Michigan Department of Environmental Quality, Air Quality Division

Permitting Guidance for Natural Gas Fired Engines at Oil and Gas Production Facilities

Natural gas combustion equipment such as engines and process heaters have the potential to emit (PTE) high levels of Carbon Monoxide (CO) and Oxides of Nitrogen (NOx) into the atmosphere. If emissions of these pollutants exceed certain thresholds a stationary source will be required to obtain an air permit or modify existing air permits. This guide has been developed to help you evaluate the CO and NOx emissions from the natural gas fired engines and process heaters at your stationary source and determine what permitting action, if any, is necessary. All stationary sources that produce natural gas should evaluate their PTE as outlined in the steps below and submit a notification of this evaluation to the MDEQ by March 15, 2007. The notification should identify the results of this evaluation as well as any proposed changes that will be made to existing air permits and/or the stationary source as explained in Tables A and B on page 3.

POTENTIAL TO EMIT EVALUATION

The steps below will help you determine the PTE from your stationary source's natural gas fired engines and process heaters. Note that when calculating PTE, the only time you can take into account emission reductions from pollution control equipment, such as a 3-way catalyst or oxidation catalyst, is when it is legally and practically enforceable. To be legally and practically enforceable the control equipment must be specifically identified in a Permit to install and the permit must contain language requiring proper operation and maintenance of the control equipment. This provision is addressed in Step 1.

STEP 1: Answer the following questions which pertain to your natural gas fired engines.

1. Do you have a Permit to Install that specifically requires a control device (i.e., 3-way catalyst or oxidation catalyst) be installed on the natural gas fired engines?

   ☐ Yes – Go to next question ☐ No – Go to Step 2

2. Does the permit also have a condition that requires proper operation and maintenance of the control device?

   ☐ Yes – Go to Step 3 ☐ No – Go to Step 2

STEP 2: Calculate the uncontrolled PTE CO and NOx from each of your natural gas fired engines. If you have engine specific emissions data you can use Table 1 on Worksheet 1 (page 4). If you do not have engine specific emissions data use Table 3 or 4 on Worksheet 2 (page 5) to calculate the PTE. Enter the uncontrolled PTE from all engines below. **Go to Step 4.**

Pollutant	Uncontrolled PTE - Engines
CO	_____ tons/yr
NOx	_____ tons/yr

STEP 3 (Skip this step if you completed Step 2): Calculate the controlled PTE CO and NOx from each of your natural gas fired engines. If you have engine specific emissions data you can use Table 2 on Worksheet 1 (page 4). If you do not have engine specific emissions data use Table 5 or 6 on Worksheet 2 (page 6) to calculate the PTE. Enter the controlled PTE from all engines below

Pollutant	Controlled PTE - Engines
CO	_____ tons/yr
NOx	_____ tons/yr

STEP 4: Calculate the PTE CO and NOx from each of your process heaters. Use Table 7 on Worksheet 3 (page 7). Enter the PTE from all process heaters below.

Pollutant	PTE – Process Heaters
CO	_____ tons/yr
NOx	_____ tons/yr

STEP 5: Calculate the total PTE from your natural gas fired engines and process heaters. Add the Uncontrolled or Controlled PTE from the engines (from Step 2 or 3) and the PTE from the process heaters (Step 4). Enter the total PTE below.

Pollutant	Total PTE
CO	_____ tons/yr
NOx	_____ tons/yr

STEP 6: Answer the following question.

Is the PTE of either CO or NOx in Step 5 equal to or greater than 100 tons per year?

☐ Yes – You are a "major source." Go to Table B on the next page to view your compliance options.

☐ No – You are a "minor source." Go to Table A on the next page to view your compliance options.

TABLE A: Compliance Options for MINOR Source (<100 tons per year PTE)

As minor source of air contaminants you can choose from any of the following compliance options:

- ☐ Apply for a Permit to Install reflecting the expected emissions from the equipment. If the PTE from an engine is less than 100 tons per year for CO and less than 40 tons per year for NOx, it may be exempt from permitting. If you believe an engine is exempt from permitting it is highly recommended that you verify your determination with your AQD inspector.

- ☐ Request a modification to an existing Permit to Install that will reflect emission factors based on engine specific data supplied by the engine manufacturer. An alternate emission factor may also be used (i.e. stack test, the most recent AP-42 [Compilation of Air Pollutant Emission Factors] or the most recent FIRE [Factor Information Retrieval] database, etc) upon approval of the AQD District Supervisor..

- ☐ Make no modification to an existing Permit to Install (i.e., do not make changes and continue to comply with requirements in existing permit).

You must choose one of the above options and notify your AQD district office which option you choose no later than **March 15, 2007**. You may use the optional "*Oil and Gas Production Facility Potential to Emit and Compliance Declaration Form"* to make this notification. It is recommended that you include the declaration form with your 2007 MAERS submittal.

If you are submitting an initial application for a Permit to Install you do not need to submit the declaration form.

TABLE B: Compliance Options for MAJOR Source (≥ 100 tons per year PTE)

A major source of air contaminants can choose from any of the following compliance options:

- ☐ Apply for a synthetic minor Permit to Install that includes a limitation on operating parameters, such as the amount of natural gas that can be used. To determine your usage limitation you will need to determine the maximum amount of natural gas that can be used in the engine(s) before exceeding the major source thresholds (100 tons/yr each for CO and NOx).

- ☐ Apply for a Permit to Install that includes new or existing control equipment that will reduce your PTE CO and NOx to below the major source thresholds. A permit is required to make the reductions achieved through the use of the control equipment legally binding.

- ☐ Replace higher emitting engine(s) with lesser emitting engine(s) to reduce the PTE to below the major source thresholds (100 tons/yr each for CO and NOx), putting you in the "minor source" category.

- ☐ Apply for a Renewable Operating Permit (ROP).

- ☐ Maintain existing ROP.

You must choose one of the above options and notify your AQD district office which option you choose no later than **March 15, 2007**. You may use the optional "*Oil and Gas Production Facility Potential to Emit and Compliance Declaration Form"* to make this notification. It is recommended that you include the declaration form with your 2007 MAERS submittal.

CALCULATION WORKSHEET 1

Potential to Emit
NATURAL GAS FIRED ENGINE

The tables below can be used to help you calculate the Potential to Emit CO and NOx from your natural gas fired engines when engine specific emissions data is available. If engine specific emission data in not available you can use Worksheet 2 to calculate your PTE.

- Table 1 should be used to calculate uncontrolled PTE CO and NOx.
- Table 2 should be used to calculate controlled PTE CO and NOx. **Table 2 should ONLY be completed if directed to do so in Step 3 on page 1**.

TABLE 1: PTE NOx and CO Uncontrolled		
A. Engine Max Brake Horsepower (bhp): **bhp**	B. grams NOx/bhp-hr:* **gNOx/bhp-hr**	C. grams CO/bhp-hr:* **gCOx/bhp-hr**
D. Potential to Emit NOx (uncontrolled): (A) x (B) x (1 lb/454 g) x (8,760 hrs/yr) x (1 ton/2,000 lbs) =		**Tons NOx/yr (uncontrolled)**
E. Potential to Emit CO (uncontrolled): (A) x (C) x (1 lb/454 g) x (8,760 hrs/yr) x (1 ton/2,000 lbs) =		**Tons CO/yr (uncontrolled)**

* Emission factors from engine data is usually provided in grams per brake horsepower-hour.

TABLE 2: PTE NOx and CO Controlled **(This table should ONLY be completed if directed to do so from Step 3 on page 1)**		
A. Engine Max Brake Horsepower (bhp): **bhp**	B. grams NOx/bhp-hr:* **gNOx/bhp-hr**	C. grams CO/bhp-hr:* **gCOx/bhp-hr**
D. Control Efficiency NOx (see note 1 below): **%**	E. Control Efficiency CO (see note 2 below): **%**	
F. Potential to Emit NOx (uncontrolled): (A) x (B) x (1 lb/454 g) x (8,760 hrs/yr) x (1 ton/2,000 lbs) =		Tons NOx/yr
G. Potential to Emit NOx (controlled): (F) x (100 – [D]/100) =		**Tons NOx/yr (controlled)**
H. Potential to Emit CO (uncontrolled): (A) x (C) x (1 lb/454 g) x (8,760 hrs/yr) x (1 ton/2,000 lbs) =		Tons CO/yr
I. Potential to Emit CO (uncontrolled): (H) x (100 – [E]/100) =		**Tons CO/yr (controlled)**

* Emission factors from engine data is usually provided in grams per brake horsepower-hour.

1. If this is a standard “rich burn” engine enter 90% unless a different engine specific control efficiency is available. If this is a lean burn engine enter 0% unless a different engine specific control efficiency is available.
2. Enter 80% unless a different engine specific control efficiency is available

CALCULATION WORKSHEET 2

Potential to Emit
NATURAL GAS FIRED ENGINE

The tables below can be used to help you calculate the Potential to Emit CO and NOx from your natural gas fired engines when engine specific emissions data is NOT available. If engine specific emission data is available you should use Worksheet 1 to calculate the PTE.

- Tables 3 and 4 should be used to calculate uncontrolled PTE CO and NOx from standard "rich burn" engines or lean burn engines.
- Tables 5 and 6 should be used to calculate controlled PTE CO and NOx from standard "rich burn" engines or lean burn engines. **Tables 5 and 6 should ONLY be completed if directed to do so in Step 3 on page 1**.

TABLE 3 - Standard "Rich Burn" Engine Uncontrolled	
A. Engine Heat Input Capacity **Btu/hr**	B. Natural Gas Usage Rate (ft^3/hr):* (A) x (1 ft^3/1,020 Btu) = **ft^3/hr**
C. Potential to Emit NOx (uncontrolled): (B) x (2,254 lbs NOx/1,000,000 ft^3) x (8,760 hrs/yr) x (1 ton/2,000 lbs) = **Tons NOx/yr**	
D. Potential to Emit CO (uncontrolled): (B) x (3,794 lbs CO/1,000,000 ft^3) x (8,760 hrs/yr) x (1 ton/2,000 lbs) = **Tons CO/yr**	

* 1,020 BTU/ft^3 is the default heating value for natural gas. If a site specific heating value is available, you may use it.

TABLE 4 – Lean Burn Engine Uncontrolled	
A. Engine Heat Input Capacity **Btu/hr**	B. Natural Gas Usage Rate (ft^3/hr):* (A) x (1 ft^3/1,020 Btu) = **ft^3/hr**
C. Potential to Emit NOx (uncontrolled): (B) x (4,162 lbs NOx/1,000,000 ft^3) x (8,760 hrs/yr) x (1 ton/2,000 lbs) = **Tons NOx/yr**	
D. Potential to Emit CO (uncontrolled): (B) x (568 lbs CO/1,000,000 ft^3) x (8,760 hrs/yr) x (1 ton/2,000 lbs) = **Tons CO/yr**	

* 1,020 BTU/ft^3 is the default heating value for natural gas. If a site specific heating value is available, you may use it.

CALCULATION WORKSHEET 2 (continued)

TABLE 5 - Standard "Rich Burn" Engine Controlled	
A. Engine Heat Input Capacity **Btu/hr**	B. Natural Gas Usage Rate (ft^3/hr):* (A) x (1 ft^3/1,020 Btu) = **ft^3/hr**
C. Control Efficiency Nox **%** Enter "90" unless a different, site specific, control efficiency is available.	
D. Control Efficiency CO **%** Enter "80" unless a different, site specific, control efficiency is available.	
E. Potential to Emit NOx (uncontrolled): (B) x (2,254 lbs NOx/1,000,000 ft^3) x (8,760 hrs/yr) x (1 ton/2,000 lbs) = Tons NOx/yr	
F. Potential to Emit NOx (controlled) (E) x (100 – [C]/100) = **Tons NOx/yr**	
G. Potential to Emit CO (uncontrolled): (B) x (3,794 lbs CO/1,000,000 ft^3) x (8,760 hrs/yr) x (1 ton/2,000 lbs) = Tons CO/yr	
H. Potential to Emit CO (controlled): (G) x (100 – [D]/100) = **Tons CO/yr**	

* 1,020 BTU/ft^3 is the default heating value for natural gas. If a site specific heating value is available, you may use it.

TABLE 6 – Lean Burn Engine Controlled	
A. Engine Heat Input Capacity **Btu/hr**	B. Natural Gas Usage Rate (ft^3/hr):* (A) x (1 ft^3/1,020 Btu) = **ft^3/hr**
C. Control Efficiency CO **%** Enter "80" unless a different, site specific, control efficiency is available.	
D. Potential to Emit NOx (uncontrolled): (B) x (4,162 lbs NOx/1,000,000 ft^3) x (8,760 hrs/yr) x (1 ton/2,000 lbs) = **Tons NOx/yr**	
E. Potential to Emit CO (uncontrolled): (B) x (568 lbs CO/1,000,000 ft^3) x (8,760 hrs/yr) x (1 ton/2,000 lbs) = Tons CO/yr	
F. Potential to Emit CO (controlled): (E) x (100 – [C]/100) = **Tons CO/yr**	

* 1,020 BTU/ft^3 is the default heating value for natural gas. If a site specific heating value is available, you may use it.

CALCULATION WORKSHEET 3

Potential to Emit
PROCESS HEATERS

The table below can be used to help you calculate the Potential to Emit CO and NOx from your natural gas fired process heaters.

TABLE 7 – Process Heaters	
A. Process Heater Heat Input Capacity **Btu/hr**	B. Natural Gas Usage Rate (ft^3/hr):* (A) x (1 ft^3/1,020 Btu) = **ft^3/hr**
C. Potential to Emit NOx (uncontrolled): (B) x (140 lbs NOx/1,000,000 ft^3) x (8,760 hrs/yr) x (1 ton/2,000 lbs) = **Tons NOx/yr**	
D. Potential to Emit CO (uncontrolled): (B) x (35 lbs CO/1,000,000 ft^3) x (8,760 hrs/yr) x (1 ton/2,000 lbs) = **Tons CO/yr**	

* 1,020 BTU/ft^3 is the default heating value for natural gas. If a site specific heating value is available, you may use it.