to estimate emissions from pressurized vessels. Again, an extended hydrocarbon analysis of the liquids involved and actual operational conditions of the production equipment are necessary as input for the models.

Even when vapors from a pressurized vessel are collected for use as process burner fuel or fuel for an IC engine, for example, emissions associated with the total vapors must be accounted for when considering potential emissions from a facility.

If the volume and rate of vented vapors are known and an extended hydrocarbon analysis is available, associated emissions may be calculated in the same manner as described on Page 60 (calculation of flash emissions). If these are not available, the volumes must be measured and analyzed in order to perform the calculations and determine associated emissions.

DEHYDRATION UNIT EMISSIONS

Regulated pollutants, mostly VOCs and HAPs, are associated vapors released from reboiler still vents and glycol flash separators. To estimate these emissions the GRI-GLYCalc v3.0 or higher model is used. This relatively inexpensive software was created by the Gas Research Institute (GRI) for determining optimal operating parameters for dehydration units and is available from the Gas Technology Institute (GTI) with a website address of http://www.gastechnology.org

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Input for the model includes an extended hydrocarbon analysis of wet gas sampled upstream of the contact tower, actual operating parameters of all associated equipment (ie reboiler still vent temp., flash separator temp., dry gas flow rate, glycol recirculation rate, condenser, etc) and physical properties of the dry and wet gas streams. The model provides an estimate of individual emission components and the rates of vapor and liquid streams exiting each process vent of a dehydration unit.

When submitting a GRI-GLYCalc model it is only necessary to submit the INPUT SUMMARY and EMISSIONS SUMMARY.

NATURAL GAS FIRED HEATERS (external combustion equipment)

NO_X, CO and VOC emissions from process unit heaters should be calculated using the emission factors (EF) provided in AP-42, Tables 1.4-1, 1.4-2 and 1.5-2. The following lists these factors:

Emission Factors for Fuel Boilers and Heaters

Pollutant	LP Gas[1] (0.3 to 10)	LP Gas (10 to 100)	Natural Gas[2] <100 MMBtu/hr heat input
NO_X	14 lb/1000 gal	19 lb/1000 gal	100 lb/MMcf
CO	1.9lb/1000 gal	3.2 lb/1000 gal	84 lb/MMcf
TOC[3]	0.5 lb/1000 gal	0.5 lb/1000 gal	11 lb/MMcf

[1] LP gas emission factors are bed on an average liquid propane heating value of 91,500 Btu/gal. Ratio the emission factor according to the Btu content of the LP actually used.

[2] Natural gas emission factors are based on an average natural gas higher heating value of 1020 Btu/scf. When the heat content of the natural gas at a site differs from 1020 Btu/scf, the emissions factor must be adjusted by the ratio of heat rates (actual Btu / 1020 Btu).

[3] VOC emissions may be determined by multiplying the calculated TOC (total organic compounds) emission rate by the weight percent of VOC compounds in the actual fuel gas stream.

PROCESS HEATER EMISSIONS - EXAMPLE CALCULATION

A 0.5 MMBtu/hr separator heater uses lease gas for fuel. A lease gas assay indicates the heating value of the gas is 1300 Btu/scf. The VOC weight fraction of the gas is 20%. The burner operates 8760 hours/year. From the table above, the Natural Gas EFs for a 0.5 MMBtu/hr natural gas heater are 100 lb NO_X/MMcf, 84 lb CO/MMcf and 11 lb TOC/MMcf.

NO_X emissions:

Adjust the NO_X emission factor: 100 lb/MMCF × (1300 Btu/1020 Btu) = 127.4 lb NO_X/MMcf

NO_X = (0.5 MMBtu/hr) × (1 scf/1020 Btu) × (127.4 lb NO_X/MMcf) × (8760 hr/yr) × (ton/2000 lb) = 0.27 TPY NO_X

For CO emissions, the same calculation is used except the EF is 84 lb/MMcf.

VOC emissions:

TOC = 0.5 × 1/1020 × 11 × (1300/1020) × 8760/2000 = 0.03 TPY

0.03 TPY × (20% VOC/100) = 0.006 VOC TPY VOC ← INSIGNIFICANT at less than 0.1 TPY

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EMISSION ESTIMATIONS & CALCULATIONS

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FLARES

The NO_X and CO emissions for flares should be based on **0.14 lb NO_X/MMBtu and 0.035 lb CO/MMBtu** and the reported fuel usage based heat input. VOC and HAP emissions from flaring should be based upon the guaranteed destruction efficiency of the flare. Reported flared gases must include pilot gas with heat content and flared gas with average estimated heat content. The rational for using these factors as opposed to AP-42 factors for flares is that the flare factors are believed to be only applicable to chemical plant type flares engaged in burning low BTU gases. The gases typically burned in flares in Wyoming contain more than 900 Btu/scf and emissions are expected to be closer to the AP-42 factors for NO_X and CO from gas fired heaters and boilers greater than 10 MMBtu/hr.

FLARE EMISSIONS - EXAMPLE CALCULATIONS
VOC, HAP, NO_X, CO, H_2S & SO_2 emissions from a tank vapor combustor

125 scf/hour of 1350 Btu/scf gas from flashing losses is routed to a combustor for incineration. 125 scf/hour amounts to 50 TPY VOC emissions and 10 TPY HAP emissions. Destruction efficiency for VOCs and HAPs is certified by the flare manufacturer to be 98%. The flare pilot uses 5 scf/min of field gas with a heat content of 1000 Btu/scf. The flared tank gas contains 4.4 mol% H_2S and 5.5 wt% H_2S. Molecular weight of the tank flash vapors is 28 lb/lb-mol.

NO_X emissions from flare
= (125 scf/hr) × (1350 Btu/scf) × (0.14 lb NO_X /MMBtu) × (MMBtu/10^6 Btu) × (8760 hr/yr) × (1 ton/2000 lb) = 0.1 TPY NO_X

NO_X emissions from pilot
= (5 scf/min) × (1000 Btu/scf) × (0.14 lb NO_X/MMBtu) × (MMBtu/10^6 Btu) × (60 min/hr) × (8760 hr/yr) × (1 ton/2000 lb) = 0.18 TPY NO_X
For CO emissions the same calculations are used except the EF for CO is 0.035 lb/MMBtu.

VOC emissions from flare
= (50 TPY VOC) × (100% - 98%/100)
= 50 TPY VOC × 0.02 = 1.0 TPY VOC

HAP emissions from flare
= (10 TPY HAP) × 0.02 = 0.2 TPY HAP

Unflared H_2S emissions from tank flash
(125 scf/hr) × (28 lb/lb-mol) × (1 lb-mol/379 scf) × (8760 hr/yr) × (ton/2000 lb) = 40 TPY of tank flash
(40 TPY tank flash) × (5.5/100) = 2.2 TPY H_2S

Flared H_2S emissions
= (2.2 TPY) × (100% - 98%/100)
= 0.04 TPY H_2S ← INSIGNIFICANT at less than 0.1 TPY

SO_2 emissions from flaring sour gas
(125 scf/hr) × (8760 hr/yr) × (1 lb-mol/379 scf) × (64 lb SO_2/lb/mol) × (ton/2000 lb) × (4.4/100)
= 4.1 TPY SO_2 Where 64 lb/lb-mol = molecular weight of SO_2

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ANOTHER FLARE EMISSIONS EXAMPLE CALCULATION
NO_X, CO emissions from a controlled dehydration unit

The GRI-GLYCalc model predicts 25 SCFM exiting the glycol flash separator and 5 SCFM exiting the reboiler still vent of an uncontrolled dehydration unit. Both streams contain a total of 50 TPY VOC emissions and 25 TPY HAPs emissions. Both streams are routed to a flare for emission control through combustion. The flare achieves 98% destruction of VOCs and HAPs by converting the vapors to NO_X, CO and water vapor. NO_X and CO emissions must be determined.

NO_X emissions from flare
(30 SCF/min) × (1050 Btu/SCF) × (0.14 lb NO_X/MMBtu) × (1 MMBtu/10^6 Btu) × (60 min/hr)
× (8760 hr/yr) × (1 ton/2000 lb)
= 1.1 TPY NO_X

Where: 30 SCF/min = the glycol flash stream (25 SCF/min) + the reboiler stream (5 SCF/min)
1050 BTU/SCF = the heat content of the waste gas streams (**assume at least 1000 BTU/SCF if the heat content is unknown**)

PNEUMATIC PUMPS

If a pneumatic pump uses natural gas as the motive gas, the pump will release VOC and HAP emissions each time it strokes since all motive gas is vented by the pump. To determine emissions from the pump, manufacturer's information regarding gas useage must be known as well as the hydrocarbon composition of the motive gas.

PNEUMATIC PUMP EMISSIONS - EXAMPLE CALCULATION

A Texsteam Series MX pump is used to circulate hot glycol in heat trace lines. The pump moves 0.15 gallons per 40 strokes and is currently stroking at 20 strokes per minute (spm). The pump requires 24 scf for each gallon of glycol pumped. The pump motive gas weighs 20 lb/lb-mol and contains 50 wt% VOCs and 30 wt% HAPs.

Pump useage/vent rate
= (20 strokes/min) × (0.15 gallons/40 strokes) × (24 scf/gallon) = 1.8 scf/min

VOC emissions = (1.8 scf/min) × (20 lb/lb-mol) × (lb-mol/379 scf) × (ton/2000 lb) × (525600 min/yr)
= 25 TPY total gas emitted by pump
(25 TPY total gas) × (50 wt% VOC/100) = 12.5 TPY VOC emissions

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SOUR GAS

SO_2 emissions from burning sour gas are based on the mass balance conversion of H_2S to SO_2.

$$2H_2S + 3O_2 \rightarrow 2SO_2 + 2H_2O$$

EMISSIONS FROM BURNING SOUR GAS - EXAMPLE CALCULATION

10 MCFD of produced sour gas with 4.4 mol% H_2S is flared.

SO_2 emissions from flare
(10 Mcf/day) × (1 day/24 hr) × (1 lb-mol/379 scf) × (64 lb SO_2/lb-mol) × (1000 scf/Mcf) × (4.4/100) = 3.1 lb/hr SO_2
(3.1 lb/hr SO_2) × (ton/2000 lb) × (8760 hr/yr) = 13.5 TPY SO_2

Calculate NO_X and CO using the flare emission factors and examples shown on the previous page.

TRUCK LOADING

VOC emissions from loading oil or condensate into tank trucks should be estimated using the following formula with data from AP-42 tables.

$$L_L - 12.46 \times S \times P \times M/T$$

Where: **L_L** = loading loss, pound per 1,000 gallons of liquid loaded (lb/1000 gal)
S = a saturation factor (See Table 5.2-1 below)
P = true vapor pressure of liquid loaded (psia)
M = molecular weight of tank vapors (lb/lb-mol)
T = temperature of bulk liquid loaded (ºR) (ºR = ºF + 460)

"**S**" values are obtained from Table 5.2-1.
"**M**" and "**N**" values are obtained from Table 7.1-2.

Table 5.2-1 Saturation (S) Factors for Calculating Petroleum Liquid Loading Losses

Cargo Carrier	Mode of Operation	"S" Factor
tank trucks and rail tank cars	submerged loading of a clean cargo tank	0.50
	submerged loading: dedicated normal service	0.60
	submerged loading: dedicated vapor balance service	1.00
	splash loading of a clean cargo tank	1.45
	splash loading: dedicated normal service	1.45
	splash loading: dedicated vapor balance service	1.00

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Table 7.1-2 Properties of Selected Petroleum Liquids
Only crude oil properties are supplied here. The full table of values can be found in AP-42, Table 7.1-2)

petroleum liquid	vapor molecular weight at 60ºF (lb/lb-mol)	condensed vapor density at 60ºF (lb/gal)	liquid density at 60ºF (lb/gal)	true vapor pressure (psi) at various temperatures in ºF						
				40	50	60	70	80	90	100
	"M"			"P"						
Crude Oil RVP 5	50	4.5	7.1	1.8	2.3	2.8	3.4	4.0	4.8	5.7

TRUCK LOADOUT - EXAMPLE CALCULATION

360 bbls of crude oil per month is loaded by truck. The oil is stored at an average annual temperature of 50ºF. The truck is designed such that liquids enter into the tank bottom (submerged loading) to avoid splashing. The truck capacity is 90 bbl and takes 1 hour to load.

From Table 5.2-1 for submerged loading, dedicated normal service: "**S**" = 0.6
From Table 7.1-2 for crude oil, RVP = 5 at 50ºF: "**P**" = 2.3
From Table 7.1-2 for crude oil, RVP = 5 at 50ºF: "**M**" = 50

$$L_L = \frac{(12.46) \times (0.60) \times (2.3 \text{ psi}) \times (50 \text{ lb/lb-mol})}{(50^\circ\text{F} + 460)} = 1.69 \text{ lb/1000 gal}$$

Loading losses (TPY) = (1.69 lb/1000 gal) × (annual sales of 360 bbl/mo) × (12 mo/yr) × (42 gal/bbl) × (ton/2000 lb) = 0.15 TPY

Emissions (lb/hr) = (1.69 lb/1000 gal) × (truck load rate of 90 bbl/hr) × (42 gal/bbl) = 6.39 lb/hr

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FUGITIVE EMISSIONS

The easiest way to calculate total hydrocarbon fugitive emissions is to multiply the number of components at a site by the EPA Average Emissions Factors shown in the tables below. The first table lists the average emission rates of **total hydrocarbon** (THC) to be assumed for all components in hydrocarbon service installed at a site. The factors are current as of June 15, 1996 and given in pounds per component - day (lb/component-day). The second table lists speciated rates.

The only information needed for this method is a count or estimate of the number of flanges, connectors (other than flanges), open-ended lines, pumps, valves and "other" components at the site grouped by stream (gas, light oil, heavy oil, water/oil). The number of components can be determined by either counting them in the field or by estimating them.

EPA Average Emission Factors for Total Hydrocarbon (THC) Emissions From O&G Production Operations

(lb/component-day)

equipment type	equipment service category			
	gas	heavy oil (< 20ºAPI)	light oil (> 20ºAPI)	water/light oil [1]
connector	.011	.0004	.011	.0058
flange	.021	.000021	.0058	.00015
open ended line	.11	.0074	.074	.013
other [2]	.47	.0017	.4	.74
pump	.13	not available	.69	.0013
valve	.24	.00044	.13	.0052

SOURCE: US EPA Bulletin Board (Leaks_OG.WP5; 8/9/1995)

[1] The water/light oil emission factors apply to water streams in light oil service with water content between 50% and 99%. For streams with water content > 99% the emission rate is considered negligible.

[2] The "other" equipment type includes compressor, pressure relief valves, diaphragms, drains, dump arms, hatches, instruments, meters, polished rods and vents.

Speciated hydrocarbon emission rates can be estimated by multiplying the total hydrocarbon emission rates obtained from the table above by the values listed in the table below.

Speciated Fugitive Emission Factors

(Estimated weight fractions of THC emissions in each category)

	Methane	NMHC	VOC	$C6^+$	Benzene	Toluene	Ethyl-Benzene	Xylenes
light crude	0.613	0.387	0.292	0.02430	0.00027	0.00075	0.00017	0.00036
heavy crude	0.942	0.058	0.030	0.00752	0.00935	0.00344	0.00051	0.00372
gas production	0.92	0.080	0.035	0.00338	0.00023	0.00039	0.00002	0.00010

NOTES: 1. Emission factor = Speciated Emissions/Total Emissions
2. NMHC = Non-methane hydrocarbons
3. VOC = Propane and heavier hydrocarbons

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FUGITIVE EMISSIONS - EXAMPLE CALCULATION

A site has 25 valves in light oil service containing condensate.

EPA Average Emissions Table: The THC emission factor for valves in light oil service is 0.13 lb/component-day.

VOC Emissions (lb/component-day) = 25 valves × 0.13 lb THC/valves-day = 3.25 lb/day

Speciated Fugitive Emissions Table: The estimated weight fraction of THC emissions for light crude are listed in row 1 of the table. For VOCs the weight fraction is 0.292.

VOC Emissions (TPY) = 3.25 lb/day × 1 ton/2000 lb × 365 day/hr × 0.292 = 0.17 TPY VOC

total HAP emissions (lb/component-day) = 25 valves × 0.13 lb THC/valves-day = 3.25 lb/day

total HAP weight fractions = 0.02430 + 0.00027 + 0.00075 + 0.00017 + 0.00036 = 0.0259

total HAP Emissions (TPY) = 3.25 lb/day × 1 ton/2000 lb × 365 day/yr × 0.0259 = 0.015 TPY total HAPs

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EMISSION ESTIMATIONS & CALCULATIONS

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INTERNAL COMBUSTION ENGINE EMISSIONS

The preferred method for calculating engine emissions is to use emission factors provided by the engine Manfacturer. If these can not be obtained, emissions can be estimated using AP-42 emission factors. The most commonly used tables are below.

AP-42 Table 3.2-1: Emission Factors for Uncontrolled Natural Gas-Fired Engines

Pollutant	2-cycle lean burn		4-cycle lean burn		4-cycle rich burn	
	g/Hp-hr (power input)	lb/MMBtu (fuel input)	g/Hp-hr (power input)	lb/MMBtu (fuel input)	g/Hp-hr (power input)	lb/MMBtu (fuel input)
NO_X	10.9	2.7	11.8	3.2	10.0	2.3
CO	1.5	0.38	1.6	0.42	8.6	1.6
TOC [1]	5.9	1.5	5.0	1.3	1.2	0.27

[1] TOC is total organic compounds (sometimes referred to as THC). To determine VOC emissions calculate TOC emissions and multiply the answer by the VOC weight fraction of the fuel gas.

AP-42 Table 3.3-1: Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines [a]

pollutant	Gasoline Fuel		Diesel Fuel	
	g/Hp-hr (power output)	lb/MMBtu (fuel input)	g/Hp-hr (power output)	lb/MMBtu (fuel input)
NO_X	5.0	1.63	14.1	4.41
CO	199	62.7	3.03	0.95
TOC				
exhaust	6.8	2.10	1.12	0.35
evaporative	0.30	0.09	0.00	0.00
crankcase	2.2	0.69	0.02	0.01
refueling	0.5	0.15	0.00	0.00

[a] When necessary, an average brake=specific fuel consumption (BSFC) of 7,000 Btu/Hp-hr was used to convert from lb/MMBtu to g/Hp-hr. To convert from g/Hp-hr to kg/kw-hr, multiply by 0.00134.

ENGINE EMISSIONS - EXAMPLE CALCULATION

Manutacturer's NO_X emission factor for a 2-cycle lean burn engine is 2.0 g/Hp-hr. The maximum site-rated horsepower is 250 Hp. The engine is expected to run year round (8760 hr/yr). The engine fuel contains 25 wt% VOCs. From Table 3.2-1, the TOC EF is 5.9 g/Hp-hr.

NO_X emissions = (2.0 g/Hp-hr) × (250 Hp) × (8760 hr/yr) × (ton/2000 lb) × (1 lb/453.6 g) = 4.8 TPY

VOC emissions = (5.9 g/Hp-hr) × (250 Hp) × (8760 hr/yr) × (ton/2000 lb) × (1 lb/453.6 g) × (25/100) = 3.6 TPY

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CONVERTING MOLE PERCENT TO WEIGHT PERCENT

Many emission estimation and calculation methods require weight percents to be used, rather than mole percents. Most lab analyses list gas constituents in mole percents, however you can request the lab provide both mole and weight percents.

The following describes how to convert mol% to wt% for gas mixtures.

a. From the gas lab analysis, convert each component's mole percent (**column 1**) to a mole fraction (**column 2**) by dividing each by 100.
b. Multiply each mole fraction (**column 2**) by the molecular weight (**column 3**) of each component. This gives the molecular weight of each separate component. (**column 4**)
c. Sum the molecular weight of all components (**column 4**) to get the total gas MW. (**85.08**)
d. Sum all the VOC component MWs, to get the total VOC MW.
   VOC = all C_3^+, or methane plus components. (**81.50**)
e. Divide the VOC MW by the total gas MW. **(81.50 ÷ 85.08) = 0.9580**
f. Multiply the VOC weight fraction times 100 to get the VOC weight percent.
   0.9580 × 100 = 96 wt% VOC

	1	**2**	**3**	**4** = MW of each component
gas components	$mol\%_i$	$mol\%_i$ / 100	MW_i	2×3
CO_2	0.07	0.0007	44.01	0.0308
N_2	0.03	0.0003	28.01	0.0084
Methane (C_1)	9.32	0.0932	16.04	1.4949
Ethane (C_2)	6.79	0.0679	30.07	2.0418
Propane (C_3)	8.40	0.0840	44.10	3.7044
Isobutane (iC_4)	3.46	0.0346	58.12	2.0110
N-Butane (nC_4)	5.85	0.0585	58.12	3.4000
Isopentane (iC_5)	4.45	0.0445	72.15	3.2107
N-Pentane (nC_5)	3.55	0.0355	72.15	2.5613
N-Hexane (nC_6)	2.84	0.0284	86.18	2.4475
Hexanes (C_6)	3.76	0.0376	84.18	3.1652
Benzene	0.54	0.0054	78.11	0.4218
Heptanes (C_7)	11.42	0.1142	100.20	11.4428
Toluene	0.18	0.0018	92.14	0.1659
Octanes (C_8)	16.80	0.1680	114.23	19.1906
Ethyl Benzene	0.21	0.0021	106.17	0.2230
Xylenes	4.10	0.0410	106.17	4.3530
Nonanes (C_9)	5.11	0.0511	128.26	6.5541
Decanes Plus (C_{10}^+)	13.11	0.1311	142.29	18.6542
	100.00	1.00		**85.08** = $MW_{TOTAL\ GAS}$

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APPENDIX C

DEFINITIONS

B L A N K

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Air Contaminant - shall mean dust, fumes, mist, smoke, other particulate matter, vapor, gas or any combination of these; but shall not include steam or water vapor.

Condensate - Hydrocarbon liquid separated from natural gas that condenses due to changes in temperature, pressure, or both, and remains liquid at standard conditions.

Custody Transfer - The transfer of produced petroleum and/or condensate, after processing and/or treatment in the producing operations, from storage vessels or automatic transfer facilities to pipelines or any other forms of transportation.

Division - The Department of Environmental Quality, Air Quality Division

First Date of Production - The date permanent production equipment is in place and product is consistently flowing to sales lines, gathering lines or storage tanks. Production occurring during well completion activities which is routed to temporary production equipment is considered to occur prior to the First Date of Production. If extended periods of time pass between zone completions but production from initially completed zones is consistently flowing to permanent production equipment, the First Date of Production is the date when production from the initial zones began consistently flowing to the permanent production equipment, even through more zones will be competed later.

Fugitive Emissions (Fugitives) - Air emissions which result from gas vapors escaping through and around seals, packing, gaskets, threads, and other such pressure sealing connections.

Grand fathered - A facility, installation or site which was built or in service before May 29, 1974 and that has not been physically or operationally changed, causing an increase in any pollutant (to which any state standard applies) or causing the emission of a new pollutant. (Modifications which could eliminate grandfather status are increasing production rate by fracturing, acidizing, recompletion of a zone, change in artificial lift methods, bringing new wells into a central battery or a waterflood response. Also such things as installing an engine, increasing horsepower, change in burner ratings. This list is not all inclusive and judgement should be used to determine appropriate status.)

HAP - Hazardous air pollutant, found in Section 112(b) of the Clean Air Act is a list of 188 contaminants with the classification "hazardous air pollutant". Typical hazardous air pollutants include benzene, toluene, ethyl-benzene, xylene, n-hexane, formaldehyde, methanol and others.

Major Source - A source which emits either 100 TPY or more of a regulated pollutant, 10 TPY or more of a hazardous air pollutant, or 25 TPY or more of the total hazardous air pollutants.

Major Emitting Facility - A facility which either has the potential to emit 250 TPY or more of any one regulated are pollutant or is a named facility and has the potential to emit 100 TPY or more of any one regulated air pollutant.

Potential to Emit - The maximum capacity of a stationary source to emit any air pollutant under its physical and operational design. Any physical or operational limitation on the capacity of a source to

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emit an air pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored or processed, shall be treated as part of its design if the limitation is enforceable by the EPA and the Division.

Regulated pollutants - Also known as criteria pollutants, Air pollutant emissions which have ambient air standards associated with them. Regulated pollutants include such emissions as volatile organic compounds (VOC), nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SO_2), hazardous air pollutants (HAP) and others.

Synthetic Minor - "Synthetic Minor" sources are sources that do the following types of things to limit emission rates below 100 TPY: 1) limit operating hours of a source or 2) limit production rates such that source emissions are less than 100 TPY.

VOC - Volatile organic compound means any organic compound which participates in atmospheric photochemical reactions; typically considered C_3^+ or Non-methane/ethane hydrocarbon vapors.

VOC Weight Percent - This is the weight of the volatile organic compounds, expressed as a percent, as compared to the total weight of the compounds in a gas stream. (This should not be confused with the volume or mole percent of a gas stream, which is usually how it is expressed in a lab analysis of a gas.)

Worst case - A situation allowed in air permitting in the State of Wyoming where a facility, site or source (which is representative of all the facilities, sites or sources within a designated field area) may be used to represent the worst air emissions for the field area sources.

Wyoming Environmental Quality Act - Wyoming Statute, Title 35 "Public Heath and Safety", Chapter 11 "Environmental Quality" which provides the authority for the rules and regulations of the Air Quality Division.

B L A N K

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