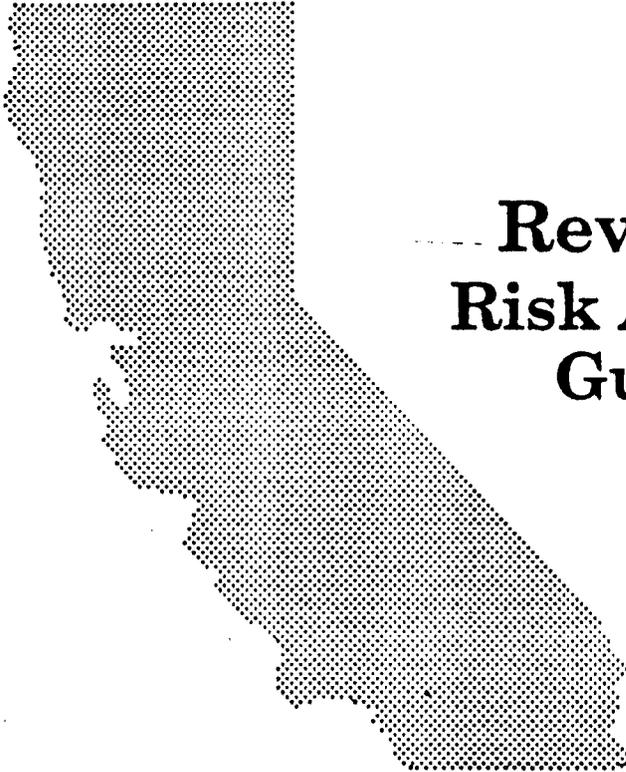


CAPCOA

Air Toxics "Hot Spots" Program



**Revised 1992
Risk Assessment
Guidelines**

Prepared by the:

**Toxics Committee of the
California Air Pollution Control
Officers Association (CAPCOA)**

October 1993

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Risk Assessment Guidelines**

Prepared by the:

**Toxics Committee of the California Air
Pollution Control Officers Association (CAPCOA),
in consultation with the**

**Air Toxicology Unit
Air Toxicology and Epidemiology Section
Office of Environmental Health Hazard Assessment**

and the

**Special Projects Section
Toxic Air Contaminant Identification Branch
Air Resources Board**

October 1993

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I.

INTRODUCTION

A. DEVELOPMENT OF GUIDELINES

These guidelines were developed by the AB 2588 Risk Assessment Toxics Committee (Committee) which was formed at the direction of the Board of Directors of the California Air Pollution Control Officers Association (CAPCOA). The Committee includes representatives of 11 16 districts and staff of the Air Resources Board (ARB) and the Office of Environmental Health Hazard Assessment (OEHHA).

The purpose of these guidelines is to provide risk assessment procedures for use in the preparation of the health risk assessments required under the Air Toxics "Hot Spots" Information and Assessment Act of 1987 (Health and Safety Code Section 44360 et seq.). This law established a statewide program for the inventory of air toxics emissions from individual facilities as well as requirements for risk assessment and public notification of potential health risks (see Appendix A).

These guidelines are in large part composed of the risk assessment procedures outlined in the Air Toxics Assessment Manual published by CAPCOA. Additions and changes to procedures in the Air Toxics Assessment Manual were made by the Committee in order to be consistent with requirements of the Air Toxics "Hot Spots" Act, the ARB Emission Inventory Criteria and Guidelines Regulations (California Code of Regulations (CCR), Titles 17 and 26, Section 93300-93354), and other risk assessment activities of local districts, ARB and the OEHHA. If the reader needs to prepare a risk assessment under another program, the risk assessment may need to follow a different set of guidelines. Therefore, appropriate California and federal agencies should be contacted. For example, if a facility must comply with risk assessment requirements under the Resource Conservation and Recovery Act (RCRA) or the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the California Department of Toxic Substances Control must be contacted to determine if a risk assessment written to comply with AB 2588 will also satisfy RCRA/CERCLA requirements.

B. RISK ASSESSMENT REQUIREMENTS

The Air Toxics "Hot Spots" Act specifies that each local Air Pollution Control District (district) determine which facilities will prepare a health risk assessment. As defined under the Air Toxics "Hot Spots" Act, a health

risk assessment includes a comprehensive analysis of the dispersion of hazardous substances in the environment, the potential for human exposure, and a quantitative assessment of both individual and populationwide health risks associated with those levels of exposure. Districts are to determine which facilities will prepare risk assessments based on a prioritization process outlined in the law.

The process by which districts are to identify priority facilities for risk assessment involves consideration of potency, toxicity, quantity of emissions, proximity to sensitive receptors such as hospitals, daycare centers, worksites and residences, and any other factors a district determines may indicate a potential significant risk to receptors. As part of this process districts are to categorize facilities as high, intermediate, or low priority. Districts are also to hold a public hearing prior to establishing these priorities. The first facilities subject to the Air Toxics "Hot Spots" Act were to be prioritized by December 1, 1990. These are the facilities which were required to submit emission inventory plans by August 1, 1989. The district prioritization process is outside the scope of these guidelines.

Facilities designated by a district as "high priority" are to submit a health risk assessment to the district within 150 days. Districts may grant a 30-day extension. In addition, a district may require any facility to prepare and submit a risk assessment according to the district priorities established for purposes of the Air Toxics "Hot Spots" Act.

C. RISK ASSESSMENT REVIEW PROCESS

The Air Toxics "Hot Spots" Act risk assessments are to be reviewed by the local district and the OEHHA. Districts may consult with the ARB regarding emission impacts and modeling data. The district, taking into account the comments of the OEHHA, is to approve the risk assessment or return it for revision and resubmission. If the risk assessment is not revised and resubmitted within 60 days, the district may modify the risk assessment and approve it as modified. Based on the approved health risk assessment, the district is to determine if there is a significant health risk associated with emissions from the facility. If the district determines that facility emissions pose a significant health risk, the facility operator is to provide notice to all exposed individuals regarding the results of the risk assessment. Notification is to be made according to procedures specified by the district.

The guidelines provide that, with district approval, screening risk assessment procedures may be used in place of a refined risk analysis. Screening risk assessments must be reviewed by districts and by the OEHHA to ensure that the screening procedures do not underestimate health risks. Based on the level of risk estimated in a screening assessment, a district may require submittal of a refined risk assessment.

D. USE OF GUIDELINES

The intent of the Committee in developing the guidelines was to provide risk assessment procedures for use in the Air Toxics "Hot Spots" Program. The use of consistent risk assessment methods and report presentation should: 1) allow comparison of one facility to another; 2) expedite the review of risk assessments by reviewing agencies; and 3) minimize revision and resubmittal of risk assessments. The guidelines specify when districts or the OEHHA should be consulted during preparation of a risk assessment to ensure that the risk assessment methodology used is as complete as possible and appropriate on a site specific basis.

These guidelines should be used in conjunction with the emission data collected and reported pursuant to requirements of the ARB Emission Inventory Criteria and Guidelines Regulations (CCR, Title 17, Section 93300-93354). This regulation outlines requirements for the collection of emission data, based on an inventory plan which must be approved by the district. The emissions reported under this program are routine or predictable and include continuous and intermittent releases and predictable process upsets or leaks. Emissions for unpredictable releases (e.g., accidental catastrophic releases) are not reported under this program.

For landfill sites, these guidelines should be applied to the results of the landfill testing required under Health and Safety Code Section 41805.5 (AB 3374, Chapter 1055, 1986, Calderon) as well as to any emissions reported under the emission inventory requirements of the Air Toxics "Hot Spots" Act (e.g., from flares or other onsite equipment). Districts should be consulted to determine the specific Calderon landfill testing data to be used.

E. UNCERTAINTY IN RISK ASSESSMENT

There is a great deal of uncertainty associated with the process of risk assessment. The uncertainty arises from lack of data in many areas necessitating the use of assumptions. The assumptions used in these guidelines are designed to err on the side of health protection in order to avoid underestimation of risk to the public. Sources of uncertainty which may either overestimate or underestimate risk include: extrapolation of toxicity data in animals to humans, uncertainty in the air dispersion models, and in the estimation of emissions.

Effects of exposure to more than one carcinogen or toxicant are also not quantified in the risk assessment. Many examples of additivity or synergism (effects greater than additive) are known. For chemicals which act synergistically, the risk assessment could underestimate the risks. Some chemicals may have antagonistic effects (lessen the toxic effects produced by another chemical). For chemicals which act antagonistically, the risk assessment could overestimate the risks. Additionally, there may be chemicals which pose health risks but are not considered in a given risk assessment for a number of reasons, including lack of information on toxicity; this could result in underestimating the risk.

Other sources of uncertainty which tend to overestimate risk can be found in exposure estimates where little or no data are available (e.g., soil ingestion rates, water consumption rates, and dermal penetration of some chemicals from a soil matrix).

The estimates of cancer potency in humans contain many sources of uncertainty. Factors including metabolism, target site sensitivity, diet, immunological responses, and genetics may influence the process of carcinogenicity. Differences in these factors in different species and within human populations usually cannot be easily quantified and incorporated into risk assessment. The human population is much more diverse both genetically and culturally (e.g., lifestyle, diet) than bred experimental animals. The intraspecies variability among humans is expected to be much greater than in laboratory animals. Other uncertainties arise in the assumptions underlying the dose-response model used, and in extrapolating from large experimental doses, where other toxic effects may compromise the assessment of carcinogenic potential, to much smaller environmental doses. When epidemiological data are used to generate a carcinogenic potency, less uncertainty is involved in the extrapolations from workplace exposures to environmental exposures. The uncertainty in the estimates of carcinogenic potency of a chemical are not readily quantified with much certainty. Thus, it should be realized that estimates of cancer risk are uncertain. Risk assessment is best used as a ruler to compare one source with another. Consistent approaches to risk assessment are necessary to fulfill this function. This is one of the purposes of developing these guidelines.

Uncertainty is difficult to quantify, and, in most cases, the quantification of uncertainty is itself uncertain. As such, the risk levels generated in a risk assessment are useful as a yardstick to compare one source with another and prioritize concerns. Risk estimates generated by a risk assessment should not be construed as the expected rates of disease in the exposed population but are merely estimates of risk, based on current knowledge and a large number of assumptions. In addition, the estimates of risk generated by risk assessments frequently refer to a maximally exposed person.

These guidelines present a consistent approach to the assessment of risk so that sources of air contaminants can be compared to one another. The guidelines do not include specific methods for estimating uncertainty. However, the district may allow for the submittal of uncertainty analyses. Interested facility operators should contact the district prior to submitting such an analysis.

In September of 1992, the Governor approved amendments to the Air Toxics "Hot Spots" Information and Assessment Act (SB 1731, Calderon). The amendments add two major elements to the program. First, the OEHHA must prepare and adopt risk assessment guidelines. Second, significant risk facilities must prepare and implement risk reduction audits and plans. The guidelines that OEHHA develops are to include supplemental information such

as likelihood distributions, microenvironmental characteristics, population distributions and descriptions of risk when exposure is reduced. The OEHHA is expected to begin developing the guidelines during 1993 using the CAPCOA Air Toxics "Hot Spots" Program Risk Assessment Guidelines as a starting point. The OEHHA guidelines will become the standard for risk assessments prepared under the Air Toxics "Hot Spots" Program. Therefore, the CAPCOA Air Toxics "Hot Spots" Program Risk Assessment Guidelines is not expected to be updated.

Estimates of uncertainty are useful in that uncertainty analyses may help the risk manager and risk communicator in pinpointing the key assumptions used in risk assessment that influence the estimates of risk. Allowing submission of such analyses is at district option. If an uncertainty analysis is included as part of the risk assessment generated for the Air Toxics "Hot Spots" Act, it should: 1) be clearly identified and presented separate (e.g., separate cover, appendix) from the risk assessment prepared in accordance with the guidelines; and 2) identify any deviations from the methodology in the risk assessment guidelines including the basis for such deviations. An uncertainty analysis should not use cancer potency factors that differ from those presented in Tables III-6 and III-7. Specifically, if such an analysis is presented, it is to be limited to the following:

1. identifying the chemicals of greatest concern which pose the most risk for each important health impact (e.g., which pose the highest cancer risks or contribute greatly to hazard index for noncancer health effects);
2. identifying the exposure pathway(s) that is most influential in the estimate of health risk, with respect to those compounds which are of greatest concern and pose the most risk; and
3. describing how changes in exposure assumptions within a scientifically valid range, and with respect to those compounds contributing the most to the risk, can influence the final risk estimate.

II.

OVERVIEW OF HEALTH RISK ASSESSMENT

A. HAZARD IDENTIFICATION

For air toxics sources, hazard identification involves determining the potential health effects which may be associated with emitted pollutants. The purpose is to identify qualitatively whether a pollutant is a potential human carcinogen or is associated with other types of adverse health effects. For the Air Toxics "Hot Spots" Act risk assessments, the pollutants to be evaluated are from the list of substances for which emissions are quantified according to the ARB Emission Inventory Criteria and Guidelines Regulations (CCR, Title 17, Section 93300-93354). This list is contained in Appendix B of these guidelines. These guidelines specify which substances from Appendix B shall be considered known or potential human carcinogens for risk assessment purposes (cancer potency values are listed in Tables III-6 and III-7). These guidelines also identify the substances to be evaluated for noncancer health effects (Tables III-8 and III-910).

B. DOSE-RESPONSE ASSESSMENT

A dose-response assessment is the process of characterizing the relationship between the exposure to an agent and the incidence of an adverse health effect in exposed populations. In quantitative carcinogen risk assessment the dose-response relationship is expressed in terms of a potency slope which is used to calculate the probability or risk of cancer associated with a given exposure level. The OEHHA has compiled cancer potency values, which should be used in risk assessments for the Air Toxics "Hot Spots" Act, in Tables III-6 and III-7.

Potency slope factors listed in Table III-6 were derived by the United States Environmental Protection Agency (U.S. EPA) or by the OEHHA and have undergone public review and comment. Potency slope factors listed in Table III-7 have not undergone the same extent of review as those presented in Table III-6. The unit risk factors (i.e., those presented in Table III-7) are therefore considered ~~screening~~ preliminary values for use at the discretion of the districts. Section III-E describes procedures for use of potency values in estimating excess cancer risk.

For noncarcinogenic effects, dose-response data developed from animal or human studies are used to develop noncancer ~~acceptable~~ reference exposure levels (acute and chronic). These guidelines provide the levels

which should be compared to exposures resulting from facility emissions as presented in risk assessments prepared under the Air Toxics "Hot Spots" Act. These levels include reference dose levels (RfDs) developed by the U.S. EPA and reference exposure levels which have been developed by the OEHHA (see Tables III-8 and III-910).

C. EXPOSURE ASSESSMENT

The purpose of the exposure assessment is to estimate the extent of public exposure to each substance for which cancer risk will be quantified or noncancer effects evaluated. This involves emission quantification, modeling of environmental transport, evaluation of environmental fate, identification of exposure routes, identification of exposed populations, and estimation of short-term and long-term exposure levels. These activities are described in Section III. A multipathway exposure model which includes inhalation, ingestion, and dermal routes of exposure is included in Section III-D. The noninhalation exposure analysis is included in order to account for exposure to deposited air emissions through pathways such as ingestion of contaminated soils, mother's milk, or dermal absorption.

D. RISK CHARACTERIZATION

As the final step of risk assessment, risk characterization is an integration of the health effects and public exposure information developed for emitted pollutants. Under the Air Toxics "Hot Spots" Act, risk assessments are to quantify both individual and populationwide health risks (Health and Safety Code Section 44306). The risk assessments are facility specific and the calculated risk should be combined for pollutants emitted by a single facility. For example, cancer risk from multiple carcinogens should be considered additive. For multiple pollutant exposures to noncarcinogens, a hazard index approach should be applied for air contaminants associated with the same toxic endpoint. Any emitted carcinogens which are not included in the quantitative analysis due to lack of a potency value, should be qualitatively identified. Screening Preliminary cancer potency values compiled by OEHHA may also be used in the risk characterization at district option. The use of cancer potency factors and the hazard index approach for evaluating the potential for noncarcinogenic health effects is described in Chapter III of these guidelines.

III.

RISK ASSESSMENT PROCEDURES

A. DESCRIPTION OF EMISSIONS

The emission information contained in the Air Toxics "Hot Spots" Act Emission Inventory Reports ("Inventory Reports"), provides the data to be used in the risk assessment process. This includes the information on emission sources, emitted substances, emission rates, and release parameters which is developed according to the ARB Emission Inventory Criteria and Guidelines ("Inventory Guidelines") Regulations.

Use of updated emission information to account for process changes or shutdown must be approved by the district prior to the submittal of the risk assessment. In addition, it must be stated clearly in the risk assessment if the emission estimates are based on future reductions. This section summarizes the requirements which apply to the emission information which is used for Air Toxics "Hot Spots" Act risk assessments.

1. Air Toxics "Hot Spots" Emissions

Substances Emitted

The risk assessment should identify all substances emitted by the facility which are on the Air Toxics "Hot Spots" Act list of substances. In addition, if a surrogate is used for a listed substance, the listed substance must also be clearly indicated as the emitted substance.

This The list of substances is compiled by ARB from several lists referenced in the law for the Air Toxics "Hot Spots" Program. These The substances included on the Air Toxics "Hot Spots" Program list are those substances found on lists developed by the International Agency for Research on Cancer, the U.S. Environmental Protection Agency EPA, the U.S. National Toxicology Program, the California Air Resources Board ARB (list used in the Toxic Air Contaminant Program), the Hazard Evaluation System and Information Service (State of California), or on the Proposition 65 list of carcinogens and reproductive toxicants (State of California).

The Inventory Guidelines Regulations specifies that Inventory Reports must identify and account for all listed substances used, manufactured, formulated or released. Under the regulations, the list is divided into two groups for reporting purposes. For the first group (listed in these

guidelines in Appendix B-I), all emissions must be quantified. For substances in the second group (listed in these guidelines in Appendix B-II), emissions are not quantified, however, facilities must report whether the substance is used, produced, or otherwise present onsite. Chemicals or substances in this second group which the facility uses, produces or which are otherwise present should be listed in a table in the risk assessment. Facilities preparing risk assessments or risk assessment updates under the third phase of the program (i.e., those that were required to submit emission inventory plan or update plan to the district by August 1, 1991) are only initially required to address all of the substances listed in Appendix B-I and B-II, with the exception of those with a 6/91 add date.

Facilities that must comply with the Resource Conservation and Recovery Act and Comprehensive Environmental Response, Compensation and Liability Act (RCRA/CERCLA) requirements for risk assessment need to consult the Department of Toxic Substances Control (DTSC) Remedial Project Manager to determine which substances must be evaluated in their risk assessment in addition to the list of AB 2588 chemicals. Some RCRA/CERCLA facilities may emit chemicals which are not currently listed under the "Hot Spots" Program.

Emission Estimates Used in the Risk Assessment

The risk assessment must include emission estimates for all substances for which emissions were required to be quantified in the facility's emission inventory report. Specifically, risk assessments are to include both annual average emissions and maximum one-hour emissions for each pollutant. Emissions for each substance must be reported for individual emitting processes within a facility. Total facility emissions for an individual air contaminant will be the sum of the emissions reported, by process, for that facility. Information on hours of operation and relative monthly activity must be reported for each emitting process.

The risk assessment should include tables which present the emission information (i.e., emission rates for each substance and release) in a clear and concise manner. The district may permit the facility to base the risk assessment on more current emission estimates (i.e., actual emission reductions) than those presented in the emission inventory report. If this is the case, it is suggested that the emission reductions be enforceable and be realized by the time the risk assessment is submitted to the district. However, if the district allows a facility to use emission estimates in the risk assessment based on future controls, the risk assessment must clearly state that this is the case and should specify the reduction in emissions that will be achieved as well as when the reductions will be achieved. If more current emission information than that presented in the emission inventory report is used as the basis for the risk assessment, it should also be identified. Specifically, a table presenting emission estimates included in the emission inventory report as well as those upon which the risk assessment is based should be presented. The district should be consulted concerning the specific format for presenting the emission information.

Districts must be consulted before use of updated emission information in the risk assessment. Districts may require that any updated emission rates used in risk assessments be based on enforceable emission reductions.

Facilities which must also comply with RCRA/CERCLA requirements for risk assessment need to consult the DTSC Remedial Project Manager to determine what constitutes appropriate emissions data for use in their risk assessment. Source testing may be required for such facilities even if it is not required under the "Hot Spots" Program. Additional requirements for statistical treatment of source test results may also be imposed by the DTSC on RCRA/CERCLA facilities.

Release Parameters

In addition to reporting emission quantities from all emission points, it is necessary to know how substances are released into the atmosphere. Release parameters (e.g., stack height and diameter, stack gas velocity, release temperature and emission source location in UTM coordinates) are needed to use air dispersion models. The Inventory Guidelines specify the release parameters which must be reported for each stack, vent, ducted building exhaust site, or other site of exhaust release. This information should also be included in the air dispersion portion of the risk assessment. It is recommended that this information be presented in tables included in the risk assessment.

Emission Controls

The risk assessment should include a description of control equipment and its efficiency in reducing emissions of substances on the Air Toxics "Hot Spots" list. The Inventory Guidelines require that this information be included in the Inventory Reports, along with the emission data for each emitting process. The Inventory Reports must indicate whether the control equipment was fully or only partially operational during the reporting period. If the equipment did not operate full-time, the reported overall control efficiency must be adjusted to account for downtime of control equipment.

2. Landfill Site Emissions

Emission estimates for landfill sites should include both the results of the testing required under Health and Safety Code Section 41805.5 (AB 3374, Calderon) and any emission data reported pursuant to the Inventory Guidelines. The results of the Calderon landfill testing program should be used to estimate emission rates of substances from landfill surfaces or through offsite migration. Districts should be consulted to determine the specific Calderon data to be used in the risk assessment. The Air Toxics "Hot Spots" Act risk assessments should include emissions for listed substances including equipment related emissions from landfill operations.

B. ESTIMATION OF AMBIENT CONCENTRATIONS

Estimation of the facility's impact on ambient air concentrations, using air quality modeling, is required for the risk assessment. The risk assessment should identify which dispersion model(s) was used as well as the model options that were selected (e.g., point versus area source, building downwash) for each release point. All models used as basis for the risk assessment must be in the public domain. All assumptions, parameter values, and algorithms used must be presented in summary form (e.g., ISCST2 input and output files).

As with the emission information, information on the model(s) and modeling options selected should be clearly presented in tables. In order to provide for district evaluation of the risk assessment, a diskette containing all model input files and output files should be included as part of the risk assessment submittal. The district should be consulted concerning the required format of the diskette prior to submittal of the risk assessment.

A screening model may be used to provide a maximum concentration which is likely to overestimate public exposure. The other option is a refined modeling analysis which takes into account site specific meteorological data.

In order to obtain district approval of the modeling procedures used in the refined risk assessment, submittal of a brief modeling protocol is recommended (see Appendix C). The modeling protocol should be submitted as early as possible in the 150 day risk assessment process in order to avoid delay with the modeling analysis. District modeling guidelines, if available, should be followed when preparing protocols and performing modeling procedures for the Air Toxics "Hot Spots" Act. For questions regarding screening or refined modeling procedures or the availability of district modeling guidelines, district staff should be contacted. Districts may consult with ARB on appropriate modeling techniques for specific facilities. All models used for screening and refined air dispersion analysis, for exposure assessment, and for risk assessment must be in the public domain in order to allow for public review of the risk assessment as required by the Air Toxics "Hot Spots" Act.

1. Screening Air Dispersion Analysis

A screening air dispersion model may be used to estimate the maximum ambient air concentrations resulting from facility operation. Use of screening models in place of refined modeling procedures is optional. Districts should be consulted before the use of screening models; districts may require a refined analysis. Screening modeling procedures should be used in all cases where representative meteorological data is not available.

Appropriate screening models should be selected to take into account the type of source (point or area), terrain, and building downwash conditions. The models recommended for screening are PTPLU 2 and SCREEN 2. However, SCREEN 2 offers more flexibility when specifying the source characteristics (i.e. volume, area, and point sources); therefore, it may be preferable to use SCREEN 2. The ISCST2 model, used with appropriate meteorological inputs, may also be appropriate for some facilities. To convert screening model results (one-hour) to other required averaging times (annual), a multiplying factor of 0.1 should be used. References for the models and users guides are in Appendix D.

Additional screening procedures which assure that ambient concentrations are not underestimated may also be acceptable to districts. The district should be consulted to determine the appropriate models and model options for specific facilities. If a refined modeling analysis is done, screening results need not be reported unless substances were omitted from a refined analysis based on the results from the screening analysis. The district should be consulted regarding specific criteria for the omission of substances from a refined analysis.

2. Models and Model Options

For the refined air dispersion modeling analysis, Table III-1 lists recommended models which could be used for the terrain and land-use descriptions indicated. The most recent version of these models should be used. References for the models and users guides are given in Appendix D. Information on the use of air quality models is contained in the EPA documents Guideline on Air Quality Models (Revised), (EPA Publication EPA-450-2-78-027R, July 1986), Supplement A to the Guideline on Air Quality Models (Revised), (EPA publication EPA-450/2-78-027R, July 1987), Draft Supplement B to the Guidelines on Air Quality Models (Revised), (EPA publication EPA-450/2-78-027R, September 1990), and in the available district guidelines. To facilitate the selection of models, the district should be consulted for recommendations on the appropriate model(s) or a protocol submitted for district review and approval.

Typically, a flat-terrain model should be used when the elevation of terrain features is lower than the top of the stack or release point of the source. A complex-terrain model should be used when terrain heights exceed the height of the stack. If a facility has receptors both above and below the height of the stack, it may be necessary to use more than one model. However, the selection and application of complex terrain models should be verified with the district prior to conducting the modeling analysis. Facilities with emissions of short duration also require special attention in determining the appropriate modeling techniques.

Each model identified in Table III-1 has several model options which could be selected by the user. EPA recommended options, as described in the appendix to the EPA Guideline on Air Quality Models, should be used unless the district approves other options.

Table III-1^a

Recommended Air Quality Models For Refined Risk Assessments

Application	Land Use ^b	Model
<u>FLAT TERRAIN</u>	Rural/Urban	ISCST 2
<u>COMPLEX TERRAIN</u>		
Point Sources	Rural	COMPLEX I
Area Sources	Rural	SHORTZ
All Sources	Urban	SHORTZ
Point Sources	Rural	RTDM 3.2/ <u>CTDMPLUS</u>

--a-- Please consult references in Appendix D. Facilities in the Santa Barbara Air Pollution Control District should also consult the Santa Barbara County Air Toxics Dispersion Modeling Guidelines.

b - Procedures for defining a rural or urban land use are provided in EPA's Guideline on Air Quality Models. District staff should also be consulted in determining the appropriate land-use classification.

The selection of averaging times in the modeling analysis is based on the health effects of concern. For an analysis of carcinogenic or other chronic effects, annual average concentrations are required. Table III-2 lists the substances for which annual average concentrations must be calculated (for analysis of cancer risk and chronic noncancer effects). Some districts may also require calculation of annual average concentrations for the additional substances in Table III-3 (for screening cancer risk analysis). For the analysis of acute effects, one-hour maximum concentrations should be estimated for the substances identified in Table III-4.

3. Model Input Data

Model inputs must be assembled before a model simulation can be performed. These data should include:

- (1) emissions and release parameters,
- (2) meteorological data, and
- (3) receptor locations.

Emission and Release Parameters

The model user's guide should be consulted for the specific emission and release parameters required. Some release parameters are included in the emission inventory reports for the Air Toxics "Hot Spots" Act. Additional release parameters may need to be obtained on a case-by-case basis. The emission and release parameters should be clearly presented in the risk assessment.

Meteorological Data

The model user should acquire enough meteorological data to ensure that the worst-case meteorological conditions are adequately represented in the model results. The period of record recommended for use in the model is three to five years. (Note: The worst-case year should be the year which yields the greatest maximum chronic offsite risk. If the only adverse health effects associated with all emitted pollutants from a given facility are acute, the worst-case year should be the year which yields the greatest maximum acute offsite risk.) However, the district may determine that one year of representative meteorological data is sufficient to adequately characterize the facility's impact. If no representative meteorological data is available, screening modeling procedures should be used.

Otherwise, to determine annual average concentrations for analysis of chronic health effects, the data can be averaged if a minimum of three years of meteorological data are available. For calculation of the one-hour maximum concentrations needed to evaluate acute effects, the worst-case year should be used in conjunction with the maximum hourly emission rate. For example, the annual average concentrations and one-hour maximum

Table III-2

Substances For Which Annual Average
Concentrations Should Be Calculated

Acetaldehyde
 Acrolein
 Acrylamide
 Acrylonitrile
 Ammonia
 Arsenic
 Arsenic compounds (inorganic)
 Asbestos
 Benzene
 Benzidine (and its salts)
Benzyl chloride
 Beryllium
 Bis(chloromethyl)ether
Bromine
Bromine compounds
 Hydrogen bromide
 Bromine pentafluoride
 1,3-Butadiene
 Cadmium
 Cadmium compounds
 Carbon tetrachloride
 Chlorinated dibenzofurans (2,3,7,8-equivalents)
 Chlorinated dibenzo-p-dioxins (2,3,7,8-equivalents)
 Chlorine
 Chlorobenzene (Monochlorobenzene)
 Chloroform
 Chlorofluorocarbons
Chlorophenols
 2-Chlorophenol
 2,4,6-Trichlorophenol
 Pentachlorophenol
 Tetrachlorophenols
 Chloropicrin
Chloroprene
 Chromium (hexavalent)
 Coke oven emissions
 Copper
 Cresols (o, m, p)
 1,2-Dibromo-3-chloropropane (DBCP)
 p-Dichlorobenzene (1,4-Dichlorobenzene)
 3,3'-Dichlorobenzidene
 Di(2-ethylhexyl)phthalate (DEHP)
 Dimethylamine
 1,4-Dioxane
 Epichlorohydrin
Ethyl acrylate
Ethyl chloride

Table III-2 (continued)

Substances for Which Annual Average
Concentrations Should be Calculated

Ethylene dibromide (1,2-Dibromoethane)
 Ethylene dichloride (1,2-Dichloroethane)
 Ethylene oxide
 Formaldehyde
 Gasoline vapors
Glutaraldehyde
 Glycol ethers:
 Ethylene glycol butyl ether
 Ethylene glycol ethyl ether
 Ethylene glycol ethyl ether acetate
 Ethylene glycol methyl ether
 Ethylene glycol methyl ether acetate
 Hexachlorobenzene
 Hexachlorocyclohexanes
 Hexachlorocyclopentadiene
 Hydrazine
 Hydrochloric acid
 Hydrogen cyanide
 Hydrogen fluoride
 Hydrogen sulfide
 Isocyanates:
 Methyl isocyanate
 Toluene-2,4-diisocyanate
 Toluene-2,6-diisocyanate
 Lead compounds (inorganic)^a
Maleic anhydride
 Manganese
 Mercury
 Methanol
 Methyl bromide (Bromomethane)
 Methyl chloroform (1,1,1-Trichloroethane)
 Methylene chloride (Dichloromethane)
 4,4'-Methylene dianiline (and its dichloride)
 Methyl mercury (Dimethylmercury)
Methyl methacrylate
Mineral fibers (<1% free silica)
Naphthalene
 Nickel
 Nickel carbonyl
 Nickel subsulfide
 Nitrobenzene

a - Report both the 30 day and the annual average concentrations for lead.
 Refer to Appendix M for more information.

Table III-2 (continued)

Substances For Which Annual Average
Concentrations Should Be Calculated

2-Nitropropane
N-Nitrosodiethylamine
N-Nitrosodimethylamine
p-Nitrosodiphenylamine
N-Nitrosodi-n-butylamine
N-Nitrosodi-n-propylamine
N-Nitrosomethylethylamine
N-Nitrosopyrrolidine
PAHs (Polycyclic aromatic hydrocarbons)
including, but not limited to:
Benz[a]anthracene
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[a]pyrene
Dibenz[a,h]anthracene
Indeno[1,2,3-cd]pyrene
PCBs (Polychlorinated biphenyls)
Perchloroethylene (Tetrachloroethylene)
Phenol
Phosphine
Phosphorus
Phthalic anhydride
Propylene oxide
Selenium compounds
Sodium hydroxide
Styrene
Toluene
Trichloroethylene
Urethane
Vinyl chloride
Vinylidene chloride
Xylenes
Zinc

Table III-3

Additional Substances for Which Districts
May Require Annual Average Concentrations

Acetamide
2-Aminoanthraquinone
Amitrole
Benzidene-based dyes
Carbon black extracts
Carrageenan (degraded)
Chloramphenicol
4-Chloro-o-phenylenediamine
p-Chloro-o-toluidine
Creosotes
p-Cresidine
Cupferron
2,4-Diaminoanisole
2,4-Diaminotoluene
p-Dimethylaminoazobenzene
1,1-Dimethylhydrazine (UDMH)
Dimethyl sulfate
Environmental tobacco smoke
Ethylene thiourea
Griseofulvin
4,4-Methylene bis(2-chloroaniline)(MOCA)
Metronidazole
Michler's ketone
Niridazole
Nitrogen mustard N-oxide
N-nitrosomorpholine
N-nitrosopiperidine
Phenobarbital
Potassium bromate
1,3-Propane sultone
Silica, respirable crystalline
Thioacetamide
Thiourea

Table III-4

Substances for Which One Hour Maximum
Concentrations Should be Calculated

Acrolein
Ammonia
Arsine
Benzyl chloride
Carbon tetrachloride
Chlorine
Copper
1,4-Dioxane
Ethylene glycol methyl ether
Ethylene glycol ethyl ether
Ethylene glycol monoethyl ether acetate
Ethylene glycol monobutyl ether
Formaldehyde
Hydrochloric acid
Hydrogen cyanide
Hydrogen fluoride
Hydrogen sulfide
Lead^a
Maleic anhydride
Mercury
Methyl chloroform
Methylene chloride
Nickel compounds
Perchloroethylene (Tetrachloroethylene)
Phosgene
Propylene oxide
Selenium
Sodium hydroxide
Xylenes

a - Report for comparison purposes. Refer to Appendix M for more information.

concentrations for four years of meteorological data are calculated below:

Year	Annual Average	Maximum One-Hour
1	7 ug/m ³	100 ug/m ³
2	5 ug/m ³	80 ug/m ³
3	9 ug/m ³	90 ug/m ³
4	8 ug/m ³	110 ug/m ³

In the above example, the annual average concentration is averaged over four years to obtain approximately 7.2 ug/m³. The one-hour maximum concentration is the highest one-hour concentration for the years simulated. Therefore, 110 ug/m³ is the peak one-hour concentration that should be used to evaluate acute effects.

The meteorological data may be collected from the National Weather Service, or other district-approved source. The data selected for the model should be quality-checked for representativeness and sufficiency before use. The document On-site Meteorological Program Guidance for Regulatory Modeling Applications (EPA Publication EPA-450/4-87-013, June 1987) provides an overview for determining the adequacy and quality of meteorological data. The user should contact the district to discuss meteorological input and appropriate data. The risk assessment should indicate if the district required the use of a specified meteorological data set. All memos indicating district approval of meteorological data should be attached in an appendix. If no representative meteorological data is available, screening modeling procedures should be used.

Receptor Points

The modeling analysis should contain a network of receptor points with sufficient detail (in number and density) to permit the estimation of the maximum concentrations. The results from a screening model (if available) can be used to identify the area(s) where the maximum concentrations are likely to occur. Receptor points should also be located at the population centroids and sensitive receptor locations identified in Section III-C. The exact configuration of the receptor array used in an analysis will depend on the topography, population distribution patterns, and other site-specific factors. All receptor locations should be identified in the risk assessment as UTM coordinates and receptor number. The receptor numbers in the summary tables should match receptor numbers in the computer output. In addition to UTM coordinates, the street address(es), where possible, should be provided for the estimated maximum offsite risk (for carcinogenic and noncarcinogenic health effects) as well as the estimated maximum individual offsite risk (for carcinogenic and noncarcinogenic effects) at an existing receptor. It is possible that the estimated maximum offsite risk for carcinogenic, chronic noncarcinogenic, and acute noncarcinogenic risk occur at different locations.

To evaluate localized impacts, receptor height should be taken into account at the point of maximum impact on a case-by-case basis. For example, receptor heights may have to be included to account for receptors significantly above ground level.

4. Zone of Impact

As part of the estimation of the exposed population for the cancer risk analysis, it is necessary to determine the geographic area affected by the facility. One approach would be to define a "zone of impact" surrounding the source by generating an isopleth in which the total excess lifetime cancer risk from inhalation exposure to all emitted carcinogens is greater than 10^{-6} (one in 1,000,000). However, when depicting the risk assessment results, risk isopleths must present the total cancer and noncancer risk from both inhalation and noninhalation pathways. The zone of impact should be clearly shown on a map with geographic markers of adequate resolution (see Section C.2).

Using the above approach, the "zone of impact" can be defined by using the dispersion model to generate an isopleth where the cancer risks are equal to 10^{-6} . This is done by using the product of emission rates and unit risks to yield lifetime cancer risks rather than ambient air concentrations as the model output. Some districts may prefer to use a cancer risk of 10^{-7} as the zone of impact. Therefore, the district should be consulted before modeling efforts are initiated. If the zone of impact is greater than 25 kilometers from the facility at any point, the district should be consulted. The district may specify limits on the area of the zone of impact.

5. Results

All model output reports should be submitted with the risk assessment. The results of the modeling analysis should be summarized and a model output submitted. The summary should include the following information:

- (1) predicted one-hour maximum concentration (for substances in Table III-4) and annual average concentrations (for substances in Tables III-2 and III-3) at each receptor location (centroids, sensitive receptors, and the locations of maximum offsite risk {if it yields the highest risk} and maximum individual offsite risk at an existing receptor). This data should be tabulated in a summary table.
- (2) UTM coordinates and street address of the facility.
- (3) Adequate maps of the facility (with property boundary identified) and the modeling domain (see Section C.2).

C. DESCRIPTION OF EXPOSED POPULATION

The refined risk assessment requires a detailed analysis of the population which is exposed to pollutants emitted from the facility. The detailed population exposure analysis should provide estimates of the number of individuals in residences and offsite workplaces, as well as at sensitive

receptor sites such as schools, daycare centers and hospitals. Districts may require that locations with high densities of sensitive individuals be identified (e.g., schools, daycare centers, hospitals). The overall exposed residential and worker populations should be apportioned into smaller geographic subareas. The information needed for each subarea is (1) the number of exposed persons, and (2) the receptor location at which the calculated ambient air concentration is assumed to be representative of the exposure to the entire population in the subarea.

A multi-tiered approach is suggested for this analysis. First, census tracts which the facility could significantly impact should be identified. A census tract should be divided into smaller subareas if it is close to the facility where ambient concentrations may vary widely. The district may determine that census tracts provide sufficient resolution near the facility to adequately characterize population exposure.

Further downwind where ambient concentrations are less variable, the census tract level may be acceptable to the district. The district may determine that the aggregation of census tracts (e.g., the census tracts making up a city are combined) is appropriate for receptors which are considerable distances from the facility. For screening risk assessments, a detailed description of the exposed population is not required. If a facility must also comply with RCRA/CERCLA risk assessment requirements, health effects to onsite workers may also need to be addressed. The DTSC's Remedial Project Manager should be consulted on this issue.

1. Screening Estimate

A screening risk assessment should include an estimate of the maximum potential exposed population. The impact area to be considered should be selected to be health protective (i.e., will not underestimate the number of exposed individuals). A worst-case assumption would be to assume that all individuals within a large radius of the facility would be exposed to the maximum concentration. Districts should be consulted to determine the population estimate which should be used for screening purposes.

2. Refined Population Estimate - Census Tracts

For the refined risk assessment, the boundaries of census tracts can be used to define the geographic area to be included in the population exposure analysis.

The two basic steps in defining the area under analysis are:

- (1) Identify the "zone of impact" (as defined in section III-4) on a map detailed enough to provide for resolution of the population to the subcensus tract level (The U.S. Geological Survey (USGS) 7.5-minute series maps provide sufficient detail). This is necessary to clearly identify the zone of impact, location of the facility.

and sensitive receptors within the zone of impact. If significant development has occurred since the USGS survey, this should be indicated.

- (2) Identify all census tracts within the zone of impact using a U.S. Bureau of Census or equivalent map (e.g., Thomas Brothers). If only a portion of a census tract lies within the zone of impact, the population used in the burden calculation should include the proportion of the population in that isopleth zone. The census tract boundaries should be transferred to a map, such as a USGS map (referred to hereafter as the "base map".)

An alternative approach for estimating population exposure in heavily populated urban areas is to apportion census tracts to a cartesian grid cell coordinate system. This method allows a cartesian coordinate receptor concentration field to be merged with the population grid cells. This process may be computerized and minimizes manual mapping of centroids and census tracts.

The district may determine that the aggregation of census tracts (e.g., the census tracts making up a city are combined) is appropriate for receptors which are considerable distances from the facility. If the district permits such an approach, it is suggested that the census tract used to represent the aggregate be selected in a manner to ensure that the approach is health protective. For example, the census tract included in the aggregate that is nearest (downwind) to the facility should be used to represent the aggregate.

3. Refined Population Estimate - Subcensus Tract Analysis

Within each census tract are smaller population units. These units [urban block groups (BG) and rural enumeration districts (ED)] contain about 1,100 persons. BGs are further broken down into statistical units called blocks. Blocks are generally bounded by four streets and contain an average of 70 to 100 persons. However, the populations presented above are average figures and population units may vary significantly. In some cases, the EDs are very large and identical to a census tract.

The area requiring detailed (subcensus tract) resolution of the exposed residential and worker population will need to be determined on a case-by-case basis through consultation with the district. The district may determine that census tracts provide sufficient resolution near the facility to adequately characterize population exposure.

It is necessary to limit the size of the detailed analysis area because inclusion of all subcensus tract areas would greatly increase the resource requirements of the analysis. For example, an urban area of 100,000 persons would involve approximately 25 census tracts, approximately 100 to 150 block groups, and approximately 1,000 to 1,400 blocks. Furthermore, a high degree

of resolution at large distances from a source would not significantly affect the analysis because wide variations in ambient concentrations would not occur. Thus, the detailed analysis of census tracts within several kilometers of a facility should be sufficient. The district should be consulted to determine the area that requires detailed analysis.

Districts should also be consulted to determine the degree of resolution required. In some cases, resolution of residential populations to the BG/ED level may be sufficient. However, resolution to the block level may also be required for those BG/EDs closest to the facility or those having maximum ambient concentration impacts. The identified employment subareas should be resolved to a similar degree of resolution as the residential population. For each subarea analyzed, the number of residents and/or workers exposed should be estimated.

Employment population data can be obtained at the census tract level from the U.S. Census Bureau or from local planning agencies. This degree of resolution will generally not be sufficient for most risk assessments. For the area requiring detailed analysis, zoning maps, general plans, and other planning documents should be consulted to identify subareas with worker populations.

The boundaries of each residential and employment population area should be transferred to the base map.

4. Centroid Locations

For each subarea analyzed, a centroid location (the location at which a calculated ambient concentration is assumed to represent the entire subarea) should be determined. When population is uniformly distributed within a population unit, a geographic centroid based on the shape of the population unit can be used. Where population is not uniformly distributed, a population-weighted centroid is needed. Another alternative could be to use the concentration at the point of maximum impact within that census tract as the concentration to which the entire population of that census tract is exposed.

The centroids represent locations that should be included as receptor points in the dispersion modeling analysis. Annual average concentrations should be calculated at each centroid using the modeling procedures presented in Section III-B.

For census tracts and BG/EDs, judgments can be made using census tract maps and street maps to determine the centroid location. At the block level, a geographic centroid is sufficient.

5. Sensitive Receptor Locations

Individuals who may be more sensitive to toxic exposures than the general population are distributed throughout the total population. Sensitive populations may include young children and chronically ill individuals. Districts may require that locations with high densities of sensitive individuals be identified (e.g., schools, daycare centers, hospitals). The risk assessment should state what the district requirements were regarding identification of sensitive receptor locations.

Although sensitive individuals are protected by general assumptions made in the cancer risk assessment, their identification may be useful to assure the public that such individuals are being considered in the analysis. For noncancer effects, the identification of such individuals may be crucial in evaluating the potential impact of the toxic effect.

6. Results

The following information from the population description analysis should be included with the risk assessment:

- (1) Base map, including,
 - (a) boundary of analysis area,
 - (b) boundaries of population and employment subareas,
 - (c) locations of centroids, and whether they are population or geographically weighted, and
 - (d) locations of sensitive receptors.
- (2) Summary of exposed population or computer printout, including,
 - (a) population subarea identifier (e.g., census tract number and block number),
 - (b) number of residents or workers,
 - (c) centroid locations (UTM coordinates).

D. ESTIMATION OF NONINHALATION EXPOSURES

In order to estimate long-term exposures resulting from facility air emissions, the risk assessment must analyze both inhalation and noninhalation pathways of exposure for certain substances. For some facilities, noninhalation pathways of exposure may contribute significantly to the estimated risk. Exposure through noninhalation pathways result when pollutants are deposited on soils, crops, and surface waters.

Both primary (direct) and secondary (indirect) pathways may contribute to the total multipathway exposure. The primary pathways, other than inhalation, are ingestion and dermal exposure. Secondary pathways of

exposure are those which result from assimilation of the pollutant into a food source. The substances to be evaluated for noninhalation pathways of exposure are in Table III-5. Facilities which do not emit any substances in Table III-5 need not prepare a noninhalation exposure assessment. Table III-5 provides the oral cancer potency values to be used in the risk assessment for those substances in the table which are carcinogenic by the oral route. In addition, Table III-5 lists oral acceptable reference exposure levels (AELs) (RELs) for several substances. These oral AELs RELs are to be used to evaluate the potential noncancer adverse health effects through noninhalation pathways of exposure.

1. Screening Analysis Health Risk Assessment

If a screening health risk assessment is being prepared, the exposure analysis should include the four minimum pathways recommended by the OEHHA. These are inhalation, soil ingestion, dermal exposure and mother's milk. For the screening analysis, exposures should be estimated for the maximum exposed individual.

Evaluation of noninhalation pathways should be included if the facility emits any of the substances listed in Table III-5. Appendix E provides the algorithms, default values, and assumptions for estimating the noninhalation exposures for individual receptors. The computerized template described on page III-2122 for use in the refined risk assessment can also be used for the screening analysis.

2. Pathways of Exposure

For the refined risk assessment, the zone of impact for the facility should be evaluated to identify the potential pathways of exposure resulting from deposited air emissions. The potential primary and secondary noninhalation pathways which should be evaluated are:

Primary non-inhalation

Dermal Exposure
Water Ingestion
Crop Ingestion
(Direct Deposition)
Soil Ingestion

Secondary non-inhalation

Mother's Milk
Fish Ingestion
Crop Ingestion (Root Uptake)
Poultry Meat and Eggs
Meat from:
Cattle, Goats, Pigs, Sheep
Dairy Products

In all multipathway risk assessments, inhalation, dermal exposure, soil ingestion, and mother's milk pathways should be included when estimating risk. For some facilities, districts may require that other pathways be included if they occur within the zone of impact of the facility. In order to assess the additional noninhalation pathways, site-specific data are needed. Consumption of locally produced and homegrown food sources (animals and crops) must be determined. In addition, local surface waters must be

Table III-5

Substances to be Evaluated for Noninhalation Exposures

Substance	Oral Potency Value (mg/kg-d) ⁻¹	Oral AELREL (mg/kg/day)	Reference ^a
Arsenic	1.7	1.0E-3	1,2
Beryllium	4.3 _b	5.0E-3	3,2
Cadmium	NA ^b	1.0E-3	4
Chlorobenzene	NA	2.0E-2	4
Chromium (hexavalent)	0.42	5.0E-3	5,2
Chlorinated dibenzo-p-dioxins (as 2,3,7,8-equivalents)	1.33E+5	1.0E-9	6,7
Chlorinated dibenzofurans (as 2,3,7,8-equivalents)	1.33E+5	1.0E-9	6,7
2-Chlorophenol	NA	5.0E-3	4
p-Dichlorobenzene	4.0E-2	2.0E+1	2
Hexachlorobenzene	1.8E+0	8.0E-4	8,2
Hexachlorocyclohexanes	4.0E+0	3.0E-4	8,2
Lead	NA	4.3E-4	9
Mercury	NA	3.0E-4	2
Nitrosamines:		NA	8
N-Nitrosodiethylamine	36	NA	8
N-Nitrosodimethylamine	16	NA	8
p-Nitrosodiphenylamine	9.0E-3	NA	8
N-Nitrosodi-n-butylamine	10.8	NA	8
N-Nitrosodi-n-propylamine	7	NA	8
N-Nitrosomethylethylamine	22	NA	8
N-Nitrosomorpholine	6.7E+0	NA	8
N-Nitrosopiperidine	9.4E+0	NA	8
N-Nitrosopyrrolidine	2.1	NA	8
PAH (Polycyclic aromatic hydrocarbons) including, but not limited to:	11.5	NA	
Benz[a]anthracene	11.5	NA	10
Benzo[b]fluoranthene	11.5	NA	10
Benzo[k]fluoranthene	11.5	NA	10
Benzo[a]pyrene	11.5	NA	10
Dibenz[a,h]anthracene	11.5	NA	10
Indeno[1,2,3-cd]pyrene	11.5	NA	10
Naphthalene	NA	4.0E-3	2
Polychlorinated biphenyls (PCBs)	7.7E+0	NA	8
Pentachlorophenol	1.6E-2	3.0E-2	8,2
2,4,6-Trichlorophenol	7.0E-2	NA	8
2,4,5-Trichlorophenol	NA	1.0E-1	2

References for Table III-5

a - References listed are for potency value and oral AEL REL, respectively.

b - NA = Oral potency value or oral AEL REL not available.

1. U.S. EPA; Health Assessment Document for Inorganic Arsenic. EPA 600/8-83-021F, March 1984; and U.S. Environmental Protection Agency Integrated Risk Information System, 1988.
2. U.S. EPA. Health Effects Assessment Summary Tables, 1991.
3. U.S. EPA, Health Assessment Document for Beryllium. November 1987. EPA/600/8-84/026F; and U.S. Environmental Protection Agency, Integrated Risk Information System, 1990.
4. U.S. EPA, Integrated Risk Information System
5. Memorandum from David Seigel, Ph.D., Chair of the Standards and Criteria Workgroup to members of the Standards and Criteria Workgroup, May 30, 1991.
6. Air Resources Board and Department of Health Services, 1986. Staff Report: Public Hearing to Consider the Adoption of a Regulatory Amendment Identifying Chlorinated Dioxins and Dibenzofurans as Toxic Air Contaminants. Release Date: June 6, 1986.
7. U.S. EPA, 1985, Health Assessment Document for Polychlorinated Dibenzo-p-Dioxins, EPA 600/8-84-014.
8. Potency slopes derived by Reproductive and Cancer Hazard Assessment Section; Office of Environmental Health Hazard Assessment.
9. Based on conversion from the CAAQS - California Ambient Air Quality Standard.
10. U.S. EPA, Health Effects Assessment for Benzo[a]pyrene. September 1984. EPA-540/1-86-022.

identified to assess the contribution of contaminated water supplies (resulting from direct deposition) to direct human exposure or through assimilation by animals or crops. Figure III-1 illustrates pathways by which air emissions may result in human exposure.

3. Noninhalation Exposure Estimate

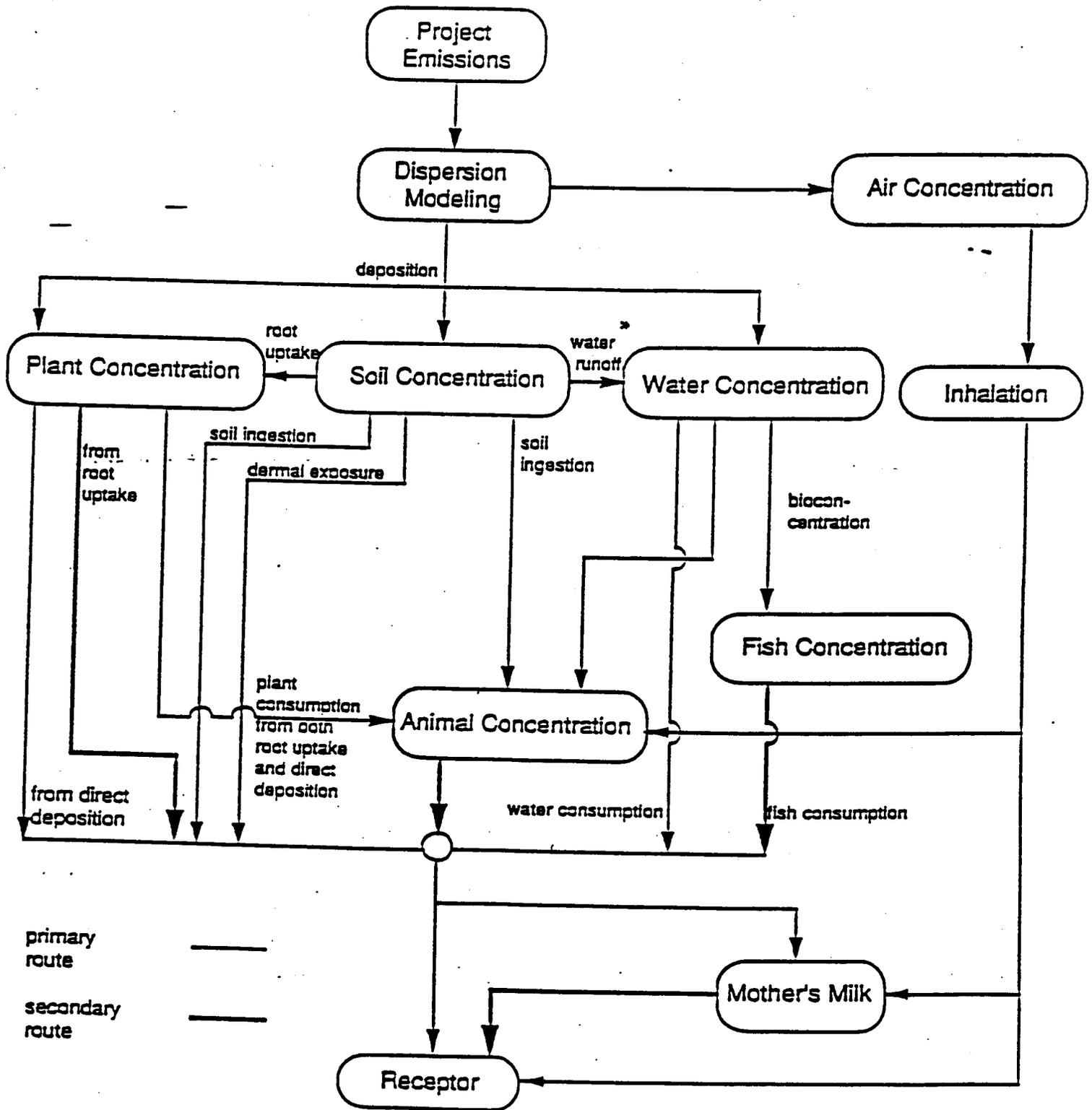
To calculate the noninhalation exposure, the environmental fate of facility air emissions must be determined. The results of dispersion modeling provide air concentrations which are used in an environmental fate analysis to determine soil and water concentrations. With the results of the environmental fate evaluation, estimates of the concentrations in soil, vegetation and animals can be made. Human noninhalation exposure is determined based on the estimated concentrations in soil, water, and plant and animal food sources. Appendix E contains algorithms, default values, and assumptions for estimating (1) the environmental fate of facility emissions in soil and water, (2) concentrations in vegetation and animals, and (3) human exposures through specific pathways. Appendix E also identifies the necessary site-specific input parameters. In the absence of facility specific information on the size of emitted particles, the default values for deposition velocity should be used. If parameters are used which differ from those in Appendix E (e.g., site-specific parameters), sufficient documentation should be included. If any pathways were excluded, adequate justification should be presented.

The suggested algorithms for each pathway were developed largely based on information provided in the South Coast Air Quality Management District (SCAQMD) document Multi-pathway Health Risk Assessment Input Parameters Guidance Document, 1988. However, additional input parameters have been provided by the OEHHA and the SCAQMD document should not be used in lieu of these guidelines. A computer template containing these algorithms, which can be used with commercially available spreadsheet software, is available through the ARB. An order form for the program can be found in Appendix F. To obtain the template, contact the Toxic Air Contaminant Identification Branch of the ARB.

In addition to the program mentioned above, a second program developed by the Santa Barbara County Air Pollution Control District for use in preparing risk assessments under AB 2588 is available through the California Air Pollution Control Officers Association (CAPCOA). To obtain information on how to order this model write or call: Stewart Wilson, Executive Director, CAPCOA, at 3232 Western Drive, Cameron Park, CA 95682, (916) 676-4323.

All models used to determine exposure levels for the risk assessment must be in the public domain in order to allow for public review as required by the Air Toxics "Hot Spots" Act. All algorithms and assumptions used must be clearly presented in tabular form in the risk assessment.

EXPOSURE ROUTES



* - The AFB/CE-1A computer program does not currently address the water runoff pathway.

E. ESTIMATION OF HEALTH RISK

The exposure data developed for inhalation and other pathways must be evaluated to determine the potential for acute and chronic noncancer health effects and to estimate cancer risk. This section provides cancer potency values and noncancer reference exposure levels which should be used for the risk assessment (Tables III-6, III-7, III-8, and III-910). On an annual basis The OEHHA will compile the health numbers to be used. Updates to these tables are expected to will be available each year when OEHHA releases the new risk assessment guidelines that are required under Senate Bill 1731 (Calderon). Therefore, the CAPCOA Risk Assessment Guidelines is not expected to be updated.

1. Screening Cancer Risk Analysis

A screening risk assessment should (1) estimate the maximum offsite cancer risk, (2) estimate the maximum potential cancer burden, and (3) compare the estimated maximum exposure levels (acute and chronic) with the OEHHA reference exposure levels for noncancer effects. The overall procedures described in this section for use in the refined risk assessment should also be used in the screening analysis. For the screening analysis, only the maximum offsite cancer risk is calculated. Population burden is not calculated for individual population units (i.e., census tracts, urban block groups, rural enumeration districts). For an estimate of the maximum potential cancer burden, it can be conservatively assumed that the exposed population's risk is the same as the maximum offsite cancer risk. A cancer burden based on this assumption would overestimate the population-wide health impact.

2. Cancer Risk Analysis

The refined risk assessment should include a quantitative assessment of both individual and populationwide health risks. Districts should be consulted before use of alternate procedures. The substances to be evaluated for cancer risk are those listed in Table III-6 and, at district option, those in Table III-7.

The analysis of individual risk must include an estimate of the highest increased cancer risk resulting from the facility's emissions. Specifically, the risk assessment is to include an estimate of the maximum offsite cancer risk as well as the maximum individual offsite cancer risk at an existing receptor unless the higher of these two estimated risks occurs at an existing receptor. If the highest estimated risk is the maximum offsite cancer risk at an existing receptor, it is not necessary to report the maximum offsite risk. The maximum offsite cancer risk can occur at any offsite location which is not currently associated with receptors (e.g., areas zoned for future development, unoccupied areas). The maximum individual offsite cancer risk at an existing receptor can occur at any location where receptors are currently located (e.g., residences, businesses).

Table III-6

OEHHA and U.S. EPA Cancer Potency Values

Substance	Unit Risk ($\mu\text{g}/\text{m}^3$) ⁻¹		Reference ^c
Acetaldehyde	2.2E-6	2.7E-6	IRIS OEHHA-ATES/ARB
Acrylamide		1.3E-3	IRIS/OEHHA-RCHAS
Acrylonitrile		2.9E-4	OEHHA-RCHAS
Arsenic		3.3E-3	OEHHA-ATES/ARB
Arsenic compounds (inorganic)		3.3E-3	OEHHA-ATES/ARB
Asbestos	[1.9E-4/100 fibers/m ³] ^a		OEHHA-ATES/ARB
Benzene		2.9E-5	OEHHA-RCHAS
Benzidine (and its salts)		1.4E-1	OEHHA-RCHAS
Beryllium		2.4E-3	IRIS
Bis(chloromethyl)ether		1.3E-2	OEHHA-RCHAS
1,3-Butadiene	2.8E-4	1.7E-4	IRIS OEHHA-ATES/ARB
Cadmium		4.2E-3	OEHHA-RCHAS
Cadmium compounds		4.2E-3	OEHHA-ATES/ARB
Carbon tetrachloride		4.2E-5	OEHHA-RCHAS,ATES
Chlorinated dibenzo-p-dioxins ^b (as 2,3,7,8-equivalents) ^b		3.8E+1	OEHHA-RCHAS,ATES/ARB
Chlorinated dibenzofurans ^b (as 2,3,7,8-equivalents)		3.8E+1	OEHHA-RCHAS,ATES/ARB
Chloroform		5.3E-6	OEHHA-ATES/ARB
Chlorophenols			
Pentachlorophenol		4.6E-6	OEHHA-RCHAS
2,4,6-Trichlorophenol		2.0E-5	OEHHA-RCHAS
Chloroprene		1.3E-7	OEHHA-RCHAS
Chromium (hexavalent)		1.4E-1	OEHHA-RCHAS
Coke oven emissions		6.2E-4	IRIS
1,2-Dibromo-3-chloropropane (DBCP)		2.0E-3	OEHHA-RCHAS
p-Dichlorobenzene (1,4-Dichlorobenzene)		1.1E-5	OEHHA-RCHAS
3,3'-Dichlorobenzidene		3.4E-4	OEHHA-RCHAS
Di(2-ethylhexyl)phthalate (DEHP)		2.4E-6	OEHHA-RCHAS
1,4-Dioxane		7.7E-6	OEHHA-RCHAS
Dioxins (chlorinated) ^b (see chlorinated dibenzo-p-dioxins)			
Epichlorohydrin		2.3E-5	OEHHA-RCHAS
Ethylene dibromide (1,2-Dibromoethane)		7.1E-5	OEHHA-RCHAS,ATES/ARB
Ethylene dichloride (1,2-Dichloroethane)		2.0E-5	OEHHA-RCHAS,ATES/ARB
Ethylene oxide		8.8E-5	OEHHA-ATES/ARB
Formaldehyde	1.3E-5	6.0E-6	IRIS OEHHA-ATES/ARB

Table III-6 (continued)

OEHHA and U.S. EPA Cancer Potency Values

Substance	Unit Risk ($\mu\text{g}/\text{m}^3$) ⁻¹	Reference ^c
Furans (chlorinated) ^b	(see chlorinated dibenzofurans)	
Gasoline vapors	$1.2\text{E}-6$ [$2.5-3\text{ppm}^{-1}$]	OEHHA-RCHAS
Hexachlorobenzene	$5.1\text{E}-4$	OEHHA-RCHAS
Hexachlorocyclohexanes	$1.1\text{E}-3$	OEHHA-RCHAS
Hydrazine	$4.9\text{E}-3$	IRIS
Methylene chloride (Dichloromethane)	$1.0\text{E}-6$	OEHHA-ATES/ARB
Nickel and nickel compounds	$2.6\text{E}-4$	OEHHA-ATES/ARB
N-Nitrosodiethylamine	$1.0\text{E}-2$	OEHHA-RCHAS
N-Nitrosodimethylamine	$4.6\text{E}-3$	OEHHA-RCHAS
p-Nitrosodiphenylamine	$2.6\text{E}-6$	OEHHA-RCHAS
N-Nitrosodi-n-butylamine	$3.1\text{E}-3$	OEHHA-RCHAS
N-Nitrosomethylethylamine	$6.3\text{E}-3$	IRIS/OEHHA-RCHAS
N-Nitrosodi-n-propylamine	$2.0\text{E}-3$	OEHHA-RCHAS
N-Nitrosopyrrolidine	$6.0\text{E}-4$	IRIS/OEHHA-RCHAS
PCBs (Polychlorinated biphenyls)	$1.4\text{E}-3$	OEHHA-RCHAS
PAHs (Polycyclic aromatic hydrocarbons) including, but not limited to:		
Benz[a]anthracene	$1.7\text{E}-3$	Ref.1
Benzo[b]fluoranthene	$1.7\text{E}-3$	Ref.1
Benzo[k]fluoranthene	$1.7\text{E}-3$	Ref.1
Benzo[a]pyrene	$1.7\text{E}-3$	Ref.1
Dibenz[a,h]anthracene	$1.7\text{E}-3$	Ref.1
Indeno[1,2,3-cd]pyrene	$1.7\text{E}-3$	Ref.1
Perchloroethylene (Tetrachloroethylene)	$5.8\text{E}-7$ $5.9\text{E}-6$	EPA/Ref.2,3 OEHHA-ATES/ARB
Propylene oxide	$3.7\text{E}-6$	IRIS
Trichloroethylene	$2.0\text{E}-6$	OEHHA-ATES/ARB
Urethane	$2.9\text{E}-4$	OEHHA-RCHAS
Vinyl chloride	$7.8\text{E}-5$	OEHHA-ATES/ARB

a - A conversion factor of 100 fibers/0.003 micrograms can be multiplied by a receptor concentration of asbestos expressed in terms of micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) to yield fibers/ m^3 (EPA, 1985. Airborne Asbestos Health Risk Assessment Update). Unless other information necessary to estimate the concentration (fibers/ m^3) of asbestos at receptors of interest is available, the use of the aforementioned conversion factor is an option.

b - See Appendix G for the methodology for calculating 2,3,7,8-equivalents for Chlorinated Dibenzop-Dioxins and Chlorinated Dibenzofurans.

References to Table III-6

- c - IRIS refers to the U.S. Environmental Protection Agency's Integrated Risk Information System Database.
- OEHHA refers to the Office of Environmental Health Hazard Assessment
- OEHHA-ATES/ARB refers to reports by the California Office of Environmental Health Hazard Assessment, Air Toxicology Epidemiology Section and the California Air Resources Board prepared in the process of identifying the material as a Toxic Air Contaminant. These reports are cited in the CAPCOA Air Toxics Assessment Manual.
- OEHHA-RCHAS refers to reports prepared by the California Office of Environmental Health Hazard Assessment, Reproductive and Cancer Hazard Assessment Section as part of the implementation of the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65).
1. EPA, 1984. Health Effects Document for Benzo[a]pyrene. EPA/540/1-86/022, September, 1984. NTIS PB86-134335.
 2. EPA, 1985. Health Assessment Document for Tetrachloroethylene (Perchloroethylene). Final Report. EPA-600/8-82/005F, July, 1985, [oral potency estimate].
 3. Federal Register, 1985. Volume 50, No. 248, Thursday, September 26, 1985, Pages 52880-52884. [inhalation potency estimate].

Table III-7

Screening Preliminary Cancer Potency Values for the
Air Toxics "Hot Spots" Act

Substance	Unit Risk (ug/m ³) ⁻¹	Reference ^a
Acetamide	2.0E-5	TD50DB
2-Aminoanthraquinone	9.4E-6	TD50DB
Amitrole	2.7E-4	TD50DB
Benzidine-based dyes	1.4E-1	see Benzidine in Table III-6
Carbon black extracts	1.7E-5	(based on 1% PAHs)
Carrageenan (degraded)	5.8E-7	TD50DB
Chloramphenicol	3.1E-6	TD50DB
4-Chloro-o-phenylenediamine	4.6E-6	TD50DB
p-Chloro-o-toluidine	1.2E-4	TD50DB
Creosotes	1.7E-3	see Benzo(a)pyrene
p-Cresidine	3.1E-5	TD50DB
Cupferron	6.3E-5	TD50DB
2,4-Diaminoanisole	2.3E-5	TD50DB
2,4-Diaminotoluene	4.3E-4	TD50DB
p-Dimethylaminoazobenzene	1.3E-3	TD50DB
1,1-Dimethylhydrazine (UDMH)	4.9E-4	Ref.1/OEHHA-PETS
Dimethyl sulfate	4.0E-3	OEHHA-RCHAS
Environmental tobacco smoke	(2.8E-5)	Ref.2/OEHHA-ATES
Ethylene thiourea	1.3E-5	TD50DB
Gasoline vapors	1.2E-6	1.6E-6 [3.5E-3ppm ⁻¹] OEHHA-RCHAS U.S. EPA
Griseofulvin	1.1E-6	TD50DB
Isocyanates		
Toluene-2,4-diisocyanate	1.1E-5	Ref.3/OEHHA-ATES
Toluene-2,6-diisocyanate	1.1E-5	Ref.3/OEHHA-ATES
Lead	8.0E-5	see Lead compounds
Lead Compounds	8.0E-5	TD50DB
(acetate, basic)		
4,4-Methylene bis	3.7E-5	HEAST/U.S. EPA
(2-chloroaniline) (MOCA)		
4,4'-Methylene dianiline	3.4E-4	TD50DB
(and its dichloride)		
Metronidazole	5.1E-5	OEHHA-RCHAS
Michler's ketone	2.5E-4	TD50DB
Niridazole	1.0E-4	Ref.4/OEHHA-ATES
Nitrogen mustard N-oxide	1.1E-3	TD50DB
2-Nitropropane	1.3E-3	RCHAS
N-Nitrosomorpholine	1.9E-3	TD50DB
N-Nitrosopiperidine	2.7E-3	TD50DB
Phenobarbital	1.3E-4	TD50DB
Potassium bromate	1.4E-4	Ref.5/OEHHA-RCHAS
1,3-Propane sultone	6.9E-4	TD50DB

Table III-7 (continued)

Screening Preliminary Cancer Potency Values for the
Air Toxics "Hot Spots" Act

Substance	Unit Risk ($\mu\text{g}/\text{m}^3$) ⁻¹	Reference ^a
Selenium compounds (Selenium sulfide)	1.4E-4	TD50DB
Silica (crystalline & respirable) ^b	0.45 to 2.9E-4	Ref.6,7,8/OEHHA-ATES
Styrene	5.7E-7	Ref. 9
Thioacetamide	3.5E-4	TD50DB
Thiourea	5.5E-4	Ref.10

a - TD50DB are values derived from the TD50 database published by L.S. Gold et al. in Environmental Health Perspectives 58:9-319, 1984 and in two updates and a summary (Environmental Health Perspectives 67:161-200, 1986; 74:237-329, 1987; 79:259-272, 1989). The unit risk values were obtained by applying the multistage model to datasets compiled in this publication.

Unit risk values with Ref. after them were either obtained from the cited reference or were calculated by the Office of Environmental Health Hazard Assessment (OEHA) staff using the computer program GLOBAL86 with animal tumor incidence data cited in the reference and human equivalent doses based on the stated animal doses using a surface area correction. In the case of environmental tobacco smoke, the estimate by Wells of 14,000 lung and other cancer deaths per year due to passive smoking was multiplied by 70 years and divided by $2.5\text{E}+8$ people to develop a lifetime risk for the U.S. population, then the risk was divided by the estimated exposure of $140 \mu\text{g}/\text{m}^3$ to calculate the unit risk. Thus this number is not a 95% UCL. For the purpose of screening, all carcinogenic PAHs are considered to be equal in potency to benzo[a]pyrene. There are various schemes being developed to assess relative potency, but none is widely accepted yet.

OEHA-PETS refers to the California Office of Environmental Health Hazard Assessment, Pesticide and Environmental Toxicology Section.
OEHA-RCHAS refers to reports prepared by the California Office of Environmental Health Hazard Assessment, Reproductive and Cancer Hazard Assessment Section as part of the implementation of the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65).
OEHA-ATES refers to the California Office of Environmental Health Hazard Assessment, Air Toxicology Epidemiology.

b - A range is presented for this estimate of potency. Refer to Appendix I for a detailed discussion of the carcinogenicity of crystalline silica.

References to Table III-7

1. Goldenthal EI, 1989. Two Year Oncogenicity Study in Rats. Unsymmetrical Dimethylhydrazine. International Research and Development Corporation, Mattawan, MI.
2. Wells AJ, 1988. An estimate of adult mortality in the United States from passive smoking. Environment International 14:249-265.
3. National Toxicology Program, 1986. Toxicology and Carcinogenesis Studies of Commercial Grade 2.4(80%) - and 2.6(20%) - toluene diisocyanate in F344/N Rats and B6C3F₁ Mice (Gavage studies). U.S. Department of Health and Human Services.
4. Urman HK, Bulay O, Clayson DS, Shubik P, 1975. Carcinogenic effects of niridazole. Cancer Letters, 1:69-74.
5. Kurokawa Y, Hayashi Y, Maekawa A, Takahashi M, Kokubo T, 1982. Induction of renal cell tumors in F-344 rats by oral administration of potassium bromate, a food additive. Gann 73:335-338.
6. Dagle GE, Wehner AP, Clark ML., Buschbom R., 1986. Chronic inhalation exposure of rats to quartz. In: Silica, Silicosis, and Cancer. Goldsmith DF, Winn DM, Shy CM (eds.), Praeger, New York, pp. 255-266.
7. Holland LM, Wilson JS, Tillery MI, Smith DM, 1986. Lung cancer in rats exposed to fibrogenic dusts. In: Silica, Silicosis, and Cancer. Goldsmith DF, Winn DM, Shy CM (eds.), Praeger, New York, pp. 267-279.
8. Muhle, H., Takenada, S., Mohr, U., Dasenbrock, C., Mermelstein, R., 1989. Lung tumor Induction Upon Long-Term Low-Level Inhalation of Crystalline Silica," American Journal of Industrial Medicine, 15:343-346.
9. U.S. EPA, 1991. Health Effects Assessment Summary Tables.
10. U.S. EPA, 1989. Letter from Fred S. Hauchman, EPA Office of Air Quality Planning and Standards, to Kenneth M. Hines, Kentucky Division for Air Quality, June 22, 1989.

Facilities which must also comply with RCRA/CERCLA risk assessment requirements may also need to include additional modeling results when analyzing cancer risk. The DTSC's Remedial Project Manager should be consulted on this issue.

The individual excess cancer risk is the sum of the risks due to both inhalation and noninhalation pathways of exposure. The populationwide assessment should include a calculation of total population excess cancer burden. The following procedures for estimating cancer risk have been developed to be consistent with the California/OEHHA Guidelines for Chemical Carcinogen Risk Assessments and Their Scientific Rationale.

A carcinogenic potency value is needed to estimate excess cancer risk for a substance. Potencies are expressed either in units of inverse dose as a potency slope (i.e. $(\text{mg}/\text{kg}/\text{day})^{-1}$) or, for inhalation exposures, as a unit risk factor (i.e. $(\text{ug}/\text{m}^3)^{-1}$). The unit risk factor is defined as the estimated probability of a person contracting cancer as a result of constant exposure to an ambient concentration of $1 \text{ ug}/\text{m}^3$ over a 70 year lifetime. A potency slope is a factor which when multiplied by the dose of a carcinogen gives the associated lifetime cancer risk. Potency values represent the theoretical probability of extra cancer cases occurring in the exposed population assuming 70 year lifetime exposure. The derivation of the carcinogenic potency values takes into account the available information on pharmacokinetics, mechanism of carcinogenic action, and the effect of different models on low dose extrapolation. These values are generally the 95% upper confidence limits on risk; the actual excess cancer risks are not likely to be higher, and may be lower than those estimated using these procedures.

The OEHHA has compiled the inhalation cancer potency values which should be used in all risk assessments for the Air Toxics "Hot Spots" Act (Table III-6). These values have been developed either by the U.S. EPA or the OEHHA. For substances which have been evaluated by both the OEHHA and the EPA, the OEHHA potency value should be used. Table III-7 contains additional potency values compiled by the OEHHA for the Air Toxics "Hot Spots" Act. These numbers are considered screening preliminary values which may be used at district option. Facilities should consult the district to determine if the screening preliminary values should be included in the risk assessment. Oral cancer potency values for applicable pollutants are provided in Table III-5. On an annual basis the OEHHA will compile the cancer potency values to be used. We anticipate that updates to the guidelines will become available each November year when OEHHA releases the new Risk Assessment Guidelines that are required by Senate Bill 1731 (Calderon). Therefore, the CAPCOA Risk Assessment Guidelines is not expected to be updated.

If a facility must also comply with RCRA/CERCLA risk assessment requirements, durations of exposure other than 70 years may need to be addressed in the risk assessment. The DTSC's Remedial Project Manager should be consulted on this issue.

Individual Excess Cancer Risk (Inhalation)

The cancer risk for each emitted substance is calculated by multiplying the estimated ambient air concentration at a given receptor by the chemical specific unit risk factor. The cancer risk analysis should include (1) a calculation of the cancer risk at each receptor location, and (2) an estimate of the maximum offsite cancer risk and the maximum individual offsite cancer risk at an existing receptor (if the highest of these two risks occurs at an existing receptor, it is not necessary to report the maximum offsite cancer risk) (these may be equivalent). The maximum offsite cancer risk is an estimate of the highest increased cancer risk at any location which is not currently associated with receptors (e.g., areas zoned for future development, unoccupied areas). The maximum individual offsite cancer risk at an existing receptor is an estimate of the highest increased cancer risk at any location where receptors (e.g., residences, businesses) are currently located. The maximum offsite cancer risk at a receptor location is the sum of the individual risks for each substance.

A 70 year lifetime exposure should be assumed for all individuals except for offsite workers. For offsite workers, it may be appropriate to adjust the exposure period to account for a working lifetime of 8 hours per day, 240 days per year for 46 years. However, if the facility's emissions do not occur continuously (i.e., 24 hours/day, 365 days/year) such an adjustment may not be appropriate. For example, if a facility's emissions occur on a schedule which coincides with that of offsite workers (e.g., emissions occur weekdays from 8:00 a.m. to 5:00 p.m.), it is not appropriate to make any adjustments. The maximum individual offsite cancer risk at an existing receptor should be determined for residential and worker populations by identifying the residential and worker receptor points with the highest inhalation cancer risk. If the highest inhalation cancer risk occurs at a residential receptor, it is not necessary to report the highest inhalation cancer risk at a worker receptor.

Population Excess Cancer Burden (Inhalation)

To assess the populationwide health risk posed by the facility, the total population excess cancer burden should be calculated. The population excess cancer burden is an estimate of the increased number of cancer cases in a population as a result of exposure to emitted substances. For each population unit (city, census tract, subarea, or grid), the excess cancer burden should be calculated for both residential and worker populations. The excess cancer burden for a population unit is the product of the exposed population and the estimated individual risk from ambient air. The sum of the excess cancer burden for each population unit will give the total estimate of population excess cancer burden. Monterey Bay Unified Air Pollution Control District has proposed an alternative method for characterizing populationwide cancer risk (Appendix H). Districts should be consulted before use of alternative procedures.

Individual Excess Cancer Risk (Multipathway)

If the multipathway exposure analysis described in Section III-D was required for the facility, the cancer risk analysis should include a calculation of the maximum offsite cancer risk and the maximum individual offsite cancer risk at an existing receptor from both inhalation and noninhalation exposures (if the highest of these two risks occurs at an existing receptor, it is not necessary to report the maximum offsite cancer risk). To determine the maximum offsite cancer risk as well as the maximum individual offsite cancer risk at an existing receptor, the combined inhalation and noninhalation risk should be calculated for each receptor location. The inhalation risk for each pollutant at a receptor location is calculated by multiplying the ambient air concentration by the unit risk factor. The noninhalation risk for each pollutant at a receptor location is calculated by multiplying the average daily dose of the substance by the potency slope. The average daily dose of each substance should be calculated using the results of the dispersion modeling and the multipathway exposure algorithms in Appendix E. The estimated risks for individual substances are added to provide the total excess cancer risk for the receptor locations.

As described in Section III-D, a template that calculates the total risk from both inhalation and noninhalation pathways for individual receptor locations is available and can be ordered using the form provided in Appendix F.

Population Excess Cancer Burden (Multipathway)

For a multipathway risk assessment, the total of the inhalation and noninhalation excess cancer burden should be calculated for each census tract or other population unit. The cancer burden for each population unit is calculated by multiplying the total excess lifetime cancer risk at the centroid location (for all pathways) by the number of persons in the population unit. Monterey Bay Unified Air Pollution Control District has proposed an alternative method for characterizing populationwide cancer risk (Appendix H). Districts should be consulted before use of alternative procedures.

3. Evaluation of Noncancer Health Effects

An evaluation of the potential noncancer adverse health effects of both short-term (acute) and long-term (chronic) exposures to facility emissions should be included in the risk assessment. The potential for chronic noncancer health effects should be evaluated by comparing the long-term exposure levels (the average daily intake for noninhalation and the estimated annual average concentrations for inhalation) from all pathways with the acceptable exposure levels specified in Tables III-5 and III-8. This comparison should be made at the maximum impacted offsite location (i.e., the offsite location receiving the highest dose of the substance).

under evaluation) and the maximum impacted offsite location at an existing receptor (i.e., the offsite location, where a receptor is currently located, receiving the highest dose of the substance under evaluation). The comparison is the ratio of the estimated concentration of the substance under evaluation divided by the applicable acceptable exposure level listed for that substance in Tables III-6 and III-8. This ratio is referred to as the hazard index for the substance under evaluation.

The potential for acute effects should be evaluated by comparing the one-hour maximum concentrations with the acceptable exposure levels in Table III-9. In this case, the comparison is the estimated concentration of the substance under evaluation divided by the applicable acceptable exposure level listed for that substance in Table III-9. The comparison should be made at the maximum impacted offsite location (i.e., the offsite location with the highest one-hour concentration of the substance under evaluation) and the maximum impacted offsite location at an existing receptor (i.e., the offsite location, where a receptor is currently located, with the highest one-hour concentration of the substance under evaluation). It is necessary to note that many of the substances required to be evaluated for noncancer health effects are also carcinogens. Such substances must be evaluated for their potential for both carcinogenic and noncancer health effects.

Acceptable exposure levels are used as indicators of potential adverse health effects. They are generally based on the most sensitive adverse health effect reported in the medical and toxicologic literature. They are designed to protect the most sensitive individuals in the population by the inclusion of "margins of safety". Appendix J provides a more detailed discussion of the derivation of noncancer acceptable exposure levels.

For a single substance, exposure at or below the acceptable exposure level (i.e., hazard index is equal to or less than one) is not expected to result in adverse health effects. However, exposures above the acceptable exposure level do not necessarily equate to significant health risks. Instead, further examination of the implication of such a result is required. It is suggested that the district contact the OEHHA concerning guidance on assessing exceedances of the applicable acceptable exposure level for individual substances.

In the case of exposure to multiple substances with noncancer health effects, it is also necessary to calculate a total hazard index. Specifically, when two or more pollutants emitted from a facility have a toxic effect on the same organ or organ system, the exposures should be analyzed using a total hazard index approach.

For Air Toxics "Hot Spots" risk assessments, background concentrations of certain criteria pollutants must be included as part of the total hazard index calculation. Therefore, a total hazard index must be calculated for facilities that may only emit one substance with noncarcinogenic effects. The following text discusses the approach for calculating a total hazard index including the procedure for addressing ambient concentrations of specified criteria pollutants.

The total hazard index approach assumes that the combination of multiple subthreshold exposures could result in an adverse health effect. In the absence of information, the assumption is also made that the effects of each substance are additive for a given organ system. In fact, the actions of some respiratory irritants have been shown to be synergistic, that is, the effects are greater than the sum. Thus, in some cases this approach may underestimate the health impact.

The total hazard index should include background levels for six criteria pollutants (i.e., lead, ozone, nitrogen dioxide, sulfur dioxide, sulfates, and hydrogen sulfide). The background concentrations should be representative of the annual average concentration near the facility being evaluated. This information can be obtained from the Air Resources Board's annual California Air Quality Data reports. To obtain this information, you can contact the Toxic Air Contaminant Identification Branch at the ARB.

The chronic and acute acceptable exposure levels for the six criteria pollutants are provided in Tables III-8 and III-9, respectively. The toxicological endpoints associated with acute and chronic exposure to these substances are provided in Tables III-9 and III-10, respectively. This approach is necessary because nongancer effects are assumed to occur only when a threshold is surpassed. The additional exposure from a particular facility when combined with background levels of criteria pollutants may cause the threshold to be exceeded. Appendix K presents a sample calculation of a hazard index and total hazard index where background concentrations of criteria pollutants are included.

For chronic exposures, Table III-10 lists the substances to be considered in the total hazard index for each toxicological endpoint. The estimated exposure to a given substance from the facility emissions is divided by the acceptable exposure level listed for that substance in Tables III-5 and III-8. For a given target organ, this ratio is summed for all substances which affect that target organ.

The acceptable exposure levels listed in Tables III-5 and III-8 were developed for the most sensitive adverse toxicological endpoint. In some cases, the same acceptable exposure levels must be used for different endpoints because of the lack of information. This usually results in a health protective estimate of the total hazard index. If the total hazard index exceeds one, a more in-depth analysis is initiated.

For acute exposures, a total hazard index should be calculated for respiratory irritation using the levels in Table III-9 for those compounds that are respiratory irritants. The same approach should be used for other substances listed in Table III-9 having toxicological endpoints other than respiratory irritation.

The substances in Tables III-5, III-8, III-9 and III-10 were selected for quantitative assessment based on the availability of health effects information and districts' priorities for noncancer risk assessment. Other substances may be included in updates to these guidelines as the OEHHA develops additional acceptable exposure levels. The OEHHA's updates to Tables III-5, III-8, III-9, and III-10 are expected to be available each year.

For the acute health effects evaluation, the short-term dispersion modeling described in Section III-B provides the maximum one-hour concentrations. For the analysis of chronic health effects, the dispersion modeling provides annual average concentrations. The determination of long-term exposure levels may need to include noninhalation pathways as described in Section III-D.

The estimated short-term and long-term exposure levels (at the maximum impacted offsite location and the maximum impacted offsite location where an existing receptor is located) for single substances should be compared with a measure of acceptable exposure (Tables III-5 and III-8 for chronic exposure and III-9 for acute exposure) to determine if the pollutant concentration may result in adverse health effects. If the highest exposure levels (short-term, long-term) occur at an existing receptor, it is not necessary to report the maximum offsite exposure.

An evaluation of the potential noncancer health effects from both short-term (acute) and long-term (chronic) exposures to toxicant emissions should be included in the risk assessment. The chronic and acute noncancer health effects are to be reported separately. Many of the carcinogenic substances are also associated with noncancer health effects. Such substances must be evaluated for potential noncancer health effects as well as cancer risk.

Reference exposure levels, or RELs, are used as indicators of potential adverse health effects. An REL is a concentration level ($\mu\text{g}/\text{m}^3$) or dose ($\text{mg}/\text{kg}\text{-day}$) at (or below) which no adverse health effects are anticipated. RELs are generally based on the most sensitive adverse health effect reported in the medical and toxicological literature. Additionally, RELs are designed to protect the most sensitive individuals in the population by the inclusion of margins of safety. It should be noted that exceeding the REL does not automatically indicate a health impact. Please note that previous editions of these guidelines refer to acceptable exposure levels, or AELs, in place of RELs. The change in terms was made because reference exposure level is more appropriate scientifically, and both terms are equivalent for use in risk assessment preparation. Appendix J provides a more detailed discussion of the derivation of noncancer reference exposure levels.

Evaluation of Chronic Noncancer Health Effects

The potential for chronic health effects should be evaluated by comparing the long-term exposure levels (the average daily intake for the noninhalation route of exposure, and the estimated annual average

concentration for the inhalation route) to the RELs given in Table III-5 (oral REL column) and Table III-8. The method used for comparison is a simple ratioing method called the hazard index approach. The chronic hazard index for each substance is calculated by dividing the estimated annual average exposure level by the REL. This ratio is called the hazard index. The individual hazard index for each substance affecting the same target organ is then summed (please see Appendix K and Table III-9 for additional information). Thus, for each target system or organ, this sum, referred to as the total hazard index, reflects impacts from all evaluated substances affecting the target organ. For chronic exposures, Table III-9 lists the substances to be considered in the total hazard index for each toxicological endpoint.

The total hazard index approach assumes that the combination of multiple subthreshold exposures could result in an adverse health effect. In the absence of information, the assumption is also made that the effects of each substance are additive for a given organ system. In fact, the actions of some respiratory irritants have been shown to be synergistic, the effects are greater than the sum. Thus, in some cases this approach may actually underestimate the health impact.

The hazard index should be calculated for exposures at the maximum impacted offsite location (location of the maximum exposed individual [MEI]), and the maximum impacted offsite location at an existing receptor (e.g., the site receiving the highest exposure where a receptor is currently located). These may be the same site, or they may be different locations. The maximum impact may occur in a commercial area where there are no residents. In this case, the hazard index at the location of the maximum impacted resident in any surrounding area should also be calculated.

The total chronic hazard index for respiratory effects should include consideration of background concentrations of criteria pollutants if the total hazard index for the facility exceeds 0.5. If the total hazard index for the facility exceeds 0.5, background concentrations of criteria pollutants should be used to calculate a second total chronic hazard index (i.e., facility's contribution + background). The following criteria pollutants should be included in this calculation: ozone, nitrogen dioxide, sulfur dioxide, sulfates, and hydrogen sulfide. The hazard index for lead should include background concentrations of lead (target organs are cardiovascular/blood, central nervous system/peripheral nervous system, immune system, kidney, and reproductive system). Appendix K presents a sample calculation of a hazard index and total hazard index where background concentrations of criteria pollutants are included.

The background concentrations used in the chronic hazard index calculations should be representative of the annual average concentrations near the facility being evaluated. This information can be obtained from the Air Resources Board's annual California Air Quality Data Reports. To obtain this information, you can contact the Toxic Air Contaminant Identification Branch at the ARB. In cases where information on background concentrations is unavailable, the district may direct the facility operator

to make an alternative assumption. The RELs cited in Table III-8 for the criteria pollutants are the California ambient air quality standards.

Total hazard indices of one or less are not considered to be indicative of public health impacts from noncancer toxicity of the evaluated substances. However, exposures above the REL for individual substances or a total hazard index greater than one may indicate that the source has a significant potential to cause adverse noncancer risks. The district may wish to contact OEHHA concerning guidance on assessing exceedances of a hazard index of one.

Evaluation of Acute Noncancer Health Effects

The Air Toxics "Hot Spots" risk assessments should evaluate the potential for health effects from acute (short-term) exposures to peak emissions that result from routine operation of a facility including continuous and intermittent releases and predictable process upsets and leaks. The acute RELs are designed to evaluate health effects from short-term exposure of the public to these routine peak emissions. They are not based on levels used for evacuation in the event of a major accident. If a facility also must comply with RCRA/CERCLA risk assessment requirements, it may need to evaluate a non-routine accident scenario in its risk assessment. Different acute RELs may need to be used for that scenario. The DTSC Remedial Project Manager should be consulted on this issue.

The potential for acute health effects should be evaluated by comparing the estimated one-hour maximum concentrations with the acute RELs provided in Table III-10. As with the evaluation of chronic noncancer health impacts, the hazard index approach is used. The hazard index for each substance should be calculated using the one-hour maximum concentrations obtained from the appropriate air modeling as the numerator and the acute REL (as provided in Table III-10) as the denominator. The hazard index should be calculated for the point of maximum offsite impact (e.g., the offsite location with the highest one-hour maximum ground level concentration of the substance under evaluation; the MEI), and the maximum impacted offsite location where there is currently a receptor. In a manner similar to the calculation of chronic noncancer hazard indices, the total hazard index for acute exposure is calculated for each target organ and includes the hazard index for each evaluated substance affecting that target organ.

The total acute hazard index for respiratory effects should include consideration of background concentrations of criteria pollutants if the total hazard index for the facility exceeds 0.5. If the total hazard index for the facility exceeds 0.5, background concentrations of criteria pollutants should be used to calculate a second total acute hazard index (i.e., facility's contribution + background). The following criteria pollutants should be included in this calculation: ozone, nitrogen dioxide, sulfur dioxide, sulfates, and hydrogen sulfide.

The background concentrations used in the acute hazard index calculations should be representative of the annual average concentrations near the facility being evaluated. This information can be obtained from

the Air Resources Board's annual California Air Quality Data Reports. To obtain this information, you can contact the Toxic Air Contaminant Identification Branch at the ARB. In cases where information on background concentrations is unavailable, the district may direct the facility operator to make an alternative assumption. The REIs cited in Table III-10 for the criteria pollutants are the California ambient air quality standards.

For a single substance, exposure at or below the REI is not expected to result in adverse health effects. Acute exposure estimates greater than the REI or total acute hazard indices greater than one may indicate that the source has a significant potential to cause adverse noncancer risks. As for the chronic hazard index estimates, the district may wish to contact OEHHA for guidance in assessing hazard indices greater than one.

If a facility must also comply with RCRA/CERCLA risk assessment requirements, durations of exposure other than 70 years may need to be addressed in the risk assessment. The DTSC's Remedial Project Manager should be consulted on this issue.

Table III-8

Noncancer Acceptable Reference Exposure Levels (Chronic)

Substance	Inhalation ^a	
	(ug/m ³)	Reference ^b
Acetaldehyde	9.0E+0	IRIS
Acrolein	2.0E-2	IRIS
Acrylamide	{7.0E-1}	IRIS
Acrylonitrile	2.0E+0	IRIS
Ammonia ^c	1.0E+2	IRIS
Arsenic ^c	5.0E-1	TLV'
Benzene ^c	7.1E+1	TLV
Benzidine (and its salts)	{1.0E+1}	IRIS
Benzyl chloride	1.2E+1	TLV'
Beryllium ^d	4.8E-3	TLV'
Bromine	1.7E+0	TLV'
Bromine compounds		
Hydrogen bromide	2.4E+1	TLV'
Bromine pentafluoride	1.7E+0	TLV'
Cadmium	{3.5E+0}	IRIS
Carbon tetrachloride ^c	{2.4E+0}	IRIS
Chlorinated dibenzo-p-dioxins ^{c,d} (as 2,3,7,8-equivalents)	{3.5E-6}	Ref.1
Chlorinated dibenzofurans ^c (as 2,3,7,8-equivalents)	{3.5E-6}	Ref.1
Chlorine	7.1E+0	TLV'
Chlorobenzene (monochlorobenzene)	{7.0E+1}	IRIS
Chlorofluorocarbons	{7.0E+2}	IRIS
Chloroform ^c	{3.5E+1}	IRIS
Chlorophenols		
2-Chlorophenol	1.8E+1	IRIS
Pentachlorophenol	2.0E-1	DTSC
Tetrachlorophenols	8.8E+1	DTSC
Chloropicrin	1.7E+0	TLV'
Chloroprene	1.0E+0	HEAST
Chromium (hexavalent) ^c	2.0E-3	HEAST
Copper	2.4E+0	TLV'
Cresols (o, m, p)	1.8E+2	IRIS
Dibenzodioxins (chlorinated) (see chlorinated dibenzo-p-dioxins)		
Dibenzofurans (chlorinated) (see chlorinated dibenzofurans)		
1,2-Dibromo-3-chloropropane (DBCP)	2.0E-1	IRIS

Table III-8 (continued)

Noncancer Acceptable Reference Exposure Levels (Chronic)

Substance	Inhalation ^a ($\mu\text{g}/\text{m}^3$)	Reference ^b
p-Dichlorobenzene (1,4-Dichlorobenzene)	7.0E+2	EPA
1,4-Dioxane	4.0E+0	ref.2
Di(2-ethylhexyl)phthalate	{7.0E+1}	IRIS
Dimethylamine	2.0E+0	IRIS
Epichlorohydrin	3.0E-1	HEAST
Ethyl acrylate	4.8E+1	TLV'
Ethyl chloride	1.0E+4	IRIS
Ethylene Dibromide ^c (1,2-Dibromoethane)	4.6E+0	OEHHA-PETS
Ethylene Dichloride ^c (1,2-Dichloroethane)	9.5E+1	TLV'
Ethylene glycol butyl ether	2.0E+1	HEAST
Ethylene glycol monoethyl ether	2.0E+2	IRIS
Ethylene glycol ethyl ether acetate	6.4E+1	TLV'
Ethylene glycol methyl ether	2.0E+1	IRIS
Ethylene glycol methyl ether acetate ^c	5.7E+1	TLV'
Ethylene oxide ^d	6.0E+2	OEHHA-ATES/Ref.3
Formaldehyde ^d	3.6E+0	IRIS, TLV'
gamma-Hexachlorocyclohexane	{1.0E+0}	IRIS
Gasoline vapors	2.1E+3	TLV'
Glutaraldehyde	1.7E+0	TLV'
Hexachlorobenzene	{2.8E+0}	IRIS
Hexachlorocyclopentadiene	2.4E-1	IRIS, TLV'
Hydrazine	2.4E-1	TLV'
Hydrochloric acid	7.0E+0	IRIS
Hydrogen cyanide	{7.0E+1}	IRIS
Hydrogen fluoride	5.9E+0	TLV'
Hydrogen sulfide	4.2E+1	CAAQS
Isocyanates		
Toluene-2,4-diisocyanate	9.5E-2	TLV
Toluene-2,6-diisocyanate	9.5E-2	TLV
Methyl isocyanate ^e	3.6E-1	TLV'
Lead and compounds	1.5E+0	CAAQS
Maleic anhydride	2.4E+0	TLV'
Manganese and compounds	4.0E-1	IRIS
Mercury and compounds (inorganic)	3.0E-1	HEAST

Table III-8 (continued)

Noncancer Acceptable Reference Exposure Levels (Chronic)

Substance	Inhalation ^a ($\mu\text{g}/\text{m}^3$)	Reference ^b
Methanol	6.2E+2	TLV
Methyl bromide	6.0E+0	HEAST
Methyl chloroform (1,1,1-TCA)	{3.2E+2}	IRIS
Methylene chloride ^c	3.0E+3	HEAST
4,4'-Methylene dianiline (and its dichloride)	1.9E+0	TLV'
Methyl mercury	{1.0E+0}	IRIS
Methyl methacrylate	9.8E+2	TLV'
Mineral fibers (< 1% free silica)	2.4E+1	TLV'
Naphthalene	{1.4E+1}	HEAST
Nickel and nickel compounds ^c	2.4E-1	TLV'
Nitrobenzene	{1.7E+0}	IRIS
Nitrogen dioxide	4.7E+2	CAAQS
2-Nitropropane	2.0E+1	IRIS
Ozone	1.8E+2	CAAQS
Perchloroethylene ^c (Tetrachloroethylene)	{3.5E+1}	IRIS
Phenol	4.5E+1	TLV
Phosphine	{1.0E+1}	IRIS
Phosphorous (white)	{7.0E-2}	IRIS
Phthalic anhydride	{7.0E+3}	IRIS
PCBs (Polychlorinated biphenyls)	1.2E+0	TLV'
Propylene oxide	3.0E+1	IRIS
Selenium compounds	5.0E-1	TLV'
Silica (respirable, crystalline) ^e	1.2E+0	TLV'
Sodium hydroxide	4.8E+0	TLV'
Styrene	{7.0E+2}	IRIS
Sulfates	2.5E+1	CAAQS
Sulfur dioxide	6.6E+2	CAAQS
Toluene	2.0E+2	DTSC
Trichloroethylene ^c	6.4E+2	TLV
Vinyl chloride ^c	2.6E+1	CAAQS
Vinylidene chloride	{3.2E+1}	IRIS
Xylenes	3.0E+2	HEAST
Zinc compounds	3.5E+1	SPHEM

a - Values in {} have been converted from oral acceptable exposure levels (mg/kg/day) by assuming a 70 kg person breathes 20 m³ per day and equal absorption occurs by the inhalation and oral routes.

- b - IRIS, "Reference Doses from EPA's Integrated Risk Information System";
OEHHA-ATES, level was calculated by the Office of Environmental Health Hazard Assessment staff using a 100-fold safety factor with a NOEL from the literature;
OEHHA-PETS refers to the Office of Environmental Health Hazard Assessment, Air Toxicology and Epidemiology Section;
SPHEM, the Superfund Public Health Evaluation Manual, 1986, pp. 149-156;
CAAQS, California Ambient Air Quality Standard;
EPA, letter from EPA's Pollutant Assessment Branch listing chemicals with verified inhalation RfDs as of July 31, 1989;
HEAST, EPA Health Effects Assessment Summary Tables, Fourth Quarter FY 1991;
DTSC, Department of Toxic Substances Control Applied Action Levels;
TLV' indicates that the number is derived from an ACGIH TLV value which has been divided by an uncertainty factor of 420. [4.2 (to extrapolate from a 40 hour work week to a 168 hour full week) times 10 (to extrapolate from healthy workers to sensitives) times 10 (since adverse health effects are often seen at the TLVs)]
- c - Declared a Toxic Air Contaminant by ARB due to carcinogenicity.
- d - Considered a carcinogen by EPA.
- e - TLV for crystobalite divided by 42. The endpoint is silicosis (lung disease).
- e - NOTE : Report both the 30-day and the annual average concentrations for lead. See Appendix M for more information

References to Table III-8

1. EPA, 1985. "Health Assessment Document for Polychlorinated Dibenzo-p-Dioxins," EPA 600/8-84-014.
2. See Appendix J for derivation of AEL.
3. Snellings M. W.; Zelenak, J. P.; and Weil, C.S., 1982. "Effects on Reproduction in Fischer 344 Rats Exposed to Ethylene Oxide by Inhalation for One Generation," Toxicology and Applied Pharmacology 63:382-388.

Table III-109

Toxicological Endpoints to be Considered
in a Hazard Index (Chronic Toxicity)

Chemical	System or Organ Affected ^a							
	CV/BL	CNS/PNS	IMMUN	KIDN	GI/LV	REPRO	RESP	SKIN
Acetaldehyde							X	
Acrolein							X	
Acrylamide		x ^b						
Acrylonitrile								X
Ammonia							X	X
Arsenic		x					X	X
Benzene		x						
Benzidene		x						
Benzyl chloride					x			
Beryllium							X	
Bromine							X	
Bromine compounds (inorganic)								
Hydrogen bromide							X	
Bromine pentafluoride							X	
Cadmium				x	x		X	
Carbon tetrachloride				x			X	
Chlorinated dibenzo-p-dioxins			x		x	x		x
Chlorinated dibenzofurans			x		x	x		x
Chlorine							X	
Chlorobenzene (monochlorobenzene)				x	x	x		x
Chlorofluorocarbons		x						
Chloroform					x			
Chlorophenols					x			
Chloropicrin						x		
Chloroprene		x					X	
Chromium				x	x		X	
Copper (and compounds)							X	
Cresols (o, m, p)		x					X	
Crystalline silica							X	
1,2-Dibromo-3-chloropropane (DBCP)					x	x	X	
p-Dichlorobenzene (1,4-Dichlorobenzene)					x			
Di(2-Ethylhexyl)phthalate					x			
Dimethylamine								X
1,4-Dioxane		x		x	x		X	
Epichlorohydrin				x			X	
Ethyl acrylate				x				
Ethyl chloride				x	x		X	
Ethylene dibromide (1,2-Dibromoethane)						x	X	

Table III-109 (continued)

Toxicological Endpoints to be Considered
in a Hazard Index (Chronic Toxicity)

Chemical	System or Organ Affected ^a							
	CV/BL	CNS/PNS	IMMUN	KIDN	GI/LV	REPRO	RESP	SKIN
Ethylene dichloride (1,2-Dichloroethane)			x	x	x			
Dioxins (see chlorinated dibenzo-p-dioxins)								
Ethylene glycol butyl ether						x	x	
Ethylene glycol ethyl ether						x	x	
Ethylene glycol ethyl ether (acetate)						x	x	
Ethylene glycol methyl ether						x	x	
Ethylene glycol methyl ether (acetate)						x	x	
Ethylene oxide						x		
Formaldehyde								x
gamma-Hexachlorocyclohexane				x	x			
Gasoline vapors		x						x
Glutaraldehyde								x
Hexachlorobenzene					x			
Hexachlorocyclopentadiene					x			
Hydrazine								
Hydrochloric acid							x	x
Hydrogen cyanide		x					x	x
Hydrogen fluoride								
Hydrogen sulfide		x ^b					x	x
Lead and compounds	x	x	x	x		x		
Maleic anhydride								x
Manganese and compounds		x						x
Mercury and compounds (inorganic)	x	x		x	x			x
Methanol		x						
Methyl bromide								
Methyl chloroform					x			
Methylene chloride		x			x	x		
4,4'-Methylene dianiline		x			x			
Methyl isocyanate								
Methyl mercury		x					x	x
Methyl methacrylate								
Mineral fibers							x	
Naphthalene							x	
Nickel (all compounds)	x							
Nitrobenzene			x	x			x	
Nitrogen dioxide					x			
2-Nitropropane							x	
					x			

Table III-109 (continued)

Toxicological Endpoints to be Considered
in a Hazard Index (Chronic Toxicity)

Chemical	System or Organ Affected ^a							
	CV/BL	CNS/PNS	IMMUN	KIDN	GI/LV	REPRO	RESP	SKIN
Ozone							X	
PCBs (Polychlorinated biphenyls)			X		X	X		
Perchloroethylene				X	X			
Phenol				X			X	
Phosphine	X	X			X			
Phosphorous (white)						X		
Phthalic anhydride				X	X			
Propylene oxide		X		X	X	X	X	X
Selenium and compounds							X	
Sodium hydroxide							X	X
Styrene					X			
Sulfates							X	
Sulfur Dioxide							X	
Toluene		X				X		
Toluene diisocyanates							X	
Trichloroethylene		X			X			
Vinyl chloride					X	X		
Vinylidene chloride					X			
Xylenes						X	X	
Zinc and compounds	X						X	

a - CV/BL - cardiovascular or blood system; CNS/PNS - central or peripheral nervous system; IMMUN - immune system; KIDN - kidney; GI/LV - gastrointestinal system and liver; RESP - respiratory system; REPRO - reproductive system including teratogenic and developmental effects; SKIN - skin irritation or other effects.

b - Refers to primary target system(s) of concern for this chemical. Hazard index for an endpoint should include those chemicals marked x. Consult Table III-8 for levels to use in the Hazard Index calculations.

Table III-910

Noncancer Acceptable Reference Exposure Levels (Acute)

Chemical	Exposure ₃ Level (ug/m ³)	Toxic Endpoint	Reference
Ammonia	2.1E+3	Respiratory irritation	1
Acrolein	2.5E+0	Respiratory irritation	2
Arsine	1.3E+2	Blood	1
Benzyl chloride	5.0E+1	Respiratory irritation	2
Carbon tetrachloride	1.9E+2	CNS	1
Chlorine	2.3E+1	Respiratory irritation	1
Copper and compounds	1.0E+1	Respiratory irritation	2
1,4-Dioxane	2.0E+1	Eye irritation	3
Ethylene glycol methyl ether	3.2E+2	Reproductive/developmental	3
Ethylene glycol ethyl ether	3.7E+2	Reproductive/developmental	3
Ethylene glycol monoethyl ether acetate	1.6E+3	Reproductive/developmental	3
Ethylene glycol monobutyl ether	1.5E+3	Blood	3
Formaldehyde	3.7E+2	Respiratory irritation	1
Hydrochloric acid	3.0E+3	Respiratory irritation	1
Hydrogen cyanide	3.3E+3	CNS	1
Hydrogen fluoride	5.8E+2	Respiratory irritation	1
Hydrogen sulfide	4.2E+1	Respiratory irritation	4
Lead ^a	1.5E-0	CNS	5
Maleic anhydride	1.0E+1	Respiratory irritation	2
Mercury (inorganic)	3.0E+1	CNS, Kidney, Liver	3
Methyl chloroform	1.9E+5	CNS	3
Methylene chloride	3.5E+3	CNS	1
Nickel compounds	1.0E+0	Immunotoxicity	3
Nitrogen dioxide	4.7E+2	Respiratory irritation	4
Ozone	1.8E+2	Respiratory irritation	4
Perchloroethylene (Tetrachloroethylene)	6.8E+3	CNS	1
Phosgene	1.2E+1	Respiratory irritation	1
Propylene oxide	1.0E+3	CNS	3
Selenium	2.0E+0	Respiratory irritation	2
Sodium hydroxide	2.0E+1	Respiratory irritation	2
Sulfates	2.5E+1	Respiratory irritation	5
Sulfur Dioxide	6.6E+2	Respiratory irritation	4
Xylenes	4.4E+3	Respiratory irritation	2

a - Report the highest 1-hour lead concentration for comparison purposes.
See Appendix M for more information.

References to Table III-910

1. These values are equal to the ambient concentration limits (ACLs) for 60 minute exposures developed by Lewis and Alexeeff "Quantitative Risk Assessment of Noncancer Health Effects for Acute Exposure to Air Pollutants". Presented at the 1989 Annual Meeting of the Air and Waste Management Association.
2. These numbers were derived by dividing the Threshold Limit Value by 100. The TLVs in these cases were considered to be human LOAELs by Office of Environmental Health Hazard Assessment, Air Toxicology and Epidemiology Section staff. Reference: American Conference of Governmental Industrial Hygienists, Documentation of the Threshold Limit Values and Biological Exposure Indices, 1986, Cincinnati.
3. See Appendix J for references as well as an explanation of the derivation of these values.
4. California ambient air quality standard (one-hour averaging time). California Code of Regulations, Title 17, section 70200.
5. California ambient air quality standard (30-day averaging time). California Code of Regulations, Title 17, section 70200.
65. California ambient air quality standard (24-hour averaging time). California Code of Regulations, Title 17, section 70200.

IV.

ORGANIZATION OF THE HEALTH RISK ASSESSMENT REPORT

A. REFINED HEALTH RISK ASSESSMENT

The health risk assessment should be a complete document that can stand alone. The assessment should begin with an executive summary which includes a description of the facility and impact area, a map of the impact area, and a summary of the potential cancer risk, acute health effects, and chronic noncancer health effects. The summary should also indicate which chemicals are most significant in terms of health impacts and the importance of any exposure pathway. The executive summary should emphasize the results of the standard procedure and list the CAPCOA Risk Assessment Guidelines version (by date) which was used to prepare the health risk assessment.

The report should describe any deviations from the procedures recommended in these guidelines and should identify where district guidance has been provided. All calculations, assumptions, dispersion modeling and exposure modeling printouts should be included. Appendix L provides a sample table of contents and suggested tables and figures.

B. SCREENING HEALTH RISK ASSESSMENT

A screening risk assessment should include the following for review by the district and the OEHHA.

1. Description of facility
2. Identification of the CAPCOA Risk Assessment Guideline version (by date) which was used to prepare the risk assessment.
3. Identification of Air Toxics "Hot Spots" Act substances emitted
4. Individual excess cancer risk for the maximum exposed individual
5. Estimation of maximum potential excess cancer burden
6. Comparison of acute and chronic exposure levels to the OEHHA acceptable exposure levels
7. Appendices

- o All calculations
- o Dispersion modeling printouts

C. DESCRIPTION OF POTENTIAL EMISSION CONTROLS (OPTIONAL)

As an appendix to the risk assessment, districts may request a discussion of potential emission control strategies. This risk management discussion should not be included within the risk assessment. Inclusion of risk management concerns in the presentation of the risk assessment results will be considered inappropriate.

APPENDIX A

AIR TOXICS "HOT SPOTS" INFORMATION AND ASSESSMENT ACT OF 1987

- (1) Notify the agency of its determination.
- (2) Within 45 days of the notification pursuant to paragraph (1), hold a public hearing at which the agency may present information related to expenditure of the revenues from the fees.
- (3) After the public hearing, if the district determines that the agency has expended the revenues from the fees in a manner which is contrary to this chapter or which will not result in the reduction of air pollution from motor vehicles pursuant to the California Clean Air Act of 1988 or the plan prepared pursuant to Article 5 (commencing with Section 40460) of Chapter 5.5 of Part 3, the district shall withhold these revenues from the agency in an amount equal to the amount which was inappropriately expended. Any revenues withheld pursuant to this paragraph shall be redistributed to the other agencies or, upon approval of the district board, to entities specified in the work programs developed by the mobile source advisory committee, to the extent the district determines that they have complied with this chapter.
- (d) Any agency which receives fee revenues pursuant to Section 44243 or 44244 shall expend the funds within one year of the program or project completion date.

(Amended by Stats. 1992, Ch. 427, Sec. 108. Effective January 1, 1993.)

44245. The state board shall report to the Legislature on or before December 31, 1992, on the air pollution reduction programs funded pursuant to this chapter. The report shall include, but not be limited to, an analysis of the use of vehicle registration fees for air pollution programs, the efficacy and results of the programs funded by the fees and any conclusions and recommendations by the state board.

(Added by Stats. 1990, Ch. 1705, Sec. 1.)

44247. Local agencies imposing vehicle registration fees for air pollution programs pursuant to this chapter shall report to the state board on their use of the fees and the results of the programs funded by the fees and shall cooperate with the state board in the preparation of its report. These reports shall be submitted according to a schedule adopted by the state board to ensure compliance with the reporting requirements of Section 44245.

(Added by Stats. 1990, Ch. 1705, Sec. 1.)

PART 6. AIR TOXICS "HOT SPOTS" INFORMATION AND ASSESSMENT

(Part 6 added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384. Note: Sections 44380 and 44384 became operative Jan. 1, 1988.)

CHAPTER 1. LEGISLATIVE FINDINGS AND DEFINITIONS

(Chapter 1 added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44300. This part shall be known and may be cited as the Air Toxics "Hot Spots" Information and Assessment Act of 1987.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44301. The Legislature finds and declares all of the following:

(a) In the wake of recent publicity surrounding planned and unplanned releases of toxic chemicals into the atmosphere, the public has become increasingly concerned about toxics in the air.

(b) The Congressional Research Service of the Library of Congress has concluded that 75 percent of the United States population lives in proximity to at least one facility that manufactures chemicals. An incomplete 1985 survey of large chemical companies conducted by the Congressional Research Service documented that nearly every chemical plant studied routinely releases into the surrounding air significant levels of substances proven to be or potentially hazardous to public health.

(c) Generalized emissions inventories compiled by air pollution control districts and air quality management districts in California confirm the findings of the Congressional Research Service survey as well as reveal that many other facilities and businesses which do not actually manufacture chemicals do use hazardous substances in sufficient quantities to expose, or in a manner that exposes, surrounding populations to toxic air releases.

(d) These releases may create localized concentrations or air toxics "hot spots" where emissions from specific sources may expose individuals and population groups to elevated risks of adverse health effects, including, but not limited to, cancer and contribute to the cumulative health risks of emissions from other sources in the area. In some cases where large populations may not be significantly affected by adverse health risks, individuals may be exposed to significant risks.

(e) Little data is currently available to accurately assess the amounts, types, and health impacts of routine toxic chemical releases into the air. As a result, there exists significant uncertainty about the amounts of potentially hazardous air pollutants which are released, the location of those releases, and the concentrations to which the public is exposed.

(f) The State of California has begun to implement a long-term program to identify, assess, and control ambient levels of hazardous air pollutants, but additional legislation is needed to provide for the collection and evaluation of information concerning the amounts, exposures, and short- and long-term health effects of hazardous substances regularly released to the surrounding atmosphere from specific sources of hazardous releases.

(g) In order to more effectively implement control strategies for those materials posing an unacceptable risk to the public health, additional information on the sources of potentially hazardous air pollutants is necessary.

(h) It is in the public interest to ascertain and measure the amounts and types of hazardous releases and potentially hazardous releases from specific sources that may be exposing people to those releases, and to assess the health risks to those who are exposed.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44302. The definitions set forth in this chapter govern the construction of this part.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44303. "Air release" or "release" means any activity that may cause the issuance of air contaminants, including the actual or potential spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing of a substance into the ambient air and that results from the routine operation of a facility or that is predictable, including, but not limited to, continuous and intermittent releases and predictable process upsets or leaks.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44304. "Facility" means every structure, appurtenance, installation, and improvement on land which is associated with a source of air releases or potential air releases of a hazardous material.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44306. "Health risk assessment" means a detailed comprehensive analysis prepared pursuant to Section 44361 to evaluate and predict the dispersion of hazardous substances in the environment and the potential for exposure of human populations and to assess and quantify both the individual and populationwide health risks associated with those levels of exposure.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44307. "Operator" means the person who owns or operates a facility or part of a facility.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44308. "Plan" means the emissions inventory plan which meets the conditions specified in Section 44342.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44309. "Report" means the emissions inventory report specified in Section 44341.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

CHAPTER 2. FACILITIES SUBJECT TO THIS PART

(Chapter 2 added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44320. This part applies to the following:

(a) Any facility which manufactures, formulates, uses, or releases any of the substances listed pursuant to Section 44321 or any other substance which reacts to form a substance listed in Section 44321 and which releases or has the potential to release total organic gases, particulates, or oxides of nitrogen or sulfur in the amounts specified in Section 44322.

(b) Except as provided in Section 44323, any facility which is listed in any current toxics use or toxics air emission survey, inventory, or report released or compiled by a district. A district may, with the concurrence of the state board, waive the application of this part pursuant to this subdivision for any facility which the district determines will not release

any substance listed pursuant to Section 44321 due to a shutdown or a process change.

(Amended by Stats. 1989, Ch. 1254, Sec. 7.)

References at the time of publication (see page iii):

Regulations: 17, CCR, sections 90700-90703, 90704, 93303, 93306

44321. For the purposes of Section 44320, the state board shall compile and maintain a list of substances that contains, but is not limited to, all of the following:

(a) Substances identified by reference in paragraph (1) of subdivision (b) of Section 6382 of the Labor Code and substances placed on the list prepared by the National Toxicology Program issued by the United States Secretary of Health and Human Services pursuant to paragraph (4) of Section 262 of Public Law 95-622 of 1978. For the purposes of this subdivision, the state board may remove from the list any substance which meets both of the following criteria:

(1) No evidence exists that it has been detected in air.

(2) The substance is not manufactured or used in California, or, if manufactured or used in California, because of the physical or chemical characteristics of the substance or the manner in which it is manufactured or used, there is no possibility that it will become airborne.

(b) Carcinogens and reproductive toxins referenced in or compiled pursuant to Section 25249.8, except those which meet both of the criteria identified in subdivision (a).

(c) The candidate list of potential toxic air contaminants and the list of designated toxic air contaminants prepared by the state board pursuant to Article 2 (commencing with Section 39660) of Chapter 3.5 of Part 2, including, but not limited to, all substances currently under review and scheduled or nominated for review and substances identified and listed for which health effects information is limited.

(d) Substances for which an information or hazard alert has been issued by the repository of current data established pursuant to Section 147.2 of the Labor Code.

(e) Substances reviewed, under review, or scheduled for review as air toxics or potential air toxics by the Office of Air Quality Planning and Standards of the Environmental Protection Agency, including substances evaluated in all of the following categories or their equivalent: preliminary health and source screening, detailed assessment, intent to list, decision not to regulate, listed, standard proposed, and standard promulgated.

(f) Any additional substances recognized by the state board as presenting a chronic or acute threat to public health when present in the ambient air, including, but not limited to, any neurotoxins or chronic respiratory toxins not included within subdivision (a), (b), (c), (d), or (e).

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

References at the time of publication (see page iii):

Regulations: 17, CCR, sections 90700-90702, 93307, 93308, 93334, 93335

44322. This part applies to facilities specified in subdivision (a) of Section 44320 in accordance with the following schedule:

(a) For those facilities that release, or have the potential to release, 25 tons per year or greater of total organic gases, particulates, or oxides of nitrogen or sulfur, this part becomes effective on July 1, 1988.

(b) For those facilities that release, or have the potential to release, more than 10 but less than 25 tons per year of total organic gases, particulates, or oxides of nitrogen or sulfur, this part becomes effective July 1, 1989.

(c) For those facilities that release, or have the potential to release, less than 10 tons per year of total organic gases, particulates, or oxides of nitrogen or sulfur, the state board shall, on or before July 1, 1990, prepare and submit a report to the Legislature identifying the classes of those facilities to be included in this part and specifying a timetable for their inclusion.

(Amended by Stats. 1989, Ch. 1254, Sec. 8.)

References at the time of publication (see page iii):

Regulations: 17, CCR, sections 90702, 90703, 93303-93305, 93308

44323. A district may prepare an industrywide emissions inventory and health risk assessment for facilities specified in subdivision (b) of Section 44320 and subdivisions (a) and (b) of Section 44322, and shall prepare an industrywide emissions inventory for the facilities specified in subdivision (c) of Section 44322, in compliance with this part for any class of facilities that the district finds and determines meets all of the following conditions:

(a) All facilities in the class fall within one four-digit Standard Industrial Classification Code.

(b) Individual compliance with this part would impose severe economic hardships on the majority of the facilities within the class.

(c) The majority of the class is composed of small businesses.

(d) Releases from individual facilities in the class can easily and generically be characterized and calculated.

(Amended by Stats. 1989, Ch. 1254, Sec. 9.)

References at the time of publication (see page iii):

Regulations: 17, CCR, sections 93304, 93306

44324. This part does not apply to any facility where economic poisons are employed in their pesticidal use, unless that facility was subject to district permit requirements on or before August 1, 1987. As used in this section, "pesticidal use" does not include the manufacture or formulation of pesticides.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44325. Any solid waste disposal facility in compliance with Section 41805.5 is in compliance with the emissions inventory requirements of this part.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

CHAPTER 3. AIR TOXICS EMISSION INVENTORIES

(Chapter 3 added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44340. (a) The operator of each facility subject to this part shall prepare and submit to the district a proposed comprehensive emissions inventory plan in accordance with the criteria and guidelines adopted by the state board pursuant to Section 44342.

(b) The proposed plan shall be submitted to the district on or before August 1, 1989, except that, for any facility to which subdivision (b) of Section 44322 applies, the proposed plan shall be submitted to the district on or before August 1, 1990. The district shall approve, modify, and approve as modified, or return for revision and resubmission, the plan within 120 days of receipt.

(c) The district shall not approve a plan unless all of the following conditions are met:

(1) The plan meets the requirements established by the state board pursuant to Section 44342.

(2) The plan is designed to produce, from the list compiled and maintained pursuant to Section 44321, a comprehensive characterization of the full range of hazardous materials that are released, or that may be released, to the surrounding air from the facility. Air release data shall be collected at, or calculated for, the primary locations of actual and potential release for each hazardous material. Data shall be collected or calculated for all continuous, intermittent, and predictable air releases.

(3) The measurement technologies and estimation methods proposed provide state-of-the-art effectiveness and are sufficient to produce a true representation of the types and quantities of air releases from the facility.

(4) Source testing or other measurement techniques are employed wherever necessary to verify emission estimates, as determined by the state board and to the extent technologically feasible. All testing devices shall be appropriately located, as determined by the state board.

(5) Data are collected or calculated for the relevant exposure rate or rates of each hazardous material according to its characteristic toxicity and for the emission rate necessary to ensure a characterization of risk associated with exposure to releases of the hazardous material that meets the requirements of Section 44361. The source of all emissions shall be displayed or described.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

References at the time of publication (see page iii):

Regulations: 17, CCR, sections 93300, 93301, 93303-93307, 93310-93315, 93320, 93321-93324, 93330-93340, 93345-93347

44341. Within 180 days after approval of a plan by the district, the operator shall implement the plan and prepare and submit a report to the district in accordance with the plan. The district shall transmit all monitoring data contained in the approved report to the state board.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

References at the time of publication (see page iii):

Regulations: 17, CCR, sections 93300, 93301, 93303-93306, 93310-93315, 93320-93324, 93330-93340, 93345-93347

44342. The state board shall, on or before May 1, 1989, in consultation with the districts, develop criteria and guidelines for site-specific air toxics emissions inventory plans which shall be designed to comply with the conditions specified in Section 44340 and which shall include at least all of the following:

(a) For each class of facility, a designation of the hazardous materials for which emissions are to be quantified and an identification of the likely source types within that class of facility. The hazardous materials for quantification shall be chosen from among, and may include all or part of, the list specified in Section 44321.

(b) Requirements for a facility diagram identifying each actual or potential discrete emission point and the general locations where fugitive emissions may occur. The facility diagram shall include any nonpermitted and nonprocess sources of emissions and shall provide the necessary data to identify emission characteristics. An existing facility diagram which meets the requirements of this section may be submitted.

(c) Requirements for source testing and measurement. The guidelines may specify appropriate uses of estimation techniques including, but not limited to, emissions factors, modeling, mass balance analysis, and projections, except that source testing shall be required wherever necessary to verify emission estimates to the extent technologically feasible. The guidelines shall specify conditions and locations where source testing, fence-line monitoring, or other measurement techniques are to be required and the frequency of that testing and measurement.

(d) Appropriate testing methods, equipment, and procedures, including quality assurance criteria.

(e) Specifications for acceptable emissions factors, including, but not limited to, those which are acceptable for substantially similar facilities or equipment, and specification of procedures for other estimation techniques and for the appropriate use of available data.

(f) Specification of the reporting period required for each hazardous material for which emissions will be inventoried.

(g) Specifications for the collection of useful data to identify toxic air contaminants pursuant to Article 2 (commencing with Section 39660) of Chapter 3.5 of Part 2.

(h) Standardized format for preparation of reports and presentation of data.

(i) A program to coordinate and eliminate any possible overlap between the requirements of this chapter and the requirements of Section 313 of the Superfund Amendment and Reauthorization Act of 1986 (Public Law 99-499).

The state board shall design the guidelines and criteria to ensure that, in collecting data to be used for emissions inventories, actual measurement is utilized whenever necessary to verify the accuracy of emission estimates, to the extent technologically feasible.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

References at the time of publication (see page iii):

Regulations: 17, CCR, sections 93300, 93301, 93303-93307, 93310-93315, 93320-93324, 93330-93340, 93345-93347

44343. The district shall review the reports submitted pursuant to Section 44341 and shall, within 90 days, review each report, obtain corrections and clarifications of the data, and notify the State Department of Health Services, the Department of Industrial Relations, and the city or county health department of its findings and determinations as a result of its review of the report.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44344. Emissions inventories developed pursuant to this chapter shall be updated biennially, in accordance with procedures established by the state board. These biennial updates shall take into consideration improvements in measurement techniques and advancing knowledge concerning the types and toxicity of hazardous materials released or potentially released.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

References at the time of publication (see page iii):

Regulations: 17, CCR, sections 93307, 93330

44345. (a) On or before July 1, 1989, the state board shall develop a program to compile and make available to other state and local public agencies and the public all data collected pursuant to this chapter.

(b) In addition, the state board, on or before March 1, 1990, shall compile, by district, emissions inventory data for mobile sources and area sources not subject to district permit requirements, and data on natural source emissions, and shall incorporate these data into data compiled and released pursuant to this chapter.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

References at the time of publication (see page iii):

Regulations: 17, CCR, sections 93330, 93345

44346. (a) If an operator believes that any information required in the facility diagram specified pursuant to subdivision (b) of Section 44342 involves the release of a trade secret, the operator shall nevertheless make

the disclosure to the district, and shall notify the district in writing of that belief in the report.

(b) Subject to this section, the district shall protect from disclosure any trade secret designated as such by the operator, if that trade secret is not a public record.

(c) Upon receipt of a request for the release of information to the public which includes information which the operator has notified the district is a trade secret and which is not a public record, the following procedure applies:

(1) The district shall notify the operator of the request in writing by certified mail, return receipt requested.

(2) The district shall release the information to the public, but not earlier than 30 days after the date of mailing the notice of the request for information, unless, prior to the expiration of the 30-day period, the operator obtains an action in an appropriate court for a declaratory judgment that the information is subject to protection under this section or for a preliminary injunction prohibiting disclosure of the information to the public and promptly notifies the district of that action.

(d) This section does not permit an operator to refuse to disclose the information required pursuant to this part to the district.

(e) Any information determined by a court to be a trade secret, and not a public record pursuant to this section, shall not be disclosed to anyone except an officer or employee of the district, the state, or the United States, in connection with the official duties of that officer or employee under any law for the protection of health, or to contractors with the district or the state and its employees if, in the opinion of the district or the state, disclosure is necessary and required for the satisfactory performance of a contract, for performance of work, or to protect the health and safety of the employees of the contractor.

(f) Any officer or employee of the district or former officer or employee who, by virtue of that employment or official position, has possession of, or has access to, any trade secret subject to this section, and who, knowing that disclosure of the information to the general public is prohibited by this section, knowingly and willfully discloses the information in any manner to any person not entitled to receive it is guilty of a misdemeanor. Any contractor of the district and any employee of the contractor, who has been furnished information as authorized by this section, shall be considered an employee of the district for purposes of this section.

(g) Information certified by appropriate officials of the United States as necessary to be kept secret for national defense purposes shall be accorded the full protections against disclosure as specified by those officials or in accordance with the laws of the United States.

(h) As used in this section, "trade secret" and "public record" have the meanings and protections given to them by Section 6254.7 of the Government Code and Section 1060 of the Evidence Code. All information collected pursuant to this chapter, except for data used to calculate

emissions data required in the facility diagram, shall be considered "air pollution emission data," for the purposes of this section.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

References at the time of publication (see page iii):

Regulations: 17, CCR, sections 93321, 93322, 93339

CHAPTER 4. RISK ASSESSMENT

(Chapter 4 added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44360. (a) Within 90 days of completion of the review of all emissions inventory data for facilities specified in subdivision (a) of Section 44322, but not later than December 1, 1990, the district shall, based on examination of the emissions inventory data and in consultation with the state board and the State Department of Health Services, prioritize and then categorize those facilities for the purposes of health risk assessment. The district shall designate high, intermediate, and low priority categories and shall include each facility within the appropriate category based on its individual priority. In establishing priorities pursuant to this section, the district shall consider the potency, toxicity, quantity, and volume of hazardous materials released from the facility, the proximity of the facility to potential receptors, including, but not limited to, hospitals, schools, day care centers, worksites, and residences, and any other factors that the district finds and determines may indicate that the facility may pose a significant risk to receptors. The district shall hold a public hearing prior to the final establishment of priorities and categories pursuant to this section.

(b) (1) Within 150 days of the designation of priorities and categories pursuant to subdivision (a), the operator of every facility that has been included within the highest priority category shall prepare and submit to the district a health risk assessment pursuant to Section 44361. The district may, at its discretion, grant a 30-day extension for submittal of the health risk assessment.

(2) Health risk assessments required by this chapter shall be prepared in accordance with guidelines established by the Office of Environmental Health Hazard Assessment. The office shall prepare draft guidelines which shall be circulated to the public and the regulated community and shall adopt risk assessment guidelines after consulting with the state board and the Risk Assessment Committee of the California Air Pollution Control Officers Association and after conducting at least two public workshops, one in the northern and one in the southern part of the state. The adoption of the guidelines is not subject to Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code. The scientific review panel established pursuant to Section 39670 shall evaluate the guidelines adopted under this paragraph and shall recommend changes and additional criteria to reflect new scientific data or empirical studies.

(3) The guidelines established pursuant to paragraph (2) shall impose only those requirements on facilities subject to this subdivision that are necessary to ensure that a required risk assessment is accurate and complete and shall specify the type of site-specific factors that districts may take into account in determining when a single health risk assessment may be allowed under subdivision (d). The guidelines shall, in addition, allow the operator of a facility, at the operator's option, and to the extent that valid and reliable data are available, to include for consideration by the district in the health risk assessment any or all of the following supplemental information:

(A) Information concerning the scientific basis for selecting risk parameter values that are different than those required by the guidelines and the likelihood distributions that result when alternative values are used.

(B) Data from dispersion models, microenvironment characteristics, and population distributions that may be used to estimate maximum actual exposure.

(C) Risk expressions that show the likelihood that any given risk estimate is the correct risk value.

(D) A description of the incremental reductions in risk that occur when exposure is reduced.

(4) To ensure consistency in the use of the supplemental information authorized by subparagraphs (A), (B), (C), and (D) of paragraph (3), the guidelines established pursuant to paragraph (2) shall include guidance for use by the districts in considering the supplemental information when it is included in the health risk assessment.

(c) Upon submission of emissions inventory data for facilities specified in subdivisions (b) and (c) of Section 44322, the district shall designate facilities for inclusion within the highest priority category, as appropriate, and any facility so designated shall be subject to subdivision (b). In addition, the district may require the operator of any facility to prepare and submit health risk assessments, in accordance with the priorities developed pursuant to subdivision (a).

(d) The district shall, except where site specific factors may affect the results, allow the use of a single health risk assessment for two or more substantially identical facilities operated by the same person.

(e) Nothing contained in this section, Section 44380.5, or Chapter 6 (commencing with Section 44390) shall be interpreted as requiring a facility operator to prepare a new or revised health risk assessment using the guidelines established pursuant to paragraph (2) of subdivision (a) of this section if the facility operator is required by the district to begin the preparation of a health risk assessment before those guidelines are established.

(Amended by Stats. 1992, Ch. 1162, Sec. 1. Effective January 1, 1993.)

44361. (a) Each health risk assessment shall be submitted to the district. The district shall make the health risk assessment available for public review, upon request. After preliminary review of the emissions

impact and modeling data, the district shall submit the health risk assessment to the State Department of Health Services for review and, within 180 days of receiving the health risk assessment, the State Department of Health Services shall submit to the district its comments on the data and findings relating to health effects. The district shall consult with the state board as necessary to adequately evaluate the emissions impact and modeling data contained within the risk assessment.

(b) For the purposes of complying with this section, the State Department of Health Services may select a qualified independent contractor to review the data and findings relating to health effects. The State Department of Health Services shall not select an independent contractor to review a specific health risk assessment who may have a conflict of interest with regard to the review of that health risk assessment. Any review by an independent contractor shall comply with the following requirements:

(1) Be performed in a manner consistent with guidelines provided by the State Department of Health Services.

(2) Be reviewed by the State Department of Health Services for accuracy and completeness.

(3) Be submitted by the State Department of Health Services to the district in accordance with this section.

(c) The district shall reimburse the State Department of Health Services or the qualified independent contractor designated by the State Department of Health Services pursuant to subdivision (b), within 45 days of its request, for its actual costs incurred in reviewing a health risk assessment pursuant to this section.

(d) If a district requests the State Department of Health Services to consult with the district concerning any requirement of this part, the district shall reimburse the State Department of Health Services, within 45 days of its request, for the costs incurred in the consultation.

(e) Upon designation of the high priority facilities, as specified in subdivision (a) of Section 44360, the State Department of Health Services shall evaluate the staffing requirements of this section and may submit recommendations to the Legislature, as appropriate, concerning the maximum number of health risk assessments to be reviewed each year pursuant to this section.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44362. (a) Taking the comments of the State Department of Health Services into account, the district shall approve or return for revision and resubmission and then approve, the health risk assessment within 180 days of receipt. If the health risk assessment has not been revised and resubmitted within 60 days of the district's request of the operator to do so, the district may modify the health risk assessment and approve it as modified.

(b) Upon approval of the health risk assessment, the operator of the facility shall provide notice to all exposed persons regarding the results of the health risk assessment prepared pursuant to Section 44361 if, in the

judgment of the district, the health risk assessment indicates there is a significant health risk associated with emissions from the facility. If notice is required under this subdivision, the notice shall include only information concerning significant health risks attributable to the specific facility for which the notice is required. Any notice shall be made in accordance with procedures specified by the district.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44363. (a) Commencing July 1, 1991, each district shall prepare and publish an annual report which does all of the following:

(1) Describes the priorities and categories designated pursuant to Section 44360 and summarizes the results and progress of the health risk assessment program undertaken pursuant to this part.

(2) Ranks and identifies facilities according to the degree of cancer risk posed both to individuals and to the exposed population.

(3) Identifies facilities which expose individuals or populations to any noncancer health risks.

(4) Describes the status of the development of control measures to reduce emissions of toxic air contaminants, if any.

(b) The district shall disseminate the annual report to county boards of supervisors, city councils, and local health officers and the district board shall hold one or more public hearings to present the report and discuss its content and significance.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44364. The state board shall utilize the reports and assessments developed pursuant to this part for the purposes of identifying, establishing priorities for, and controlling toxic air contaminants pursuant to Chapter 3.5 (commencing with Section 39650) of Part 2.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44365. (a) If the state board finds and determines that a district's actions pursuant to this part do not meet the requirements of this part, the state board may exercise the authority of the district pursuant to this part to approve emissions inventory plans and require the preparation of health risk assessments.

(b) This part does not prevent any district from establishing more stringent criteria and requirements than are specified in this part for approval of emissions inventories and requiring the preparation and submission of health risk assessments. Nothing in this part limits the authority of a district under any other provision of law to assess and regulate releases of hazardous substances.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44366. (a) In order to verify the accuracy of any information submitted by facilities pursuant to this part, a district or the state board may proceed in accordance with Section 41510.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

CHAPTER 5. FEES AND REGULATIONS

(Chapter 5 added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44380. (a) The state board shall adopt a regulation which does all of the following:

(1) Sets forth the amount of revenue which the district must collect to recover the reasonable anticipated cost which will be incurred by the state board and the Office of Environmental Health Hazard Assessment to implement and administer this part.

(2) Requires each district to adopt a fee schedule which recovers the costs of the district and which assesses a fee upon the operator of every facility subject to this part. A district may request the state board to adopt a fee schedule for the district if the district's program costs are approved by the district board and transmitted to the state board by April 1 of the year in which the request is made.

(3) Requires any district that has an approved toxics emissions inventory compiled pursuant to this part by August 1 of the preceding year to adopt a fee schedule, as described in paragraph (2), which imposes on facility operators fees which are, to the maximum extent practicable, proportionate to the extent of the releases identified in the toxics emissions inventory and the level of priority assigned to that source by the district pursuant to Section 44360.

(b) Commencing August 1, 1992, and annually thereafter, the state board shall review and may amend the fee regulation.

(c) The district shall notify each person who is subject to the fee of the obligation to pay the fee. If a person fails to pay the fee within 60 days after receipt of this notice, the district, unless otherwise provided by district rules, shall require the person to pay an additional administrative civil penalty. The district shall fix the penalty at not more than 100 percent of the assessed fee, but in an amount sufficient in its determination, to pay the district's additional expenses incurred by the person's noncompliance. If a person fails to pay the fee within 120 days after receipt of this notice, the district may initiate permit revocation proceedings. If any permit is revoked, it shall be reinstated only upon full payment of the overdue fee plus any late penalty, and a reinstatement fee to cover administrative costs of reinstating the permit.

(d) Each district shall collect the fees assessed pursuant to subdivision (a). After deducting the costs to the district to implement and administer this part, the district shall transmit the remainder to the Controller for deposit in the Air Toxics Inventory and Assessment Account, which is hereby created in the General Fund. The money in the account is available, upon appropriation by the Legislature, to the state board and the Office of Environmental Health Hazard Assessment for the purposes of administering this part.

(Amended by Stats. 1992, Ch. 373, Sec. 1. Effective January 1, 1993.)

44380.5. In addition to the fee assessed pursuant to Section 44380, a supplemental fee may be assessed by the district, the state board, or the

Office of Environmental Health Hazard Assessment upon the operator of a facility that, at the operator's option, includes supplemental information authorized by paragraph (3) of subdivision (b) of Section 44360 in a health risk assessment, if the review of that supplemental information substantially increases the costs of reviewing the health risk assessment by the district, the state board, or the office. The supplemental fee shall be set by the state board in the regulation required by subdivision (a) of Section 44380 and shall be set in an amount sufficient to cover the direct costs to review the information supplied by an operator pursuant to paragraph (3) of subdivision (b) of Section 44360.

(Added by Stats. 1992, Ch. 1162, Sec. 2. Effective January 1, 1993.)

44381. (a) Any person who fails to submit any information, reports, or statements required by this part, or who fails to comply with this part or with any permit, rule, regulation, or requirement issued or adopted pursuant to this part, is subject to a civil penalty of not less than five hundred dollars (\$500) or more than ten thousand dollars (\$10,000) for each day that the information, report, or statement is not submitted, or that the violation continues.

(b) Any person who knowingly submits any false statement or representation in any application, report, statement, or other document filed, maintained, or used for the purposes of compliance with this part is subject to a civil penalty of not less than one thousand dollars (\$1,000) or more than twenty-five thousand dollars (\$25,000) per day for each day that the information remains uncorrected.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44382. Every district shall, by regulation, adopt the requirements of this part as a condition of every permit issued pursuant to Chapter 4 (commencing with Section 42300) of Part 4 for all new and modified facilities.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative July 1, 1988, pursuant to Section 44384.)

44384. Except for Section 44380 and this section, all provisions of this part shall become operative on July 1, 1988.

(Added by Stats. 1987, Ch. 1252, Sec. 1. Operative January 1, 1988, by its own provisions.)

CHAPTER 6. FACILITY TOXIC AIR CONTAMINANT RISK REDUCTION AUDIT AND PLAN

(Chapter 6 added by Stats. 1992, Ch. 1162, Sec. 3. Effective January 1, 1993.)

44390. For purposes of this chapter, the following definitions apply:

(a) "Airborne toxic risk reduction measure" or "ATRRM" means those in-plant changes in production processes or feedstocks that reduce or eliminate toxic air emissions subject to this part. ATRRM's may include:

- (1) Feedstock modification.
- (2) Product reformulations.
- (3) Production system modifications.
- (4) System enclosure, emissions control, capture, or conversion.
- (5) Operational standards and practices modification.

(b) Airborne toxic risk reduction measures do not include measures that will increase risk from exposure to the chemical in another media or that increase the risk to workers or consumers.

(c) "Airborne toxic risk reduction audit and plan" or "audit and plan" means the audit and plan specified in Section 44392.

(Added by Stats. 1992, Ch. 1162, Sec. 3. Effective January 1, 1993.)

44391. (a) Whenever a health risk assessment approved pursuant to Chapter 4 (commencing with Section 44360) indicates, in the judgment of the district, that there is a significant risk associated with the emissions from a facility, the facility operator shall conduct an airborne toxic risk reduction audit and develop a plan to implement airborne toxic risk reduction measures that will result in the reduction of emissions from the facility to a level below the significant risk level within five years of the date the plan is submitted to the district. The facility operator shall implement measures set forth in the plan in accordance with this chapter.

(b) The period to implement the plan required by subdivision (a) may be shortened by the district if it finds that it is technically feasible and economically practicable to implement the plan to reduce emissions below the significant risk level more quickly or if it finds that the emissions from the facility pose an unreasonable health risk.

(c) A district may lengthen the period to implement the plan required by subdivision (a) by up to an additional five years if it finds that a period longer than five years will not result in an unreasonable risk to public health and that requiring implementation of the plan within five years places an unreasonable economic burden on the facility operator or is not technically feasible.

(d) (1) The state board and districts shall provide assistance to smaller businesses that have inadequate technical and financial resources for obtaining information, assessing risk reduction methods, and developing and applying risk reduction techniques.

(2) Risk reduction audits and plans for any industry subject to this chapter which is comprised mainly of small businesses using substantially similar technology may be completed by a self-conducted audit and checklist developed by the state board. The state board, in coordination with the districts shall provide a copy of the audit and checklist to small businesses within those industries to assist them to meet the requirements of this chapter.

(e) The audit and plan shall contain all the information required by Section 44392.

(f) The plan shall be submitted to the district, within six months of a district's determination of significant risk, for review of completeness. Operators of facilities that have been notified prior to January 1, 1993, that there is a significant risk associated with emissions from the facility shall submit the plan by July 1, 1993. The district's review of completeness shall include a substantive analysis of the emission reduction measures included in the plan, and the ability of those measures to achieve emission reduction goals as quickly as feasible as provided in subdivisions (a) and (b).

(g) The district shall find the audit and plan to be satisfactory within three months if it meets the requirements of this chapter, including, but not limited to, the requirements of subdivision (f). If the district determines the audit and plan does not meet those requirements, the district shall remand the audit and plan to the facility specifying the deficiencies identified by the district. A facility operator shall submit a revised audit and plan addressing the deficiencies identified by the district within 90 days of receipt of a deficiency notice.

(h) Progress on the emission reductions achieved by the plan shall be reported to the district in the biennial updates of emission inventories required pursuant to Section 44344.

(i) If new information becomes available after the initial risk reduction audit and plan, on air toxics risks posed by a facility, or emission reduction technologies that may be used by a facility that would significantly impact risks to exposed persons, the district may require the plan to be updated and resubmitted to the district.

(j) This section does not authorize the emission of a toxic air contaminant in violation of an airborne toxic control measure adopted pursuant to Chapter 3.5 (commencing with Section 39650) or in violation of Section 41700.

(Added by Stats. 1992, Ch. 1162, Sec. 3. Effective January 1, 1993.)

44392. A facility operator subject to this chapter shall conduct an airborne toxic risk reduction audit and develop a plan which shall include at a minimum all of the following:

- (a) The name and location of the facility.
- (b) The SIC code for the facility.
- (c) The chemical name and the generic classification of the chemical.
- (d) An evaluation of the ATRRM's available to the operator.
- (e) The specification of, and rationale for, the ATRRMs that will be implemented by the operator. The audit and plan shall document the rationale for rejecting ATRRMs that are identified as infeasible or too costly.

(f) A schedule for implementing the ATRRMs. The schedule shall meet the time requirements of subdivision (a) of Section 44391 or the time period for implementing the plan set by the district pursuant to subdivision (b) or (c) of Section 44391, whichever is applicable.

(g) The audit and plan shall be reviewed and certified as meeting this chapter by an engineer who is registered as a professional engineer pursuant to Section 6762 of the Business and Professions Code, by an individual who is responsible for the processes and operations of the site, or by an environmental assessor registered pursuant to Section 25570.3.

(Added by Stats. 1992, Ch. 1162, Sec. 3. Effective January 1, 1993.)

44393. The plan prepared pursuant to Section 44391 shall not be considered to be the equivalent of a pollution prevention program or a source reduction program, except insofar as the audit and plan elements

are consistent with source reduction, as defined in Section 25244.14, or subsequent statutory definitions of pollution prevention.

(Added by Stats. 1992, Ch. 1162, Sec. 3. Effective January 1, 1993.)

44394. Any facility operator who does not submit a complete airborne toxic risk reduction audit and plan or fails to implement the measures set forth in the plan as set forth in this chapter is subject to the civil penalty specified in subdivision (a) of Section 44381, and any facility operator who, in connection with the audit or plan, knowingly submits any false statement or representation is subject to the civil penalty specified in subdivision (b) of Section 44381.

(Added by Stats. 1992, Ch. 1162, Sec. 3. Effective January 1, 1993.)

PART 9. HALOGENATED REFRIGERANTS

(Part 9 added by Stats. 1991, Ch. 874, Sec. 1.)

44470. (a) The Legislature finds and declares the following:

(1) For the first time in human history, the use and disposal of certain manmade products are actively destroying a layer of the earth's atmosphere without which human life cannot continue to exist.

(2) These products, known as chlorofluorocarbons and halons, have already begun to deplete the ozone layer which protects human and other life forms from cancer-causing ultraviolet radiation. Above California, the ozone shield has been depleted about 3 percent over the last 20 years.

(3) On January 1, 1989, a 24-nation agreement (the Montreal Protocol) became effective, calling for the reduction in use of most CFCs and halons, and the Environmental Protection Agency has issued regulations designed to freeze production of these products at current levels.

(4) The Montreal Protocol was amended in 1990 calling for a reduction of CFC manufacturing to 50 percent of 1986 levels by 1995, further reduction to 15 percent of 1986 levels by 1997, and complete elimination by the year 2000. Due to the severity of the ozone depletion problem, however, this phaseout schedule is to be reviewed in 1992 with the objective of accelerating it still further.

(5) It is essential to the health and safety of all Californians to take such steps as are necessary to further decrease and halt the destruction of the ozone layer by CFCs and halons.

(b) The Legislature further finds and declares the following:

(1) CFCs and halons contribute actively to global warming trends which could dramatically affect the economy and stability of California, including the flooding of coastal lands, loss of crop winters, and destruction of coastal wetlands and forests.

(2) Twenty-five percent of the total amount of CFCs produced every year in the United States are needlessly released into the atmosphere through mobile air-conditioning servicing, maintenance, and leaking.

(3) CFC-12 accounts for 46 percent of California's contribution to ozone depletion from CFCs. Emissions from mobile air-conditioners are estimated to account for 27 percent of all of California's CFC-12 emissions.

APPENDIX B

SUBSTANCES FOR EMISSION QUANTIFICATION AND SUBSTANCES
FOR WHICH PRODUCTION, USE OR OTHER PRESENCE MUST BE REPORTED

APPENDIX B-I

SUBSTANCES FOR WHICH EMISSIONS MUST BE QUANTIFIED

APPENDIX B-II

SUBSTANCES FOR WHICH PRODUCTION, USE, OR OTHER
PRESENCE MUST BE REPORTED

Substances For Which Emissions Must Be Quantified

Chemical Abstract (CAS) Number	Add Date ^a	Substance Name
75070		Acetaldehyde
60355		Acetamide
67641	06/91	Acetone
75058	06/91	Acetonitrile
98862	06/91	Acetophenone
53963		2-Acetylaminofluorene [PAH-Derivative, POM]
107028		Acrolein
79061		Acrylamide
79107	06/91	Acrylic acid
107131		Acrylonitrile
107051		Allyl chloride
7429905	06/91	Aluminum
1344281	06/91	Aluminum oxide (fibrous forms)
117793		2-Aminoanthraquinone [PAH-Derivative, POM]
92571		4-Aminobiphenyl [POM]
61825		Amitrole
7664417		Ammonia
6484522	06/91	Ammonium nitrate
7783202	06/91	Ammonium sulfate
62533	09/90	Aniline
90040		o-Anisidine
-		Anthracene [PAH, POM]; (see PAH)
7440360	06/91	Antimony
*	06/91	Antimony compounds **
		including but not limited to:
1327339	09/90	Antimony trioxide
7440382		Arsenic
*	06/91	Arsenic compounds (other than inorganic) **
*		Arsenic compounds (inorganic) **
		including but not limited to:
7784421		Arsine
7440393	06/91	Barium
*	06/91	Barium compounds **
-		Benz[a]anthracene [PAH, POM], (see PAH)
71432		Benzene
92875		Benzidine (and its salts) [POM]
*		Benzidine-based dyes [POM]
		including but not limited to:
1937377		Direct Black 38 [PAH-Derivative, POM]
2602462		Direct Blue 6 [PAH-Derivative, POM]
16071866	09/89	Direct Brown 95 (technical grade) [POM]

a - All listed substances except those with a (06/91) add date are required to be addressed in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

Appendix E-I
Substances For Which Emissions Must Be Quantified

Chemical Abstract (CAS) Number	Add Date ^a	Substance Name
-		Benzo[a]pyrene [PAH, POM], (see PAH)
-		Benzo[b]fluoranthene [PAH, POM], (see PAH) 271896
98077	06/91	Benzo[fluoranthene
-		Benzoic trichloride [Benzotrichloride]
-		Benzo[j]fluoranthene [PAH, POM], (see PAH)
99384	06/91	Benzo[k]fluoranthene [PAH, POM], (see PAH)
94360	06/91	Benzoyl chloride
100447		Benzoyl peroxide
7440417		Benzyl chloride
*		Beryllium
92524	09/89	Beryllium compounds **
111444	06/91	Biphenyl [POM]
542881	09/89	Bis(2-chloroethyl) ether [DCEE]
103231		Bis(chloromethyl) ether
7726956	06/91	Bis(2-ethylhexyl) adipate
*		Bromine
		Bromine compounds (inorganic) **
		including but not limited to:
7758012		Potassium bromate
75252	06/91	Bromoform
106990		1,3-Butadiene
141322	06/91	Butyl acrylate
71363	06/91	n-Butyl alcohol
78922	06/91	sec-Butyl alcohol
75650	06/91	tert-Butyl alcohol
85687	06/91	Butyl benzyl phthalate
7440439		Cadmium
*		Cadmium compounds **
156627	06/91	Calcium cyanamide
105602	06/91	Caprolactam
2425061	09/89	Captafol
133062	09/90	Captan
63252	06/91	Carbaryl [PAH-Derivative, POM]
*		Carbon black extracts
75150	09/89	Carbon disulfide
56235		Carbon tetrachloride
463581	06/91	Carbonyl sulfide
*		Carrageenan (degraded)
120809	06/91	Catechol
133904	06/91	Chloramben
55757		Chloramphenicol

a - All listed substances except those with a (06/91) add date are required to be addressed in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

Appendix B-1
Substances For Which Emissions Must Be Quantified

Chemical Abstract (CAS) Number	Add Date ^a	Substance Name
57749	09/89	Chlordane
108171262	09/89	Chlorinated paraffins (average chain length, C12; approximately 60% chlorine by weight)
7782505		Chlorine
10049044	06/91	Chlorine dioxide
79118	06/91	Chloroacetic acid
532274	06/91	2-Chloroacetophenone
*	06/91	Chlorobenzenes
		including but not limited to:
108907		Chlorobenzene
25321226	06/91	Dichlorobenzenes (mixed isomers)
		including:
95501	06/91	1,2-Dichlorobenzene
541731	06/91	1,3-Dichlorobenzene
106467		p-Dichlorobenzene {1,4-Dichlorobenzene}
120821	06/91	1,2,4-Trichlorobenzene
510156	09/90	Chlorobenzilate [POM]
		{Ethyl-4,4'-dichlorobenzilate}
13909096		1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea {Methyl CCNU}
67663		Chloroform
107302		Chloromethyl methyl ether (technical grade)
*		Chlorophenols
		including but not limited to:
120832	06/91	2,4-Dichlorophenol
87865	09/90	Pentachlorophenol
95954	06/91	2,4,5-Trichlorophenol
88062		2,4,6-Trichlorophenol
76062		Chloropicrin
125998		Chloroprene
95830		4-Chloro-o-phenylenediamine
95692		p-Chloro-o-toluidene
7440473	06/91	Chromium
*	06/91	Chromium compounds (other than hexavalent) **
18540299		Chromium, hexavalent (and compounds) **
		including but not limited to:
10294403	06/91	Barium chromate
13765190	06/91	Calcium chromate
1333820	06/91	Chromium trioxide
7758976	06/91	Lead chromate

a - All listed substances except those with a (06/91) add date are required to be addressed in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

Appendix B-1
Substances For Which Emissions Must Be Quantified

Chemical Abstract (CAS) Number	Add Date ^a	Substance Name
10588019	06/91	Sodium dichromate
7789062	06/91	Strontium chromate
-		Chrysene [PAH, POM], (see PAH)
7440484	06/91	Cobalt
*	06/91	Cobalt compounds **
*		Coke oven emissions
7440508		Copper
*	09/89	Copper compounds **
*		Creosotes
120718		p-Cresidine
1319773		Cresols (mixtures of) [Cresylic acid]
		including:
108394	06/91	m-Cresol
95487	06/91	o-Cresol
106445	06/91	p-Cresol
98828	06/91	Cumene
80159	06/91	Cumene hydroperoxide
135206		Cupferron
*	06/91	Cyanide compounds **
		including but not limited to:
74908		Hydrocyanic acid
110827	06/91	Cyclohexane
66819		Cycloheximide
1163195	06/91	Decabromodiphenyl oxide [POM]
*		Dialkylnitrosamines
		including but not limited to:
1116547		N-Nitrosodiethanolamine
53185		N-Nitrosodiethylamine
62759		N-Nitrosodimethylamine
924163		N-Nitrosodi-n-butylamine
1621647		N-Nitrosodi-n-propylamine
10595956		N-Nitrosomethylethylamine
615054		2,4-Diaminoanisole
*	09/90	Diaminotoluenes (mixed isomers)
		including but not limited to:
95807		2,4-Diaminotoluene [2,4-Toluenediamine]
334883	06/91	Diazomethane
225368		Dibenz[a,h]acridine [POM]
224420		Dibenz[a,j]acridine [POM]
-		Dibenz[a,h]anthracene [PAH, POM], (see PAH)
194592		7H-Dibenzo[c,g]carbazole [POM]

a - All listed substances except those with a (06/91) add date are required to be addressed in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

Chemical
Abstract

(CAS) Number	Add Date ^a	Substance Name
132649	06/91	Dibenzofuran [POM]
-		Dibenzofurans (chlorinated) (see Polychlorinated dibenzofurans) [POM]
-		Dibenzo[a,e]pyrene [PAH, POM], (see PAH)
-		Dibenzo[a,h]pyrene [PAH, POM], (see PAH)
-		Dibenzo[a,i]pyrene [PAH, POM], (see PAH)
-		Dibenzo[a,l]pyrene [PAH, POM], (see PAH)
96128		1,2-Dibromo-3-chloropropane [DBCP]
84742	06/91	Dibutyl phthalate
-		p-Dichlorobenzene [1,4-Dichlorobenzene] (see Chlorobenzenes)
91941		3,3'-Dichlorobenzidine [POM]
72559	09/89	Dichlorodipenyldichloroethylene [DDE] [POM]
75343	09/90	1,1-Dichloroethane [Ethylidene dichloride]
54757	06/91	Dichlorophenoxyacetic acid, salts and esters [2,4-D]
78875	09/90	1,2-Dichloropropane [Propylene dichloride]
542756		1,3-Dichloropropene
62737	09/89	Dichlorovos [DOVP]
115322	06/91	Dicofol [POM]
*	09/90	Diesel engine exhaust
*	06/91	Diesel fuel (marine)
111422	06/91	Diethanolamine
117817		Di(2-ethylhexyl) phthalate [DEHP]
64675		Diethyl sulfate
119904		3,3'-Dimethoxybenzidine [POM]
60117		4-Dimethylaminoazobenzene [POM]
121697	06/91	N,N-Dimethylaniline
57976	09/90	7,12-Dimethylbenz[a]anthracene [PAH- Derivative, POM]
119937		3,3'-Dimethylbenzidine [o-Tolidine] [POM]
79447		Dimethyl carbamoyl chloride
68122	09/90	Dimethyl formamide
57147		1,1-Dimethylhydrazine
131113	06/91	Dimethyl phthalate
77781		Dimethyl sulfate
534521	06/91	4,6-Dinitro-o-cresol and salts
51285	06/91	2,4-Dinitrophenol
42397648	06/91	1,6-Dinitropyrene [PAH-Derivative, POM]
42397659	06/91	1,8-Dinitropyrene [PAH-Derivative, POM]
25321146	06/91	Dinitrotoluenes (mixed isomers)

a - All listed substances except those with a (06/91) add date are required to be addressed in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

Substances For Which Emissions Must Be Quantified

Chemical Abstract (CAS) Number	Add Date ^a	Substance Name
121142	09/89	including but not limited to:
606202	06/91	2,4-Dinitrotoluene
123911		2,6-Dinitrotoluene
-		1,4-Dioxane
		Dioxins (Chlorinated dibenzodioxins)
		(see Polychlorinated dibenzo-p-dioxins) [POM]
630933		Diphenylhydantoin [POM]
122667		1,2-Diphenylhydrazine [Hydrazobenzene] [POM]
*		Environmental tobacco smoke
106898		Epichlorohydrin
106887	06/91	1,2-Epoxybutane
*	09/89	Epoxy resins
140885		Ethyl acrylate
100414	06/91	Ethyl benzene
75003		Ethyl chloride [Chloroethane]
-		Ethyl-4,4'-dichlorobenzilate
		(see Chlorobenzilate)
74851	06/91	Ethylene
106934		Ethylene dibromide
		{1,2-Dibromoethane}
107062		Ethylene dichloride
		{1,2-Dichloroethane}
107211	06/91	Ethylene glycol
151564	06/91	Ethyleneimine [Aziridine]
75218		Ethylene oxide
96457		Ethylene thiourea
*	09/89	Fluorides and compounds
		including but not limited to:
7664393		Hydrogen fluoride
*		Fluorocarbons (brominated)
*		Fluorocarbons (chlorinated)
		including but not limited to:
76131		Chlorinated fluorocarbon [CFC 113]
50000		Formaldehyde
*	09/90	Gasoline engine exhaust
		including but not limited to:
*	06/91	Gasoline engine exhaust
		(condensates and extracts)
		Gasoline vapors
111308		Glutaraldehyde
*		Glycol ethers and their acetates

a - All listed substances except those with a (06/91) add date are required to be addressed in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

Chemical Abstract (CAS) Number	Add Date ^a	Substance Name
		including but not limited to:
111466	09/90	Diethylene glycol
111966	09/90	Diethylene glycol dimethyl ether
112345	09/90	Diethylene glycol monobutyl ether
111900	09/90	Diethylene glycol monoethyl ether
111773	09/90	Diethylene glycol monomethyl ether
25265718	09/90	Dipropylene glycol
34590948	09/90	Dipropylene glycol monomethyl ether
629141	09/90	Ethylene glycol diethyl ether
-110714	09/90	Ethylene glycol dimethyl ether
111762	09/90	Ethylene glycol monobutyl ether
110805	09/89	Ethylene glycol monoethyl ether
111159	09/90	Ethylene glycol monoethyl ether acetate
109864	09/89	Ethylene glycol monomethyl ether
110496	09/90	Ethylene glycol monomethyl ether acetate
2807309	09/90	Ethylene glycol monopropyl ether
107982	09/90	Propylene glycol monomethyl ether
108655	09/90	Propylene glycol monomethyl ether acetate
112492	09/90	Triethylene glycol dimethyl ether
126078		Griseofulvin
76448	09/89	Heptachlor
87683	06/91	Hexachlorbutadiene
118741		Hexachlorobenzene
*		Hexachlorocyclohexanes
		including but not limited to:
58899	09/90	Lindane
77474		Hexachlorocyclopentadiene
67721	09/90	Hexachloroethane
680319		Hexamethylphosphoramide
110543	06/91	Hexane
302012		Hydrazine
7647010		Hydrochloric acid
-		Hydrocyanic acid (see Cyanide compounds **)
7783064		Hydrogen sulfide
123319	06/91	Hydroquinone
-		Indeno[1,2,3,-cd]pyrene [PAH, POM] (see PAH)
*		Isocyanates
		including but not limited to:
822060	06/91	Hexamethylene-1,6-diisocyanate
101688	06/91	Methylene diphenyl diisocyanate [MDI] [POM]
624839		Methyl isocyanate

a - All listed substances except those with a (06/91) add date are required to be addressed in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

Substances For Which Emissions Must Be Quantified

Chemical Abstract (CAS) Number	Add Date ^a	Substance Name
-		Toluene-2,4-diisocyanate (see Toluene diisocyanates)
-		Toluene-2,6-diisocyanate (see Toluene diisocyanates)
78591	06/91	Isophorone
67630	06/91	Isopropyl alcohol
80057	06/91	4,4'-Isopropylidenediphenol [POM]
7439921		Lead
*		Lead compounds (inorganic) ** including but not limited to:
7446277		Lead phosphate
*	06/91	Lead compounds (other than inorganic) ** including but not limited to:
301042		Lead acetate
1335326	09/90	Lead subacetate
108316		Maleic anhydride
7439965		Manganese
*	09/89	Manganese compounds **
7439976		Mercury
*	09/89	Mercury compounds ** including but not limited to:
7487947		Mercuric chloride
593748		Methyl mercury {Dimethylmercury}
67561		Methanol
72435	06/91	Methoxychlor [POM]
75558		2-Methylaziridine {1,2-Propyleneimine}
74839		Methyl bromide {Bromomethane}
74873	06/91	Methyl chloride {Chloromethane}
71556		Methyl chloroform {1,1,1-Trichloroethane}
56495	09/90	3-Methylcholanthrene [PAH-Derivative, POM]
3697243		5-Methylchrysene [PAH-Derivative, POM]
101144		4,4'-Methylene bis(2-chloroaniline) [MOCA] [POM]
75092		Methylene chloride {Dichloromethane}
101779		4,4'-Methylenedianiline (and its dichloride) [POM]
78933	06/91	Methyl ethyl ketone {2-Butanone}
60344	06/91	Methyl hydrazine
74884		Methyl iodide {Iodomethane}
108101	06/91	Methyl isobutyl ketone {Hexone}

^a - All listed substances except those with a (06/91) add date are required to be addressed in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

Chemical Abstract

(CAS) Number	Add Date ^a	Substance Name
80626		Methyl methacrylate
1634044	06/91	Methyl tert-butyl ether
443481		Metronidazole
90948		Michler's ketone [POM]
*	06/91	Mineral fibers (fine) (fine mineral fibers which are manmade and are airborne particles of a respirable size greater than 5 microns in length, less than or equal to 3.5 microns in diameter, with a length to diameter ratio of 3:1) including but not limited to:
*	09/89	Ceramic fibers
*	09/89	Glasswool fibers
*	09/89	Rockwool fibers
*	09/89	Slagwool fibers
		Mineral fibers (other than manmade) including but not limited to:
1332214		Asbestos
12510428		Erionite
*		Talc containing asbestiform fibers
1313275	06/91	Molybdenum trioxide
-		Naphthalene [PAH, POM] (see PAH)
7440020		Nickel
*		Nickel compounds ** including but not limited to:
373024	06/91	Nickel acetate
3333393	06/91	Nickel carbonate
13463393		Nickel carbonyl
12054487	06/91	Nickel hydroxide
1271289	06/91	Nickelocene
1313991	06/91	Nickel oxide
12035722		Nickel subsulfide
*	09/89	Nickel refinery dust from the pyrometallurgical process
61574		Nitridazole
7637372	06/91	Nitric acid
139139		Nitrilotriacetic acid
98953		Nitrobenzene
92933	09/89	4-Nitrobiphenyl [POM]
7496028	06/91	6-Nitrochrysene [PAH-Derivative, POM]
607578	06/91	2-Nitrofluorene [PAH-Derivative, POM]

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Substances For Which Emissions Must Be Quantified

Chemical Abstract (CAS) Number	Add Date ^a	Substance Name
302705		Nitrogen mustard N-oxide
100027	06/91	4-Nitrophenol
79469		2-Nitropropane
5522430	06/91	1-Nitropyrene [PAH-Derivative, POM]
156105		p-Nitrosodiphenylamine [POM]
59892		N-Nitrosomorpholine
684935		N-Nitroso-N-methylurea
100754		N-Nitrosopiperidine
930552		N-Nitrosopyrrolidine
*		#PAHs (Polycyclic aromatic hydrocarbons) [POM]
		including but not limited to:
120127	06/91	Anthracene
56553		Benz[a]anthracene
50328		Benzo[a]pyrene
205992		Benzo[b]fluoranthene
205823		Benzo[j]fluoranthene
207089		Benzo[k]fluoranthene
218019	09/90	Chrysene
53703		Dibenz[a,h]anthracene
192554		Dibenzo[a,e]pyrene
189640		Dibenzo[a,h]pyrene
189559		Dibenzo[a,i]pyrene
191300		Dibenzo[a,l]pyrene
193395		Indeno[1,2,3,-cd]pyrene
91203		Naphthalene

(+) Dibenz[a,h]acridine, Dibenz[a,j]acridine, 7H-Dibenzo[c,g]carbazole, 7,12-Dimethylbenz[a]anthracene, 3-Methylcholanthrene, and 5-Methylchrysene are now alphabetized on the list.

PAH: (Polycyclic Aromatic Hydrocarbon) - An organic compound consisting of a fused ring structure containing at least two (2) benzene rings, and which may also contain additional fused rings not restricted exclusively to hexagonal rings. The structure does not include any heteroatoms or substituent groups. The structure includes only carbon and hydrogen. PAHs are a subgroup of POM and have a boiling point of greater than or equal to 100° C.

a - All listed substances except those with a (06/91) add date are required to be addressed in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

Substances For Which Emissions Must Be Quantified

Chemical Abstract (CAS) Number	Add Date ^a	Substance Name
*	06/91	#PAH-Derivatives (Polycyclic aromatic hydrocarbon derivatives) [POM] (including but not limited to those substances listed in Appendix A with the bracketed designation [PAH-Derivative, POM])
56382	06/91	Parathion
1336363		PCBs (Polychlorinated biphenyls) [POM]
82688	06/91	Pentachloronitrobenzene {Quintobenzene}
79210	06/91	Peracetic acid
127184		Perchloroethylene {Tetrachloroethene}
50066		Phenobarbital
108952		Phenol
106303	06/91	p-Phenylenediamine
90437	06/91	2-Phenylphenol [POM]
75445		Phosgene
7723140		Phosphorus
*	09/89	Phosphorus compounds:
7803512		Phosphine
7664382	09/89	Phosphoric acid
10025873	09/89	Phosphorus oxychloride
10025138	09/89	Phosphorus pentachloride
1314563	09/89	Phosphorus pentoxide
7719122	09/89	Phosphorus trichloride
126738	09/89	Tributyl phosphate
78400	09/89	Triethyl phosphine
512561	09/89	Trimethyl phosphate
78308	09/89	Triorthocresyl phosphate [POM]
115866	09/89	Triphenyl phosphate [POM]
101020	09/89	Triphenyl phosphite [POM]
85449		Phthalic anhydride

PAH-DERIVATIVE: (Polycyclic Aromatic Hydrocarbon Derivative) - An organic compound consisting of a fused ring structure containing at least two (2) benzene rings, and which may also contain additional fused rings not restricted exclusively to hexagonal rings. The fused ring structure does not contain heteroatoms. The structure does contain one or more substituent groups. PAH-Derivatives are a subgroup of POM and have a boiling point of greater than or equal to 100° C.

a - All listed substances except those with a (06/91) add date are required to be addressed in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

Appendix E-1
Substances For Which Emissions Must Be Quantified

Chemical Abstract (CAS) Number	Add Date ^a	Substance Name
*		Polychlorinated dibenzo-p-dioxins [PCDDs] [POM]
1746016		including but not limited to: 2,3,7,8-Tetrachlorodibenzo-p-dioxin [TCDD] [POM]
40321764		1,2,3,7,8-Pentachlorodibenzo-p-dioxin [POM]
39227286		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin [POM]
57633857		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin [POM]
19408743		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin [POM]
35822463		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin [POM]
*		Polychlorinated dibenzofurans [PCDFs] [POM]
51207319		including but not limited to: 2,3,7,8-Tetrachlorodibenzofuran [POM]
57117416		1,2,3,7,8-Pentachlorodibenzofuran [POM]
57117314		2,3,4,7,8-Pentachlorodibenzofuran [POM]
70648269		1,2,3,4,7,8-Hexachlorodibenzofuran [POM]
57117449		1,2,3,6,7,8-Hexachlorodibenzofuran [POM]
72918219		1,2,3,7,8,9-Hexachlorodibenzofuran [POM]
60851345		2,3,4,6,7,8-Hexachlorodibenzofuran [POM]
67562394		1,2,3,4,6,7,8-Heptachlorodibenzofuran [POM]
55673897		1,2,3,4,7,8,9-Heptachlorodibenzofuran [POM]
*	09/89	#POM (Polycyclic organic matter) (including but not limited to those substances listed in Appendix A with the bracketed designation of [POM], [PAH, POM], or [PAH-Derivative, POM])
57830		Progesterone
1120714		1,3-Propane sultone
57578		beta-Propiolactone
123386	06/91	Propionaldehyde
114261	06/91	Propoxur {Baygon}
115071		Propylene
-		1,2-Propyleneimine (see 2-Methylaziridine)
75563		Propylene oxide
110861	06/91	Pyridine

POM: (Polycyclic Organic Matter) - Includes organic compounds with more than one benzene ring, and which have a boiling point of greater than or equal to 100° C.

a - All listed substances except those with a (06/91) add date are required to be addressed in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

Appendix B-I
Substances For Which Emissions Must Be Quantified

Chemical Abstract (CAS) Number	Add Date ^a	Substance Name
91225	06/91	Quinoline
106314	06/91	Quinone
*		Radionuclides
24267569	09/89	including but not limited to:
*	09/89	Iodine-131
50553		Radon and its decay products
*		Reserpine [POM]
7782492	06/91	Residual (heavy) fuel oils
*		Selenium
		Selenium compounds **
		including but not limited to:
7446346	09/90	Selenium sulfide
*		Silica, crystalline
7440224	06/91	Silver
*	06/91	Silver compounds **
1310732		Sodium hydroxide
100425		Styrene
95093		Styrene oxide
7664939	06/91	Sulfuric acid
100210	06/91	Terephthalic acid
79345	09/90	1,1,2,2-Tetrachloroethane
7440280	06/91	Thallium
*	06/91	Thallium compounds **
62555		Thioacetamide
62566		Thiourea
7550450	06/91	Titanium tetrachloride
108883		Toluene
*	06/91	2,4-Toluediamine (see 2,4-Diaminotoluene)
		Toluene diisocyanates
		including but not limited to:
534849		Toluene-2,4-diisocyanate
91087		Toluene-2,6-diisocyanate
95534		o-Toluidine
8001352		Toxaphene [Polychlorinated camphenes]
		1,1,1-Trichloroethane (see Methyl chloroform)
79005	06/91	1,1,2-Trichloroethane [Vinyl trichloride]
79016		Trichloroethylene
		2,4,6-Trichlorophenol (see Chlorophenols)
121448	06/91	Triethylamine
1582098	06/91	Trifluralin
95536	06/91	1,2,4-Trimethylbenzene

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Appendix B-I
Substances For Which Emissions Must Be Quantified

Chemical Abstract (CAS) Number	Add Date ^a	Substance Name
540841	06/91	2,2,4-Trimethylpentane
51796		Urethane [Ethyl carbamate]
*	06/91	Vanadium (fume or dust)
108054	06/91	Vinyl acetate
593602		Vinyl bromide
75014		Vinyl chloride
75354		Vinylidene chloride
*	09/89	-Wood preservatives (containing arsenic and chromate)
*		Xylenes (mixed xylenes) including:
108383	06/91	m-Xylene
95476	06/91	o-Xylene
106423	06/91	p-Xylene
7440666		Zinc
*	09/89	Zinc compounds ** including but not limited to:
1314132		Zinc oxide

* = single CAS number not applicable

** = metal compounds are to be reported as the metal atom equivalent in the compound, unless specific compounds are listed.

PAH: (Polycyclic Aromatic Hydrocarbon) - An organic compound consisting of a fused ring structure containing at least two (2) benzene rings, and which may also contain additional fused rings not restricted exclusively to hexagonal rings. The structure does not include any heteroatoms or substituent groups. The structure includes only carbon and hydrogen. PAHs are a subgroup of POM and have a boiling point of greater than or equal to 100° C.

PAH-DERIVATIVE: (Polycyclic Aromatic Hydrocarbon Derivative) - An organic compound consisting of a fused ring structure containing at least two (2) benzene rings, and which may also contain additional fused rings not restricted exclusively to hexagonal rings. The fused ring structure does not contain heteroatoms. The structure does contain one or more substituent groups. PAH-Derivatives are a subgroup of POM and have a boiling point of greater than or equal to 100° C.

a - All listed substances except those with a (06/91) add date are required to be addressed in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

POM: (Polycyclic Organic Matter) - Includes organic compounds with more than one benzene ring, and which have a boiling point of greater than or equal to 100° C.

[] - This designation indicates a synonym for the substance listed.

a - All listed substances except those with a (06/91) add date are required to be addressed in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

NOTE THAT REPORTING OF A TOTAL FOR A SUBSTANCE WHICH IS A SUBSTANCE GROUP HEADING DOES NOT SUPERCEDE THE REQUIRED REPORTING OF THE INDIVIDUAL SUBSTANCES WHICH ARE LISTED IN APPENDIX B UNDER THE GROUP HEADING.

Substances For Which Production, Use, or Other
Presence Must Be Reported

Chemical Abstract Service (CAS) Number	Add ^a Date	Substance Name
26148685	09/89	A-alpha-C [2-Amino-9H-pyrido[2,3-b]indole]
34256821	09/89	Acetochlor
546883	09/90	Acetohydroxamic acid
62476399	09/90	Acifluorfen [POM]
50760	09/90	Actinomycin D
23214928		Adriamycin [PAH-Derivative, POM]
3688537		AF-2
*		Aflatoxins
15972608	09/89	Alachlor
309002	09/89	Aldrin
107186	06/91	Allyl alcohol
28981977	09/90	Alprazolam [POM]
39831555	09/90	Amikacin sulfate
60093		p-Aminoazobenzene [4-Aminoazobenzene] [POM]
97563		o-Aminoazotoluene [POM]
6109973	09/89	3-Amino-9-ethylcarbazole hydrochloride [POM]
125848	09/90	Aminoglutathimide
82280		1-Amino-2-methylanthraquinone [PAH-Derivative; POM]
68006837	09/89	2-Amino-3-methyl-9H-pyrido(2,3-b) indole {MeA-alpha-C}
712585		2-Amino-5-(5-nitro-2-furyl)-1,3,4-thiadiazole
54625		Aminopterin
*		2-Amino-9H-pyrido(2,3-b) indole (see A-alpha-C)
*		Analgesic mixtures containing phenacetin
*		Androgenic (anabolic) steroids including but not limited to:
58184	09/90	Methyltestosterone
434071		Oxymetholone
58220	09/89	Testosterone and its esters including but not limited to:
315377	09/90	Testosterone enanthate
134292		o-Anisidine hydrochloride
104949	06/91	p-Anisidine
140578		Aramite
50782	06/91	Aspirin
492908		Auramine [POM]

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Substances For Which Production, Use, or Other
Presence Must Be Reported

Chemical Abstract Service (CAS) Number	Add ^a Date	Substance Name
115025		Azaserine
446866		Azathioprine
103333	09/90	Azobenzene [POM]
98873	06/91	Benzal chloride
55210	06/91	Benzamide
5411223	09/90	Benzphetamine hydrochloride [POM]
1694093		Benzyl violet 43 [POM]
*		Betal quid with tobacco
494031		N-N-Bis(2-chloroethyl)-2-naphthylamine [Chlornaphazine] [PAH-Derivative, POM]
154938		Bischloroethyl nitrosourea
108601	06/91	Bis(2-chloro-1-methylethyl) ether
*		Bitumens, extracts of steam-refined and air-refined bitumens
*		Elecmycins
75274	09/90	Bromodichloromethane
1689845	06/91	Bromoxynil
55981		1,4-Butanediol dimethanesulfonate [Busulfen/Myleran]
25013165		Butylated hydroxyanisole [BHA]
123728	06/91	Butyraldehyde
3068880		beta-Butyrolactone
630080	09/89	Carbon monoxide
41575944	09/90	Carboplatin
474259	09/90	Chenodiol
305033		Chlorambucil
1620219		Chlorcyclizine hydrochloride [POM]
143500		Chlordecone [Kepone]
6164983	09/89	Chlordimeform
115286	09/89	Chlorendic acid
124481	09/90	Chlorodibromomethane
13010474		1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea [CCNU]
553473	09/89	3-Chloro-2-methylpropene
*	06/91	p-Chloro-o-toluidine (strong acid salts)
*		Chlorophenoxy herbicides
1897455	09/89	Chlorothalonil

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Substances For Which Production, Use, or Other
Presence Must Be Reported

Chemical Abstract Service (CAS) Number	Add ^a Date	Substance Name
4680788	06/91	C. I. Acid Green 3 [POM]
559642	06/91	C. I. Basic Green 4 [POM]
999388	06/91	C. I. Basic Red 1 [POM]
559619	09/89	C. I. Basic Red 9 monohydrochloride [POM]
2832408	06/91	C. I. Disperse Yellow 3 [POM]
(NOTE: "C. I." means "color index")		
87296	09/89	Cinnamyl anthranilate [POM]
15663271		Cisplatin
6358538		Citrus Red No. 2 [POM]
50419	09/90	Clomiphene citrate [POM]
8007452	09/89	Coal tars
21725462	09/90	Cyanazine
14901087		Cycasin
50180		Cyclophosphamide
13121705	09/89	Cyhexatin
147944	09/89	Cytarabine
3468631	09/90	D and C Orange No. 17 [PAH-Derivative, POM]
2092560	06/91	D and C Red No. 8 [PAH-Derivative, POM]
5160021	09/90	D and C Red No. 9 [PAH-Derivative, POM]
81889	09/90	D and C Red No. 19 [POM]
4342034		Dacarbazine
1596845	09/90	Daminozide
17230885	09/90	Danazol
20830813		Daunomycin [PAH-Derivative, POM]
23541506	09/90	Daunorubicin hydrochloride [PAH-Derivative, POM]
50293		DOT {1,1,1-Trichloro-2,2-bis(p-chlorophenyl)ethane} [POM]
613354		N,N'-Diacetylbenzidine [POM]
2303164	06/91	Diallate
39156417		2,4-Diaminoanisole sulfate
101804		4,4'-Diaminodiphenyl ether [POM]
764410	09/90	1,4-Dichloro-2-butene
28434868	09/89	3,3'-Dichloro-4,4'-diaminodiphenyl ether [POM]
72548	09/89	Dichlorodiphenyldichloroethane {DDO} [POM]
540590	06/91	1,2-Dichloroethylene
78886	06/91	2,3-Dichloropropene
60571	09/89	Dieldrin

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Substances For Which Production, Use, or Other
Presence Must Be Reported

Chemical Abstract Service (CAS) Number	Add ^a Date	Substance Name
84173	09/90	Dieneestrol [POM]
1464535		Diepoxybutane
1615801		1,2-Diethylhydrazine
84662	06/91	Diethyl phthalate
101906		Diglycidyl-rasorcinol ether [DGRE]
94586		Dihydrosafrole
20325400	06/91	3,3'-Dimethoxybenzidine dihydrochloride [POM]
55738540		trans-2-[(Dimethylamino)methylimino]- 5-[2-(3-nitro-2-furyl)vinyl]-1,3,4-oxadiazole
540738		1,2-Dimethylhydrazine
105579	06/91	2,4-Dimethylphenol [2,4-Xylenol]
513371	09/89	Dimethylvinylchloride [DMVC]
25154545	09/90	Dinitrobenzenes (mixtures of) including:
99550	06/91	m-Dinitrobenzene
529290	06/91	o-Dinitrobenzene
100254	06/91	p-Dinitrobenzene
117840	06/91	n-Dioctyl phthalate
39300453	09/90	Dinocap
88857	09/89	Dinosab
2475458	06/91	Disperse Blue 1 [PAH-Derivative, POM]
554250	09/90	Doxycycline
379793	09/90	Ergotamine tartrate [POM]
*		Estrogens, nonsteroidal including but not limited to:
56531		Diethylstilbestrol [POM]
*		Estrogens, steroidal including but not limited to:
50282	09/90	Conjugated estrogens
53167		Estradiol 17 beta
57636		Estrone
72333		Ethinyl estradiol
541413	06/91	Mestranol
62500		Ethyl chloroformate
33419420	09/90	Ethyl methanesulfonate
54350480		Etoposide [POM]
		Etretinate

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Substances For Which Production, Use, or Other
Presence Must Be Reported

Chemical Abstract Service (CAS) Number	Add ^a Date	Substance Name
2164172	06/91	Flucmeturon
51218	09/89	Fluorouracil
76437	09/90	Fluoxymesterone
13311847	09/90	Flutamide
133073	— 09/89	Folpet
3570750		2-(2-Formylhydrazino)-4-(5-nitro-2-furyl) thiazole
67459	09/90	Furazolidone
60558050	09/90	Furmacyclex
67730114		Glu-P-1 (2-Amino-6-methyldipyrido[1,2-a:3',2'- -d]imidazole)
67730103		Glu-P-2 (2-Aminodipyrido[1,2-a:3',2'- -d]imidazole)
765344		Glycidaldehyde
556525	09/90	Glycidol
16568028		Gyromitrin {Acetaldehyde methylformylhydrazone}
2784943	09/89	HC Blue 1
23092173	09/90	Halazepam [PGM]
1024573	09/89	Heptachlor epoxide
1335871	06/91	Hexachloronaphthalene [PAH-Derivative, PGM]
10034932		Hydrazine sulfate
3778732	09/90	Ifosfamide
76180966		IQ {2-Amino-3-methylimidazo[4,5-f]quinoline}
9004664		Iron dextran complex
78842	06/91	Isobutyraldehyde
120581	09/90	Isosafrole
4759482		Isotretinoin
77501634	09/89	Lactofen [PGM]
303344	09/89	Lasiocarpine
554132	06/91	Lithium carbonate
519164	06/91	Lithium citrate
846491	09/90	Lorazepam [PGM]
*	09/89	Lubricant base oils and derived products, specifically vacuum distillates, acid treated oils, aromatic oils, mildly solvent-refined oils, mildly hydro-treated- oils and used engine oils.

a - All listed substances except those with a (06/91) add data are required to be addressed qualitatively (i.e., listed if they are used, produced, or otherwise present) in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

Substances For Which Production, Use, or Other
Presence Must Be Reported

Chemical Abstract Service (CAS) Number	Add ^a Date	Substance Name
8018017	09/90	Mancozeb
12427382	09/90	Maneb
555335	06/91	Megestrol acetate
148823		Melphalan
9002680	09/90	Menotropins
6312761	09/90	Mercaptopurine
531760	09/89	Merphalan
3963959	06/91	Methacycline hydrochloride
60560	09/90	Methimazole
55052	09/89	Methotrexate
15475566	09/90	Methotrexate sodium
484208		5-Methoxypsoralen
96333	06/91	Methyl acrylate
550963	09/90	Methylazoxymethanol
592621	09/89	Methylazoxymethanol acetate
838880	09/89	4,4'-Methylene bis(2-methylaniline) [POM]
101611		4,4'-Methylene bis(N,N-dimethyl) benzenamine [PGM]
74953	06/91	Methylene bromide
66273		Methyl methanesulfonate
129157		2-Methyl-1-nitroanthraquinone (uncertain purity) [PAH-Derivative, POM]
70257		N-Methyl-N'-nitro-N-nitrosoguanidine
615532	09/89	N-Methyl-N-nitrosourethane
924425	09/90	N-Methyloacrylamide
55042		Methylthiouracil
9006422	09/90	Metiram
53467968	09/90	Midazolam hydrochloride [POM]
*		Mineral oils (untreated and mildly treated oils; and those used in occupations such as mulespinning, metal machining, and jute processing).
2385355		Mirax
62015398	09/90	Misoprostol
53077		Mitomycin C
70476823	09/90	Mitoxantrone hydrochloride [PAH-Derivative, POM]
315220		Monocrotaline

a - All listed substances except those with a (06/91) add date are required to be addressed qualitatively (i.e., listed if they are used, produced, or otherwise present) in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

Substances For Which Production, Use, or Other
Presence Must Be Reported

Chemical Abstract Service (CAS) Number	Add ^a Date	Substance Name
139913		5-(Morpholinomethyl)-3-[(5-nitrofurfurylidene)amino]-2-oxazolidinone
505602		Mustard gas {Sulfur mustard}
86220420	09/90	Nafarelin acetate [PAH-Derivative, POM]
3771195		Nafencin [POM]
134327	09/90	1-Naphthylamine [PAH-Derivative, POM]
91538		2-Naphthylamine [PAH-Derivative, POM]
1405103	09/90	Neomycin sulfate
56391572	09/90	Netilmicin sulfate
54115	09/90	Nicotine
*	06/91	Nitrilotriacetic acid (salts) including but not limited to: Nitrilotriacetic acid, trisodium salt monohydrate
18662538	06/91	
602979		5-Nitroacenaphthene [PAH-Derivative, POM]
99592		5-Nitro-o-anisidine
1836755		Nitrofen (technical grade)
67209	06/91	Nitrofurantoin
55870	09/90	Nitrofurazone
555840		1-[(5-Nitrofurfurylidene)amino]-2-imidazol- idinone
531828		N-[4-(5-Nitro-2-furyl)-2-thiazolyl]acetamide
51752		Nitrogen mustard {Mechlorethamine}
53867	09/89	Nitrogen mustard hydrochloride
53630	06/91	Nitroglycerin
88755	06/91	2-Nitrophenol
57835924	06/91	4-Nitropyrene [PAH-Derivative, POM]
86306	09/89	N-Nitrosodiphenylamine [POM]
759739		N-Nitroso-N-ethylurea
60153493	09/89	3-(N-Nitrosomethylamino)propionitrile
64091914	09/89	4-(N-Nitrosomethylamino)-1-(3-pyridyl)- 1-butanone [NNK]
615532		N-Nitroso-N-methylurethane [N-Methyl-N- nitrosourethane]
4549400		N-Nitrosomethylvinylamine
16543558		N-Nitrosomornicotine
13255229		N-Nitrososarcosine

a - All listed substances except those with a (06/91) add date are required to be addressed qualitatively (i.e., listed if they are used, produced, or otherwise present) in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1982.

Substances For Which Production, Use, or Other
Presence Must Be Reported

Chemical Abstract Service (CAS) Number	Add ^a Date	Substance Name
6333002	09/90	Norgestrel
303479	09/90	Ochratoxin A [POM]
2234131	06/91	Octachloronaphthalene [PAH-Derivative, POM]
2946175		Oil Orange SS [PAH-Derivative, POM]
20816120	06/91	Osmium tetroxide
79572	06/91	Oxytetracycline
794934		Panfuran S [Dihydroxymethylfuratrizine]
115673	09/90	Paramethadione
52675	06/91	Penicillamine
57330	09/90	Pentobarbital sodium
63989	09/90	Phenacamide
62442		Phenacetin
94780		Phenazopyridine hydrochloride
3546109	09/89	Phenesterin
59961	09/89	Phenoxybenzamine [POM]
63923	09/90	Phenoxybenzamine hydrochloride [POM]
122501	09/90	Phenyl glycidyl ether
57410		Phenytoin [POM]
88891	06/91	Picric acid
54911	09/90	Pipobroman
18378897	09/90	Plicamycin [PAH-Derivative, POM]
*		Polybrominated biphenyls [PBBs] [POM]
53573581	09/89	Polygeenan
3761533		Ponceau MX [PAH-Derivative, POM]
3564098		Ponceau 3R [PAH-Derivative, POM]
366701		Procarbazine hydrochloride
*		Progestins
71589		including but not limited to:
68224		Medroxyprogesterone acetate
51525		Norethisterone
302794	09/89	Propylthiouracil
*	09/89	all-trans-Retinoic acid
36791045	09/90	Retinol/retinyl esters
81072		Ribavirin
94597		Saccharin
*		Safrole
		Shale oils

a - All listed substances except those with a (06/91) add date are required to be addressed qualitatively (i.e., listed if they are used, produced, or otherwise present) in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

Appendix E-11
Substances For Which Production, Use, or Other
Presence Must Be Reported

Chemical Abstract Service (CAS) Number	Add ^a Date	Substance Name
132274		Sodium o-phenylphenate [POM]
129449	09/89	Sodium saccharin
*		Scots
10048132		Starigmatocystin [POM]
3810740	06/91	Streptomycin sulfate
18883664		Streptozotocin
95067		Sulfallate
54963241	09/90	Tamoxifen citrate [POM]
846304	09/90	Temazepam [POM]
5216251	09/90	p-alpha, alpha, alpha-Tetrachlorotoluene
951115	06/91	Tetrachlorvinphos
64753	06/91	Tetracycline hydrochloride
509148	09/90	Tetranitromethane
50351		Thalidomide
139651		4,4'-Thiodianiline [POM]
154427	09/90	Thioguanine
1314201		Thorium dioxide
*		Tobacco products, smokeless
49842071	09/90	Tobramycin sulfate
*		alpha-chlorinated toluenes
636215		o-Toluidine hydrochloride
106490	09/90	p-Toluidine
299752		Trecsulfan
29911015	09/90	Triazolam [POM]
52586	06/91	Trichlorfon
13647353	09/90	Trilostane
127480	06/91	Trimethadione
62768	09/90	Tris(aziridinyl)-p-benzoquinone {Triaziquone}
52244		Tris(1-aziridinyl) phosphine sulfide {Thictapa}
125727	09/89	Tris(2,3-dibromopropyl)phosphate
62450060		Trp-P-1 (3-amino-1,4-dimethyl-5H-pyrido[4,3- b]indole)
62450071		Trp-P-2 (3-Amino-1-methyl-5H-pyrido[4,3-b] indole)
72571		Trypan blue [PAH-Derivative, POM]
66751		Uracil mustard

a - All listed substances except those with a (06/91) add date are required to be addressed qualitatively (i.e., listed if they are used, produced, or otherwise present) in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

Substances For Which Production, Use, or Other
Presence Must Be Reported

Chemical Abstract Service (CAS) Number	Add ^a Date	Substance Name
26995915	09/90	Urofollitropin
99661		Valproate
143679	09/90	Vinblastine sulfate [POM]
2068782	09/90	Vincristine sulfate [POM]
106876	09/90	4-Vinyl-1-cyclohexene diepoxide [Vinyl cyclohexene dioxide]
81812		Warfarin [POM]
87627	06/91	2,6-Xylidene
12122577	09/90	Zineb

* = single CAS number not applicable

PAH: (Polycyclic Aromatic Hydrocarbon) - An organic compound consisting of a fused ring structure containing at least two (2) benzene rings, and which may also contain additional fused rings not restricted exclusively to hexagonal rings. The structure does not include any heteroatoms or substituent groups. The structure includes only carbon and hydrogen. PAHs are a subgroup of POM and have a boiling point of greater than or equal to 100° C.

PAH-DERIVATIVE: (Polycyclic Aromatic Hydrocarbon Derivative) - An organic compound consisting of a fused ring structure containing at least two (2) benzene rings, and which may also contain additional fused rings not restricted exclusively to hexagonal rings. The fused ring structure does not contain heteroatoms. The structure does contain one or more substituent groups. PAH-derivatives are a subgroup of POM and have a boiling point of greater than or equal to 100° C.

POM: (Polycyclic Organic Matter) - Includes organic compounds with more than one benzene ring, and which have a boiling point of greater than or equal to 100° C.

[] - This designation indicates a synonym for the substance listed.

a - All listed substances except those with a (06/91) add date are required to be addressed qualitatively (i.e., listed if they are used, produced, or otherwise present) in risk assessments prepared under the third phase of the program (i.e., those facilities that were required to submit an emission inventory plan or update plan to the district by August 1, 1991). The original list was approved by the Board in July 1988.

NOTE THAT REPORTING OF A TOTAL FOR A SUBSTANCE WHICH IS A SUBSTANCE GROUP HEADING DOES NOT SUPERCEDE THE REQUIRED REPORTING OF THE INDIVIDUAL SUBSTANCES WHICH ARE LISTED IN APPENDIX A UNDER THE GROUP HEADING.

APPENDIX C

MODELING PROTOCOL OUTLINE

Appendix C

Modeling Protocol Outline

1. Emissions

- Specify that emission estimates for all substances for which emissions were required to be quantified will be included in the risk assessment. This includes both annual average emissions and maximum one-hour emissions of each pollutant from each process.
- Specify the format in which the emissions information will be provided (consult with the district concerning format prior to submitting the protocol).
- Specify the basis for using emissions data, other than that included in the emission inventory report, for the risk assessment (consult with the district concerning the use of updated emissions data prior to submitting the protocol).
- Specify the format for presenting release parameters (e.g., stack height and diameter, stack gas velocity, release temperature) for each process as part of the risk assessment (consult with the district concerning the format prior to submitting the protocol).

2. Models

- Identify model(s) to be used, including version number.
- Identify additional models to be run if receptors are found above stack height.
- Specify which model results will be used for receptors above stack height.
- Specify the format for presenting the model options selected for each run (consult with the district concerning the format prior to submitting the protocol).

3. Meteorological Data

- Specify type, source, and year (e.g. hourly surface data, upper air mixing height information).

- Evaluate whether the data is representative.
- Describe QA/QC procedures.
- Identify whether there are any gaps in the data; if so, describe how the data gaps were filled.

4. Deposition

- Specify method to calculate deposition (if applicable).

5. Receptors

- Identify method to determine maximum exposed individual for residential and occupational areas for long-term exposures (e.g. a Cartesian grid and 500-meter grid increments).
- Identify method to determine maximum short-term impact.
- Identify method to evaluate cancer risk in the vicinity of the facility for purposes of calculating cancer burden (e.g. centroids of the census tracts in the area within the zone of impact).
- Specify that UTM coordinates and street addresses, where possible, will be provided for specified receptor locations.

APPENDIX D

REFERENCES FOR DISPERSION MODELS AND USERS GUIDES

Appendix D

References for Dispersion Models and Users Guides

CTDMPLUS

Environmental Protection Agency (1990): "User's Guide to the Complex Terrain Dispersion Model Plus Algorithms for Unstable Situations (CTDMPLUS). U.S. Environmental Protection Agency Publication EPA-600/8-89-041.

SCREEN

Brode, R. W. (1988): "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources (DRAFT)," U.S. Environmental Protection Agency Publication EPA-450/4-88-010, August 1988.

SCREEN 2

Brode, R. W. (1992): "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised " U.S. Environmental Protection Agency Publication EPA-450/R-92-019.

Brode, R. W. (1992): "SCREEN 2. Model User's Guide", U.S. Environmental Protection Agency Publication EPA-450/4-92-006.

ISCST2

Environmental Protection Agency (1992): "User's Guide for the Industrial Source Complex (ISC2) Dispersion Models, Volumes I, II, and III User Instructions". U.S. Environmental Protection Agency Publication EPA-450/4-92-008a, b, and c, March 1992.

PTPLU-2

Pierce, T. E., D.B. Turner, J.A. Catalano, and F.V. Hale (1982): "PTPLU - A Single Source Gaussian Dispersion Algorithm," U.S. Environmental Protection Agency Publication EPA-600/8-82-014.

Pierce, T.E. (1986): "ADDENDUM TO PTPLU - A Single Source Gaussian Dispersion Algorithm," U.S. Environmental Protection Agency Publication EPA/600/8-86/042.

LONGZ and SHORTZ

Bjorklund, J.R., and J.F. Bowers (1982): "User's Instructions for the SHORTZ and LONGZ Computer Programs, Volumes I and II, "U.S. Environmental Protection Agency Publication EPA-903/9-82-004A and B, March 1982.

Winges, K.D. (1986): "User's guide for POSTZ - A Postprocessor for the SHORTZ Air Quality Model," U.S. Environmental Protection Agency Publication EPA-910/9-86-144.

VALLEY

Burt, E.W. (1977): "VALLEY Model User's Guide," NTIS Accession Number PB-274 054, September 1977.

U.S. Environmental Protection Agency (1982): "Addendum/Supplemental Information to the VALLEY Model," Distributed as part of the UNAMAP Version 6 Documentation, December 1982.

U.S. EPA Modeling Guidelines

Environmental Protection Agency (1986): "Guideline on Air Quality Models (Revised)," U.S. Environmental Protection Agency Publication EPA-450/2-78-027R, July 1986.

Environmental Protection Agency (1986): "Supplement A to the Guideline on Air Quality Models (Revised)," U.S. Environmental Protection Agency Publication EPA-450/2-78-027R, July 1987.

Environmental Protection Agency (1990): "Draft Supplement B to the Guideline on Air Quality Models (Revised)." U.S. Environmental Protection Agency Publication EPA-450/2-78-027R, September 1990.

Collecting Met Data

Environmental Protection Agency (1986): "On-Site Meteorological Program Guidance for Regulatory Modeling Applications," U.S. Environmental Protection Agency Publication EPA-450/4-87-013, June 1987.

APPENDIX E-I

LISTING OF MODIFICATIONS MADE TO
CLEMENT DOCUMENT ALGORITHMS AND
ASSUMPTIONS

APPENDIX E-II

ENVIRONMENTAL FATE, EXPOSURE,
AND RISK ALGORITHMS;

APPENDIX E-III

LIST OF REFERENCES

Appendix E-I

Listing of Modifications Made to Clement Document Algorithms and Assumptions

Section*	Clement Recommendation	Modification
<u>Environmental Fate</u>		
I.A.1	No method provided for estimating concentration in air.	Ground-level concentration for a specific location is determined by multiplying the pollutant emission rate at the stack by the site specific dilution factor (X/Q).
I.A.2.a. 2>b>2:	No value given for deposition velocity.	Use 0.02 m/s for controlled facilities and 0.05 m/s for uncontrolled facilities.
I.A.3.	Concentration in water is based on Thibodeaux et al. steady state model relating sediment concentrations to water concentrations. The model considers both direct deposition and runoff. contribution is under	Simplified calculation based on contribution to water from direct deposition only. Contribution from direct deposition is based on deposition, water surface area, volume of water in water body and number of volume changes. The contribution from run-off will not be considered at this time. An approach to calculate run-off development.
I.B.2.	Concentration of pollutant in animal products based on the fraction of feed crops grown locally, feed/product transfer coefficient, bioavailability,	In addition to Clement algorithms, exposure to air, water, pasture/grazing, and soil is also considered in determining pollutant concentrations in animal products.

* Refers to outline format used for Appendix E-II

Section	Clement Recommendation	Modification
	concentration in food source, and amount of food ingested.	
<u>Estimation of Exposure Dose</u>		
All Pathways	Exposure rates vary with age of individual in question.	Exposure rates are constant for 70 years.
All Pathways	Average body weight vary with age.	Average body weight is constant (70 kg) except for mother's milk pathway, which uses 6.5 kg for one year.
II.A.2.a.	Inhalation rates vary with age.	Inhalation rate is constant (20 m ³ /d) for 70 years.
All noninhalation pathways except for mother's	Bioavailability factors are used to determine the fraction of ingested contaminant that is absorbed in the body	GI absorption factors are used to determine the amount of contaminant absorbed. For soil and milk ingestion, both GI factors and bioavailability are used.
II.B.2.b.	Surface area of body changes with age.	Body surface area remains constant for 70 years (4,656 cm).
II.B.2.d	Dermal absorption is 10% for organics and 1% for metals.	For organic emissions use dermal absorption factor of 15% for PCB, 2% for TCDD/TCDF, 3% for PAH and use Clement value for other organic emissions. For metals, use as absorption factor of 1% for chromium, 0.2% for cadmium, 0.2% for nickel, 1% for mercury and 0.1% for other metals.

Section	Clement Recommendation	Modification
II.C.1.b. 2>	Amount of soil ingested varies with age.	Soil ingestion is constant for 70 years (110 mg/d).
II.C.2.b. 2>	Amount of water ingested varies with age.	Water ingestion is constant for 70 years (2 l/d).
II.C.3.a. 2>b>	Food intake varies with age.	Values for quantity of produce ingested differ from Clement values.
II.C.3.b.	For animal products, only consider beef product ingestion.	In addition to beef, pork, poultry, and sheep/goat products are considered.
II.C.3.c.	Not intergrate mother's milk pathway into maximum risk calculation.	For dioxins, PAHs and PCBs, two exposure scenarios will be evaluated for the maximum risk calculation. The first scenario includes the mother's milk pathway. For this ingestion scenario, the mother would be exposed for 26 years, the child ingests mother's milk for a year, and the child--now an adult--is exposed to all other pathways for the remainder of the facility's 44 years of operation. For the other scenario, the mother's milk pathway is not included and the exposure period for all pathways is 70 years.
III.B.2.	The dose is multiplied by the potency slope to determine the risk of cancer.	A unit risk factor is used to determine the risk for the inhalation pathway and potency slopes are used for the other pathways.

**Appendix E-II
Environmental Fate, Exposure,
and Risk Algorithms**

I. ESTIMATION OF THE ENVIRONMENTAL FATE OF FACILITY EMISSIONS

Once emissions exit the exhaust stack of an incinerator, the pollutants will be dispersed in the air. The pollutants in the exhaust gas with high vapor pressures will remain in the vapor phase, and pollutants with lower vapor pressures will adsorb to fly ash and soil particulate. The emission plume will contain both vapor phase pollutants and particulate. Particulate will deposit at a rate which is dependent on the particle size. The pollutants will deposit on vegetation, on soil, and in water.

The following algorithms calculate the estimated environmental fate of facility emissions, that is, what portion (concentration) of the facility's emissions remains in the air, is deposited on the soil, is deposited in water, is deposited on or is taken up by vegetation, and is taken up by animals.

A. Estimation of Concentrations in Air, Soil, and Water

1. Air

Concentration in air (GLC) is a function of the facility emission rate and the dilution factor (X/Q) at the points under evaluation.

a. Formula:

$$GLC = E\text{-rate} * X/Q$$

- 1> GLC = Ground-level concentration (UG/M3)
- 2> E-rate = Pollutant emission rate (G/S)
- 3> X/Q = Dilution factor provided by dispersion modeling (UG/M3/G/SEC)

b. Recommended default values:

- 1> E-rate = Facility specific, pollutant emission rate
- 2> X/Q = For point of interest, site specific, from dispersion modeling

c. Assumptions:

- 1> No plume depletion
- 2> Emission rate will remain constant for the 70 years of facility life

2. Soil

The average concentration in soil (Cs) is a function of the deposition, accumulation period, chemical specific soil half-life, mixing depth, and soil bulk density.

a. Formula:

$$Cs = Dep * X / (Ks * SD * BD * Tt)$$

- 1> Cs = Average soil concentration over the evaluation period (UG/KG)
- 2> Dep = Deposition on the affected soil area per day (UG/M2/D)

a> Formula:

$$Dep = GLC * Dep-rate * 86,400$$

- 1: GLC = Ground-level concentration (UG/M3)
- 2: Dep-rate = Vertical rate of deposition (M/S)
- 3: 86,400 = Seconds per day conversion factor (S/D)

b> Recommended default values:

- 1: GLC = Calculated above, see I.A.1.a.
- 2: Dep-rate = Use 0.02 meters/second for controlled or 0.05 meters/second for uncontrolled sources.

c> Assumptions:

- 1: Deposition rate remains constant for the 70 year facility life

3> X = Integral function

a> Formula:

$$X = \left[\frac{\text{EXP}(-Ks * Tf) - \text{EXP}(-Ks * To)}{Ks} \right] + Tt$$

- 1:EXP = Exponent base e = 2.72
- 2:Ks = Soil elimination constant

a: Formula:

$$Ks = .693 / t_{1/2}$$

- 1) .693 = Natural log of 2
- 2) $t_{1/2}$ = Chemical specific soil half-life (D)

b: Recommended default values

- 1) $t_{1/2}$ = See Table 1
- 3: Tf = End of evaluation period (D)
- 4: To = Beginning of evaluation period (D)
- 5: Tt = Total days of exposure period Tf-To (D)

b> Recommended default values:

- 1: Ks = Calculated above, see I.A.2.a.3>a>2:
- 2: Tf = 25,550 (D) = 70 YR [OEHHA]
= 9,125 (D) for mother in mother's milk pathway
- 3: To = 0 (D) for mother in mother's milk pathway and for adult not affected by mother's milk pathway
= 9,490 (D) for adult in mother's milk pathway

3. GI Absorption Factors provided by CEPA. Assume GI absorption fraction of 1 when comparing human and animal exposures (equivalent absorption across species).

When calculating dose by the oral route of exposure for the purpose of assessing cancer risk, the gastrointestinal absorption is taken into account only when derivation of the oral cancer potency factor has been adjusted to account for absorption. This is rarely the case. In most instances, the cancer potency slope is derived from animal or human data without regard to the actual absorbed dose, but rather is based on estimates of administered dose. In some instances, gastrointestinal absorption may be used to correct the exposure. In all other cases, the exposure should not be adjusted for absorption as the cancer potency factors are not so adjusted.

When calculating dose in order to assess noncancer (chronic or acute) hazards, the doses should not be adjusted for absorption unless the reference dose for that particular route of exposure has been adjusted for absorption. In certain instances, when the reference dose used is extrapolated across routes of exposure and a large difference in absorption exists between the routes of exposure, the dose calculations may adjust for the differential absorptions.

4. Dermal description of many compounds is limited. The guidelines have incorporated dermal description factors to account for the decreased absorption relative to other routes of exposure, for estimates of dermal dose used to assess both cancer and noncancer health hazards. The dermal description values come from literature describing absorption of chemicals across the skin. In some cases, there are good data available for specific compounds. In other cases, an absorption fraction is inferred from data for similar chemicals. In a few cases the effects of absorption to a soil or flyash matrix on dermal bioavailability has been studied. In these rare instances, the dermal description factor used in the guidelines accounts for this decreased bioavailability (e.g., the dermal description value for dioxins/furans accounts for decreased bioavailability).
5. The guidelines allow for adjusting for bioavailability where the evidence warrants. For example, there are good data which indicate that dioxin is not so available to an organism when bound to soil or flyash matrices relative to when it is in solution or in food. Therefore, a bioavailability factor is incorporated into the model to account for this difference. When information becomes available for other chemicals of concern, this type of bioavailability will be incorporated into the model.

If the user has questions regarding applicability of using absorption factors, CEPA should be consulted.

6. NA - Data Not Available ---to be provided at a later date.

- 4> SD = Soil mixing depth (M)
- 5> BD = Soil bulk density (KG/M3)

b. Recommended default values:

- 1> Dep = Calculated above, see I.A.2.a.2>
- 2> X = Calculated above, see I.A.2.a.3>
- 3> Ks = Calculated above, see I.A.2.a.3>a>2:
- 4> SD = 0.01 (M) for playground setting and 0.15 (M) for agricultural setting [OEHHA;Clement]
- 5> BD = 1,333 (KG/M3) [Clement]
- 6> Tt = 25,550 (D) = 70 (YR) [OEHHA] for individual not affected by mother's milk pathway
 - = 9,490 (D) for mother in mother's milk pathway
 - = 16,060 (D) for adult in mother's milk pathway

c. Assumptions:

- 1> Pollutants are uniformly mixed in soil
- 2> Pollutants are not leached or washed away, except where evidence exists to the contrary
- 3> For the MEI ingesting mother's milk, the Mother is exposed for first 26 years, the child receives milk for the last year of the mother's exposure period, and then the adult is exposed to all other pathways for the final 44 years; for the MEI which does not ingest mother's milk, the MEI's exposure period is 70 years for all pathways

3. In Water

The average concentration in water (Cw) is a function of direct deposition and material carried in by surface run-off. However, only the contribution from direct deposition will be considered at this time.

a. Formula:

$$C_w = C_{depw}$$

- 1> Cw = Average concentration in water (UG/KG)

2> **Cdepw** = Contribution due to direct deposition (UG/KG)

a> Formula:

$$Cdepw = Dep * SA * 365 / (WV * VC)$$

- 1: **Dep** = Deposition on water body per day (UG/M2/D)
- 2: **SA** = Water surface area (M2)
- 3: **365** = Days per year (D/YR)
- 4: **WV** = Water volume (KG)
- 5: **VC** = Number of volume changes per year

b> Recommended default values:

- 1: **Dep** = Calculated above, see I.A.2.a.2>
- 2: **SA** = Site specific water surface area (M2)
- 3: **WV** = Site specific water volume in (KG)
- 4: **VC** = Site specific number of volume changes per year

(SA, WV, and VC values can be acquired from the applicable Department of Water Resources (DWR) Regional office)

c> Assumptions:

- 1: All material deposited into the water remains in the water column

B. Estimation of Concentrations in Vegetation and Animal Products

Estimates of the concentration in vegetation and animals requires the use of the results of the air, water, and soil environmental fate evaluation. Plants and animals will be exposed to the pollutants at the concentrations previously calculated in I.A. above.

1. Vegetation

The average concentration in and on vegetation (C_f) is a function of direct deposition and root translocation or uptake from exposed soil.

a. Formula:

$$C_f = C_{depv} * BIO + C_{trans}$$

- 1> C_f = Average concentration in and on specific types of vegetation (UG/KG)
- 2> C_{depv} = Concentration due to direct deposition (UG/KG)

a> Formula:

$$C_{depv} = [Dep * IF / (k * Y)] * (1 - EXP[-kT])$$

- 1: Dep = Deposition on affected vegetation per day (UG/M²/D)
- 2: IF = Interception fraction
- 3: k = Weathering constant (1/D)
- 4: Y = Yield (KG/M²)
- 5: EXP = Exponent base e
- 6: T = Growth period (D)

b> Recommended default values:

- 1: Dep = Calculated above, see I.A.2.a.2>
- 2: IF = crop specific
 - a: Root crops = 0 [Baes et al.]
 - b: Leafy crops = .2 [Baes et al.]
 - c: Vine crops = .1 [Baes et al.]
- 3: k = .693/14 (D) [Clement]
- 4: Y = 2 (KG/M²) [CA Department of Food and Agriculture dot maps]
- 5: T = 45-90 (D) [Clement]

c> Assumptions

- 1: No deposition on root crops.

3>BIO = Bioavailability
= See Table 1

4>Ctrans = Concentration due to root
translocation or uptake (UG/KG)

a> Formula:

$$C_{trans} = C_s * UF_2$$

1: C_s = Average soil concentration (UG/KG)
2: UF_2 = Uptake factor based on soil
concentration

b> Recommended default values:

1: C_s = Calculated above, see I.A.2.
2: UF_2 =

a: Inorganic compounds---see Table 1
b: Organic compounds:

1) Formula:

$$UF_2 = [(0.03 * Kow^{0.77}) + 0.82] / [(Koc)(Foc)]$$

a) 0.03 = Empirical constant
b) Kow = Octanol:water
partition factor
c) 0.77 = Empirical constant
d) 0.82 = Empirical constant
e) Koc = Organic carbon
partition coefficient
f) Foc = Fraction organic
carbon in soil

2) Recommended default values:

a) Kow = Chemical specific,
see Handbook of
Chemical Property
Estimation Methods

- b) Koc = Chemical specific,
see Handbook of
Chemical Property
Estimation Methods
- c) Foc = 0.1

2. Animal Products

The average concentration in animal products (Cfa) depends on which routes of exposure exist for the animals. Animal exposure routes include inhalation, soil ingestion, ingestion of contaminated feed and pasture, and ingestion of contaminated water.

a. Formula:

$$Cfa = (Inhalation + Water ingestion + Feed ingestion + \underline{Pasture/Grazing ingestion} + Soil ingestion) * Fi$$

- 1> Cfa = Average concentration in farm animals and their products (UG/D)
- 2> Inhalation = Dose through inhalation (UG/D)

a> Formula:

$$Inhalation = RR * GLC$$

- 1: RR = Inhalation rate for animal (M3/D)
- 2: GLC = Ground-level concentration (UG/M3)

b> Recommended default values:

- 1: RR = See Table 2
- 2: GLC = Calculated above, see I.A.1.

c> Assumptions

- 1: All material inhaled is 100% absorbed

**Table 2
Defaults For Animal Pathway**

	CATTLE/LACTATING	PIGS	POULTRY	GOATS/SHEEP
BW (D,G) (KG)	5E+02 (B)*	6E+01 (C)	2E+00 (A)	4E+01 (B)
RR (M ³ /D)	8E+01	7E+00	1E+00	6E+00
WI (KG/D)	1E+02 (B)	8E+00 (C)	6E-01 (A)	6E+00 (B)
FI (KG/D)	8E+00 (E) / 6E+01 (B)	2E+00 (C)	3E-01 (A)	2E+00 (B)
%Sf	1E-02 (E)	1e-02 (F)	1e-02 (F)	1E-02 (E)
%Sp	5E-02 (E)	3E-02 (F)	3E-02 (F)	7E-02 (E)

* Superscript letters in parenthesis refers to references given in the next section

3> Water ingestion = Dose through water ingestion (UG/D)

a> Formula:

$$\text{water ingestion} = WI * \%SW * Cw$$

- 1: WI = Water ingestion for animal (KG/D)
- 2: %SW = % Water ingested from a contaminated body of water
- 3: Cw = Average concentration in water (UG/KG)

b> Recommended default values:

- 1: WI = See Table 2
- 2: %SW = Site specific, need to survey % water ingestion practices in affected area
- 3: Cw = Calculated above, see I.A.3.

4> Feed ingestion = Dose through feed ingestion (UG/D)

a> Formula:

$$\text{feed ingestion} = (1 - \%G) * FI * L * Cf$$

- 1: %G = % Diet provided by grazing
- 2: FI = Feed ingestion rate (KG/D)
- 3: L = % Of locally grown feed that is not pasture
- 4: Cf = Concentration in feed (UG/KG)

b> Recommended default values:

- 1: %G = Site specific % diet provided by grazing (need to survey)
- 2: FI = See Table 2
- 3: L = Site specific, % of feed that is not pasture
- 4: Cf = As calculated above, see I.B.1.

5> Pasture/Grazing ingestion = Dose through pasture/grazing (UG/D)

a> Formula:

$$\text{Pasture/Grazing ingestion} = \%G * Cf * FI$$

- 1: %G = % Diet provided by grazing
- 2: Cf = Concentration in pasture/grazing material (UG/KG)
- 3: FI = Feed ingestion rate (KG/D)

b> Recommended default values:

- 1: %G = Site specific % diet provided by grazing (need to survey)
- 2: Cf = As calculated above, see I.B.1.

3: FI = See Table 2

6> Soil ingestion = Dose through soil ingestion (UG/KG)

a> Formula:

$$\text{Soil ingestion} = SI * Cs$$

1: SI = Soil ingestion rate for animal (KG/D)

a: Formula:

$$SI = [(1 - \%G) * \%Sf * FI] + \%G * \%Sp * FI$$

- 1) %G = % Diet provided by grazing
- 2) %Sf = Soil ingested as a % of feed ingested
- 3) FI = Feed ingestion rate (KG/D)
- 4) %Sp = Soil ingested as a % of pasture ingested

b: Recommended default values:

- 1) %G = Site specific % diet provided by grazing
- 2) %Sf = See Table 2
- 3) FI = See Table 2
- 4) %Sp = See Table 2

2: Cs = Average soil concentration (UG/KG)

b> Recommended default values:

- 1: SI = Calculated above
- 2: Cs = Calculated above, see I.A.2.

7> F_i = Transfer coefficient of contaminant from diet to animal product (D/KG)

a> Recommended default values:

1: F_i = See Table 1

b> Assumptions:

- 1: The transfer coefficient is the same for all exposure routes
- 2: The transfer coefficient for goat's milk is the same as for cow's milk
- 3: The transfer coefficient for all meat is the same
- 4: The transfer coefficient for eggs is the same as for meat

3. Fish Products

The average concentration in fish (C_f) is based on the concentration in water and a bioconcentration factor.

a. Formula:

$$C_f = C_w * BCF$$

- 1> C_f = Concentration in fish (UG/KG)
- 2> C_w = Concentration in water (UG/KG)
- 3> BCF = Bioconcentration factor

b. Recommended default values:

- 1> C_w = Calculated above, see I.A.3.
- 2> BCF = See Table 1

c. Assumptions:

- 1> All contaminants in water are available for bioaccumulation

- 2> Contaminant is present in a soil or fly ash matrix
- 3> Contaminants do not accumulate in water

II. ESTIMATION OF EXPOSURE DOSE

Once the concentration of pollutants are estimated in air, soil, water, plants, and animal products, they are used to evaluate estimated exposure to people. Exposure is evaluated by calculating the lifetime average daily dose. The following algorithms calculate this dose for exposure through inhalation, dermal absorption, and ingestion pathways.

A. Estimation of Exposure Through Inhalation

Exposure through inhalation (Dose-inh) is a function of the respiration rate and the concentration of a pollutant in the air.

1. Formula:

$$\text{Dose-inh} = \text{RR} * \text{GLC} / (\text{ABW} * 1,000)$$

- a. Dose-inh = Exposure dose through inhalation (MG/KG/D)
- b. RR = Respiration rate (M3/D)
- c. GLC = Ground-level concentration (UG/M3)
- d. ABW = Average body weight (KG)
- e. 1,000 = Micrograms to milligram conversion factor (UG/MG)

2. Recommended default values:

- a. RR = 20 (M3/D) [OEHHA]
- b. GLC = Calculated above, see I.A.1.
- c. ABW = 70 (KG) [OEHHA]

3. Assumptions:

- a. All material inhaled is absorbed

B. Estimation of Exposure Through Dermal Absorption.

Exposure through dermal absorption (Dose-dermal) is a function of the soil or dust loading of the exposed skin surface, skin surface area exposed, and the concentration and availability of the pollutant.

1. Formula:

$$\text{Dose-Dermal} = Cs * SA * SL * ABS / (ABW * 1E9)$$

- a. Dose-dermal = Exposure dose through dermal absorption (MG/KG/D)
- b. Cs = Average soil concentration (UG/KG)
- c. SA = Surface area of exposed skin (CM2)
- d. SL = Soil loading on skin (MG/CM2)
- e. ABS = Fraction absorbed across skin
- f. ABW = Average body weight (KG)
- g. 1E9 = Micrograms to kilogram conversion factor (UG/KG)

2. Recommended default values:

- a. Cs = Calculated above, see I.A.2.
- b. SA = 4,656 (CM2) [Clement]
- c. SL = .5 (MG/CM2/D) [OEHHA]
- d. ABS = See Table 1
- e. ABW = 70 KG [OEHHA]

C. Estimation of Exposure Through Ingestion.

Exposure through ingestion is a function of the concentration of the pollutant in the substance ingested (soil, water, and food), the gastrointestinal absorption of the pollutant in a soil or fly ash matrix, and the amount ingested.

1. Exposure through Ingestion of Soil

a. Formula:

$$\text{Dose-s} = Cs * Is * GI * BIO * 1E-6 / (ABW * 1,000)$$

- 1> Dose-s = Exposure dose through ingestion of soil (MG/KG/D)
- 2> Cs = Average soil concentration (UG/KG)
- 3> Is = Lifetime average ingestion rate per day for soil (MG/D)
- 4> GI = Gastrointestinal absorption factor
- 5> BIO = Bioavailability
- 6> 1E-6 = Conversion factor (KG/MG)
- 7> ABW = Average body weight (KG)
- 8> 1,000 = Conversion factor (UG/MG)

b. Recommended default values:

- 1> Cs = Calculated above, see I.A.2
- 2> Is = 110 (MG/D) [OEHHA]
- 3> GI = See Table 1
- 4> BIO = See Table 1
- 5> ABW = 70 (KG) [OEHHA]

c. Assumptions:

- 1> Soil ingested contains the average concentration of the pollutants

2. Exposure through Ingestion of Water

a. Formula:

$$Dose-w = Cw * Iw * GI * BIO / ABW * 1,000$$

- 1>Dose-w = Exposure dose through ingestion of water (MG/KG/D)
- 2>Cw = Water concentration (UG/KG)
- 3>Iw = Lifetime average water ingestion rate (KG/D)
- 4>GI = Gastrointestinal absorption factor
- 5>BIO = Bioavailability
- 6>ABW = Average body weight (KG)
- 7>1,000 = Conversion factor (UG/MG)

b. Recommended default values:

- 1> Cw = Calculated above, see I.A.3.
- 2> Iw = 2 (KG/D) = 2 (LITERS/D) [OEHHA]
- 3> GI = See Table 1
- 4> BIO = See Table 1
- 5> ABW = 70 (KG) [OEHHA]

3. Exposure through Ingestion of Food

The exposure through food ingestion can be through ingestion of plant products, animal products (including fish) and mother's milk.

a. Plant products

Exposure through ingesting plants (Dose-p) is a function of the type of plant, gastrointestinal absorption factor, bioavailability and the fraction of plants ingested that are homegrown. The calculation is done for each type of plant.

1> Formula:

$$\text{Dose-p} = Cf * IF * GI * L / ABW * 1,000$$

- a>Dose-p = Exposure dose through ingestion of plant products (MG/KG/D)
- b>Cf = Concentration in plant type F (UG/KG)
- c>If = Consumption of plant type F (KG/D)
- d>GI = Gastrointestinal absorption factor
- e>L = Fraction of plant type F homegrown
- f>ABW = Average body weight (KG)
- g>1,000 = Conversion factor (UG/MG)

2> Recommended default values:

- a>Cf = Calculated above, see I.B.1.
- b>IF = See below
- 1: Root crop = .05 (KG/D) [USDA Western Region]
- 2: Vine crop = .25 (KG/D) [USDA Western Region]

3: Leafy crop = .01 (KG/D) [USDA Western Region]

Ingestion rates are from USDA Western Region Survey results. Dark green vegetables are represented in the leafy category. Yellow vegetables, tomatoes, fruit (excluding citrus juice and bananas) and "other" are included in the vine vegetable category. Potatoes are included in the root vegetable category.

c>GI = See Table 1
d>L = Site specific fraction of produce homegrown or locally produced (need survey)
e>ABW = 70 (KG) [OEHHA]

b. Animal products

Exposure through animal product ingestion (Dose-ap) is a function of what type of meat is ingested, as well as animal milk products and eggs. The calculation is done for each type.

1> Formula:

$$\text{Dose-ap} = Cf * If * GI * L / ABW * 1,000$$

a> Dose-ap = Exposure dose through ingestion of animal or fish products (MG/KG/D)
b> Cf = Concentration in food type f (UG/KG)
c> If = Consumption of food type f (KG/D)
1: Im = Milk consumed
2: Ib = Meat consumed
3: Ifi = Fish consumed
d> GI = Gastrointestinal absorption factor
e> L = Fraction of product type f homegrown
f> ABW = Average body weight (KG)
g> 1,000 = Conversion factor (UG/MG)

2> Recommended default values:

- a> Cf = Calculated above, see I.B.2.
- b> If = See below
- 1: Im = .300 (KG/D) [ARB MRI report]
- 2: Ib = .100 (KG/D) [ARB MRI report]
- 3: Ifi = .024 (KG/D) [OEHHA]
- c> GI = See Table 1
- d> L = Site specific fraction of product locally produced.
- e> ABW = 70 (KG) [OEHHA]

c. Mother's Milk

Exposure through mother's milk ingestion (Dose-Im) is a function of the average pollutant concentration in mother's milk and amount of mother's milk ingested.

1> Formula:

$$\text{Dose-Im} = C_m * \text{DER}_m * F * \text{YR} / 25,550 * (\text{ABW})$$

- a> Dose-Im = Exposure dose through ingestion of mother's milk (MG/KG/D)
- b> C_m = Concentration of contaminant in mother's milk is a function of the mother's exposure through all routes and the contaminant body half-life (MG/KG milk)

1: Formula:

$$C_m = E_{mi} * t_{1/2} * f_1 * f_3 / (f_2 * .693)$$

- a: E_{mi} = Average daily maternal intake of contaminant from all routes (MG/KG milk/D)
- b: t_{1/2} = Half-life of contaminant in mother (D)

c: f1 = Fraction of contaminant that partitions to mother's fat
 d: f3 = % Fat of mother's milk
 e: f2 = % Mother's weight that is fat
 f: .693 = Natural log of 2

2: Recommended default values:

a: Emi = Sum of doses
 b: $t_{1/2}$ = 2,117 (D) for PCDDs/PCDFs = 5.8 YR [Poiger and Schlatter]
 1,460 (D) for both PCBs [Davies and Mes] and PAHs [OEHHA]
 c: f1 = .9 [Smith]
 d: f3 = .04 [Butte et al.]
 e: f2 = .33 [Butte et al.]

c> DER_m = Daily breast-milk ingestion rate (KG/D)
 d> F = Frequency of exposure (D/YR)
 e> YR = Breast-feeding period (YR)
 f> ABW = Average body weight (KG)
 g> 25,550 = Exposure period (D)

2> Recommended default values:

a> DER_m = .9 (KG/D) [Butte et al.; Whitehead and Paul]
 b> F = 365 (D) [Clement]
 c> YR = 1(YR)[Clement]
 d> ABW = 6.5 (KG) [OEHHA]

3> Assumptions:

a> For the MEI, Mother is exposed for first 26 years, the child receives milk for the last year of the mother's exposure period, and then the adult is exposed for the final 44 years.

III. ESTIMATION OF CANCER RISK

Cancer risk is a function of the lifetime average daily dose and the chemical specific potency slope. For inhalation, cancer risk is calculated using unit risk factors and ground-level concentrations.

A. Formula:

$$\begin{aligned} \text{Risk (noninhalation pathways)} &= \text{Dose} * \text{Potency Slope} \\ \text{Risk (inhalation)} &= \text{GLC} * \text{Unit Risk} \end{aligned}$$

- | | | |
|------------------|---|--|
| 1. Dose | = | Dose or the sum of doses from all routes of exposure (MG/KG/D) |
| 2. Potency Slope | = | Pollutant specific potency (1/MG/KG/D) |
| 3. GLC | = | Ground-level concentration (UG/M3) |
| 4. Unit Risk | = | Pollutant specific unit risk (1/UG/M3) |

B. Recommended default values

- | | | |
|------------------|---|------------------------------|
| 1. Dose | = | Calculated above, see II. |
| 2. Potency Slope | = | See Table IV-7 |
| 3. GLC | = | Provided by dispersion model |
| 4. Unit Risk | = | See Table IV-7 |

C. Assumptions:

1. Exposure is for 70 years

IV. ESTIMATION OF CHRONIC HEALTH RISK

As described in Chapters III. and IV., the chronic risk is determined by comparing the exposure doses to established health standards.

**Appendix E-III
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APPENDIX F

REQUEST FORM FOR ARB/OEHHA HEALTH RISK ASSESSMENT COMPUTER PROGRAM

APPENDIX G

PROCEDURE FOR CALCULATING 2,3,7,8-EQUIVALENTS FOR CHLORINATED
DIBENZO-P-DIOXINS AND CHLORINATED DIBENZOFURANS

Procedure for Calculating 2,3,7,8-Equivalents for Chlorinated
Dibenzo-p-dioxins and Chlorinated Dibenzofurans

Calculations of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Toxic Equivalents

There are 210 polychlorinated dibenzodioxin (PCDDs) and dibenzofuran (PCDFs) isomers. The various isomers are not equally toxic nor are they considered equally potent as carcinogens. For the purpose of assessing cancer risk associated with exposure to PCDDs and PCDFs, a system has been devised which uses the concept of toxic equivalent factors (TEF). The isomer 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) appears to be the most potent of the PCDDs and PCDFs. In the TEF scheme, 2,3,7,8-tetrachlorodibenzo-p-dioxin is assigned a TEF of 1. The cancer potency of all other isomers chlorinated in the 2,3,7, and 8 positions are related to TCDD. Table 1 lists the various PCDDs and PCDFs that are chlorinated in the 2,3,7, and 8 positions. TEFs were not developed for the isomers not chlorinated in the 2,3,7, and 8 positions, as these compounds do not exhibit the same toxic properties as the 2,3,7,8 isomers.

The 2,3,7,8-tetrachlorodibenzofuran (TCDF) isomer is rated as equally potent to TCDD and given a TEF of one. Similarly, pentaCDD and pentaCDF are given a TEF of one. The hexa- and heptachlorinated isomers of both PCDDs and PCDFs are given a TEF of 0.03. OctaCDD and octaCDF are not considered carcinogenic at this time and hence are given a TEF of zero. Table 2 list the TEFs for the various PCDDs and PCDFs that are chlorinated in the 2,3,7, and 8 positions.

When calculating toxic equivalents, it is necessary to know the proportion of total PCDD and PCDF that is made up of the 15 isomers chlorinated in the 2,3,7, and 8 positions. For example assume that chlorinated dibenzodioxins are emitted from a source at a rate of 1 nanogram per second. If 15 percent of the total chlorinated dioxins emitted were 2,3,7,8-tetrachloro-p-dibenzodioxin and 25 percent of the total chlorinated dioxins emitted were hexachloro-p-dibenzodioxins (chlorinated in the 2,3,7, and 8 positions), the 2,3,7,8-equivalent emission rate would be calculated as follows:

$$(0.15)(1 \text{ TEF})(1 \text{ nanogram/sec.}) + (0.25)(0.03 \text{ TEF})(1 \text{ nanogram/sec.}) = 0.1575 \text{ nanograms/sec. (TCDD equivalents emission rate)}$$

The TCDD equivalents emission rate is used as input to a dispersion model to calculate the TCDD equivalents ambient concentration at specified receptors. The TCDD equivalents unit risk factor is then used in conjunction with the TCDD equivalents ambient concentration to estimate risk at discrete receptors. The same approach is used to estimate risk from other routes of exposure (e.g., ingestion of soil).

Table 1
Chlorinated Dioxins and Dibenzofurans of Concern

	Dioxins	Furans
Tetrachloro	2,3,7,8	2,3,7,8
Pentachloro	1,2,3,7,8	1,2,3,7,8 2,3,4,7,8
Hexachloro	1,2,3,4,7,8 1,2,3,6,7,8 1,2,3,7,8,9	1,2,3,4,7,8 1,2,3,6,7,8 1,2,3,7,8,9 2,3,4,6,7,8
Heptachloro	1,2,3,4,6,7,8	1,2,3,4,6,7,8 1,2,3,4,7,8,9

Note: The numbers indicate the position of chlorine atoms on the dioxin or furan molecule.

Table 2
**DHS Estimates of Total Carcinogenic Potency
 Relative to (2,3,7,8-TCDD) for Dioxins and Furans**

<u>2,3,7,8 Isomers</u>	<u>Dioxins</u>	<u>Furans</u>
Tetra	1.00	1.00
Penta	1.00	1.00
Hexa	.03	.03
Hepta	.03	.03
Octa	.00	.00

APPENDIX H

**MONTEREY BAY UNIFIED AIR POLLUTION CONTROL DISTRICT PROPOSED METHOD
FOR CHARACTERIZING POPULATIONWIDE CANCER RISK**

Appendix H

Monterey Bay Unified Air Pollution Control District Proposed Method for Characterizing Populationwide Cancer Risk

1. Follow the Screening Analysis procedure described in Chapter 2.2.2 of the CAPCOA Air Toxics Assessment Manual, use an acceptable air quality dispersion model to estimate resultant ambient concentrations at distances from the source of emissions.
2. Calculate the risks in ascending orders of magnitude, to the point of maximum ground level impact, then descending orders of magnitude from the point of maximum ground level impact to a risk of 10^{-6} . The risk values would be expressed as 1, 1/10, 10^{-2} , 10^{-3} , 10^{-4} , 10^{-5} , and 10^{-6} , except at the point of maximum ground level impact. This point would be calculated to exact figures.

Corresponding ambient concentration values at the point of maximum ground level impact, and at each order of magnitude risk value, would be expressed beside the risk values in the output data.

3. Present the risk results on a map of the area surrounding the facility in the form of circular isopleths.

APPENDIX I

CARCINOGENICITY OF CRYSTALLINE SILICA

Appendix I

Carcinogenicity of Crystalline Silica

The International Agency for Research on Cancer (IARC) identified crystalline silica as a possible human carcinogen (group 2A) based on sufficient evidence for its carcinogenicity in experimental animals (rats) and limited evidence in humans. Since the IARC designation was made, another inhalation study in rats at a lower concentration of crystalline silica (1 mg/m^3) also showed respiratory tract tumors. Because of the IARC identification, crystalline silica was put on the list of substances covered by the Air Toxics "Hot Spots" Information and Assessment Act. Crystalline silica includes quartz, tridymite, cristobalite, coesite, and stishovite. Amorphous silica should not be included in the estimates of cancer risk.

Staff of the Office of Environmental Health Hazard Assessment (OEHHA) conducted a quantitative risk assessment for cancer due to crystalline silica exposure using standard risk assessment procedures, as described in the California "Guidelines for Chemical Carcinogen Risk Assessments and their Scientific Rationale," in order to carry out provisions of the Act. The risk number for crystalline silica was placed on the list of preliminary values (Table III-7 of these guidelines) because, although it had been developed by standard procedures, it had not been as thoroughly peer-reviewed as the unit risk values in Table III-6.

The crystalline silica inhalation unit risk is only considered to be a preliminary value since information which may impact the development of a final crystalline silica number is still undergoing internal peer-review.

The OEHHA staff recognize that crystalline silica is carcinogenic in rats by inhalation and in rats and other animals by injection and that it is able to cause mammalian cell transformation. However, although there have been three positive studies by inhalation, the most relevant route for man, they have all been in one species (rats). In the rat, a dose-response study has not been done in a single laboratory and the three positive studies do not exhibit a dose-response relationship among themselves. Carcinogenicity bioassays in hamsters have given negative results and mice have not been adequately tested. The human data on lung cancer have been interpreted by some experts to mean that lung cancer occurs only subsequent to the development of silicosis.

Another consideration is the scaling factor used in the extrapolation. The tumors occur at the site of contact with crystalline silica particles in the lung. Thus, the use of an animal-to-human surface area scaling factor, which is appropriate for a soluble molecule absorbed across a surface, may

be inappropriate for crystalline silica particles. Omission of that scaling factor lowers the risk number obtained using the scaling factor from $2.9 \times 10^{-4} (\text{ug}/\text{m}^3)^{-1}$ to $4.5 \times 10^{-9} (\text{ug}/\text{m}^3)^{-1}$. Because of this uncertainty a range is given for the inhalation unit risk.

Finally it is possible that crystalline silica is a promoter rather than an initiator of carcinogenesis. If true, the crystalline silica carcinogenesis might have a threshold, a concentration below which there would be no risk of cancer. Because of the widespread occurrence of crystalline silica it is important that its carcinogenicity and the mechanism of such carcinogenicity be thoroughly substantiated. There is much uncertainty associated with the present number. The risk is unlikely to be higher than $2.9 \times 10^{-4} (\text{ug}/\text{m}^3)^{-1}$ and it could be much lower.

Because of the unfinished internal review and the lack of external peer review, we have recommended that the designation of facilities as high priority solely due to risks calculated using the crystalline silica cancer potency preliminary value be deferred. For those facilities which were in the high priority category based solely on the crystalline silica preliminary value and were already doing risk assessments, we suggested that risks could be presented both with and without the contribution of crystalline silica.

For the Air Toxics "Hot Spots" Program, crystalline silica cancer risks should be estimated only for that fraction of particles with mass median diameter less than or equal to 10 microns, since these particles will reach the bronchi and penetrate further down the respiratory tract into the lung alveoli.

APPENDIX J

DEVELOPMENT OF NONCANCER AGGEEPTABLE REFERENCE EXPOSURE LEVELS

Appendix J

Development of Noncancer Reference Exposure Levels

This is a description of the procedure used by the OEHHA to develop noncancer reference exposure levels or RELs. In many instances, noncancer acceptable reference exposure levels have not been reported for a specific chemical, and it is necessary for the OEHHA to calculate them. The purpose of the following is to describe our scientific rationale and is not intended as guidance for the reader to develop RELs independently. Please note that previous editions of these guidelines refer to acceptable exposure levels, or AELs, in place of RELs. The change in terms was made because reference exposure level is more appropriate scientifically, and both terms are equivalent for use in risk assessment preparation.

The medical and toxicologic effects reported in the published literature were are reviewed and separated into acute, subchronic, and chronic categories. This information derives primarily from controlled animal studies since industrial or other accidents involving toxicity to humans rarely provide accurate exposure estimates. While acute and chronic data were are used to estimate acceptable concentration limits (ACLs) or acceptable reference exposure levels (AELs) (RELs) for acute and chronic exposure, respectively, the subchronic data was are evaluated for its their applicability to either category.

Chronic exposures

For acute toxicity, emphasis was placed on identifying exposures that produced lethality, serious or irreversible health effects, or no adverse effects. For chronic toxicity, emphasis was is placed on identifying exposures that which increased mortality, produced specific organ toxicity, resulted in reduced weight gain or tissue weights, or caused any clearly defined adverse effect. Lethality is a commonly reported endpoint in acute animal toxicity studies and is generally described as the median lethal concentration or LC_{50} . While such information is useful and may be the only information available in some cases, other less severe endpoints of concern are more desirable for risk assessment purposes if they are available. Irreversible or serious toxicologic effects were are noted.

Finally Ultimately, the most sensitive adverse effect was is identified from which one could base a level at which no toxicologic effects would be expected. The selection of a toxicological endpoint and the type of exposure levels identified are dependent on the availability and adequacy of the existing database for the chemical.

Once the relevant health effect in experimental animals and humans were is identified for exposure to a specific chemical, the threshold level for that effect was is estimated. Absolute threshold levels are difficult to determine from experimental laboratory animal studies or from epidemiological data, so they are often estimated. The threshold is estimated using an uncertainty factor (UF) approach (Dourson and Stara, 1983; National Academy of Sciences, 1977; Calabrese and Kenyon, 1991), or by using a benchmark dose or practical threshold approach (U.S. EPA, 1989; Lewis and Alexeeff, 1989). Although the UF approach is based in part on

scientific judgement, the general reasons for applying them are well-established and will be briefly described here. Other approaches, which use extrapolation factors and are compound substance-specific, can be substituted for the UF approach when as the data are available.

Experimentally, one can identify exposure levels for noncancer endpoints that represent a no-observed-adverse-effect-level (NOAEL), a no-observed-effect-level (NOEL), a lowest-observed-adverse-effect-level (LOAEL) or a lowest-observed-effect-level (LOEL). The NOAEL and NOEL represent practical thresholds of toxicity for the study considered. If NOAELs and NOELs cannot be derived from the study, a NOAEL is usually calculated by dividing a LOAEL by 10. Thus, the first major step in developing a noncancer chronic health risk level is that a NOAEL or NOEL for the endpoint of concern is either identified or estimated.

Upon identification of the relevant noncancer endpoints and estimated practical thresholds for toxicity, uncertainty factors (UFs) were are applied to determine the noncancer AEs RELs for humans.

To calculate AEs RELs, NOAELs (or NOELs) are typically divided by factors of 10 (in most cases) until the major sources of uncertainty in the database data have been considered. The UFs are used primarily to account for the potentially increased sensitivity in humans as compared to laboratory animals (interspecies variability) and the large range of sensitivities within the human population (intraspecies variability). Uncertainty factors are also used on a case-by-case basis to take into account inadequate experimental design or duration, and inadequacy of the database. These UFs are used to account for the limited nature of experimental studies when applying the results to a large human population.

The use of the UFs provides a health-protective approach to risk assessment and there is widespread agreement in the scientific community that this approach is likely to result in adequate margins of safety for the human population including sensitive individuals. Infants, the aged, people suffering from cardiovascular, pulmonary, hepatic, and renal disease are population groups generally considered more sensitive to the effects of toxic exposures. For example, premature and newborn infants may be more sensitive to airborne toxicants at doses below those expected to cause toxicity in adults because their lungs, livers, and kidneys may not be fully developed. The use of the UFs in the derivation of AEs the RELs is designed to protect such sensitive individuals.

Reference exposure levels (AEs) (RELs) were developed for major endpoints identified for some chemicals as shown in Tables J-A1 to J-A9. The reference exposure levels were derived using uncertainty factors UFs to account for limits in the database and scientific knowledge, and to protect public health. Human AEs The REL is the level of exposure at or below which a specified adverse health effect is not anticipated.

Therefore, health protection is achieved if the estimated or actual human exposure is below the relevant AEL REL. That is, if the calculated dose is less than the AEL REL, an adequate margin of safety exists between the predicted exposure and the estimated threshold dose for toxicity. Exposures above the AEL REL do not necessarily equate to significant health risks. Instead, further examination of the implications of this result is required. may indicate that the source has a significant potential to cause adverse noncancer risks. The district should may consult with the OEHHA concerning guidance on evaluating the significance of exceedances of the AELs RELs.

Acute exposures

Unlike chronic exposures, current levels for acute responses have not been developed by the U.S. EPA. Consequently, there is no major source of reference exposure levels for the public. As a result, we are using the following methods to derive RELs. As described in the chronic REL determination procedure, UFs can be used with appropriate data to produce an REL from a NOAEL or LOAEL. More precision is obtained by replacing the NOAEL or LOAEL with a practical threshold, similar to the benchmark dose mentioned above. Additionally, a qualitative, interim level can be determined by selecting a previously formulated planning or response level for use while a more quantitative level is derived.

Currently, one of the principal quantitative methods used in these guidelines for developing acceptable exposure levels was the Defined Practical Threshold as described in the "Quantitative Risk Assessment of Noncancer Health Effects" (Lewis and Alexeeff, 1989). In this paper, ambient concentration limits (REL equivalents) were quantitatively established for exposures up to 60 minutes for several chemicals. These concentration limits were adopted as RELs for many of the chemicals in Table III-9. Additional publications on the subject are also available (Alexeeff, et al., 1992 and Alexeeff et al., in press) and the U.S. EPA is working on a similar approach in the area of developmental toxicity.

Although these limits provide RELs useful in the hazard index procedure, they too have a certain amount of public health protection built-in in those cases where the data are uncertain. They do not necessarily indicate acute exposure concentrations for individual chemicals which could lead to serious or even lethal adverse health effects. As a result, three different RELs for planning for acute exposure to airborne toxicants are currently being examined by OEHHA. These are equivalent to RELs for the most sensitive endpoint, a serious injury level, and a fatality level, respectively. It is anticipated that these levels will provide more information to the district and the public regarding the potential for public health impacts when an exposure exceeds the REL. Further information will be provided in future updates of these guidelines.

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Table J-A

Summary of Toxicologic Data Used to Derive Reference Exposure Levels for Dioxane

<u>Endpoint</u>	<u>Test Species</u>	<u>Concentration</u>	<u>Duration</u>	<u>Type of Effect Level</u>	<u>Uncertainty Factor</u>	<u>Chronic REL</u>	<u>Acute REL</u>	<u>Reference</u>
<u>Acute Effects</u>								
<u>Lethality:</u>								
LC50	rat	13,000 ppm	4 hours	LOAEL	1000	NA	13 ppm	Phillipyuk et al. 1977
LC50	mice	18,000 ppm	2 hours	LOAEL	1000	NA	18 ppm	Phillipyuk et al. 1977
Behavioral: shock avoidance	rat	3000 ppm	4 hours	NOAEL	100	NA	30 ppm	Goldberg et al. 1966
<u>Irritation:</u>								
eye	human	50 ppm	6 hours	LOAEL	100	NA	0.5 ppm	Young et al. 1977
<u>Chronic Effects</u>								
Mortality and body weight:	rat	111 ppm	2 years	LOAEL	1000	0.1 ppm	NA	Torkelson et al. 1974
Kidney function:	rat	0.15 ppm	90 days	LOAEL	1000	0.2 ppb	NA	Phillipyuk et al. 1977
Recommended acceptable concentration limit (acute) - 0.5 ppm - 20 ug/m ³								
Recommended acceptable concentration limit (chronic) - 0.1 ppm - 4 ug/m ³								

Table J-A

Summary of Toxicologic Data Used to Derive Acute Reference Exposure Levels for Methyl Chloroform

<u>Endpoint</u>	<u>Test Species</u>	<u>Concentration</u>	<u>Duration</u>	<u>Type of Effect Level</u>	<u>Uncertainty Factor</u>	<u>Chronic REL</u>	<u>Acute REL</u>	<u>Reference</u>
<u>Acute Effects</u>								
<u>Lethality:</u>								
LC	rat	18,425 ppm	240 min.	NOAEL	100	NA	180 ppm	Calhoun et al. 1988
LC50	mice	18,358 ppm	60 min.	LOAEL	1000	NA	18 ppm	Moser et al. 1985
Neurotoxicity: reaction time, dexterity	human	350 ppm	30 min.	NOAEL	10	NA	35 ppm	Ganberale et al. 1973
Lightheadedness	human	500 ppm	60 min.	LOAEL	100	NA	5 ppm	Stewart et al. 1969
Incoordination mouse ataxia	mouse	4,000 ppm	60 min.	LOAEL	1000	NA	4 ppm	Moser et al. 1985
Incoordination	rat	15,523 ppm	240 min.	LOAEL	1000	NA	16 ppm	Calhoun et al. 1988

Recommended Acute Acceptable Concentration Limit - 35 ppm - 191,000 ug/m³

Table J-A

Summary of Toxicologic Data Used to Derive Acute Reference Exposure Levels for Mercury (Inorganic)

Endpoint	Test Species	Concentration	Duration	Type of Effect Level	Uncertainty Factor	Chronic REL	Acute REL	Reference
<u>Acute Effects</u>								
Kidney, brain damage	rabbit	28.8 mg/m ³	1 hour	LOAEL	1000	NA	30 ug/m ³	Asche et al. 1953
Pneumonitis, death	human	~50 mg/m ³	3 hours	LOAEL	100	NA	500 ug/m ³	Jaeger et al. 1979
Neurotoxicity: many symptoms	human	~44.3 mg/m ³	few hours	LOAEL	100	NA	400 ug/m ³	McFarland et al. 1978
Liver: jaundice	human	~0.025 mg/m ³	acute	NOAEL	10	NA	2.5 ug/m ³	McLaughlin et al. 1981
Neurotoxicity and respiratory	human	0.04-37 mg/m ³	few hours	LOAEL	100	NA	0.4-4 ug/m ³	Lien et al. 1985
Respiratory	human	1-2 mg/m ³	2 hours	LOAEL	100	NA	10-20 ug/m ³	Lillis et al. 1985
Recommended Acute Acceptable Concentration Limit - 30 ug/m ³								

Summary of Toxicologic Data Used to Derive Reference Exposure Levels for Propylene Oxide

Endpoint	Test Species	Concentration	Duration	Type of Effect Level	Uncertainty Factor	Chronic	Acute REL	Reference
Acute Effects								
LC	mouse	387 ppm	4 hours	LOAEL	1000	NA	0.4 ppm	NTP 1985
LC	mouse	945 ppm	240 min.	LOAEL	1000	NA	0.9 ppm	Jacobsen et al. 1956
LC	rat	1277 ppm	4 hours	NOAEL	100	NA	13 ppm	NTP 1985
LC	rat	2684 ppm	240 min.	NOAEL	100	NA	27 ppm	Jacobsen et al. 1956
LC	rat	4000 ppm	240 min.	LOAEL	1000	NA	4 ppm	Smyth et al. 1969
Motor weakness	dog	1363 ppm	240 min.	NOAEL	100	NA	14 ppm	Jacobsen et al. 1956
Irritation	guinea pig	2000 ppm	420 min.	LOAEL	1000	NA	2 ppm	Rove et al. 1956
Irritation	rat	2000 ppm	420 min.	LOAEL	1000	NA	2 ppm	Rove et al. 1956

Recommended Acceptable Concentration Limit (Acute) = 0.4 ppm = 1000 ug/m³

Summary of Toxicologic Data Used to Derive Acute Reference Exposure Levels for Nickel Compounds

Endpoint	Test Species	Concentration	Duration	Type of Effect Level	Uncertainty Factor	Chronic REL	Acute REL	Reference
Acute Effects								
Lethality:								
LC	rat	86 mg NI/m ³	30 min.	LOAEL	1000	NA	86 ug NI/m ³	Sunderman et al. 195
LC	rat	200 mg NI/m ³	30 min.	LOAEL	1000	NA	200 ug NI/m ³	Sunderman et al. 196
Immunotoxicity:								
suppression	mouse	0.11 mg NI/m ³	120 min.	NOAEL	100	NA	1.1 ug NI/m ³	Graham et al. 1978
Irritation and neurotoxicity								
	human	50 mg/m ³	30 min.	LOAEL	100	NA	0.5 mg/m ³	Zhicheng 1986

Recommended Acceptable Concentration Limit (acute) - 1 ug NI/m³

Table J-A

Summary of Toxicologic Data Used to Derive Acute Reference Exposure Levels for Ethylene Glycol Methyl Ether

Endpoint	Test Species	Concentration	Duration	Type of Effect Level	Uncertainty Factor	Chronic REL	Acute REL	Reference
Acute Effects								
Lethality:								
LC	mouse	930 ppm	420 min.	NOAEL	100	NA	9 ppm	Verner et al. 1962*
LC	rat	2,000 ppm	120 min.	NOAEL	100	NA	20 ppm	Carpenter et al. 1956
Erythrocyte fragility	rat	1000 ppm	4 hour	NOAEL	100	NA	10 ppm	Carpenter et al. 1956
Sperm abnormalities	mouse	25 ppm	5 days	NOAEL	100	NA	0.3 ppm	McGregor et al. 1983
Male Reproduction	rat	100 ppm	13 weeks	NOAEL	100	NA	1 ppm	Rap et al. 1983
Fetotoxicity	rat, mouse	10 ppm	9 days	NOAEL	100	NA	0.1 ppm	Hanley et al. 1984
Teratogenicity	rabbit	10 ppm	12 days	NOAEL	100	NA	0.1 ppm	Hanley et al. 1984
Teratogenicity	rat	50 ppm	8 days	NOAEL	100	NA	0.5 ppm	Nelson et al. 1984

Recommended Acute Acceptable Concentration Limit = 0.1 ppm = 320 ug/m³

Table J-A

Summary of Toxicologic Data Used to Derive Acute Reference Exposure Levels for Ethylene Glycol Monoethyl Ether

Endpoint	Test Species	Concentration	Duration	Type of Effect Level	Uncertainty Factor	Chronic	Acute REL	Reference
Acute Effects								
Lethality:								
LC	rat	2,000 ppm	240 min.	NOAEL	100	NA	20 ppm	Carpenter et al. 1956
LC	mice	1,130 ppm	420 min.	LOAEL	1000	NA	1 ppm	Verner et al. 1943
LC50	rat	1,989 ppm	420 min.	LOAEL	1000	NA	2 ppm	Pozzani et al. 1959
Erythrocyte fragility	rat	62 ppm	240 min.	NOAEL	100	NA	0.6 ppm	Carpenter et al. 1956
Behavioral teratogenicity	rat	100 ppm	6 days	LOAEL	1000	NA	0.1 ppm	Nelson et al. 1981, 1982
Teratogenicity	rat	10 ppm	9 days	NOAEL	100	NA	0.1 ppm	Doe et al. 1984
Teratogenicity	rabbit	50 ppm	12 days	NOAEL	100	NA	0.5 ppm	Doe et al. 1984
Teratogenicity	rabbit	160 ppm	18 days	LOAEL	1000	NA	0.2 ppm	Andre et al. 1984
Teratogenicity	rat	150 ppm	19 days	LOAEL	1000	NA	0.2 ppm	Andrew et al. 1984

Recommended Acute Acceptable Concentration Limit - 0.1 ppm - 370 ug/m³

Summary of Toxicologic Data Used to Derive Acute Reference Exposure Levels for Ethylene Glycol Monoethyl Ether Acetate

Endpoint	Test Species	Concentration	Duration	Type of Effect Level	Uncertainty Factor	Chronic REL	Acute REL	Reference
Acute Effects								
Lethality:								
LC	rat	2,000 ppm	240 min.	NOAEL	100	NA	20 ppm	Truhaut et al. 1979
LC50	rat	2,241 ppm	480 min.	LOAEL	1000	NA	2 ppm	Pozzani et al. 1959
Hemoglobinuria	rabbit	2,000 ppm	240 min.	LOAEL	1000	NA	2 ppm	Truhaut et al. 1979
Erythrocyte fragility	rat	32 ppm	240 min.	NOAEL	100	NA	0.3 ppm	Carpenter et al. 1959
Teratogenicity								
Developmental toxicity	rat	130 ppm	8 days	NOAEL	100	NA	1 ppm	Nelson et al. 1984
Developmental toxicity	rat	130 ppm	8 days	LOAEL	100	NA	1 ppm	Nelson et al. 1984
Developmental toxicity	rabbit	25 ppm	12 days	NOAEL	100	NA	0.3 ppm	Doe et al. 1984
Developmental toxicity	rat, rabbit	50 ppm	9-12 days	NOAEL	100	NA	0.5 ppm	Tyl et al. 1988

Recommended Acute Acceptable Concentration Limit - 0.3 ppm - 1620 ug/m³

Table J-A

Summary of Toxicologic Data Used to Derive Acute Reference Exposure Levels for Ethylene Glycol Monobutyl Ether

Endpoint	Test Species	Concentration	Duration	Type of Effect Level	Uncertainty Factor	Chronic	Acute REL	Reference
<u>Acute Effects</u>								
Lethality:								
LC	rat	800 ppm	420 min.	NOAEL	100	NA	8 ppm	Carpenter et al. 1956
LC	mouse	390 ppm	420 min.	NOAEL	100	NA	4 ppm	Werner et al. 1943
Hemoglobinuria								
	rat	100 ppm	420 min.	NOAEL	100	NA	1 ppm	Carpenter et al. 1956
Kidney toxicity								
	rat	202 ppm	240 min.	NOAEL	100	NA	2 ppm	Dodd et al. 1983
Erythrocyte fragility								
	rat	32 ppm	240 min.	NOAEL	100	NA	0.32 ppm	Carpenter et al. 1956
Developmental toxicity								
	rat	50 ppm	9 days	NOAEL	100	NA	0.5 ppm	Tyl et al. 1984
Developmental toxicity								
	rabbit	100 ppm	12 days	NOAEL	100	NA	1 ppm	Tyl et al. 1984

Recommended Acute Acceptable Concentration Limit - 0.3 ppm - 1500 ug/m³

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APPENDIX K

SAMPLE HAZARD INDEX CALCULATION

Appendix K

Sample Hazard Index Calculation

The examples in Tables K-1, K-2, and K-3 illustrate the approach for calculating a chronic hazard index as described in Chapter III (Section III-E,3) of these guidelines. The examples provided are for a hypothetical facility that emits lead, benzene, and 1,4-dioxane.

Calculations

Table K-1 includes the estimated annual average concentrations of lead, benzene, and 1,4-dioxane at the maximum impacted offsite location at an existing receptor. It is assumed that the annual average concentrations that are reported in Table K-1 for lead, benzene, and 1,4-dioxane are based on dispersion modeling. Table K-1 also includes the background concentrations of the six criteria pollutants (i.e., lead, nitrogen dioxide, sulfur dioxide, sulfates, hydrogen sulfide, and ozone) that are required to be addressed as part of Air Toxics "Hot Spots" risk assessments. The background concentrations (i.e., annual average concentrations) of the criteria pollutants are based on ambient monitoring results for the monitoring station that best represents the facility. The chronic AELs/RELS presented in Table K-1 are from Table III-8 of these guidelines.

Table K-1

**Concentration at the Maximum Impacted Offsite Location
Where an Existing Receptor is Located**

<u>Substance</u>	<u>Annual Average Concentration ug/m³</u>	<u>Chronic AEL/REL ug/m³</u>
Lead	0.5	1.5
Benzene	50	71
1,4-Dioxane	2	4
Background Concentrations ^a		
Criteria Pollutants:		
Lead	0	1.5
Ozone	25	180
Nitrogen dioxide	50	470
Sulfur Dioxide	150	660
Sulfates	5	25
Hydrogen sulfide	0	42

a - The concentrations reported for the criteria pollutants (six) to be addressed in Air Toxics "Hot Spots" risk assessments are the annual average concentrations.

Table K-2 uses the information presented in Table K-1 to present the individual hazard index (i.e., the annual average concentration divided by the applicable chronic AELI REL) for the substances emitted by the hypothetical facility. Risk assessments prepared under the Air Toxics "Hot Spots" Program are required to present this information. The district should be consulted concerning the format for presenting the evaluation of noncarcinogenic health effects.

Table K-2

Calculation of Individual Hazard Index

<u>Substance</u>	<u>Annual Average Concentration/ Chronic REL</u>
Lead	0.33
Benzene	0.70
1,4-Dioxane	0.50
Criteria Pollutants:	
Lead	0
Ozone	0.14
Nitrogen dioxide	0.11
Sulfur Dioxide	0.23
Sulfates	0.20
Hydrogen sulfide	0

Table K-3 uses the information presented in Table K-2 as well as the chronic toxicological endpoint information presented in Table III-101 2 of these guidelines to calculate the total hazard index.

Results

Based on the results in Table K-2, a chronic hazard index of one is not equaled or exceeded for any individual substance. However, Table K-3 shows that a total chronic hazard index of one is exceeded for central or peripheral nervous system effects as well as respiratory effects. In the case of respiratory effects, the background concentrations of the criteria pollutants are significantly contributing to the exceedance of one. For a discussion of the significance of exceeding a hazard index of one, refer to Appendix J.

Table K-3

Calculation of Total Hazard Index

Substance	Toxicological Endpoints\ System or Organ Affected ^{a,b}							
	CV/BL	CNS/PNS	IMMUN	KIDN	GI/LV	REPRO	RESP	SKIN
Benzene		0.70						
1,4-Dioxane		0.50		0.50	0.50		0.50	
Lead/lead compounds	0.33	0.33	0.33	0.33		0.33		

Criteria Pollutants:

Hydrogen sulfide							0	
Lead/lead compounds	0	0	0	0		0		
Nitrogen dioxide							0.11	
Ozone							0.14	
Sulfates							0.20	
Sulfur dioxide							0.23	

Total Hazard Index	0.33	1.53*	0.33	0.83	0.50	0.33	1.18*
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* - Total hazard index for specific toxicological endpoint exceeds one.

a - CV/BL - cardiovascular or blood system; CNS/PNS - central or peripheral nervous system; IMMUN - immune system; KIDN - kidney; GI/LV - gastrointestinal system or liver; RESP - respiratory system; REPRO - reproductive system including teratogenic and developmental effects; SKIN - skin irritation or other effects.

b - Each value reported is the ratio of the annual average concentration over the chronic AEL. The chronic AELs are provided in Table III-8 and the chronic toxicological endpoints are specified in Table III-10.

b - Refers to primary target system(s) of concern for each chemical. Hazard indices should be calculated for each specified toxicological endpoint and should include all emitted chemicals that impact that endpoint. These are marked with an X in the appropriate row and column. Consult Tables III-8 for reference exposure levels to use in the chronic hazard index calculations.

APPENDIX L

SAMPLE TABLE OF CONTENTS/SUGGESTED TABLES AND FIGURES

Appendix L-1

Sample Table of Contents for Refined Risk Assessment

I. Executive Summary

- A. Description of facility
- B. Description of impact area
 - 1. Location of maximum exposed individual
 - 2. Location and impact at sensitive receptors
 - 3. Isopleths of ambient air concentrations
- C. Summary of results
 - 1. Emissions of concern
 - 2. Cancer risk
 - 3. Acute and chronic noncancer health risks
 - 4. Note the version of the Risk Assessment Guidelines used to prepare the risk assessment

II. Risk Assessment Procedures

- A. Hazard identification
 - 1. Substances emitted
 - 2. Identification of carcinogens
 - 3. Identification of substances for noncancer effects evaluation
- B. Exposure assessment
 - 1. List of all emission sources
 - 2. Quantification of emissions by pollutant and process
 - 3. Emission release parameters (e.g., stack height and diameter) for each process
 - 4. Air quality modeling-models used, selected options, estimated annual average and peak one-hour concentrations, diskette with model input files
 - 5. Definition of zone impact
 - 6. Identification of population units and sensitive receptors (UTM coordinates and street addresses of specified) receptors
 - 7. Identification of noninhalation pathways

C. Risk characterization

1. Map of impact zone

- o Location of maximum exposed individual
- o Location of sensitive receptors
- o Overlay with isopleths of risk (overlay maps)

2. Calculation of cancer risk

- o Maximum individual risk
- o Individual risk by population unit (district option)
- o Cancer burden (overlay with isopleths of risk)

3. Evaluation of noncancer risks

- o Comparison of acute and chronic exposure levels to OEHHA acceptable exposure levels or EPA reference dose levels (using hazard index approach as specified in guidelines).
- o Overlay hazard index isopleth on maps

4. o Qualitative discussion of toxicity of emitted listed Air Toxics "Hot Spots" Program substances which cannot be quantitatively assessed (information provided in material safety data sheets or toxicology handbook).

III. Conclusions

IV. Risk Management Options (at district option)

V. References

VI. Appendices

A. All calculations

B. Dispersion modeling printouts

C. Exposure modeling print outs

1. Risk by pathway
2. Exposure calculations

D. Population characterization

E. Alternative Risk Assessment Methods

Appendix L-2

Suggested Tables and Figures:

1. Executive Summary

- ** table of all listed Air Toxics "Hot Spots" Program substances that are emitted_
- ** table(s) that list the known and potential human carcinogens emitted by the facility, the maximum offsite cancer risk and maximum individual offsite cancer risk at an existing receptor
- ** table that shows excess cancer burden for each receptor group and the total excess cancer burden.
- ** table that presents the (acute and chronic) individual hazard index for each substance at the maximum impacted offsite location as well as the maximum impacted offsite location at an existing receptor.
- ** table that presents the (acute and chronic) total hazard index for each toxicological endpoint at the maximum impacted offsite location as well as the maximum impacted offsite location at an existing receptor.

2. Risk Assessment Procedures

a. hazard assessment

- ** tables listing all "Hot Spots" Act substances which are emitted.
- ** tables that indicate substances to be evaluated for cancer risk and noncancer effects.

b. exposure assessment

- ** tables with emissions rates for emitted "Hot Spots" Act substances from each process. Emissions reported in lbs/yr and maximum lbs/hr. Release parameters (e.g., stack height and diameter) for each release point. Total emissions need only be reported for substances which can not be quantitatively addressed in the risk assessment.
- ** sample calculations should be provided at each step to indicate how reported emission data was used. A reader should be able to reproduce the risk assessment without the need for clarification.

- ** table identifying any emission estimates used for the risk assessment that are not reflected in the emission inventory report.
- ** general description of the methods used to estimate emissions.
- ** tables that summarize the annual average concentrations that are calculated for all the substances at each site. The use of tables that present the relative contribution of each emission point to the receptor concentration is recommended. (These tables should have clear reference to the computer model which generated the data. It should be made clear to any reader how data from the computer output was transferred to these tables.) [As an alternative, the above two tables could contain just the values for sites of maximum impact and sensitive receptors. All the values would be found in the Appendices.]
- ** tables that provide the UTM coordinates and street addresses, where possible, of specified receptor locations.
- ** tables that summarize short-term concentrations for analysis of acute effects.
- ** a map that shows the location of the facility, zones of impact, sites of maximum exposure, location of all sensitive receptors. This should be a true map (one that shows roads, structures, etc.), drawn to scale, and not just a schematic drawing.
- ** output tables that identify the modeling parameters as well as the maximum impacts. For example, the first few pages of the ISCST2 output, which describes the regulatory options and emission parameters that were selected.
- ** a diskette containing the input files used for the models (e.g., the ISCST2 input file containing the regulatory options and emission parameters, receptors locations, meteorology, etc.). By providing this information on a diskette, it will allow district staff to expedite review of the risk assessment.

c. risk characterization

- ** tables that present risks for both the inhalation pathway and applicable noninhalation pathways.
- ** tables that list risk for each pollutant by pathway.

** table that presents the (acute and chronic) individual hazard index for each substance at the maximum impacted offsite location as well as the maximum impacted offsite location at an existing receptor.

** table that presents the (acute and chronic) total hazard index for each toxicological endpoint at the maximum impacted offsite location as well as the maximum impacted offsite location at an existing receptor.

** tables that list the excess cancer burden for each site.

3. Conclusions

** summary tables (similar to those described in #1 above) that will lend support to any concluding statements.

4. Risk Management Appendix (at district option)

** summary tables of risk reductions achievable with potential control strategies.

APPENDIX M

OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT
MEMORANDUMS REGARDING LEAD
AND CRYSTALLINE SILICA

OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

2151 BERKELEY WAY, ANNEX 11
BERKELEY, CA 94704

May 7, 1993

Mr. Stewart J. Wilson
Executive Director
CAFCOA
3232 Western Drive
Cameron Park, California 95682

Re: Evaluation of acute exposure to lead in the Air Toxics Hot Spots Program

Dear Mr. Wilson:

Recently OEHHA staff have had several inquiries from local Air Pollution Control Districts about the use of the California Ambient Air Quality Standard for lead of $1.5 \mu\text{g}/\text{m}^3$ to calculate an acute hazard index for lead exposure in the Air Toxics Hot Spots program. This inquiry has arisen because several facilities subject to AB 2588 have acute (one hour) impacts at the Maximally Exposed Individual exceeding this level, while the standard is based on exposure averaged over a 30 day period. The highest one hour exceedance of which we are presently aware is approximately 93 times this level. This exceedance indicates that a child could be exposed to $140 \mu\text{g}/\text{m}^3$ lead in the air for one hour, a very high exposure. Because of lead's well known toxicity, the possibility of such exceedances is of great concern to staff. We have used a standard based on a 30 day averaging period but frankly we have not yet found anything better to use. Therefore, as an interim step, until we can find a more appropriate Reference Exposure Level for acute exposure to lead, we suggest that a 30 day averaging time be used to estimate the lead exposure at impacted receptors so that a hazard index for lead can be calculated. Since exposure for 30 days cannot be called acute, the hazard index would be for subchronic exposure. We would also suggest that facilities report their highest one hour lead concentration in the report for comparative purposes.

Because of this change some facilities may not have to notify under Hot Spots. This, however, does not exempt them from compliance with other laws such as Proposition 65.

The chronic Reference Exposure Level for lead will remain at $1.5 \mu\text{g}/\text{m}^3$. However, we are currently considering lead in the toxic air contaminant identification process. Based on that process we may soon recommend a change in the Reference Exposure Level to $0.75 \mu\text{g}/\text{m}^3$. We continue to look for toxicological studies that could result in the development of an appropriate acute reference exposure level.

We hope that this change is acceptable to you and to the affected Districts. If you have any questions about our approach, please call me at (510) 540-2907.

Sincerely,

George V Alexeeff
George V. Alexeeff, Ph.D.
Chief, Air Toxicology and
Epidemiology Section

OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

2151 BERKELEY WAY, ANNEX 11
BERKELEY, CA 94704



May 5, 1993

Mr. Stewart J. Wilson
Executive Director
CAPCOA
3232 Western Drive
Cameron Park, California 95682

Re: Reference Exposure Level for Crystalline Silica

Dear Mr. Wilson:

The Air Toxicology and Epidemiology Section (ATES) is recommending that the use of the Reference Exposure Level (REL) for respirable crystalline silica in Hot Spots risk assessments be put on hold until it can be peer reviewed by the Air Resources Board Scientific Review Panel as part of the Office of Environmental Health Hazard Assessments (OEHHA's) adoption of Air Toxics Hot Spots Program Risk Assessment Guidelines. This postponement will allow external peer review and public discussion of the most appropriate way to assess the risks of exposure to respirable crystalline silica. ATES will no longer consider the REL in its review of the Air Toxics Hot Spots risk assessments. As indicated in the February 22, 1991 letter, a similar position was taken for the cancer unit risk value.

In order to implement the Air Toxics Hot Spots Information and Assessment Act of 1987, a right-to-know law, staff were faced with providing guidance on evaluating the health impact of hundreds of listed chemicals and a paucity of peer reviewed values for health effects. In the case of crystalline silica, known to the State to cause cancer, we used animal cancer studies to develop a cancer potency. For non-cancer effects of silica we considered $50 \mu\text{g}/\text{m}^3$ to be a No Observed Adverse Effect Level. The $50 \mu\text{g}/\text{m}^3$ is the Threshold Limit Value used by the American Conference of Governmental Industrial Hygienists. This No Observed Adverse Effect Level was divided by 4.2, a time adjustment factor, and by 10, the usual human intraspecies uncertainty factor, to obtain a Reference Exposure Level (REL) of $1.2 \mu\text{g}/\text{m}^3$. The toxic endpoint of concern was respiratory effects, particularly silicosis, a well known, debilitating fibrotic disease of the lungs most often caused by chronic occupational exposure to respirable crystalline silica, but also seen after high level acute exposure.

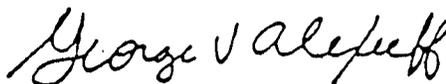
While this methodology is adequate to develop a criterion to identify potential problems, OEHHA does not feel it is necessarily appropriate to use as a basis for stringent regulatory action. Such a criterion needs to undergo more thorough review. That is the process we are now planning for crystalline silica.

Mr. Stewart J. Wilson
May 6, 1993
Page 2

The US EPA has been developing a Reference Exposure Concentration (RfC) for crystalline silica in the range of 0.03 to 2.0 $\mu\text{g}/\text{m}^3$. Note that the chronic REL of 1.2 $\mu\text{g}/\text{m}^3$ falls within the range. ATEs had hoped to adopt the US EPA criterion, however, the US EPA has apparently put development of the crystalline silica RfC on hold. Therefore, ATEs will go ahead with the peer review of its own criterion. The process will allow for public and external peer review of the REL.

If you have additional questions about this issue, please call me at (510) 540-2907.

Sincerely,



George V. Alexeeff, Ph.D., Chief
Air Toxicology and Epidemiology Section