AIR QUALITY DIVISION
OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

PERMIT EXEMPT DETERMINATION GUIDANCE
OIL AND NATURAL GAS INDUSTRY

This guidance document is intended to help facilities determine if they qualify as a *permit exempt facility*. We will discuss the definition of a permit exempt facility and provide some example calculations of potential and actual emissions. This guidance is targeted toward Oil and Gas facilities but may also be helpful for other industries.

Basic Information

Primary Pollutants
The primary pollutants of concern for oil and gas facilities are nitrogen oxides (NO_X), carbon monoxide (CO), and volatile organic compounds (VOC). Emissions of particulate matter (PM), and sulfur dioxide (SO_2) are normally negligible from these facilities. These pollutants are referred to as "criteria pollutants." In addition to criteria pollutants, there may be emissions of hazardous air pollutants (HAPs). The primary HAPs emitted by oil and gas facilities are benzene, toluene, ethyl benzene, xylenes, n-hexane, and formaldehyde.

Regulation
Under the definitions listed in OAC 252:100-7:

> **"Permit exempt facility"** means a facility that:
> (A) has actual emissions in every calendar year that are 40 tons per year (TPY) or less of each regulated air pollutant;
> (B) is not a de minimis facility as defined in OAC 252:100-7-1.1;
> (C) is not a "major source" as defined in OAC 252:100-8-2 for Part 70 sources;
> (D) is not a "major stationary source" as defined in OAC 252:100-8-31 for PSD facilities in attainment areas;
> (E) is not a "major stationary source" as defined in OAC 252:100-8-51 for facilities in nonattainment areas;
> (F) is not operated in conjunction with another facility or source that is subject to air quality permitting;
> (G) is not subject to an emission standard, equipment standard, or work practice standard in the Federal NSPS (40 CFR Part 60) or the Federal NESHAP (40 CFR Parts 61 and 63); and
> (H) is not subject to the requirements of OAC 252:100-39-47.

Applicability
A permit exempt facility has actual emissions of less than 40 TPY, and potential emissions of less than 100 TPY of any regulated pollutant, 10 TPY of any single HAP, and 25 TPY of any

combination of HAPs. In addition, a permit exempt facility is not subject to any standards under federal NSPS (New Source Performance Standards) or NESHAP (National Emission Standards for Hazardous Air Pollutants), and is not an aerospace facility in Tulsa County. You can be subject to recordkeeping-only requirements under NSPS or NESHAP and still be permit exempt. Permit exempt facilities do not have to pay annual operating fees, but remain subject to all other applicable State and Federal air quality control rules and standards.

Certain new Stationary Spark Ignition Internal Combustion Engines are subject to emission standards under NSPS Subpart JJJJ and therefore require a permit. The following table lists the manufacture dates and horsepower rating categories for engines that are applicable to NSPS Subpart JJJJ. Engines manufactured after the dates and in the horsepower ranges are subject to NSPS Subpart JJJJ and are required to have a permit. NESHAP Subpart ZZZZ affects owner/operators of engines > 500 HP at area sources. NESHAP Subpart ZZZZ requires compliance with NSPS Subpart JJJJ, so we will only address NSPS Subpart JJJJ.

Engines Subject to NSPS Subpart JJJJ		
Engine Type and Fuel	**Maximum Engine Power**	**Manufacture Date**
Non-Emergency SI Natural Gas and Non-Emergency SI Lean Burn LPG	$100 \leq HP < 500$	After 7/1/2008
Non-Emergency SI Lean Burn Natural Gas and LPG.	$500 \leq HP < 1,350$	After 1/1/2008
Non-Emergency SI Natural Gas and Non-Emergency SI Lean Burn LPG (except lean burn $500 \geq HP < 1,350$)	$HP \geq 500$	After 7/1/2007

Certain tanks that store volatile organic liquids are subject to requirements under NSPS, depending on their capacity, contents, and construction/reconstruction date. Tanks with a capacity of greater than 470 barrels (bbl) (constructed after 7/23/84) that store a volatile organic liquid with a vapor pressure greater than 1.5 psia (crude oil, condensate, etc) are subject to Subpart Kb, and could therefore not qualify as permit exempt. Larger tanks would likely be subject to equipment and/or standards under Subpart K, Ka, or Kb, but are less common at sites considered as candidates for permit exempt status. Most tanks that are located at production sites (210 bbl, 300 bbl, etc) are smaller than the minimum regulated size of 470 bbl and could be located at a permit exempt facility.

See the section on Glycol Dehydrator emissions (page 11) for a discussion of NESHAP Subpart HH applicability.

Facility Evaluation

Potential vs. Actual Emissions

The first emissions calculation step is to determine if the facility is a potential major source of 100 tons per year (TPY). If a facility has potential emissions of any one criteria pollutant in excess of 100 TPY, it is not permit exempt. In a permit exempt context, "potential emissions" do not take into account any air pollution control devices present. If an engine is equipped with a

catalytic converter, the emission reduction from the catalyst cannot be considered for "potential emissions." When calculating "potential emissions" the worst case emission factor (see discussion below) for each criteria pollutant is used and the operation is assumed to be continuous (8,760 hours/year).

The second step is to determine if actual emissions are less than 40 TPY. When calculating "actual emissions," you can take into account any air pollution control devices present (e.g. catalytic converter, flares, and condensers) and use emission factors that are less than worst case (crossover factors plus a safety factor or AP-42 factors). Actual throughput and hours of operation can be used instead of 8,760 hours.

Emission factors in AP-42 are neither EPA-recommended emission limits (e.g., best available control technology or BACT, or lowest achievable emission rate or LAER), nor standards (e.g., NESHAP or NSPS). Use of these factors as source-specific permit limits and/or as emission regulation compliance determinations is not recommended by EPA. Because emission factors essentially represent an average of a range of emission rates, approximately half of the subject sources will have emission rates greater than the emission factor and the other half will have emission rates less than the factor. As such, a permit limit using an AP-42 emission factor would result in half of the sources being in noncompliance.

If representative source-specific data cannot be obtained, emissions information from equipment vendors, particularly emission performance guarantees or actual test data from similar equipment is a better source of information for permitting decisions than an AP-42 emission factor. When such information is not available, use of emission factors may be necessary as a last resort. Whenever factors are used, one should be aware of their limitations in accurately representing a particular facility, and the risks of using emission factors in such situations should be evaluated against the costs of further testing or analyses.

The emissions from all sources at the facility need to be considered in the potential and actual emission estimates. Emissions from the engine or engines need to be added to the emissions from all the other emission sources at the facility, such as glycol dehydrators, condensate, methanol, or oil storage tanks, fugitives, truck loading emissions, and venting.

Emissions Estimates

Engines

- Potential to Emit (PTE) (Must be less than 100 TPY)

- The engine manufacturer should provide emission factors for each model of engine.

There is great confusion regarding "potential" emissions. It is common for engine manufacturers to list emission factors under multiple conditions as shown in the following table. AQD uses the worst case factors to determine potential to emit. In the following example, worst case emissions factors for each individual pollutant would be 18 g/hp-hr NO_X, 20 g/hp-hr CO, and 1.0 g/hp-hr VOC. We realize that an engine could not emit NO_X and CO at the maximum rates at the same engine setting, but the highest factor is to be used even if it is reflective of different engine

settings. We assume for potential emissions the engine is used continuously: 24 hr/day x 365 day/year = 8,760 hours/year. Usually NO_X and CO emissions are much greater than VOC emissions, so we will omit the VOC calculations in these examples.

Emission Factors

Setting	**NO_X g/hp-hr**	**CO g/hp-hr**	**VOC g/hp-hr**
Best Economy	**18.0**	1.5	0.5
Equal NOx & CO	10.0	10.0	1.0
Best Power	5.0	**20.0**	**1.0**

Example 1. A hypothetical 600 HP engine is shown as having worst-case NO_X emissions of 18 grams per horsepower-hour (g/hp-hr) and worst-case CO emissions of 20 g/hp-hr but emissions at crossover point of 10 g/hp-hr for NO_X and CO. For this engine, potential emissions would be:

$$\frac{(600HP)\times\left(\frac{18g}{HP-hr}\right)\times\left(\frac{8760hrs}{year}\right)}{\left(\frac{454g}{lb}\right)\times\left(\frac{2000lb}{ton}\right)} = 104.19 \text{ Tons per year NOx}$$

$$\frac{(600HP)\times\left(\frac{20g}{HP-hr}\right)\times\left(\frac{8760hrs}{year}\right)}{\left(\frac{454g}{lb}\right)\times\left(\frac{2000lb}{ton}\right)} = 115.77 \text{ Tons per year CO}$$

Both NO_X and CO exceed the major source threshold of 100 TPY, therefore a permit is required, either major or minor (e.g., with controls or a limit on operating hours). It is not necessary to calculate actual emissions because the potential emissions of this engine require it to be permitted.

Example 2. For a hypothetical 400 HP rich-burn engine using the same worst-case emission factors, the potential emissions would be:

$$\frac{(400HP)\times\left(\frac{18g}{HP-hr}\right)\times\left(\frac{8760hrs}{year}\right)}{\left(\frac{454g}{lb}\right)\times\left(\frac{2000lb}{ton}\right)} = 69.46 \text{ Tons per year NOx}$$

$$\frac{(400HP)\times\left(\frac{20g}{HP-hr}\right)\times\left(\frac{8760hrs}{year}\right)}{\left(\frac{454g}{lb}\right)\times\left(\frac{2000lb}{ton}\right)} = 77.18 \text{ Tons per year CO}$$

The potential emissions are less than 100 TPY, so we now calculate the actual emissions. The actual emissions, if the engine is run at crossover for 8,760 hours per year, would be:

$$\frac{(400HP)\times\left(\frac{10g}{HP-hr}\right)\times\left(\frac{8760hrs}{year}\right)}{\left(\frac{454g}{lb}\right)\times\left(\frac{2000lb}{ton}\right)} = 38.59 \text{ Tons per year NOx}$$

$$\frac{(400HP)\times\left(\frac{10g}{HP-hr}\right)\times\left(\frac{8760hrs}{year}\right)}{\left(\frac{454g}{lb}\right)\times\left(\frac{2000lb}{ton}\right)} = 38.59 \text{ Tons per year CO}$$

Note that to use the crossover factors, the rich-burn engine must be equipped with a functioning air-to-fuel ratio controller (AFRC). The actual hours of operation could be substituted for the 8,760 hours per year in the actual emissions calculation. The hypothetical 400 HP engine by itself meets the permit exempt requirements of potential emissions less than 100 TPY and actual emissions less than 40 TPY. However, all sources at the facility need to be considered in the potential and actual emissions.

Example 3. A hypothetical 500 HP rich-burn engine uncontrolled and equipped with a catalytic converter uses the following emission factors based on engine manufacturer's data and catalyst vendor's data.

Emission Factors

Setting	**NOx g/hp-hr**	**CO g/hp-hr**	**VOC g/hp-hr**
Best Economy	**18.0**	1.5	0.5
Equal NOx & CO	10.0	10.0	1.0
Best Power	5.0	**20.0**	**1.0**
Catalytic Converter	2.0	2.0	0.25

For the potential to emit calculations, the worst-case emission factors (in bold) are used.

$$\frac{(500HP)\times\left(\frac{18g}{HP-hr}\right)\times\left(\frac{8760hrs}{year}\right)}{\left(\frac{454g}{lb}\right)\times\left(\frac{2000lb}{ton}\right)} = 86.83 \text{ Tons per year NOx}$$

$$\frac{(500HP)\times\left(\frac{20g}{HP-hr}\right)\times\left(\frac{8760hrs}{year}\right)}{\left(\frac{454g}{lb}\right)\times\left(\frac{2000lb}{ton}\right)} = 96.48 \text{ Tons per year CO}$$

The potential emissions are less than 100 TPY, so we calculate the actual emissions. At crossover the engine would emit 48.24 TPY of NOx and CO, which uncontrolled would not qualify for permit exempt because actual uncontrolled emissions are over 40 TPY. But if the uncontrolled engine operates less than 7,200 hours per year, it could be permit exempt as shown in the following calculations.

$$\frac{(500HP)\times\left(\frac{10g}{HP-hr}\right)\times\left(\frac{7200hrs}{year}\right)}{\left(\frac{454g}{lb}\right)\times\left(\frac{2000lb}{ton}\right)} = 39.7 \text{ Tons per year NOx}$$

$$\frac{(500HP)\times\left(\frac{10g}{HP-hr}\right)\times\left(\frac{7200hrs}{year}\right)}{\left(\frac{454g}{lb}\right)\times\left(\frac{2000lb}{ton}\right)} = 39.7 \text{ Tons per year CO}$$

If the engine is controlled with a catalytic converter, the catalytic converter factors are used for the actual emissions calculation.

$$\frac{(500HP)\times\left(\frac{2g}{HP-hr}\right)\times\left(\frac{8760hrs}{year}\right)}{\left(\frac{454g}{lb}\right)\times\left(\frac{2000lb}{ton}\right)} = 9.65 \text{ Tons per year NOx}$$

$$\frac{(500HP)\times\left(\frac{2g}{HP-hr}\right)\times\left(\frac{8760hrs}{year}\right)}{\left(\frac{454g}{lb}\right)\times\left(\frac{2000lb}{ton}\right)} = 9.65 \text{ Tons per year CO}$$

The hypothetical 500 HP rich-burn engine uncontrolled and operated less than 7,200 hours per year or equipped with a catalytic converter meets the permit exempt requirements of potential emissions less than 100 TPY and actual emissions less than 40 TPY. Again, all sources at the facility need to be considered in the potential and actual emissions. **Please note that it is the facility's responsibility to assure that the catalytic converter is working properly. At a minimum, this requires that the engine be equipped with a functioning AFRC.**

Example 4. A hypothetical 1,300 HP lean-burn engine uses the following emission factors.

Emission Factors

Setting	NOx g/hp-hr	CO g/hp-hr	VOC g/hp-hr
Standard	2.0	2.5	1.0

The potential emissions would be:

$$\frac{(1300HP)\times\left(\frac{2g}{HP-hr}\right)\times\left(\frac{8760hrs}{year}\right)}{\left(\frac{454g}{lb}\right)\times\left(\frac{2000lb}{ton}\right)} = 25.08 \text{ Tons per year NOx}$$

$$\frac{(1300HP)\times\left(\frac{2.5g}{HP-hr}\right)\times\left(\frac{8760hrs}{year}\right)}{\left(\frac{454g}{lb}\right)\times\left(\frac{2000lb}{ton}\right)} = 31.35 \text{ Tons per year CO}$$

Since the potential emissions are under 40 TPY, you could assume that the actual and potential emissions are the same. This engine could be operated at a permit exempt facility if the other equipment does not have emissions that cause the facility to exceed the actual and potential emission thresholds.

Example Engines

The following table lists engines that Permitting or Compliance and Enforcement have determined to have potential emissions of greater than 100 TPY. If a facility has one or more of these engines it must have a permit. This engine list is not all-inclusive, but lists some of the more common engines that have been evaluated.

Engines That Require Permits

Manufacturer	Model	Horsepower
Caterpillar	G398TA	625 - 700
Caterpillar	G399TA	730 - 930
Caterpillar	G3412SITA	465 - 675
Caterpillar	G3512SITA	658 - 814
Superior	6GT825	825
Superior	8GT825	1,100
Superior	8G825	800
Superior	12G825	1,200
Superior	16G825	1,600
Waukesha	L7042G	700 - 896
Waukesha	L7042GSI	1,000 - 1,478
Waukesha	L5790GSI	709 - 1,215

Engines That Require Permits

Manufacturer	Model	Horsepower
Waukesha	3524GSI	630 - 840
Waukesha	F3521GSI	554 - 738

The following table lists engines that DEQ has determined could be located at a permit exempt facility if they are not subject to NSPS Subpart JJJJ (see page 2). Typically engines less than 240 HP may be permit exempt. It should be noted that all emissions from all the equipment at a facility must be added together to determine actual and potential emissions. If an individual engine by itself meets the requirements for permit exempt, the facility may still need a permit depending on the other equipment operating at the facility. This engine list is not all-inclusive, but lists some of the more common engines that have been evaluated.

Engines That May Be Permit Exempt

Manufacturer	Model	Horsepower
Ajax	All LE models	221 - 800
Caterpillar	G3516TALE	1,085 - 1,340
Caterpillar	G3520B	1,675
Caterpillar	G3512TALE	677 - 861
Caterpillar	G3508TALE	538 - 718
Superior	6GTLA & B	825
Superior	8GTLA & B	1,100
Superior	8GTLE	1,100
Superior	12GTLA & B	1,650
Superior	16GTLA & B	2,200
Waukesha	L7042GL	1,478
Waukesha	L5790GL	1,215
Waukesha	L5774GL	1,250

Emission Calculation Table

The following table gives estimates of potential emissions for engines. The estimates are based on the engine operating at maximum horsepower for 8,760 hours per year. Select the correct horsepower for your engine across the top of the table and the maximum emission factor (EF) from the engine manufacturer from the left of the table. AQD does not accept AP-42 factors for PTE. For example, a 500 hp engine with a worst-case emission factor of 18 g/hp-hr NOx has potential NOx emissions of 86.90 TPY (in bold). For a 1,500 hp engine you can add the 1,000 hp and the 500 hp emissions (in bold, 86.90 + 173.81 = 260.71 TPY).

Engine Emissions (TPY)

EF g/hp-hr	Horse Power (hp)									
	100	**200**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**
1	0.97	1.93	2.90	3.86	4.83	5.79	6.76	7.72	8.69	9.66
2	1.93	3.86	5.79	7.72	9.66	11.59	13.52	15.45	17.38	19.31
3	2.90	5.79	8.69	11.59	14.48	17.38	20.28	23.17	26.07	28.97
4	3.86	7.72	11.59	15.45	19.31	23.17	27.04	30.90	34.76	38.62
5	4.83	9.66	14.48	19.31	24.14	28.97	33.80	38.62	43.45	48.28
6	5.79	11.59	17.38	23.17	28.97	34.76	40.56	46.35	52.14	57.94
7	6.76	13.52	20.28	27.04	33.80	40.56	47.31	54.07	60.83	67.59
8	7.72	15.45	23.17	30.90	38.62	46.35	54.07	61.80	69.52	77.25
9	8.69	17.38	26.07	34.76	43.45	52.14	60.83	69.52	78.21	86.90
10	9.66	19.31	28.97	38.62	48.28	57.94	67.59	77.25	86.90	96.56
11	10.62	21.24	31.87	42.49	53.11	63.73	74.35	84.97	95.60	106.22
12	11.59	23.17	34.76	46.35	57.94	69.52	81.11	92.70	104.29	115.87
13	12.55	25.11	37.66	50.21	62.76	75.32	87.87	100.42	112.98	125.53
14	13.52	27.04	40.56	54.07	67.59	81.11	94.63	108.15	121.67	135.19
15	14.48	28.97	43.45	57.94	72.42	86.90	101.39	115.87	130.36	144.84
16	15.45	30.90	46.35	61.80	77.25	92.70	108.15	123.60	139.05	154.50
17	16.42	32.83	49.25	65.66	82.08	98.49	114.91	131.32	147.74	164.15
18	17.38	34.76	52.14	69.52	**86.90**	104.29	121.67	139.05	156.43	**173.81**

When calculating "actual emissions," you can take into account any air pollution control devices present (e.g. catalytic converter and condensers) and use emission factors that are less than worst case (crossover factors plus a safety factor or AP-42 factors). The engine emissions table can be used for actual emissions if the engine is used continuously. Select the correct horsepower for your engine across the top of the table and the expected operating emission factor (i.e.: crossover or catalytic converter) from the engine manufacturer from the left of the table. If you cannot find an appropriate factor for your engine, contact AQD for a factor. If the engine is operated less than 8,760 hours per year the following formula can be used to estimate actual emissions.

$$\frac{(\text{Engine HP})\times\left(\text{EF}\frac{\text{g}}{\text{HP - hr}}\right)\times\left(\frac{\text{Actual Hours}}{\text{Year}}\right)}{\left(\frac{454g}{lb}\right)\times\left(\frac{2000lb}{ton}\right)} = \text{Tons per year}$$

Tanks

TANKS4.0

Most gas-producing facilities include condensate and methanol storage tanks. Tanks have three different types of emissions: (1) working losses, (2) breathing losses, and (3) flash emissions which must be added together. We include a rough estimate of working and breathing losses for 210 bbl and 300 bbl tanks, or you can use the EPA software, TANKS4.0 (http://www.epa.gov/ttn/chief/software/tanks/index.html), for a more precise estimate. When you are uncertain of the annual throughput, please estimate high (10 or more turnovers per year).

For potential throughput, calculate the average of the last three years throughput and add 20% (This method is from NSPS Subpart HH).

Tank	TPY VOC
210 bbl Condensate Tank	1.53*
300 bbl Condensate Tank	2.21*
210 bbl Methanol Tank	0.11**

*These estimates assumed 64° API condensate and 12 turnovers per year.
**This estimate assumes methanol and 12 turnovers per year.

Flash Emissions

"Flash" emissions must also be accounted for. A spreadsheet which calculates flash emissions based on the Vazquez-Beggs correlation is available from AQD. (The spreadsheet is accessible through a link in AQD's "*Calculation of Flashing Losses/VOC Emissions*" fact sheet, available on DEQ's website – http://www.deq.state.ok.us/AQDnew/resources/Calculations11.xls.) The following table gives estimates of flash emissions from condensate based on the Vazquez-Beggs correlation and AQD default values.

Inputs	Units	Default Value
Stock Tank API Gravity	API	78.0
Separator Temperature	°F	60.0
Separator Gas Specific Gravity	—	0.9
Stock Tank Gas Molecular Weight	lb/lb-mole	49.0
VOC Fraction of the Stock Tank Gas	Fraction	0.8
Atmospheric Pressure	psia	14.7

The amount of produced condensate in barrels per day is in the left column. The inlet pressure in pounds per square inch of the last pressurized vessel prior to the tank is across the top of the table. For example, 5 BBL/day of condensate production at 50 psi would produce 7.1 TPY of VOC from flash emissions (in bold). For potential throughput, calculate the average of the last three years throughput and add 20%.

Flash Emissions (TPY VOC)

Condensate BBL/day (BBL/yr)	**Inlet Pressure (psi) (Last pressurized vessel prior to the tank)**									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
1 (365)	0.4	0.6	0.9	1.1	1.4	1.7	2.0	2.3	2.7	3.0
2 (730)	0.8	1.2	1.7	2.3	2.8	3.4	4.0	4.7	5.3	6.0
3 (1,095)	1.2	1.9	2.6	3.4	4.3	5.1	6.1	7.0	8.0	9.0
4 (1,460)	1.6	2.5	3.5	4.5	5.7	6.8	8.1	9.3	10.7	12.0
5 (1,825)	2.0	3.1	4.3	5.7	**7.1**	8.6	10.1	11.7	13.3	15.0
6 (2,190)	2.4	3.7	5.2	6.8	8.5	10.3	12.1	14.0	16.0	18.0
7 (2,555)	2.8	4.4	6.1	7.9	9.9	12.0	14.1	16.4	18.7	21.0
8 (2,920)	3.2	5.0	7.0	9.1	11.3	13.7	16.1	18.7	21.3	24.0
9 (3,285)	3.6	5.6	7.8	10.2	12.8	15.4	18.2	21.0	24.0	27.0
10 (3,650)	4.0	6.2	8.7	11.4	14.2	17.1	20.2	23.4	26.6	30.0

You will generally not need to prepare emissions estimates for storage tanks containing lube oil (either new or used) or glycols, unless these liquids are stored in tanks larger than 19,813 gallons. You will normally need to prepare estimates of emissions from condensate tanks and methanol tanks, regardless of size.

Loading Emissions

Estimated VOC emissions from truck-loading from condensate tanks are based on Equation 1 from Section 5.2.2.1 of AP-42 (1/95) (http://www.epa.gov/ttn/chief/ap42/index.html), and a load rate equal to the condensate throughput of the tanks. For potential throughput, calculate the average of the last three years throughput and add 20%. For small production facilities loading emissions are usually from 1 to 2 TPY of VOC.

Glycol Dehydrators

Many facilities operate dehydration units using glycol desiccants. Every production glycol dehydrator is an affected source under 40 CFR Part 63 Subpart HH, the NESHAP for Oil and Natural Gas Production. Glycol dehydrators with a gas throughput of less than 3 MMSCF/day or actual benzene emissions of less than 1 TPY are exempt from the control requirements in Subpart HH, but are required to keep records of the determinations of gas throughput or benzene emissions. You can still be permit exempt if all you have to do under Subpart HH is keep records. If you are subject to the control requirements under Subpart HH, you have to have a permit.

If your gas throughput exceeds 3 MMSCF/day, the owner or operator of a production glycol dehydrator must determine actual average benzene emissions using the model GRI–GLYCalc, Version 3.0 or higher, and the procedures presented in the associated GRI–GLYCalc Technical Reference Manual. Inputs to the model must be representative of actual operating conditions of the glycol dehydration unit. You may obtain GRI–GLYCalc from the Gas Technology Institute, (847)768-0500, 1700 South Mount Prospect Road, Des Plaines, Illinois 60018-1804. If your actual benzene emissions are less than 1.0 TPY, you must keep a record of the GRI–GLYCalc run that shows your benzene emissions are less than 1.0 TPY.

The required inputs to GRI–GLYCalc include a recent extended natural gas analysis (including benzene, toluene, ethyl benzene, xylenes, and n-hexane), gas throughput, contactor temperature, contactor pressure, lean glycol pump rate, glycol pump type, flash tank temperature, pressure, and controls, and any controls on the still vent. Additionally, if you input the capacity of the pump as the glycol circulation rate (i.e., rather than actual rate), you will not have to monitor the flow rate monthly.

GRI–GLYCalc allows for entering a condenser or combustion for control of VOCs and HAPs. The controls can be used for estimating the actual emissions of benzene. The estimated emissions vary greatly depending on the composition of the gas and the other inputs. There are too many variables to give an estimate of glycol dehydration unit emissions in a simple table. A GRI–GLYCalc run must be done to estimate emissions from the still vent.

A dehydration unit reboiler, or any other gas-fired heater, will have emissions of combustion products. The following is an estimate of emissions from a 1.0 MMBtu/hr reboiler using emissions factors from AP-42, Section 1.4. **This does not include the still vent or flash tank emissions.**

Heater Emissions

Unit	Capacity MMBTUH	Pollutant	Emission Factor, lb/MMBTU	Emissions	
				lb/hr	TPY
H-1	1.0	NOx	0.100	0.100	0.44
		CO	0.084	0.084	0.38
		VOC	0.0053	0.005	0.02

Venting Emissions

VOCs are emitted when gas is vented during compressor blowdowns, pigging operations, or various other maintenance operations. To estimate these emissions, you must know the VOC content of the gas stream and the amount of the gas that is vented. It is hard to determine the exact amount of gas that is vented, so many operators just estimate to the nearest million standard cubic feet (MMSCF) of gas that is vented in a year. The following table gives estimates of VOC emissions (as propane) from venting. Example: If you vent 3 MMSCF/yr of 6% VOC gas, you have venting emissions of 10.44 TPY of VOC (in bold).

Venting Emissions (TPY)

VOC Gas Content (%)	Gas Vented (MMSCF per year)									
	1	2	3	4	5	6	7	8	9	10
1	0.58	1.16	1.74	2.32	2.90	3.48	4.06	4.64	5.22	5.80
2	1.16	2.32	3.48	4.64	5.80	6.96	8.12	9.28	10.44	11.60
3	1.74	3.48	5.22	6.96	8.70	10.44	12.18	13.92	15.66	17.40
4	2.32	4.64	6.96	9.28	11.60	13.92	16.24	18.56	20.88	23.19
5	2.90	5.80	8.70	11.60	14.50	17.40	20.30	23.19	26.09	28.99
6	3.48	6.96	**10.44**	13.92	17.40	20.88	24.35	27.83	31.31	34.79
7	4.06	8.12	12.18	16.24	20.30	24.35	28.41	32.47	36.53	40.59
8	4.64	9.28	13.92	18.56	23.19	27.83	32.47	37.11	41.75	46.39
9	5.22	10.44	15.66	20.88	26.09	31.31	36.53	41.75	46.97	52.19
10	5.80	11.60	17.40	23.19	28.99	34.79	40.59	46.39	52.19	57.99
11	6.38	12.76	19.14	25.51	31.89	38.27	44.65	51.03	57.41	63.78
12	6.96	13.92	20.88	27.83	34.79	41.75	48.71	55.67	62.63	69.58
13	7.54	15.08	22.61	30.15	37.69	45.23	52.77	60.31	67.84	75.38
14	8.12	16.24	24.35	32.47	40.59	48.71	56.83	64.94	73.06	81.18
15	8.70	17.40	26.09	34.79	43.49	52.19	60.89	69.58	78.28	86.98
16	9.28	18.56	27.83	37.11	46.39	55.67	64.94	74.22	83.50	92.78
17	9.86	19.72	29.57	39.43	49.29	59.15	69.00	78.86	88.72	98.58
18	10.44	20.88	31.31	41.75	52.19	62.63	73.06	83.50	93.94	104.38
19	11.02	22.03	33.05	44.07	55.09	66.10	77.12	88.14	99.16	110.17

Venting Emissions (TPY)

VOC Gas Content (%)	Gas Vented (MMSCF per year)									
	1	2	3	4	5	6	7	8	9	10
20	11.60	23.19	34.79	46.39	57.99	69.58	81.18	92.78	104.38	115.97
21	12.18	24.35	36.53	48.71	60.89	73.06	85.24	97.42	109.59	121.77
22	12.76	25.51	38.27	51.03	63.78	76.54	89.30	102.06	114.81	127.57
23	13.34	26.67	40.01	53.35	66.68	80.02	93.36	106.69	120.03	133.37
24	13.92	27.83	41.75	55.67	69.58	83.50	97.42	111.33	125.25	139.17
25	14.50	28.99	43.49	57.99	72.48	86.98	101.48	115.97	130.47	144.97

Fugitive VOC Emissions

For a production compressor station, VOC leakage from valves, flanges, etc., is normally small – typically 1 to 3 TPY. Fugitive VOC emissions estimates are based on EPA's *1995 Protocol for Equipment Leak Emission Estimates* (EPA-453/R-95-017) and an estimated number of components in C3+ service. This reference may be obtained from www.epa.gov/ttn. Operators may use other acceptable tools to calculate fugitives such as API reference documents. Typical emission factors and other data are used in the following example calculation.

Fugitive VOC Emissions

Component Type	Count	C3+ Content	Emission Factors	Hourly Emissions	Annual Emissions
			lb/hr/source	lb/hr	TPY
Valves	100	25%	0.00992	0.25	1.1
Pressure Relief Valves	20	25%	0.01940	0.098	0.43
Open Ended Lines	0	25%	0.00441	0.000	0.00
Compressor Seals	4	25%	0.01940	0.020	0.09
Flanges/Connections	200	25%	0.00044	0.022	0.10
Total				**0.39**	**1.7**

Example Facility

The following example is for a facility equipped with a 500 HP engine (manufactured prior to 1/1/2008) with catalytic converter, one 210-bbl methanol tank, one 210-bbl condensate tank, and a glycol dehydrator. The example includes estimates for flash emissions, fugitive emissions, loading emissions, and venting emissions. For our example, we assumed 1.0 TPY of VOC emissions from condensate loading.

Potential Emissions

Sources	NO_x		CO		VOC	
	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY
C-1, 500-hp Engine (w/out cc)	19.82	86.83	22.03	96.48	1.10	4.83
D-1, Glycol Dehydrator Unit	---	---	---	---	---	12.05
H-1, Glycol Regenerator Heater	---	0.44	---	0.38	---	0.02
TK-1, 210-bbl Condensate Tank	---	---	---	---	---	1.53
FL-1, Condensate Flash	---	---	---	---	---	7.1
TK-2, 210-bbl Methanol Tank	---	---	---	---	---	0.11
TL-1, Condensate Loading	---	---	---	---	---	1.0
FUG, Process Piping Fugitives	---	---	---	---	---	1.7
V-1, Process Vent	---	---	---	---	---	10.44
Total	**---**	**87.27**	**---**	**96.86**	**---**	**38.78**

Actual Emissions

Sources	NO_x		CO		VOC	
	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY
C-1, 500-hp Engine w/cc	2.20	9.65	2.20	9.65	0.28	1.21
D-1, Glycol Dehydrator Unit	---	---	---	---	---	12.05
H-1, Glycol Regenerator Heater	---	0.44	---	0.38	---	0.02
TK-1, 210-bbl Condensate Tank	---	---	---	---	---	1.53
FL-1, Condensate Flash	---	---	---	---	---	7.1
TK-2, 210-bbl Methanol Tank	---	---	---	---	---	0.11
TL-1, Condensate Loading	---	---	---	---	---	1.0
FUG, Process Piping Fugitives	---	---	---	---	---	1.7
V-1, Process Vent	---	---	---	---	---	10.44
Total	**---**	**10.09**	**---**	**10.03**	**---**	**35.16**

The facility meets the permit exempt requirements of potential emissions less than 100 TPY and actual emissions less than 40 TPY. If a normal oil and gas facility meets the requirements of potential emissions less than 100 TPY and actual emissions less than 40 TPY, it usually meets the requirements of HAPs less than 10 TPY of any single HAP and 25 TPY of any combination of HAPs.