POLICY FOR THE CONTROL OF HAZARDOUS AIR POLLUTANT EMISSIONS IN NORTH DAKOTA (Air Toxics Policy)

PURPOSE

This document establishes the policy to be used by the North Dakota Department of Health, Division of Air Quality, for the evaluation of sources emitting Hazardous Air Pollutants (HAPs) into the ambient air. This policy document is effective until modified by the Department or until formal rules are promulgated. This policy will be used by the Department to evaluate the need for further review of emissions from a source whose emissions result in an exceedance of the levels established by this policy.

APPLICABILITY

This document is applicable to all new or modified air contaminant sources, as designated in 33-15-14-01 of the North Dakota Air Pollution Control Rules, required to submit an application for a Permit to Construct under Section 02 of Chapter 33-15-14. The Department may exempt the following source categories from the requirements of this policy: 1) sources of minor significance as determined by the Department and 2) any source subject to National Emission Standards for Hazardous Air Pollutants for Source Categories (MACT) which has demonstrated compliance with the residual risk provisions of the Clean Air Act.

Certain additional sources of HAPs will be considered for emission control by the Department on a case-by-case basis or as deemed appropriate. These may include "nontraditional" sources such as air strippers for the removal of organic contaminants from groundwater, ethylene oxide sterilizers, or any existing or new source where there is reason to believe that HAPs being emitted pose a significant risk to human health or the environment.

Sources affected by this document are required to complete an Air Pollution Permit Application (AP 100) if an application has not been submitted, a HAP Permit Application (AP-117), and submit any additional information needed by the Department to evaluate the potential risk to human health or the environment from HAP emissions.

AUTHORITY

The Department has authority to control HAP emissions under Section 33-15-02-04, subsection 3 of the North Dakota Air Pollution Control Rules which states, "The ambient air shall not contain air contaminants in concentrations that would be injurious to human health or well-being or unreasonably interfere with the enjoyment of property or that would injure plant or animal life. The Department may establish, on a case-by-case basis, specific limits of concentration for these contaminants."

DEFINITIONS

Hazardous Air Pollutant

For the purpose of this document, a hazardous air pollutant is defined as any air pollutant lacking an applicable ambient air quality standard which may contribute to a significant increase in human mortality, cause serious irreversible or incapacitating reversible illness, pose a significant threat to human health or the environment, or be considered by the Department of Health to pose a community problem. This definition is consistent with Section 33-15-02-04, subsection 03 of the North Dakota Air Pollution Control Rules and with Section 112 of the Federal Clean Air Act.

Unit risk factor is an estimate of the probability of developing cancer when exposed to 1 $\mu g/m^3$ of a substance for 70 years.

Maximum individual carcinogenic risk is an estimate of the probability of developing cancer by an individual exposed to the greatest concentration of a substance in the ambient air over a 70-year period (U.S. EPA 1975). This is obtained by following the procedure outlined in the Dispersion Modeling Section of this document. For example, a maximum individual carcinogenic risk of 8×10^{-4} implies that eight people out of 10,000 would be expected to develop cancer when exposed for 70 years to the maximum concentration of a substance in the ambient air.

New HAP Emission Unit is a unit constructed or modified after July 29, 1987 which emits a hazardous air pollutant.

Existing HAP Emission Unit is a unit constructed on or before July 29, 1987 which emits a hazardous air pollutant.

Modified means to make a physical change to an emission unit which increases the hourly emission rate of any HAP.

BACKGROUND

The control of air pollutants has traditionally concentrated on a relatively few "criteria" pollutants, whose emissions are regulated by various local, state and federal rules. Particulate matter less than 10 microns in diameter (PM_{10}), sulfur dioxide, nitrogen dioxide, carbon monoxide, and lead emissions are regulated by placing emission limits on designated air contaminant sources. The Federal NSPS program regulates, in addition to the previously mentioned pollutants, several air contaminants from select sources. Some effort has been made to control HAPs on the federal and state levels through the NESHAP and MACT programs. However, promulgation of new NESHAPs by EPA has been slow, requiring 4-5 years. Also, the NESHAP program has concentrated on pollutants posing a national health risk, not a local health risk. Small population centers are often overlooked in the federal process. The MACT program addresses less than 190 pollutants and generally applies only to major sources of HAPs.

Increased local and national concern about the release of hazardous/toxic substances, the relative slowness of NESHAP and MACT promulgation at the federal level, the wide variety of chemicals released to the atmosphere and increased encouragement at the federal level, are the primary impetuses for a policy document delineating the Department's policy with respect to the control of routine releases of HAPs.

APPROACH

The approach used by the Department to evaluate a permit application for a new emission unit(s) releasing HAPs into the ambient air is to require: a) An analysis of the carcinogenic health effects of emissions.; and b) An analysis of the non-carcinogenic health effects of emissions.

Analysis of Carcinogenic Health Effects

A list of HAPs which are considered to have known or possible carcinogenic health effects is included as Appendix B. This list is compiled by the Department using the following sources: 1) US EPA Integrated Risk Information System (IRIS) database, which is available at: http://www.epa.gov/iris/; and 2) US EPA table of Prioritized Chronic Dose-Response Values for Screening Risk Assessments, which is available at: http://www.epa.gov/ttn/atw/toxsource/table1.pdf. Other unit risk factors may be used upon approval by the Department.

The maximum individual carcinogenic risk (MICR) shall be calculated as outlined in the ADetermination of Compliance@ section of this document. For those HAPs with known or possible carcinogenic health effects, an analysis is required to demonstrate that the

combined impact of new HAP emission units does not result in a maximum individual carcinogenic risk (as defined by this policy) of greater than 1×10^{-5} (one in one hundred thousand).

It must be stressed that the acceptable MICR of 1×10^{-5} is not meant to establish a health-based standard. Rather, the acceptable MICR level of 1×10^{-5} will be used by the Department as a mechanism to evaluate the need for further review of emissions from sources emitting HAPs with known or possible carcinogenic health effects.

Analysis of Non-Carcinogenic Health Effects

An analysis is required to demonstrate that the combined impact of all new HAP emission units does not cause an exceedance of an applicable Guideline Concentration (GC) as defined by this policy.

Guideline Concentrations are developed based on the use of the TLV-TWA, the TLV-STEL or the TLV-C developed by the American Conference of Governmental Industrial Hygienists. Substances designated by the ACGIH as simple asphyxiants such as helium whose mechanism of action is primarily through reduction of oxygen and which, upon dilution in ambient air should pose little health risk, are exempt. The following substances for which an ambient standard has been established in Section 33-15-02-04 of the North Dakota Air Pollution Control Rules are also exempt: sulfur dioxide, hydrogen sulfide, carbon monoxide, ozone, nitrogen dioxide and lead. In addition to those substances for which an ambient standard has been established, aluminum oxide, coal dust, grain dust and portland cement are also exempt based on the Department=s determination that the ambient standard for PM_{10} adequately addresses emissions of these substances.

The ACGIH (2010) defines the TLV-TWA as the time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, for a working lifetime without adverse effect. The TLV-STEL is the concentration to which it is believed that workers can be exposed continuously for a short period of time without suffering from: (1) irritation; (2) chronic or irreversible tissue damage; (3) dose-rate-dependent toxic effects; or (4) narcosis of sufficient degree to increase the likelihood of accidental injury, impaired self-rescue or materially reduced work efficiency, and provided that the daily TLV-TWA is not exceeded. The TLV-C is the concentration that should not be exceeded during any part of the working exposure. Eight-hour and 1-hour Guideline Concentrations (GCs) for the pollutants specified in Appendix A are established from the TLV-TWA and TLV-STEL/TLV-C, respectively, of the ACGIH. Also, only certain substances have a 1-hour Guideline Concentration. These substances have been recognized by the ACGIH as having acute effects as well as chronic effects and have an appropriate TLV-STEL or TLV-C. Therefore, the

Department believes an additional shorter averaging period is warranted for these substances.

Computation of both the 8-hour and 1-hour Guideline Concentrations (GCs) are based on the application of certain correction factors to the TLV-TWA and TLV-STEL/TLV-C, respectively. Eight-hour GCs are calculated by first extrapolating the dose incurred during a 40-hour work week to an "equivalent" continuous weekly dose by dividing the TLV-TWA by 4.2 (168/40 hours). The TLV-TWA is then adjusted by dividing by a factor of 1.75 representing the average lung ventilation volume of 10 cubic meters/24 hours for a 6-year old child weighing 20 kg compared to the average ventilation volume of 20 cubic meters/24 hours for an adult weighing 70 kg (Commonwealth of Massachusetts 1985). This is done to protect children, whom for various reasons such as differing ventilation, absorption, and excretion rates, and immature immune systems, may be more susceptible to the effects of these pollutants. Finally, the TLV-TWA is divided by a safety factor of 5 to protect additional portions of the exposed population and to account for the fact that only HAPs from new HAP emission units are addressed by the policy with the use of guideline concentrations. Therefore, the preliminary 8-hour Guideline Concentration (GC) is given by equation 1.

$$\text{Preliminary } GC_{8\text{-hour}} = \text{TLV-TWA} / (4.2 \times 5 \times 1.75) \quad (1)$$

The above equation results in a divisor of 36.75. However, to simplify calculation of the GC and to provide an additional factor of safety, the divisor is adjusted to 50. So, the Guideline Concentration of a HAP for an 8-hour averaging period based on the TLV-TWA is:

$$GC_{8\text{-hour}} = \text{TLV-TWA} / 50 \quad (2)$$

The same divisor of 50 is applied to the TLV-STEL or TLV-C in calculating the 1-hour GC. This results in a conservative 1-hour GC. The 1-hour GC, based on the TLV-STEL or TLV-C, is:

$$GC_{1\text{-hour}} = \text{TLV-STEL (or TLV-C)} / 50 \quad (3)$$

When necessary, a GC will be set by the Department for those substances lacking an appropriate TLV. This will be done by applying the appropriate safety factors, determined to be necessary to prevent adverse health effects because of extrapolation from incomplete toxicity data or animal toxicity data, to the No Observable Effect Level (NOEL) or any other measure of toxicity, as deemed appropriate by the Department.

The AGGIH regularly updates the TLV-TWA and TLV-STEL for the various chemicals. The Department will use the latest version of the ACGIH handbook to determine the appropriate GC. Should that

data conflict with a GC listed in this policy, the most current TLV will be used for determining compliance.

It must be stressed that the Guideline Concentration for a substance is not an ambient standard. Rather, the Guideline Concentration will be used by the Department as a mechanism to further evaluate the need for further review of emissions from sources whose predicted concentrations exceed either the 8-hour or 1-hour Guideline Concentration.

DETERMINATION OF COMPLIANCE

To determine compliance with the applicable 8-hour GC, 1-hour GC or carcinogenic risk criteria, the maximum off-property, ground-level ambient concentration of each HAP emitted from an affected HAP source must be calculated using the dispersion modeling procedure outlined in the following section entitled "Dispersion Modeling Procedure." Maximum concentrations for each HAP must be calculated using the maximum potential HAP emission rate for the time period of the GC (i.e., 1-hour, 8-hour or other averaging period). For HAPs with known or possible carcinogenic health effects (i.e., those HAPs for which a unit risk factor has been developed), a maximum annual concentration for each HAP and the maximum individual carcinogenic risk associated with emissions from the source must be calculated. When calculating a maximum annual concentration as part of a Tier 1 or Tier 2 analysis (as described in the Dispersion Modeling Procedure Section), the maximum potential annual average HAP emission rate must be used. The results of these calculations must then be used to determine if emissions from the affected HAP source comply with the GC(s), the hazard index or the carcinogenic risk criteria established by this policy.

Facilities emitting more than one HAP will be given special consideration by the Department because of the possibility of synergism between pollutants. For example, where two or more carcinogenic risk assessments are required, risks from the individual pollutants will be assumed to be additive and the combined maximum individual carcinogenic risk from all HAPs with known or possible carcinogenic health effects must be less than 1×10^{-5}. Similarly, the non-carcinogenic health effects of multiple HAPs emitted from a source are assumed to be additive if the available toxicity data are insufficient to determine otherwise. The non-carcinogenic health effects of multiple HAPs into the ambient air will be evaluated according to equation 4:

$$\text{Hazard Index} = MC_1/GC_1 + MC_2/GC_2 + \ldots + MC_n/GC_n \quad (4)$$

where MC_1, MC_2,..., MC_n are the modeled ambient concentrations for HAPs 1, 2, ..., n and GC_1, GC_2, ..., GC_n are the Guideline Concentrations for HAPs 1, 2, ..., n. A hazard index less than or equal to 1 will be considered acceptable, whereas a hazard index greater than 1 will trigger further review by the Department.

DISPERSION MODELING PROCEDURE

A three-tiered approach to calculating the maximum off-property, ground-level ambient concentration of each HAP is recommended. The analysis begins with Tier 1, which is the simplest technique and involves the most conservative assumptions. Each successive tier involves more refined, less conservative techniques. If application of the Tier 1 procedure results in predicted compliance with the requirements of this policy, no further analysis is necessary. However, if the subject source is not predicted to comply with this policy after application of the Tier 1 procedure, a Tier 2 analysis will be necessary. Likewise, failure to comply after the Tier 2 procedure mandates a Tier 3 analysis.

The Tier 1 procedure involves the use of simple look-up tables to determine maximum off-property, ground-level ambient concentrations for each HAP with a minimum of source information. The Tier 2 procedure requires use of a computer and the EPA SCREEN3 model. Lastly, the Tier 3 procedure involves use of a refined computer model. Through use of detailed information on source and meteorological conditions, the Tier 3 procedure provides the most realistic (least conservative) HAP concentrations.

Tier 1 Procedure

The Tier 1 procedure utilizes look-up Tables 1 and 2 (see pages 16 and 17), which provide normalized maximum 1-hr concentrations for various stack heights and downwind distances. Table 1 is used to determine HAP impacts from stacks which are good engineering practice (GEP) height with respect to all nearby buildings. Table 2 applies for stacks which are less than GEP height with respect to nearby buildings. In the latter case, maximum ground-level concentrations will generally be higher because of building downwash effects. GEP height, in the context of the present analysis, is defined as follows:

$$H_g = H + 1.5L \quad (5)$$

Where:

H_g = good engineering practice stack height, measured from the ground-level elevation at the base of the stack,

H = height of nearby structure, measured from the ground-level elevation at the base of the stack,

L = lesser dimension, height or projected width, of nearby structure.

"Nearby" is defined as less than 5L distance from the stack. If more than one nearby structure is present, GEP height should be based on the structure which produces the largest H_g in Equation 5.

The Tier 1 procedure does not apply for highly reactive pollutants or for releases which are heavier than air (dense gas releases). The Tier 1 procedure is not applicable to scenarios involving non-point sources (i.e., area, volume, or line sources). The procedure is also not applicable to scenarios involving significant terrain height variations or complex building downwash, specifically:

1. terrain elevation above stack-base elevation exceeds H_s within 50 H_s of the stack location, where H_s = stack height,

2. any building within 5L of the stack location exceeds the stack height.

If either of these conditions exist, or if non-point sources are involved, a Tier 2 analysis will be necessary.

The Tier 1 procedure involves the following steps:

1. Determine the stack height (meters) for the HAP source.

2. Using Equation 5, determine if the stack height is GEP with respect to all nearby structures.

3. Select the appropriate Table 1 or 2, depending on the GEP status of the stack. Table 1 may be used only if the stack height is GEP with respect to all nearby structures.

4. In the table, select the row for the stack height nearest to, but less than or equal to, the actual stack height.

5. Determine the lateral distance (meters) from the HAP release point to the nearest point off-property. (If the property is not bounded by a fence, this distance is zero.)

6. In the table, select the column for the distance nearest to, but less than, the distance determined in Step 5.

7. Beginning with the value indicated by the intersection of the row from Step 4 and column from Step 6, proceed down the row to the right to find the largest value to the right of and including the intersection value.

8. Multiply the value from Step 7 by the 1-hour emission rate for each HAP from the stack, to estimate the maximum off-property 1-hour concentration for each HAP for this stack.

9. If more than one stack is present, repeat Steps 1-8 for each stack. Then, if any stacks have common HAPs, add the Step 8 results for each stack to determine the total off-property 1-hour concentration for each HAP.

10. Determine the maximum individual carcinogenic risk (MICR) for any HAP with a known or possible carcinogenic effect. First, multiply the Step 9 results for each HAP by the appropriate conversion factor (Table 3) to estimate a 70-year average concentration. Then, multiply the 70-year average concentration by the Unit Risk Factor (from Appendix B) for each HAP to determine the MICR for each HAP. Lastly, sum the MICR for individual HAPs to determine total MICR.

11. Determine the hazard index for all HAPs for which a Guideline Concentration (GC) has been established (see Appendix A). For any HAPs which have 8-hour average GCs, multiply the total 1-hour concentration (Step 9) by the appropriate conversion factor (Table 3) to estimate a maximum 8-hour average concentration. Then, determine the hazard index using Equation 4 and the GCs from Appendix A. Note that for HAPs which have both 1-hour and 8-hour GCs, the higher of the two ratios (MC/GC) should be utilized in Equation 4.

If the total MICR as computed in Step 10 is greater than 1×10^{-5}, a Tier 2 analysis will be necessary for the HAPs with known or possible carcinogenic health effects. Likewise, if the hazard index computed in Step 11 is greater than one, a Tier 2 analysis will be necessary to evaluate the non-carcinogenic health effects.

Tables 1 and 2 were created using the EPA SCREEN3 model (U.S. EPA, 1995). For a given release height and downwind distance, the SCREEN3 model can select the highest predicted concentration from a matrix of predictions for all plausible meteorological conditions. Plume rise was not considered in developing Tables 1 and 2, thus ensuring conservativeness of the resultant entries. Table 2 was created by entering generic building dimensions into SCREEN3 to simulate structural downwash effects. A range of building sizes for each stack height was considered, including dimensions which induced plume entrainment into the building cavity region (i.e., cavity concentrations). Though the range of simulated building dimensions was limited, the entries in Table 2 are likely

conservative for any building configuration, given that plume rise was not accounted for.

Tier 2 Procedure

The Tier 2 procedure involves use of the EPA SCREEN3 computer screening model (U.S. EPA 1995). For a given set of source conditions and downwind distances, the SCREEN3 model selects the highest predicted 1-hour concentration from a matrix of predictions for all plausible meteorological conditions. The SCREEN3 model can simulate point and area sources, and building downwash conditions. Use of SCREEN3 constitutes a less conservative procedure than the Tier 1 analysis because plume rise and building downwash are more realistically treated. A screening model other than the EPA SCREEN3 model may be used upon approval by the Department.

The Tier 2 procedure is not applicable for highly reactive pollutants or for dense gas releases. The Tier 2 procedure may be applied for area sources (as defined in the SCREEN3 Model User's Guide), but is not recommended for volume or line sources.

The Tier 2 procedure involves the following steps:

1. Assemble the source input information necessary for SCREEN3, including:
   - stack height (point source)
   - stack diameter (point source)
   - stack gas exit velocity (point source)
   - stack gas exit temperature (point source)
   - source length (area source, must be square)
   - emission release height (area source)

2. Using Equation 5, determine if the stack height is GEP with respect to all nearby structures. If not, building dimensions (height, length, width) reflective of the most significant nearby structure will be needed (see Tier 1 procedure for a description of "nearby").

3. Execute SCREEN3 using:
   - unit emission rate (1.0 g/sec)
   - source parameters from Step 1
   - all meteorological conditions
   - ambient temperature of 293EK
   - rural dispersion
   - receptor elevation of 0.0
   - a range of receptors which reflects the distance from the stack (source) to the closest property boundary (zero if no fence), out to at least 100 H_s from the stack (H_s = stack/release height)

- downwash building dimensions determined in Step 2, if downwash is applicable
- no terrain screening

4. Execute SCREEN3 again using the input conditions in Step 3, but with the simple terrain screening option, and the five receptors described below:

   - Receptor 1 - highest terrain feature between the stack location and 25 H_s from the stack location (any radial direction)

   - Receptor 2 - highest terrain feature between 25 H_s and 50 H_s from the stack location

   - Receptor 3 - highest terrain feature between 50 H_s and 75 H_s from the stack location

   - Receptor 4 - highest terrain feature between 75 H_s and 100 H_s from the stack location

   - Receptor 5 - use the downwind distance associated with the maximum prediction from Step 3, and the maximum elevation for this distance (i.e., in any radial direction)

   H_s = stack height or release height (point or area source, respectively). If the receptor elevation is above stack-top elevation, substitute H_s - 0.1 meter for receptor height. Do Not use complex terrain screening.

   Terrain elevations should be obtained from USGS 7.5 minute topographic maps or digital elevation models. On a case-by-case basis, the Department may determine that terrain screening is not necessary. In this event, the results from Step 3 should be assumed final.

5. Multiply the maximum prediction from Step 4 by the maximum 1-hour emission rate in grams/second for each HAP from the stack, to estimate the maximum off-property 1-hour concentration for each HAP for this stack.

6. If more than one stack is present, repeat Steps 1-5 for each stack. Then, if any stacks have common HAPs, add the Step 5 results for each stack to determine the total off-property 1-hour concentration for each HAP.

7. Determine the MICR for each HAP with a known or possible carcinogenic health effect. First, multiply the Step 6 results for each HAP by the appropriate conversion factor (Table 3) to estimate a 70-year average concentration. Then,

multiply the 70-year average concentration by the Unit Risk Factor (from Appendix B) for each HAP to determine the MICR for each HAP. Lastly, sum the MICR for individual HAPs to determine total MICR.

8. Determine the hazard index for HAPs for which a Guideline Concentration (GC) has been established (see Appendix A). For any HAPs which have 8-hour average GCs, multiply the total 1-hour concentration (Step 6) by the appropriate conversion factor (Table 3) to estimate a maximum 8-hour average concentration. Then, determine the hazard index using Equation 4 and the GCs from Appendix A. Note that for HAPs which have both 1-hour and 8-hour GCs, the higher of the two ratios (MC/GC) should be utilized in Equation 4.

If the total MICR as computed in Step 7 is greater than 1×10^{-5}, a Tier 3 analysis will be necessary for the HAPs with known or possible carcinogenic health effects. Likewise, if the hazard index computed in Step 8 is greater than one, a Tier 3 analysis will be necessary to evaluate the non-carcinogenic health effects.

Tier 3 Procedure

The Tier 3 procedure involves use of refined EPA computer models. The use of refined models constitutes a less conservative procedure than Tier 2 primarily because refined models use actual hour-by-hour meteorological data, and because refined models treat multiple stack scenarios and elevated terrain more realistically than SCREEN3.

Candidate models for the Tier 3 procedure include AERMOD or ISC-PRIME. AERMOD is the preferred tool if the modeling problem is dominated by terrain effects. Other approaches may be needed if highly reactive pollutants or dense gas releases are involved.

The procedure for application of refined models is well-documented elsewhere and, because of its complexity, is not included here. The reader is referred to the EPA "Guideline on Air Quality Models" (U.S. EPA 2005) for instructions on refined modeling analyses. The Department may also be contacted regarding procedures for refined analyses.

Maximum 1-hour and 8-hour HAP concentrations needed to determine compliance with the Guideline Concentrations and the Hazard Index can be obtained directly from refined model output. To emulate the 70-year average concentration needed for the MICR analysis, the refined model should be used to determine a 5-year period average concentration (five years of sequential meteorological data are typically available for refined models). The Department considers this 5-year period average to be representative of the 70-year average for the MICR analysis.

RISK ASSESSMENT PROCEDURE

Risk assessments should be conducted according to the procedure outlined in the section of this document entitled "Dispersion Modeling Procedure." The Department acknowledges the problem of exposure from multiple environmental pathways, but will presently consider only exposure through the air. Any questions concerning the appropriate models for the risk assessments should be directed to the Department prior to performing these assessments.

LIMITATIONS OF THE APPROACH

There are several limitations to the TLV approach. The ACGIH handbook clearly states that the TLVs "... are guidelines or recommendations for the control of potential health hazards and for no other use, e.g., ... in estimating the toxic potential of continuous, uninterrupted exposures...". This is in part because the TLV-TWA permits excursions above the specified concentration provided equivalent excursions below the limit occur. The TLV approach also ignores possible antagonistic responses between HAPs, frequently provides one TLV for substances with many valences or isomers, assumes an arbitrary safety factor, adjusts the TLV to an appropriate exposure for hypersensitive portions of the exposed population, and assumes a dose incurred during a 40-hour workweek has the same effects as if the dose was incurred continuously for one week. However, the Guideline Concentrations set by this method are being used as a "trigger" for further review of sources where a potential problem may be possible, not as an ambient standard.

Limitations of the risk assessment are directly related to an inability to assign uncertainty to numbers used in the risk assessment process. Because of the assumption of "no threshold dose" for carcinogens and a linear extrapolation of the data to considerably lower risks, the unit risk factor is an upper estimate of the potency. The actual potency may be considerably less.

SPECIAL CONSIDERATIONS

This policy does not supersede any applicable state or federal rule, regulation or law.

QUESTIONS

Any questions about this document should be directed to:

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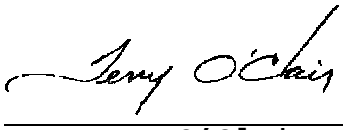
This document is available at:
http://www.ndhealth.gov/AQ/Toxics.htm

HISTORY

Effective July 29, 1987. Amended November 11, 1989; March 27, 1991; September 15, 1993; October 31, 1994; April 2001; August 2003; June 20, 2007; November 22, 2007; August 25, 2010

Approved:  Date: August 25, 2010

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DOCUMENTATION

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TABLE 1
MAXIMUM NORMALIZED 1-HOUR CONCENTRATIONS[1] - GEP STACKS (mg/m^3)

Stack Ht. (meters)	Downwind Distance (meters)													
	10	**20**	**30**	**40**	**50**	**75**	**100**	**150**	**200**	**300**	**400**	**500**	**750**	**1000**
1	149	156	142	110	85	48	31	16	9.8	5.0	3.1	2.1	1.1	.67
5	.41	4.3	5.0	5.5	5.5	5.4	5.4	5.0	4.8	3.4	2.4	1.8	.97	.63
10	[2]neg.	.007	.64	1.1	1.2	1.3	1.4	1.3	1.2	1.1	1.1	1.0	.72	.52
20	neg.	neg.	neg.	.013	.064	.23	.29	.31	.32	.27	.27	.24	.19	.16
30	neg.	neg.	neg.	neg.	neg.	.025	.078	.13	.13	.14	.13	.11	.10	.080
50	neg.	neg.	neg.	neg.	neg.	neg.	.0012	.022	.045	.048	.084	.046	.041	.034
100	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	.0086	.015	.015	.013	.011
200	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	.0035	.0060	.0048

[1]Normalized with respect to emission rate (1.0 grams/sec used)

[2]neg. = negligible, defined as less than 0.001 milligrams/m^3

TABLE 2
MAXIMUM NORMALIZED 1-HOUR CONCENTRATIONS[1] - NON-GEP STACKS (mg/m^3)

Stack Ht. (meters)	Downwind Distance (meters)													
	10	**20**	**30**	**40**	**50**	**75**	**100**	**150**	**200**	**300**	**400**	**500**	**750**	**1000**
1	149	156	142	110	85	48	31	16	9.8	5.0	3.1	2.1	1.1	.67
5	23	17	19	18	16	12	9.3	6.5	4.9	3.4	2.4	1.8	.97	.63
10	5.8	3.8	3.8	4.5	4.9	5.0	4.0	3.0	2.4	1.7	1.3	1.1	.72	.52
20	1.5	1.5	.60	.60	.60	.78	.88	.89	.71	.52	.42	.35	.25	.19
30	.65	.65	.65	.22	.22	.22	.27	.32	.33	.26	.21	.17	.12	.099
50	[2]neg.	neg.	neg.	neg.	neg.	neg.	neg.	.071	.084	.094	.087	.073	.055	.044
100	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	.024	.025	.025	.024	.019
200	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	.0035	.0060	.0049

[1]Normalized with respect to emission rate (1.0 grams/sec used)

[2]neg. = negligible, defined as less than 0.001 milligrams/m^3

TABLE 3
CONVERSION OF 1-HOUR CONCENTRATIONS
TO OTHER AVERAGING TIMES

Averaging Time	Multiplying Factor*
8 hours	0.7
70 years	0.08

* For Tier 3 refined modeling analyses, 8-hour average and 70-year average concentrations should be derived directly from model output, as discussed in ATier 3 Procedure@ on page 12 of this document.

Appendix A. Guideline Concentrations (GCs)

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Acetaldehyde	0.901	--
Acetic Acid	0.736	0.491
Acetic Anhydride	--	0.418
Acetone	35.613	23.742
Acetone Cyanohydrin, as CN	0.100	--
Acetonitrile	--	0.672
Acetophenone	--	0.983
Acetylsalicylic Acid (Aspirin)	--	0.100
Acrolein	0.00459	--
Acrylamide	--	0.0006
Acrylic Acid	--	0.118
Acrylonitrile	--	0.087
Adipic Acid	--	0.100
Adiponitrile	--	0.177
Alachlor	--	0.020
Aldrin	--	0.001
Allyl Alcohol	--	0.024
Allyl Chloride	0.125	0.063
Allyl Glycidyl Ether	--	0.093
Allyl Propyl Disulfide	--	0.061
Alumium and Compounds as Al		
Metal Dust	--	0.2
Pyro Powders, as Al	--	0.1
Soluble Salts	--	0.04
Alkyls, as Al	--	0.04
2-Aminopyridine	--	0.037
Amitrole	--	0.004
Ammonia	0.488	0.348
Ammonium Chlodide Fume	0.400	0.2
Ammonium Perfluorooctanoate	--	0.0002
Ammonium Sulfamate	--	0.2
tert-Amyl Methyl Ether	--	1.672
Aniline	--	0.152
o-Anisidine	--	0.01

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
p-Anisidine	--	0.01
Antimony and Compounds, as Sb	--	0.01
Antimony Hydride	--	0.01
ANTU	--	0.006
Arsenic	--	0.0002
Arsine	--	0.000319
Asphalt (pretroleum) Fumes	--	0.01
Atrazine	--	0.100
Azinphos-Methyl	--	0.004
Barium, Soluble Compounds, as Ba	--	0.01
Barium Sulfate	--	0.2
Benomyl	--	0.02
Benzene	0.16	0.0319
Benzotrichloride	0.016	--
Benzoyl Chloride	0.0575	--
Benzoyl Peroxide	--	0.1
Benzyl Acetate	--	1.228
Benzyl Chloride	--	0.104
Berryllium and Compounds, as Be	--	0.000001
Biphenyl	--	0.025
Bis (2-dimethylaminoethyl) Ether (DMAEE)	0.0197	0.007
Bismuth Telluride		
Undoped	--	0.2
Se-Doped	--	0.1
Borate Compounds, Inorganic	0.12	0.04
Boron Oxide	--	0.2
Boron Tribromide	0.205	--
Boron Trifluoride	0.0555	--
Bromacil	--	0.2
Bromine	0.0261	0.013
Bromine Pentafluoride	--	0.014
Bromoform	--	0.103
1-Bromopropane	--	1.006
1,3-Butadiene	--	0.088
n-Butanol	--	1.213
sec-Butanol	--	6.063

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
tert-Butanol	--	6.063
2-Butoxyethanol	--	1.933
2-Butoxyethyl Acetate	--	2.621
n-Butyl Acetate	19.004	14.253
sec-Butyl Acetate	--	19.004
tert-Butyl Acetate	--	19.004
n-Butyl Acrylate	--	0.210
n-Butylamine	0.299	--
Butylated Hydroxytoluene	--	0.040
tert-Butyl Chromate, as CrO_3	0.002	--
n-Butyl Glycidyl Ether	--	0.32
n-Butyl Lactate	--	0.598
n-Butyl Mercaptan	--	0.037
o-sec-Butylphenol	--	0.614
p-tert-Butyl Toluene	--	0.121
Cadmium	--	0.0002
and Compounds, as Cd	--	0.00004
Calcium Chromate	--	0.00002
Calcium Cyanamide	--	0.01
Calcium Hydroxide	--	0.1
Calcium Oxide	--	0.04
Calcium Silicate, Synthetic	--	0.2
Calcium Sulfate	--	0.2
Camphor, Synthetic	0.374	0.249
Caprolactam	--	0.1
Captafol	--	0.002
Captan	--	0.1
Carbaryl	--	0.01
Carbofuran	--	0.002
Carbon Black	--	0.07
Carbon Disulfide	--	0.062
Carbon Tetrabromide	0.0814	0.027
Carbon Tetrachloride	1.258	0.629
Carbonyl Fluoride	0.27	0.108
Catechol	--	0.45
Cellulose	--	0.2

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Cesium Hydroxide	--	0.04
Chlordane	--	0.01
Chlorinated Camphene	0.02	0.01
o-Chlorinated Deiphenyl Oxide	--	0.01
Chlorine	0.058	0.029
Chlorine Dioxide	0.017	0.00552
Chlorine Trifluoride	0.0076	--
Chloroacetaldehyde	0.0642	--
Chloroacetone	0.0757	--
2-Chloroacetophenone	--	0.00632
Chloroacetyl Chloride	0.0139	0.00462
Chlorobenzene	--	0.921
o-Chlorobenzylidene Malononitrile	0.00771	--
Chlorobromomethane	--	21.168
Chlorodifuoromethane	--	70.732
Chlorodiphenyl (42% Chlorine)	--	0.02
Chlorodiphenyl (54% Chlorine)	--	0.01
Chloroform	--	0.977
bis(Chloromethyl) Ether	--	0.000094
1-Chloro-1-Nitropropane	--	0.202
Chloropentafluoroethane	--	126.356
Chloropicrin	--	0.0134
1-Chloro-2-Propanol and 2-Chloro-1-Propanol	--	0.0773
beta-Chloroprene	--	0.724
2-Chloropropionic Acid	--	0.00888
o-Chlorostyrene	8.503	5.669
o-Chlorotoluene	--	5.178
Chlorpyrifos	--	0.002
Chromite Ore Processing (Cromate), as Cr	--	0.001
Chromium and Inorganic Compounds, as Cr		
Metal and Cr III Compounds	--	0.01
Water-soluble Cr VI Compounds	--	0.001
Insoluble Cr VI Compounds	--	0.0002
Chromyl Chloride	--	0.00317
Citral	--	0.623
Clopidol	--	0.2
Coal Tar Pitch Volatiles as Benzene Soluble Aerosol	--	0.004

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Cobalt and Inorganic Compounds, as Co	--	0.0004
Cobalt Carbonyl	--	0.002
Cobalt Hydrocarbonyl	--	0.002
Copper		
Fume	--	0.004
Dusts and Mists	--	0.02
Cotton Dust, Raw, Untreated	--	0.002
Coumaphos	--	0.001
Cresol, All Isomers	--	0.4
Crotonaldehyde	0.0172	--
Crufomate	--	0.1
Cumene	--	4.916
Cyanamide	--	0.04
Cyanogen	--	0.426
Cyanogen Chloride	0.0151	--
Cyclohexane	--	6.884
Cyclohexanol	--	4.097
Cyclohexanone	4.014	1.606
Cyclohexene	--	20.157
Cyclohexylamine	--	0.811
Cyclonite	--	0.01
Cyclopentadiene	--	4.055
Cyclopentane	--	34.42
Cyhexatin	--	0.1
2,4-D	--	0.2
DDT	--	0.02
Decaborance	0.015	0.005
Demeton	--	0.001
Demeton-S-Methyl	--	0.001
Diacetone Alcohol	--	4.751
Diazinon	--	0.0002
Diazomethane	--	0.00688
Diborane	--	0.00227
2-N-Dibutylaminoethanol	--	0.07088
Dibutyl Phenyl Phosphate	--	0.07025
Dibutyl Phosphate	--	0.1
Dibutyl Phthalate	--	0.1

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Dichlroacetic Acid	--	0.0527
Dichloroacetylene	0.00777	--
o-Dichlorobenzene	6.013	3.006
p-Dichlorobenzene	--	1.203
1,4-Dichloro-2-Butene	--	0.000511
Dichlorodifluoromethane	--	98.904
1,3-Dichloro-5,5-Dimethyl Hydantoin	0.008	0.004
1,1-Dichloroethane	--	8.096
1,2-Dichloroethylene, All Isomers	--	15.861
Dichloroethyl Ether	1.170	0.585
Dichlorofluoromethane	--	0.842
Dichloromethane	--	3.474
1,1-Dichloro-1-Nitroethane	--	0.236
1,2-Dichloropropene	--	0.0908
2,2-Dichloropropionic Acid	--	0.1
Dichlorotetrafluoroethane	--	139.820
Dichlorvos (DDVP)	--	0.002
Dicrotophos	--	0.001
Dicyclopentadiene	--	0.541
Dicyclopentadienyl Iron, as Fe	--	0.2
Dieldrin	--	0.002
Diesel Fuel as Total Hydrocarbons	--	2.0
Diethanolamine	--	0.02
Diethylamine	0.897	0.299
2-Diethylaminoethanol	--	0.192
Diethylene Triamine	--	0.0844
Di(2-Ethylhexyl) Phthalate (DEHP)	--	0.1
Diethyl Ketone	21.136	14.091
Diethyl Phthalate	--	0.1
Difluorodibromomethane	--	17.164
Diglycidyl Ether	--	0.00106
Diisobutyl Ketone	--	2.909
Diisopropylamine	--	0.414
N, N-Dimethylacetamide	--	0.713
Dimethylamine	0.553	0.184
Dimethylaniline	0.991	0.496
Dimethyl Carbamoyl Chloride	--	0.00044

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Diemthyl Disulfide	--	0.0385
Dimethylethoxysilane	0.128	0.0426
Dimethylformamide	--	0.598
1,1-Dimethylhydrazine	--	0.000492
Dimethyl Phthalate	--	0.1
Dimethyl Sulfate	--	0.0103
Dimethyl Sulfide	--	0.508
Dinitrobenzene, All Isomers	--	0.0206
Dinitro-o-Cresol	--	0.04
3,5-Dinitro-o-Toluamide	--	0.02
Dinitrotoluene	--	0.004
1,4-Dioxane	--	1.441
Dioxathion	--	0.002
1,3-Dioxolane	--	1.212
Diphenylamine	--	0.2
Dipropyl Ketone	--	4.695
Diquat		
Total Dust	--	0.01
Respirable Fraction	--	0.002
Disulfram	--	0.04
Disulfoton	--	0.001
Diuron	--	0.2
Divinyl Benzene	--	1.065
Dodecyl Mercaptan	--	0.0166
Endosulfan	--	0.002
Endrin	--	0.002
Enflurane	--	11.319
Epichlorohydrin	--	0.0378
EPN	--	0.002
Ethanol	37.685	--
Ethanolamine	0.3	0.15
Ethion	--	0.001
2-Ethoxyethanol	--	0.369
2-Ethoxyethyl Acetate	--	0.541
Ethyl Acetate	--	28.826
Ethyl Acrylate	1.228	0.409
Ethylamine	0.553	0.184

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Ethyl Amyl Ketone	--	1.049
Ethyl Benzene	10.855	8.684
Ethyl Bromide	--	0.446
Ethyl tert-Butyl Ether	--	0.418
Ethyl Butyl Ketone	7.006	4.670
Ethyl Chloride	--	5.278
Ethyl Cyanoacrylate	--	0.0205
Ethylene	--	4.589
Ethylene Chlorohydrin	0.0659	--
Ethylenediamine	--	0.492
Ethylene Dichloride	--	0.809
Ethylene Glycol	2.0	--
Ethylene Glycol Dinitrate	--	0.00622
Ethylene Oxide	--	0.036
Ethylenimine	0.00352	0.0018
Ethyl Ether	30.315	24.252
Ethyl Formate	--	6.06
2-Ethylhexanoic Acid	--	0.1
Ethylidene Norbornene	0.492	--
Ethyl Mercaptan	--	0.0254
N-Ethylmorpholine	--	0.471
Ethyl Silicate	--	1.704
Fenamiphos	--	0.001
Fensulfothion	--	0.0002
Fenthion	--	0.001
Ferbam	--	0.1
Ferrovanadium Dust	0.06	0.02
Flour Dust	--	0.01
Fluorides, as F	--	0.05
Fluorine	0.0622	0.0311
Fonofos	--	0.0002
Formaldehyde	0.00737	--
Formamide	--	0.368
Formic Acid	0.376	0.188
Furfural	--	0.157
Furfural Alcohol	1.204	0.802
Gallium Arsenide	--	0.000006

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Gasoline	28.63	17.178
Germanium Tetrahydride	--	0.0125
Glutaraldehyde, Activated and Inactivated	0.00409	--
Glycerin Mist	--	0.2
Glycidol	--	0.121
Glyoxal	--	0.002
Graphite (All forms except graphite fibers)	--	0.04
Hafnium	--	0.1
Halothane	--	8.073
Heptachlor and Heptachlor Epoxide	--	0.001
Heptane, All Isomers	40.982	32.785
Hexachlorobenzene	--	0.00004
Hexachlorobutadiene	--	0.00427
Heptachlorocyclopentadiene	--	0.00223
Hexachloroethane	--	0.194
Hexachloronapthalene	--	0.004
Hexafluoroacetone	--	0.0136
Hexafluoropropylene	--	0.01227
Hexahydrophthalic Anhydride, All Isomers	0.0001	--
Hexamethylene Diisocyanate	--	0.00069
n-Hexane	--	3.525
Hexane, Other Isomers	70.495	35.247
1,6-Hexanediamine	--	0.0475
1-Hexane	--	3.442
sec-Hexyl Acetate	--	5.898
Hexylene Glycol	2.417	--
Hydrazine	--	0.00026
Hydrogenated Terphenyls (nonirradiated)	--	0.0986
Hydrogen Bromide	0.132	--
Hydrogen Chloride	0.0597	--
Hydrogen Cyanide	--	0.104
Cyanide Salts	--	0.1
Hydrogen Fluoride	0.0327	0.00818
Hydrogen Peroxide	--	0.0278
Hydrogen Selenide	--	0.00331
Hydroquinone	--	0.02
2-Hydroxypropyl Acrylate	--	0.0532

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Indene	--	0.475
Indium and Compounds, as In	--	0.002
Iodeine	--	0.021
Iodoform	--	0.193
Iron Oxide (Fe_2O_3)	--	0.1
Iron Pentacarbonyl, as Fe	0.0320	0.016
Iron Salts, Soluble, as Fe	--	0.02
Isoamyl Alcohol	9.013	7.211
Isobutanol	--	3.031
Isobutyl Acetate	--	14.253
Isobutyl Nitrite	0.0844	--
Isooctyl Alcohol	--	5.326
Isophorone	0.565	--
Isophorone Diisocyanate	--	0.00091
2-Isopropoxyethanol	--	2.13
Isopropyl Acetate	16.708	8.354
Isopropanol (2-Propanol)	19.661	9.831
Isopropylamine	0.483	0.242
N-Isopropylaniline	--	0.221
Isopropyl Ether	25.908	20.894
Isopropyl Glycidyl Ether	7.128	4.752
Kaolin	--	0.04
Kerosene/Jet Fuels, as Total Hydrocarbon Vapor	--	4.0
Ketene	0.0516	0.017
Lead and Inorganic Compounds, as Pb	--	0.001
Lead Chromate, as Pb	--	0.001
as Cr	--	0.00024
Lindane	--	0.01
Lithium Hydride	--	0.0005
Liquified Petroleum Gas	--	40.9
Magnesium Oxide	--	0.2
Malathion	--	0.02
Mealeic Anhydride	--	0.00802
Manganese and Inorganic Compounds, as Mn	--	0.004
Manganese Cyclopentadienyl Tricarbonyl	--	0.002

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Mercury		
Alkyl Compounds	0.0006	0.0002
Aryl Compounds	--	0.002
Elemental and Inorganic Forms	--	0.0005
Mestityl Oxide	2.007	1.204
Methacrylic Acid	--	1.408
Methanol	6.552	5.242
Methomyl	--	0.5
Methoxychlor	--	0.2
2-Methoxyethanol	--	0.00622
2-Methoxyethyl Acetate	--	0.00966
2-Methoxymethylethoxy propanol (DPGME)	18.184	12.123
4-Methoxyphenol	--	0.1
1-Methoxy-2-Propanol	11.058	7.372
Methyl Acetate	15.149	12.119
Methyl Acetylene	--	32.777
Methyl Acetylene-Propadiene Mixture	40.971	32.777
Methyl Acrylate	--	0.141
Methylacrylonitrile	--	0.0549
Methylal	--	62.249
Methylamine	0.381	0.127
Methyl N-Amyl Ketone	--	4.67
N-Methyl Aniline	--	0.0438
Methyl Bromide	--	0.0777
Methyl tert-butyl Ether	--	3.606
Methyl n-Butyl Ketone	0.819	0.41
Methyl Chloride	4.13	2.065
Methyl Chloroform	49.112	38.198
Methyl 2-Cyanoacrylate	--	0.0182
Methylcyclohexane	--	32.128
Methylcyclohexanol	--	4.67
o-Methylcyclcohexanone	6.882	4.588
2-Methylcyclopentadienyl Manganese Tricarbonyl	--	0.004
Methyl Demeton	--	0.001
Methylene Bisphenyl Isocyanate (MDI)	--	0.00102
4,4-Methylene bis(2-Chloroaniline)	--	0.00219

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Methylene bis(4-Cyclohexylisocyanate)	--	0.00107
4,4-Methylene Dianiline	--	0.0162
Methyl Ethyl Ketone	17.693	11.796
Methyl Ethyl Ketone Peroxide	0.0288	--
Methyl Formate	7.368	4.912
Methyl Hydrazine	--	0.00038
Methyl Iodide	--	0.232
Methyl Isoamyl Ketone	--	4.671
Methyl Isobutyl Carbinol	3.343	2.09
Methyl Isobutyl Ketone	6.145	1.639
Methyl Isocyanate	--	0.000933
Methyl Isopropyl Ketone	--	14.092
Methyl Mercaptan	--	0.0197
Methyl Methacrylate	8.191	4.095
1-Methyl Naphthalene and 2-Methyl Naphthalene	--	0.0582
Methyl Parathion	--	0.0004
Methyl Propyl Ketone	10.573	--
Methyl Silicate	--	0.125
alpha-Methyl Styrene	--	0.967
Methyl Vinyl Ketone	0.0115	--
Metribuzin	--	0.1
Mevinphos	--	0.0002
Mica	--	0.06
Mineral oil, exc. metal working fluids	--	0.1
Molybdenum		
Soluble Compounds	--	0.01
Metal and Insol. Compounds (Resp. Fraction)	--	0.06
Metal and Insoluble Compounds (Total)	--	0.2
Monochloroacetic Acid	--	0.0387
Monocrotophos	--	0.001
Morpholine	--	1.425
Naled	--	0.002
Napthalene	1.573	1.0486
Natural Rubber Latex (As Total Proteins)	--	0.000002

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Nickel, as Ni		
Elemental	--	0.03
Soluble Inorganic Compounds	--	0.002
Insoluble Inorganic Compounds	--	0.004
Nickel Subsulfide	--	0.002
Nickel Carbonyl, as Ni	--	0.00698
Nicotine	--	0.01
Nitrapyrin	0.4	0.2
Nitric Acid	0.206	0.103
Nitric Oxide	--	0.614
p-Nitroaniline	--	0.06
Nitrobenzene	--	0.101
p-Nitochlorobenzene	--	0.0129
Nitroethane	--	6.141
Nitrogen Trifluoride	--	0.581
Nitroglycerin	--	0.00929
Nitromethane	--	0.999
1-Nitropropane	--	1.822
2-Nitropropane	--	0.729
Nitrotoluene, All Isomers	--	0.224
5-Nitro-o-Toluidine	--	0.02
Nitrous Oxide	--	1.8
Nonane	--	20.983
Octachloronaphthalene	0.006	0.002
Octane, All Isomers	--	28.0294
Osmium Tetroxide, as Os	0.00012	0.0000416
Oxalic Acid	0.04	0.02
p,p-Oxybis(Benzenesolfonyl Hydrazide)	--	0.002
Oxygen Diflouride	0.00221	--
Paraffin Wax Fume	--	0.04
Paraquat Total Dust	--	0.01
Paraquat Respirable Fraction	--	0.002
Parathion	--	0.001
Pentaborane	0.000775	0.000258
Pentachloronaphthalene	--	0.01
Pentachloronitrobenzene	--	0.01
Pentachlorophenol	--	0.01

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Pentaerythritol	--	0.2
Pentane, All Isomers	--	35.411
Pentyl Acetate, All Isomers	10.65	5.325
Perchloromethyl Mercaptan	--	0.0152
Perchloryl Fluoride	0.503	0.251
Perfluorobutyl Ethylene	--	20.131
Perfluoroisobutylene	0.00164	--
Persulfates, as Persulfate	--	0.002
Phenol	--	0.385
Phenothiazine	--	0.1
o-Phenylenediamine	--	0.002
m-Phenylenediamine	--	0.002
p-Phenylenediamine	--	0.002
Phenyl Ether Vapor	0.278	0.139
Phenyl Glycidyl Ether	--	0.0123
Phenylhydrazine	--	0.00885
Phenyl Mercaptan	--	0.00901
Phenylphosphine	0.0045	--
Phorate	--	0.001
Phosgene	--	0.00809
Phosphine	0.0278	0.00834
Phosphoric Acid	0.06	0.02
Phosphorus (Yellow)	--	0.002
Phosphorus Oxychloride	--	0.0125
Phosphorus Pentachloride	--	0.017
Phosphorus Pentasulfide	0.6	0.02
Phosphorus Trichloride	0.0562	0.0225
Phthalic Anyhride	--	0.121
m-Phthalodinitrile	--	0.1
Picloram	--	0.2
Picric Acid	--	0.002
Pindone	--	0.002
Piperazine Dihydrochloride	--	0.1
Platinun		
Metal	--	0.02
Soluble Salts, as Pt	--	0.00004
Polyvinyl Chloride	--	0.02

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Portland Cement	--	0.02
Potassium Hydroxide	0.04	--
n-Propanol (n-Propyl Alcohol)	--	4.915
2-Propanol	19.661	9.831
Propargyl Alcohol	--	0.0459
Propiolactone	--	0.0295
Propionaldehyde	--	0.951
Propionic Acid	--	0.606
Propoxur	--	0.01
n-Propyl Acetate	20.885	16.708
Propylene	--	17.211
Propylene Dichloride	--	0.924
Propylene Glycol Dinitrate	--	0.00679
Propylene Oxide	--	0.095
Propyleneimine	0.0187	0.00934
n-Propyl Nitrate	3.439	2.149
Pyrethrum	--	0.1
Pyridine	--	0.0647
Quinone	--	0.00884
Resorcinol	1.801	0.901
Rhodium		
Metal	--	0.02
Insoluble compounds, as Rh	--	0.02
Soluble compounds, as Rh	--	0.0002
Ronnel	--	0.1
Retenone (Commercial)	--	0.1
Selenium and Compounds, as Se	--	0.004
Selenium Hexafluoride, as Se	--	0.00789
Sesone	--	0.2
Silica, Crystalline and Cristobalite	--	0.0005
Silicon Carbide (Nonfibrous)		
Total Dust	--	0.2
Respirable Fraction	--	0.06
Silicon Tetrahydride	--	0.131
Silver		
Metal, Dust and Fume	--	0.002
Soluble Compounds	--	0.0002

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Soapstone		
Total Dust	--	0.12
Respirable Fraction	--	0.06
Sodium Azide		
as Sodium Azide	0.0058	--
as Hydrazoic Acid Vapor	0.0022	--
Sodium Bisulfite	--	0.1
Sodium Fluoroacetate	--	0.001
Sodium Hydroxide	0.04	--
Sodium Metabisulfate	--	0.1
Starch	--	0.2
Stearates	--	0.2
Stoddard Solvent	--	11.452
Strontium Chrmoate, as Cr	--	0.00001
Stychnine	--	0.003
Styrene, Monomer	3.408	1.704
Subtilisins, as Crystalline Active Enzyme	0.00000120	--
Sucrose	--	0.2
Sulfometuron Methyl	--	0.1
Sulfotepp (TEDP)	--	0.002
Sulfur Hexafluoride	--	119.485
Sulfuric Acid	--	0.004
Sulfur Monochloride	0.11	--
Sulfur Pentafluoride	0.00208	--
Sulfur Tetrafluoride	0.00884	--
Sulfuryl Fluoride	0.835	0.417
Sulprofos	--	0.002
Synthetic Vitreous Fibers		
Continuous Filament Glass Fibers	--	0.1
2,4,5-T	--	0.2
Talc		
Containing No Asbestos Fibers	--	0.04
Terrurium and Compounds, as Te, Excluding Hydrogen Telluride	--	0.002
Tellurium Hexafluoride	--	0.00395
Temephos	--	0.02
Terbufos	--	0.0002

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Terephthalic Acid	--	0.2
Terphenyls	0.1	--
1,1,2,2-Tetrabromomethane	--	0.0283
1,1,1,2-Tetrachloro-2,2-Difluoroethane	--	16.673
1,1,2,2-Tetrachloro-1,2-Difluoroethane	--	8.337
1,1,2,2-Tetrachloroethane	--	0.137
Tetrachloroethylene	13.562	3.391
Tetrachloronaphthalene	--	0.04
Tetraethyl Lead	--	0.002
Tetraethyl Pyrophosphate	--	0.0002
Tetrafluoroethylene	--	0.164
Tetrahydrofuran	5.898	2.949
Tetrakis (Hydroxymethyl) Phosphonium Chloride	--	0.04
Tetrakis (Hydroxymethyl) Phosphonium Sulfate	--	0.04
Tetramethyl Lead, as Pb	--	0.003
Tetramethyl Succinonitrile	--	0.0557
Tetranitromethane	--	0.000802
Tetryl	--	0.03
Thallium and Soluble Compounds, as Tl	--	0.0004
4,4-Thiobis(6-tert-butyl-m-cresol)	--	0.2
Thioglycolic Acid	--	0.0754
Thionyl Chloride	0.0195	--
Thiram	--	0.001
Tin, as Sn		
Metal	--	0.04
Oxide and Inorganic Compounds	--	0.04
Organic Compounds	0.004	0.002
Titanium Dioxide	--	0.2
Toluene	--	1.507
Toluene-2,4- or 2,6-Diisocyanate	0.00285	0.000712
o-Toluidine	--	0.175
m-Toluidine	--	0.175
p-Poluidine	--	0.175
Tributy Phosphate	--	0.0436
Trichloroacetic Acid	--	0.134
1,2,4-Trichlorobenzene	0.742	--

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
1,1,2-Trichloroethane	--	1.091
Trichloroethylene	2.687	1.075
Trichlorofluoromethane	112.376	--
Trichloronaphthalene	--	0.1
1,2,3-Trichloropropane	--	1.206
1,1,2-Trichloro-1,2,2-Trifluoroethane	191.616	153.292
Trichlorphon	--	0.02
Triethanolamine	--	0.1
Triethylamine	0.248	0.0828
Trifluorobromomethane	--	121.816
1,3,5-Triglycidyl-s-Triazinetrione	--	0.001
Trimellitic Anhydride	0.00001	0.00004
Trimethylamine	0.725	0.242
Trimethyl Benzene	--	2.458
Trimethyl Phosphite	--	0.203
2.4.6-Trinitrotoluene	--	0.002
Triorthocresyl Phosphate	--	0.002
Triphenyl Phosphate	--	0.06
Tungsten, as W		
Metal and Insoluble Compounds	0.2	0.1
Soluble Compounds	0.06	0.02
Turpentine and Selected Monoterpenes	--	2.225
Uranium (Natural)		
Soluble and Insoluble Compounds, as U	0.012	0.004
n-Valeraldehyde	--	3.523
Vanadium Pentoxide as V	--	0.001
Vinyl Acetate	1.056	0.704
Vinyl Bromide	--	0.0437
Vinyl Chloride	--	0.0511
4-Vinyl Cyclohexane	--	0.00885
Vinyl Cyclohexane Dioxide	--	0.0115
Vinyl Fluoride	--	0.0377
N-Vinyl-2-Pyrrolidone	--	0.00455
Vinylidene Chloride	--	0.397
Vinylidene Fluoride	--	26.192
Vinyl Toluene	9.667	4.834
Warfarin	--	0.002

POLLUTANT	GUIDELINE CONCENTRATION (mg/m^3)	
	1-HOUR	8-HOUR
Wood Dusts		
Western Red Cedar	--	0.01
All Other Species	--	0.02
Xylene	13.026	8.684
m-Xylene-Diamine	0.002	--
Xylidine (Mixer Isomers)	--	0.0496
Yttrium and Compounds, as Y	--	0.02
Zinc Chloride Fume	0.04	0.02
Zinc Chromates, as Cr	--	0.0002
Zinc Oxide	0.2	0.04
Ziconium and Compounds, as Zr	0.2	0.1

Appendix B. Unit risk factors

Contaminant	Unit Risk Factor* ($m^3/\mu g$)
Acetaldehyde	2.2 E-06
Acetamide	2.0 E-05
Acrylamide	1.0 E-04
Acrylonitrile	6.8 E-05
Aldrin	4.9 E-03
Allyl chloride	6.0 E-06
2-Aminoanthraquinone	9.4 E-06
Aniline	1.6 E-06
Aramite	7.1 E-06
Arsenic	4.3 E-03
Azobenzene	3.1 E-05
Benzene	7.8 E-06
Benzidine	6.7 E-02
Benzo(a)anthracene	1.1 E-04
Benzo(a)pyrene	1.1 E-03
Benzo(b)fluoranthene	1.1 E-04
Benzo(j)fluoranthene	1.1 E-04
Benzo(k)fluoranthene	1.1 E-04
Benzotrichloride	3.7 E-03
Benzyl choride	4.9 E-05
Beryllium	2.4 E-03
Bis(chloroethyl)ether (BCEE)	3.3 E-04
Bis(chloromethyl)ether	6.2 E-02
Bis(2-ethylhexyl)phthalate	2.4 E-06
Bromoform	1.1 E-06
1,3-butadiene	3.0 E-05
Cadmium and cadmium compounds	1.8 E-03
Captan	1.0 E-06
Carbazole	5.7 E-06
Carbon Tetrachloride	6.0 E-06
Chlordane	1.0 E-04
Chlorobenzilate	7.8 E-05
Chloroform	2.3 E-05
Chromium VI compounds	1.2 E-02
Chrysene	1.1 E-05
Coke Oven Emissions	6.2 E-04
Cyanazine	2.4 E-04
DDE	9.7 E-05
Dibenz(a,h)anthracene	1.2 E-03
Dibenz(a,h)acridine	1.1 E-04
Dibenz(a,j)acridine	1.1 E-04
7H-Dibenzo[c,g]carbazole	1.1 E-03
Dibenzo(a,e)pyrene	1.1 E-03
Dibenzo(a,h)pyrene	1.1 E-02
Dibenzo(a,i)pyrene	1.1 E-02
Dibenzo(a,l)pyrene	1.1 E-02

Contaminant	Unit Risk Factor* ($m^3/\mu g$)
p,p'-Dichlorodiphenyltrichloroethane (DDT)	9.7 E-05
Dichloromethane	4.7 E-07
7,12-Dimethylbenz(a)anthracene	7.1 E-02
1,2-dibromo-3-chloropropane	2.0 E-03
1,2-dibromoethane	6.0 E-04
p-Dichlorobenzene	1.1 E-05
3,3'-Dichlorobenzidine	3.4 E-04
1,2-dichloroethane	2.6 E-05
Dichloroethyl ether	3.3 E-04
1,3-dichloropropene	4.0 E-06
Dichlorvos	8.3 E-05
Dieldrin	4.6 E-03
3,3'-Dimethoxybenzidine	4.0 E-06
p-Dimethylaminoazobenzene	1.3 E-03
3,3'-Dimethylbenzidine	2.6 E-03
1,8-Dinitropyrene	1.1 E-03
2,4-dinitrotoluene	8.9 E-05
2,4/2,6-Dintrotoluene mixture	1.9 E-04
1,4-dioxane	7.7 E-06
1,2-diphenylhydrazine	2.2 E-04
Epichlorohydrin	1.2 E-06
Ethyl benzene	2.5 E-06
Ethyl carbamate	2.9 E-04
Ethylene Dibromide	6.0 E-04
Ethylene Dichloride	2.6 E-05
Ethylene Oxide	8.8 E-05
Ethylene Thiourea	1.3 E-05
Ethylidene Dichloride (1,1-Dichloroethane)	1.6 E-06
Formaldehyde	1.3 E-05
Heptachlor	1.3 E-03
Heptachlor Epoxide	2.6 E-03
Hexachlorobenzene	4.6 E-04
Hexachlorobutadiene	2.2 E-05
Alpha-hexachlorocyclohexane (a-HCH)	1.8 E-03
Beta-hexachlorocyclohexane (b-HCH)	5.3 E-04
Hexachlorocyclohexane, Technical (HCH)	5.1 E-04
Hexachlorodibenzo-p-dioxin, mixture	1.3 E+00
Hexachloroethane	4.0 E-06
Hydrazine	4.9 E-03
Hydrazine Sulfate	4.9 E-03
Indeno(1,2,3-cd)pyrene	1.1 E-04
Isophorone	2.7 E-07
Lindane (gamma HCH)	3.1 E-04
3-methylcholanthrene	6.3 E-03
5-Methylchrysene	1.1 E-03
Methyl Hydrazine	3.1 E-04
Methylene Chloride (dichloromethane)	4.7 E-07
4,4'-methylene-bis-2-chloroaniline	4.3 E-04

Contaminant	Unit Risk Factor* ($m^3/\mu g$)
4,4'-Methylenedianiline	4.6 E-04
Methyl tert-butyl ether	2.6 E-07
Naphthalene	3.4 E-05
Nickel Refinery Dust	2.4 E-04
Nickel Subsulfide	4.8 E-04
5-Nitroacenaphthene	3.7 E-05
Nitrobenzene	4.0 E-05
6-Nitrochrysene	1.1 E-02
2-Nitrofluorene	1.1 E-05
1-Nitropyrene	1.1 E-04
4-Nitropyrene	1.1 E-04
2-nitropropane	5.6 E-06
N-nitroso-di-n-butylamine	1.6 E-03
N-nitrosodiethylamine	4.3 E-02
Nitrosodimethylamine	1.4 E-02
N'-Nitrosomorpholine	1.9 E-03
N-nitrosopyrrolidine	6.1 E-04
Pentachloronitrobenzene	7.4 E-05
Pentachlorophenol	5.1 E-06
Polybrominated Biphenyls	2.5 E-03
Polychlorinated Biphenyls (PCBs)	1.0 E-04
1,3-Propane Sultone	6.9 E-04
Propylene Dichloride	1.9 E-05
Propylene Oxide	3.7 E-06
2,3,7,8-tetrachloro-dibenzo-p-dioxin	3.3 E+01
1,1,1,2-tetrachloroethane	7.4 E-06
1,1,2,2-tetrachloroethane	5.8 E-05
Tetrachloroethene	5.9 E-06
2,4-Toluene Diamine	1.1 E-03
2,4/2,6-Toluene diisocyanate mixture (TDI)	1.1 E-05
o-Toluidine	5.1 E-05
1,1,2-trichloroethane	1.6 E-05
Trichloroethylene	2.0 E-06
2,4,6-trichlorophenol	3.1 E-06
Toxaphene	3.2 E-04
Trifluralin	2.2 E-06
Vinyl Bromide	3.2 E-05
Vinyl Chloride	8.8 E-06

* Note that the unit risk factors are in units of $m^3/\mu g$. When calculating the maximum individual carcinogenic risk (MICR) for a pollutant, the estimated 70-year average concentration must be in units of $\mu g/m^3$ prior to multiplying by the unit risk factor to obtain the MICR.