MPCA Emissions Estimating Guidance for Use in an Air Emissions Risk Analysis

This document provides additional guidance for preparing emission estimates for input into the risk analysis screening spreadsheet of an Air Emissions Risk Analysis (AERA), and is to be viewed as a supplement to the Minnesota Pollution Control Agency's (MPCA) AERA Guidance, section 2.3 *Identifying Chemicals Emitted and Estimating Emission Rates* (September 2007). It is the goal of the MPCA that emission estimates used in an AERA should be the most accurate estimate of emissions over the appropriate timeframe with a reasonable certainty that chemical emission rates are not underestimated, irrespective of the data source from which they are derived.

As described in the AERA guidance[1], one or both of two facility operating scenarios may be chosen for assessment: the proposed "potential to emit" as defined by permit conditions, or an emissions scenario that is not the potential to emit (PTE) but describes another level of emissions. Regardless, emission rates selected for assessment become the basis of enforceable limits if the MPCA believes limits are necessary.

Generating Emission Estimates

1. **For those pollutants subject to a limit on a mass per process rate basis** (i.e. lb/gallon applied, lb/mmBtu heat input, or gr/dscf of exhaust gas, etc.) use that emission limit combined with the maximum capacity to determine maximum hourly emissions (which becomes the *acute* emissions rate). For those pollutants for which an emission limit is set on a mass per time basis (i.e. lb/hr), use the emission limit as the maximum hourly emission rate. Multiply the hourly emission rate by 8760 and divide by 2000 to determine annual emissions in tons per year unless there is a limit in the permit (or you propose a limit for your permit) on annual operations or emissions, or if the facility is incapable of operating 8760 hours per year at maximum capacity (the *chronic* emissions rate). If there is (or will be) a limit on operation, either physical or permit limited, use that limit to determine annual emissions.
2. **For those pollutants *not subject to an emission limit,* and a published emission factor is used to determine emissions,** use the emission factor combined with maximum emission unit operation to determine hourly emissions (the *acute* emissions rate). If the factor is for uncontrolled emissions and your permit does (or will) require the use of control equipment, you may include the control efficiency percentage in your calculation for use of the control equipment. Again, multiply this hourly emission rate number by 8760 to determine annual emissions unless there is a permit limit (or your proposed limit for your permit) on annual operations or emissions, or if the facility is incapable of operating 8760 hours per year at maximum capacity (the *chronic* emissions rate). If there is (or will be) a limit on annual operation, either physical or permit limited, use that limit to determine annual emissions.

   Hierarchy of Emission Factor Databases. The Environmental Protection Agency's (EPA) Compilation of Air Pollutant Emission Factors (AP-42), Factor Information REtrieval (FIRE) as well as the California Air Toxics Emission Factors (CATEF) database are preferred sources of factors. When using emission factors, generally EPA's factors presented in AP-42 should be used where available. When a factor for a given pollutant is not available from AP-42, FIRE or CATEF may be used. If you determine that either FIRE, CATEF, or another published emission factor has been developed using more robust data than that used for AP-42, that alternate factor may be used.

   Alternative Emission Factor Databases. Alternative emission factor databases may be used for the source of the factor if the MPCA agrees that the data presented is more robust than that developed by EPA. For example, industry group datasets or documents may provide additional data. A company may choose an industry group published document that incorporates data from several similar facilities. When using alternative emission factors, describe the number of tests used to generate the factor, and the similarity of the emission unit, operating conditions, and control equipment to the proposed facility.

[1] MPCA "Air Emissions Risk Analysis (AERA) Guidance Version 1.1, September 2007, p. 19.

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Emission factors are typically arithmetic averages. Emission factors such as those found in AP-42 are arithmetic averages of the available data set. If used without modifying to account for being an arithmetic average, the MPCA will describe the resulting risk estimate as potentially underestimated (see discussion of the development of emission factors from stack test data in item 4 below). You should describe any mitigating factors if AP-42 factors are believed to be upper-bound estimates of the emission source's performance.

3. **For those pollutants where emissions are determined by a mass balance** calculation rather than an emission factor (i.e. evaporative material usage) calculate each chemical emission rate at the maximum hourly usage rate for the emission unit (the *acute* emissions rate). To convert to the annual emissions rate, multiply by 8760 and divide by 2000 (the *chronic* emissions rate). Bottlenecks in the process and annual emission caps may be taken into account that would limit the annual emissions. If there is control equipment, you may include the control efficiency percentage in your calculation for both the acute and chronic emissions rate for the use of control equipment. For emission units that use more than one material resulting in the emission of multiple chemicals from different materials, calculate the emissions for each chemical using the properties of the material that contains the greatest amount of that chemical. This commonly involves using chemical content data from several different materials in order to determine the maximum emission rate for each chemical of concern. To obtain chemical contents of materials used, the company may use Material Safety Data Sheet (MSDS) or other similar product data sheets.

4. **Using an emission factor developed from stack emission tests.** Carcinogenic and chronic noncarcinogenic toxicity values are based on lifetime average exposures. Thus, emission factors that represent long-term average emissions (often taken as one year) are most appropriate for estimating long-term exposures. In contrast, acute toxicity values are based on exposures over a short period of time. Emission factors that represent short-term peak emissions (often one hour) are most appropriate for estimating short-term exposures.

   The 95 percent upper confidence limit (UCL) of a mean is defined as a value that, when calculated repeatedly for randomly drawn subsets of site data, equals or exceeds the true mean 95 percent of the time. The 95 percent UCL provides a conservative estimate of the average concentration (not to be confused with the 95^{th} percentile of the measured data). Due to the uncertainty associated with estimating the true average emission rate, the 95 percent UCL of the arithmetic mean should be used because it provides reasonable confidence that the true average emission rate will not be underestimated.

   For purposes of cancer and chronic noncancer risk assessment, the 95 percent upper confidence limit of the arithmetic mean (UCL-AM) of stack test data should be used. The EPA has formulated guidance for calculating the UCL-AM: USEPA, OSWER, 2002, *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (www.hanford.gov/dqo/training/ucl.pdf). The guidance has been implemented in the EPA ProUCL software (http://www.epa.gov/nerlesd1/tsc/software.htm). This software may be downloaded and run to obtain UCL-AM values from stack test data.

   For acute (hourly) emission rates use the higher of the maximum measured value or the UCL-AM (in practice the UCL-AM exceeds the maximum measured value only in unusual cases with few data points). If there are too few measurements to calculate the UCL-AM, use the highest measured value for acute, cancer, and chronic non-cancer risk assessments. Generally, four or more measurements are required to obtain UCL-AM values from ProUCL.

   It should be emphasized that the data should be from stack testing done at the emissions unit under consideration or at similar unit(s). If the unit has been modified, previously generated test data may not be appropriate. In other words, the calculation of an appropriate UCL-AM is based upon the assumption that the data set under study consists of observations from a single population that is representative of the source in question.

   The UCL-AM computation methods in ProUCL cover a wide range of skewed data distributions arising from the various environmental applications, including all UCL-AM computation methods contained in the EPA guidance document. ProUCL tests for normality, lognormality, and gamma distribution of the data set. In addition, several distribution free non-parametric methods are included in ProUCL.

5. **Data with non-detects**. Whenever possible, measured values should be retained in the database, including values below the detection limit. Substituting zero, the detection limit, or one-half the detection limit amounts to censoring the data and should be avoided. Substituting with zero biases the mean low and the variance high. Substituting with the detection limit biases the mean high and the variance low. Substituting the one half the detection limit introduces unpredictable biases. Detection limits for the stack testing method should be chosen so that there is a reasonable expectation of detecting the pollutants to be measured.

Despite the above, left-censored (below detection) data are frequently encountered in stack testing and other environmental data, giving rise to analytical problems. ProUCL described above does not handle left-censored data sets with non-detects—all of the parametric and non-parametric recommendations for computing the mean, standard deviation, UCL-AM and all other statistics computed by ProUCL are based upon full data sets without censoring. If a relatively modest number of censored data points are present (e.g., < 15 percent), the common one hal,f detection limit substitution may be used to compute the various statistics (including the UCL-AM). If larger amounts of censored data are present, the options are to use the highest measured value and/or to compare various censoring methods. Justification should be given for the selected UCL-AM in such cases. The issue of estimating the mean, standard deviation, and an appropriate UCL-AM in left censored data sets with varying degrees of censoring is currently under investigation by EPA.

If a chemical is not expected to be present, non-detects may be assigned "zero" for purposes of risk assessment. Justification should be provided to describe why such a chemical is not expected to be present.

Exemption for assessing non-detect pollutants from Natural Gas Boilers. The following pollutants have E rated emission factors, which are based on detection limits from AP-42. These pollutants do not need to be included in quantitative emission estimates from natural gas fueled boilers because of the associated uncertainty. Instead, they should be discussed qualitatively. All other pollutants with AP-42 values should be included quantitatively.

56-49-5	3-Methylchloranthrene
57-97-6	7,12-Dimethylbenz(a)anthracene
83-32-9	Acenaphthene
203-96-8	Acenaphthylene
120-12-7	Anthracene
56-55-3	Benz(a)anthracene
50-32-8	Benzo(a)pyrene
205-99-2	Benzo(b)fluoranthene
191-24-2	Benzo(g,h,i)perylene
205-82-3	Benzo(k)fluoranthene
218-01-9	Chrysene
53-70-3	Dibenzo(a,h)anthracene
193-39-5	Indeno(1,2,3-cd)pyrene
7440-41-7	Beryllium
7782-49-2	Selenium

6. **The methodology for calculating toxic emissions pre- and post- modification at existing facilities should be the same.**

Documentation of the Basis of Emission Estimates

1. **In general,** assumptions and data relied upon should be described in the emissions estimating portion of the AERA submittal. Provide as much description as possible so that the source of data and its treatment in creating emission estimates is clear. Provide support for assumptions made, and be prepared to provide references if requested.

2. **Use reasonable effort to identify sources of emissions data.** Section 2.3.3 of the AERA describes common sources of emissions data (some of them listed above in item 2). The MPCA expects a project proposer to use a reasonable amount of effort reviewing these datasets for likely emissions data.

   If no data are available for a pollutant, and it is unreasonable to make a comparison to a similar type of air emissions source, a facility owner does not have to provide emissions data for the pollutant. In order to assert that no data is available, you must describe the attempts made to identify emission factors (e.g. list databases consulted, literature reviewed, internet searches, industry databases, personal interviews with experts, etc.).

3. **Report the reference for sources of emission factors and/or estimates.** The reference to each emission factor used within the RASS must be reported. The spreadsheet available on MPCA's AERA Web site, www.pca.state.mn.us/air/aera.html, and has been developed to ease demonstrating how emission factors and emission unit estimates were developed and providing the reference to the data source.

   If an equation is used to determine the emission factor, clearly document the source of the factors and the rationale for the equation, and provide easy to follow calculations.

4. **Provide rationale for the selection of an emission factor.** The rationale for excluding any emissions factor or data point within a dataset must be described. List any factors, data points and their references that were excluded from use in determining emissions. Do not describe a factor or data point that would typically appear in a dataset as an "outlier" without providing an explanation.