OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

GUIDANCE DOCUMENT **February 7, 2012**

SUBJECT: Potential to Emit

Potential to Emit (PTE) is defined as the maximum capacity of a stationary source to emit any air pollutant based on its physical and operational design. Thus, your PTE is the maximum amount of air pollution that your facility could possibly emit if

- Each process unit is operated at 100% of design capacity;
- Materials that emit the most air pollution are processed 100% of the time;
- All of the equipment is operating 24 hours per day, 365 days per year; and
- No pollution control equipment is used, unless the equipment is required by a federal rule.

Any physical or operational limitation on the capacity of the source to 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 "federally enforceable." Even if you never operate at your PTE, it is theoretically possible to do so.

How Do I Calculate My PTE?

This is typically a 4-step process. You should consider the emissions units that emit a pollutant, and then the pollutant that is being emitted.

Step 1: Identify all emissions sources (units and processes) at your facility. These include all emissions from vents and stacks, or emissions that could reasonably pass through a vent or stack. Fugitive emissions (i.e., those emissions that cannot reasonably be collected and routed through a stack or vent, such as dust from roads, slag pile, etc.) must be considered in determining whether a source is a major stationary source if it belongs to one of the categories of stationary sources listed in Table 1.

Table 1 – Categories of Stationary Sources (Note: For these categories, fugitive emissions must be considered in determining whether a source is a major stationary source.)

(i) Coal cleaning plants (with thermal dryers);
(ii) Kraft pulp mills;
(iii) Portland cement plants;
(iv) Primary zinc smelters;
(v) Iron and steel mills;
(vi) Primary aluminum ore reduction plants;
(vii) Primary copper smelters;
(viii) Municipal incinerators capable of charging more than 250 tons of refuse per day;
(continued next page)

Table 1 (Continued) – Categories of Stationary Sources (Note: For these categories, fugitive emissions must be considered in determining whether a source is a major stationary source.)

- (ix) Hydrofluoric, sulfuric, or nitric acid plants;
- (x) Petroleum refineries;
- (xi) Lime plants;
- (xii) Phosphate rock processing plants;
- (xiii) Coke oven batteries;
- (xiv) Sulfur recovery plants;
- (xv) Carbon black plants (furnace process);
- (xvi) Primary lead smelters;
- (xvii) Fuel conversion plants;
- (xviii) Sintering plants;
- (xix) Secondary metal production plants;
- (xx) Chemical process plants;
- (xxi) Fossil-fuel boilers (or combination thereof) totaling more than 250 million British thermal units per hour heat input;
- (xxii) Petroleum storage and transfer units with a total storage capacity exceeding 300,000 barrels;
- (xxiii) Taconite ore processing plants;
- (xxiv) Glass fiber processing plants;
- (xxv) Charcoal production plants;
- (xxvi) Fossil-fuel-fired steam electric plants of more than 250 million British thermal units per hour heat input;

In addition, facilities in certain New Source Performance Standard (NSPS) source categories must include fugitive emissions in the calculation of PTE. If the emission source is within a source category that is regulated by a NSPS that was promulgated on or before August 7, 1980, fugitive emissions of all pollutants from the emission source must be included when calculating PTE. For example, fugitive emissions of both criteria pollutants and HAPs from gas turbines must be included in determining whether a stationary source is required to obtain a Part 70 permit. In this case, fugitives are included regardless of whether that particular gas turbine is subject to an NSPS. This is because an NSPS limiting emissions from this source category (gas turbines) was promulgated before August 7, 1980 (40 CFR Part 60 Subpart GG). If a permit is required, fugitive emissions are evaluated during the permitting process.

Fugitive emissions are usually particulate matter or VOCs, including HAPs. They are produced from various activities, e.g., when operating processes, or during material storage and transfer (from evaporation or wind erosion). They do not include emissions from emission units installed within a building. Fugitive emission sources can vary significantly even between similar plants or businesses. Therefore, every attempt should be made to quantify fugitive emissions through a source-specific engineering analysis.

Not all emission sources are obvious. Besides stacks and vents for manufacturing processes, attention must be paid to auxiliary activities at the plant. Conveyors, tank truck loading and unloading, tanks, valves and vents, wastewater treatment plant emissions, and dust from roads are all potential air emission sources. Degreasing tanks, welding activities, pumps, valves, painting and cleanup activities also emit pollutants that may need to be counted. Emissions from vehicle engines do not need to be included in calculation of PTE. However, dust from vehicular truck traffic must be included, in most cases, if fugitive emissions are required to be calculated. A final step in identifying emissions units to include in calculating PTE is to then delete those activities identified as a “trivial activity” at OAC 252:100, Appendix J. Emissions from these activities need not be counted in determining your PTE.

Step Two: Identify the pollutants that are being emitted. Pollutants are typically identified using three fairly broad categories and pollutants from all three categories are typically referred to *in toto* as "regulated pollutants." Regulated pollutants include a number of specifically defined pollutants, as well as any substance for which an air emissions limit or standard is set by an existing permit or regulation. The first broad category of pollutants includes substances designated by the US Environmental Protection Agency (EPA) as Criteria Air Pollutants (CAPs). CAPs include those pollutants for which a national ambient air quality standard is established: NO_x, SO_2, CO, Ozone (as VOCs), PM_{10} and Lead. The second broad category of pollutants includes substances identified by EPA as Hazardous Air Pollutants (HAPs). HAPs include those pollutants regulated under Section 112 of the Clean Air Act. It should be noted that although HAPs are typically referred to as "the 188 hazardous air pollutants," the actual list is much longer, since many of the pollutants are identified as compounds, consisting of many individual pollutants in the family of compounds. Also note that for HAPs that are listed as a compound group, e.g., glycol ethers, the aggregate of all compounds are considered as if they were a single pollutant, i.e., the 10 TPY major source threshold applies to the aggregate of that compound group. The third broad category of pollutants includes substances identified by EPA as greenhouse gases (GHGs), including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). The mass of emissions of each greenhouse gas is multiplied by the global warming potential of each gas and these values are summed to generate a carbon dioxide equivalent (CO_{2e}) emissions rate which is used to determine the regulatory status of a facility. While this guidance document provides information of how to determine PTE for any pollutant, the specifics of the GHG program are beyond the scope of this guidance document.

Step Three: How do I calculate my PTE? There are several methods that can be used to calculate PTE. These include the emission factor method, material balances, stack tests, and emissions models. The emission factor method is probably most often used to calculate PTE.

The Emission Factor Method:

$$PTE = EF \cdot PR \cdot (1 - CE/100) \cdot T \cdot SF$$

Where PTE = potential to emit
EF = emission factor
PR = physical or operational design rate
CE = control efficiency (if established by permit)
T = operational time (8,760 hours unless a lesser time is established by permit)
SF = safety factor (optional – see Step 4)

Emission factors are are average amounts of a given pollutant that are released from a particular type of process. They are usually expressed as mass of pollutant per mass of material used or produced, or as mass of pollutant per unit of energy consumed. They are the result of testing that has been done for several similar processes or pieces of equipment. The factors are found in government publications such as AP-42 (Compilation of Air Pollutant Emission Factors), AIRS (Aerometric Information Retrieval System), FIRE (Factor Information Retrieval) database, or manufacturer specifications and/or guarantees. However, note that you assume some risk in using emissions factors based on general information instead of site-specific data. If an inappropriate safety factor (see discussion to follow) is used in calculating site-specific emissions, and the factors change, your estimate of PTE may be lower than the actual level. This could result in your facility being determined to be in noncompliance with one or more applicable requirements. It is your responsibility to accurately establish your facility's emissions levels.

Other Methods

A **material balance approach** also may provide reliable average emission estimates for specific sources. If you know how much material enters a process, how much leaves as finished product, and how much is recycled or recovered, you can estimate the amount that enters the air. For some sources, a material balance may provide a better estimate of emissions than emission tests would. In general, material balances are appropriate for use in situations where a high percentage of material is lost to the atmosphere (e.g., sulfur in fuel, or solvent loss in an uncontrolled coating process.) In contrast, material balances may be inappropriate where material is consumed or chemically combined in the process, or where losses to the atmosphere are a small portion of the total process throughput. As the term implies, one needs to account for all the materials going into and coming out of the process for such an emission estimation to be credible.

Stack tests (source-specific tests or continuous emission monitors) can also be used to calculate PTE at a facility. However, be aware that the results will be applicable only to the conditions existing at the time of the testing or monitoring. To provide the best estimate of longer-term (e.g., yearly or typical day) emissions, these conditions should be representative of the source's maximum capacity. Any stack test data used must be validated and accepted by the DEQ. Any Continuous Emission Monitoring data used must be from a monitor that has been tested and certified in accordance with DEQ policies.

Emissions models are available commercially, and from EPA, that have been developed to estimate emissions from a particular source or source category. Use of these models to estimate emissions must be approved by DEQ prior to use.

Step Four: Incorporate a safety factor into the results. Safety factors should be included in most methods used to calculate PTE. In some cases, such as manufacturer's guarantees, they are already incorporated into the emissions factor. However, note that the basis for the guarantee should also be considered if it was not developed consistent with the site-specific use for the particular emissions unit. For example, most reciprocating internal combustion engine manufacturers rate their engines based on a standard established by ISO 3046-1. The rating is specific to a defined set of standard conditions, and may require adjustment for conditions under which the engine is actually operated. In addition, engines are typically rated under various operating conditions, e.g., "best fuel economy" and/or differing "loads." The PTE should be calculated as the "worst-case" under which the engine could be operated. Equipment restricting operating conditions, such as automatic control of the air-to-fuel ratio, or rpm controls to limit the horsepower range, only reduce the PTE if conditions in a permit provide a practical method to restrict operation over the desired operating range.

In other cases, e.g., use of stack test results, and use of general emissions factors such as from AP-42, the size of the safety factor should be based on the uncertainty associated with the method used to estimate the factor. In general, the more actual emissions data collected under conditions similar to that under which the unit is expected to be operated, the smaller the uncertainty. Thus, both the amount of data, and the representativeness of that data should be given consideration in establishing the size of the safety factor. A statistical approach is provided at the end of this guidance document as an example of one method that could be used to establish the safety factor.

How Do I Determine Maximum Capacity?

In most cases, the maximum capacity of a source is based on its physical and operational design. However, there are sources for which inherent physical limitations for the operation restrict the potential emissions of individual emission units. An inherent limitation is defined as “a limitation on emissions that results from unchanging and unavoidable physical constraints on the operation of a business.” This is commonly called a “bottleneck.” A bottleneck is part of the physical design and physically prohibits increased capacity. For example, a paint spray booth at a small auto body shop uses two spray guns to spray paint. The PTE could be calculated assuming that both guns are operated continuously 8,760 hours per year. However, because there are limitations on the number of cars that can actually be painted per day the PTE calculation should take into consideration this bottleneck and adjust the PTE accordingly. Where such inherent limitations can be documented by a source and confirmed by the DEQ, they can be considered in estimates of a source’s PTE.

The EPA, in issuance of various guidance and regulations, has identified several instances where an inherent limitation on PTE should be recognized. They include:

- In guidance issued in 1995 EPA recognized that a “reasonable and realistic worst-case” estimate of hours of required operation for emergency generators could be used to estimate PTE. The “worst-case” is typically considered to be 500 hours.

- In guidance issued in 1995 EPA recognized that country grain elevators are clearly constrained in their operation, to the extent that they are designed to serve, and as a matter of operation only serve a limited geographical area from which a finite amount of grain can be grown and harvested. Moreover, the principal determinant of which given elevator will be used by a farmer is the proximity of the elevator to the harvest. Consequently a single elevator serves essentially the same geographic area from year to year. The EPA believes that this constraint is “inherent” to the operation of the elevator (i. e., operation of the elevator is directly linked to a specific and definable harvest area). The grain handling and storage facilities at grain elevators are designed to handle very large amounts of grain in a relatively short period of time (i.e., at harvest). Although the physical capability exists to handle large amounts of grain throughout the year, such a year-round operation is clearly unachievable as a practical matter and does not occur in reality. Although the amount of grain harvested during any one year will vary somewhat, the EPA believes that an estimable and reasonable upper bound can be determined which would never be exceeded absent extraordinary circumstances.

- In guidance issued in 1996 EPA recognized that batch chemical production facilities are not able to use one operations unit for more than one production cycle at a time since the production occurs in discrete batches, rather than as a continuous process in which raw materials are continuously being fed, and products continuously being removed. Moreover, the addition of raw material and withdrawal of product do not occur simultaneously in a batch operation. In addition, operation units (reactors, etc.) at batch chemical plants may not be dedicated to the production of a single chemical. Rather, the collection of operation units at a given plant site is available to manufacture a variety of different chemicals. The particular equipment used, the sequence of that equipment, and the time each piece of equipment is in operation may change with each different product manufactured (i.e., each production cycle). Thus, the "worst-case" emissions may be determined by deriving an average rate over an entire production cycle and emissions may be calculated based on the greatest number of batches that could occur in a year's time. The list of products and raw materials should include all products that the source, in the exercise of due diligence and best engineering judgment, reasonably knows that it can produce.

- In the promulgation of 40 CFR Part 63, Subpart HH, EPA recognized that facilities dependent on gas fields for throughput usually operate at considerably less than the maximum capacity of the equipment present, because the supply of gas available to process is an inherent physical limit on operations. The MACT standard allows calculation of PTE to be based upon annual throughput data, incorporating a safety factor, instead of maximum capacity of the equipment, and if throughput data shows an uninterrupted 5-year history of decline, an alternative and even less stringent method of calculating PTE is allowed.

- In the promulgation of 40 CFR Part 63, Subpart HHH, EPA recognized that dehydrators and other equipment used during withdrawal operations at facilities for underground storage of natural gas could not operate 8,760 hours per year, but only because gas must be injected into the reservoir before it can be withdrawn. Dehydrators used to remove moisture from gas when it is withdrawn from the reservoir do not operate during the injection phase of the injection/withdrawal cycle. PTE is determined based upon a calculation of the injection/withdrawal cycle time, assuming that the cycle is performed at the maximum possible rate year-round.

- It's also important to note that, in several of these instances, comments received on the regulations proposed that EPA should consider "seasonal operation" of the facility as an inherent limitation on PTE. This was rejected as not appropriate for these specific cases. In addition, we are not aware of any rule or guidance specifically recognizing seasonal operation (because of weather changes throughout the year) as an inherent limitation on PTE.

How Can I Limit My PTE?

Any number of methods may be used to limit emissions. The methods can be used singly or in combination. In general, two considerations must be followed when proposing permit conditions meant to lower the PTE. First, the reduction in PTE must be permanent, quantifiable and otherwise enforceable. Second, the stationary source must be able to meet its business needs while operating under the conditions required by the permit. Some of the more common methods of reducing the PTE are:

- Limiting production (e.g., amount of material processed),
- Limiting operation (e.g., hours, fuel type, raw material type),
- Limiting emissions by adding air emission control equipment, and/or
- Limiting emission rates (must be used with a production or operation limit).

How Do I Ensure that the Limitation on PTE Is Federally Enforceable?

In general, "federally enforceable" means that the conditions in a permit are enforceable in a practical manner. Practicable enforceability for a source-specific permit means that: (1) the permit's provisions must specify a technically accurate limitation and the portions of the source subject to the limitation, (2) the time period for the limitation (hourly, daily, monthly, and annual limits such as rolling annual limits), and (3) the method to determine compliance including appropriate monitoring, record keeping, and reporting.

Safety Factor Sample Calculation

The following procedure could be used to extrapolate limited datasets of emissions information used to derive an emissions factor. The method yields an estimate of a selected upper percentile value of the emissions factor, assumes a constant coefficient of variation, and is independent of the number of data points considered. The most statistically valid estimate of an upper percentile value is a maximum likelihood estimator that is proportional to the population geometric mean. If you assume the population of data fits a lognormal distribution, this relationship is given by:

$$EF_p = EF_{mean} \bullet \exp (Z_p \bullet \sigma - 0.5 \bullet \sigma^2)$$

$$\sigma^2 = \ln (CV^2 + 1)$$

Where Z_p = normal distribution factor at the p^{th} percentile
CV = coefficient of variation

The coefficient of variation should be calculated from the data used to develop the original emissions factor, considering how it is to be applied. For example, a CV for an entire "source category" may be very different from the CV for a particular type of emissions unit or individual "model" of emissions unit. For the purposes of this example, assume that CV = 0.6, then σ^2 = 0.307. The following safety factors can then be calculated as shown in Table 2.

Table 2. Ratio of Upper Percentiles to Geometric Mean

Percentile P	**Normal Distribution Factor Z**	**Safety Factor EF_p/EF_{mean}**
90	1.283	1.74
95	1.645	2.13
99	2.386	3.11

The selection of an appropriate safety factor should be based on both the quantity of data and the quality of that data. For example, you may want to use a higher percentile in those cases where the quality of the emissions factor is rated “below average” or “poor,” or where data from a “less representative” emissions unit is being used. For a more in-depth description of emissions factor development, see “Procedures for Preparing Emission Factor Documents,” USEPA, EPA-454/R-95-015.

As a specific example, consider an oil and natural gas facility (as defined in 40 CFR Part 63, Subpart HH) that is attempting to determine applicability prior to the compliance date of Subpart HH. The facility consists of two, 2,250-hp, Cooper-Bessemer GMVH-10, 2-Stroke Lean-Burn engines that use 6,900 BTU/hp-hr of natural gas as fuel.

The February 1997 AP-42 gives the formaldehyde emissions factor as 0.263 lb/hp-hr (pounds of formaldehyde emitted per engine horsepower per hour). This results in a PTE of 5.7 TPY (tons per year) of formaldehyde for each engine. The emissions factor rating is “C,” or “average.” Thus, applying a safety factor of 2.13 (corresponding to the 95th percentile maximum likelihood estimator and conservatively considering the “average” factor as the “geometric mean”), a conservative estimate for the emissions factor would actually be 0.263 • 2.13 = 0.56 lb/hp-hr, which results in a PTE of 12.1 TPY. Note that, using the “safety factor,” each individual engine at the facility would be considered a major source for HAPs. Since it is the responsibility of the permittee to accurately estimate emissions, it would most likely be in their benefit to perform stack testing to confirm the emissions rate, and thus determine Subpart HH applicability. However, note that testing must correspond to “worst-case” operating conditions to determine the PTE.

The importance of using a safety factor to calculate emissions becomes more apparent when you consider the same scenario, with the availability of new information. The July 2000 AP-42 gives the formaldehyde emissions factor as 0.0552 lb/MMBTU (pounds of formaldehyde emitted per million British thermal units worth of fuel combusted). This results in a PTE of 3.7 TPY of formaldehyde for each engine. The emissions factor rating is “A,” or “excellent.” However, applying a safety factor of 1.74 (corresponding to the 90th percentile maximum likelihood estimator, a conservative estimate for the emissions factor would actually be 0.0552 • 1.74 = 0.096 lb/MMBTU, which results in a PTE of 6.5 TPY. Thus, using the “safety factor,” the facility would still be considered a major source for HAPs, and thus subject to Subpart HH. Again, it would most likely be to the permittee’s benefit to perform stack testing to confirm the emissions rate, and thus determine Subpart HH applicability. However, as mentioned previously, testing should correspond to “worst-case” operating conditions to determine PTE. In addition, note that a safety factor should most likely also be used with manufacturer’s emissions factors, unless guaranteed. In those cases where a guarantee is made, additional monitoring of other associated parameters is typically required.

Who Can I Contact for More Information?

For assistance, contact the Air Quality Division at (405) 702-4100 and ask to speak with a permit writer.

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