Modeling Guidelines for

Health Risk Assessments

June 2010

Form -15i

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1. Introduction

1.1 Scope

This document explains the requirements for performing health risk assessments for the Santa Barbara County Air Pollution Control District (APCD). It is assumed that the reader has some modeling experience with ISC and HARP. This document is not intended as a user's guide for HARP or ISC. User's guides for HARP and ISC are noted in the reference section of this document and should be consulted for troubleshooting or when background information is needed on a topic. The purpose of this document is to clarify the requirements for the air dispersion model using ISC and the health risk assessment using HARP.

1.2 Applicability

A Health Risk Assessment (HRA) must be completed for any facility that meets any of the following criteria:

1. A new or existing facility whose permitted criteria pollutant emissions are 10 tons per year or greater.

2. A new or existing facility emitting less than 10 tons per year of criteria pollutant emissions and the facility class is listed in Appendix E of ARB's 2007 "Emission Inventory Criteria and Guidelines" (and any updates thereof). Note that an HRA is required even if a permit is not required (e.g., the applicant is requesting an exemption). Appendix E may be found at http://www.arb.ca.gov/ab2588/final/e.pdf .

3. A new or existing facility identified by the APCD as posing a concern to public health. These include, but are not limited to, the following: the project requires a school notice pursuant to H&SC §42301.6; a health risk assessment (HRA) is required via the CEQA process; another public agency has requested that a HRA be performed; or a screening table or model shows the emissions from this facility may result in a significant risk.

2. Air Dispersion Model

At this time the APCD requires that EPA's ISC (Industrial Short Term) Model be used to perform air dispersion modeling for health risk assessments. Furthermore, the APCD requires that the health risk assessment be performed in the California Air Resources Board's HARP (available for download at http://www.arb.ca.gov/toxics/harp/harp.htm). When HARP has been updated to allow for EPA's AERMOD model and there are APCD-approved meteorology data sets available, these guidelines will be revised to allow for the use of AERMOD. The current version of HARP is Version 1.3 (Build 23.04.05), which incorporates ISC version 99155 and BPIP dated 04112.

2.1 Control Options - Regulatory and Non-Regulatory Options

The ISC model contains several regulatory options, which are set by default, as well as non-regulatory options. The APCD requires the following control options (non-regulatory):

Table 2.1 – Control Options for Dispersion Model	
Control Option	**Assumption**
Use Regulatory Default?	No
Gradual Plume Rise?	Yes
Stack Tip Downwash?	Yes
Buoyancy Induced Dispersion?	No
Calms Processing?	No
Missing Data Processing?	No
Include Building Downwash?	No
Lowbound Option?	No

The use of any other control option must be justified through a discussion in the HRA report and approved by the APCD.

2.2 Source Parameters

The following sections outline the primary source types and their input requirements. Detailed descriptions of the input fields are found in EPA's ISC User Guide (see References 1 and 2). All units specified below are based on input into HARP. The units specified below may not apply if ISC is run outside of HARP.

2.2.1 Point Sources

A point source is the most common type of release and is characterized by a traditional stack or isolated vent. Example point sources include combustion equipment with stacks and closed fixed roof tanks. See below for special notes on input requirements for point sources:

- X Coordinate: Easting UTM at the center of the point source.
- Y Coordinate: Northing UTM at the center of the point source.
- Release Height (or stack height) above Ground [feet]: The source release height above the ground.
- Stack Diameter [ft]: The inner diameter of the stack.

2.2.2 Area Sources

Area sources are used to model releases that occur over an area. Example area sources include landfills, open tanks, storage piles, slag dumps, and lagoons. The ISC model accepts rectangular areas that may also have a rotational angle specified relative to a north-south orientation. See below for special notes on input requirements for area sources. Refer to EPA's ISC User Guide (Reference 1) for more details on inputting area source data.

- X Coordinate: Easting UTM for the vertex (corner) of the area source that occurs in the southwest quadrant of the source
- Y Coordinate: Northing UTM for the vertex (corner) of the area source that occurs in the southwest quadrant of the source
- Release Height above Ground [ft]: The release height above ground.
- Options for Defining Area: The only option for defining the area is a rectangle or square. The maximum length/width aspect ratio for area sources is 10 to 1.

- Irregularly Shaped Areas: An irregularly shaped area can be represented by dividing the area source into multiple smaller areas (i.e., multiple rectangles).
- Orientation Angle: If the angle is not zero, the model will rotate the area source clockwise around the vertex. The vertex is defined by the UTM coordinates given for the area source. See Figure 2.2.2 for visual representation of the relationship between the angle, length of x side and length of y side.

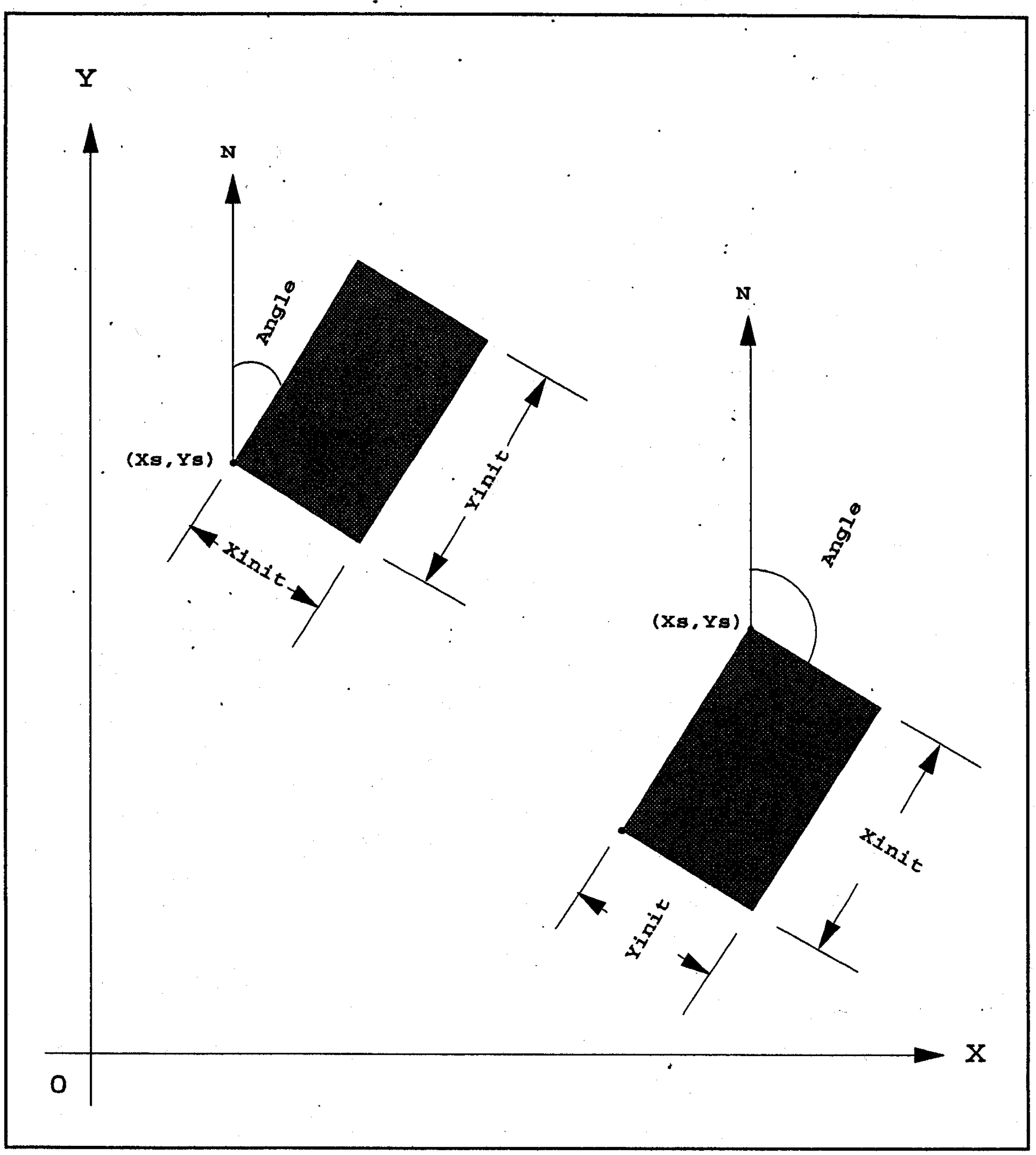


Figure 2.2.2 – Relationship of Area Source Parameters for Rotated Rectangle

2.2.3 Open Pit Sources

The open pit algorithm uses an effective area for modeling pit emissions, based on meteorological conditions. The model then treats the effective area as an area source to determine the impact of emissions. The ISC model accepts rectangular areas that may also have a rotational angle specified relative to a north-south orientation. See below for special notes on input requirements for area sources. Refer to EPA's ISC User Guide (Reference 1) for more details on inputting open pit source data.

- X Coordinate: Easting UTM for the vertex (corner) of the open pit that occurs in the southwest quadrant of the source
- Y Coordinate: Northing UTM for the vertex (corner) of the open pit that occurs in the southwest quadrant of the source
- Release Height above Ground [ft]: The average release height above the base of the pit. The release height cannot exceed the effective depth of the pit, which is calculated by the model based on the length, width and volume of the pit. A release height of zero indicates emissions are released from the base of the pit.
- Options for Defining the Open Pit: The open pit may be represented as a rectangle with a length to width ratio, aspect ratio, of up to 10 to 1. However, since the open pit algorithm generates an effective area for modeling emissions from the pit, and the size, shape and location of the effective area is a function of wind direction, an open pit cannot be subdivided into a series of smaller sources. If the aspect ratio is large than 10, the user should characterize the irregularly shaped pit areas by a rectangular shape of equal area.
- Orientation Angle: If the angle is not zero, the model will rotate the open pit clockwise around the vertex. The vertex is defined by the UTM coordinates given for the area source. See Figure 2.2.2 for visual representation of the relationship between the angle, length of x side and length of y side.

2.2.4 Volume Sources

Volume sources are used to model releases from a variety of industrial sources, such as building roof monitors, fugitive leaks from an industrial facility, multiple vents, conveyor belts, wipe cleaning, and general solvent usage. A volume source is a square area with a vertical dimension. See below for special notes on input requirements for volume sources:

- X Coordinate: Easting UTM at the center of the volume source.
- Y Coordinate: Northing UTM at the center of the volume source.
- Release Height above Ground [ft]: The release height above surface at the center of volume.
- Length of Side [ft]: The length of the side of the volume source. The volume source cannot be rotated and has the X side equal to the Y side (square).
- An irregularly shaped volume can be represented by dividing the volume source into multiple smaller volumes (i.e., multiple boxes).
- Initial Lateral Dimension (σ_{yo}) [ft]: This parameter is calculated by choosing the appropriate condition in Table 2.2.4 below.
- Initial Vertical Dimension (σ_{zo}) [ft]: This parameter is calculated by choosing the appropriate condition in Table 2.2.4 below.

Table 2.2.4 Summary of Suggested Procedures for Estimating Initial Lateral Dimension (σ_{yo}) and Initial Vertical Dimension (σ_{zo}) for Volume and Line Sources.	
Type of Source	**Procedure for Obtaining Initial Dimension**
Initial Lateral Dimension	
Single Volume Source	σ_{yo} = (side length in feet)/4.3
Line Source Represented by Adjacent Volume Sources	σ_{yo} = (side length in feet)/2.15
Line Source Represented by Separated Volume Sources	σ_{yo} = (center to center distance in feet)/2.15
Initial Vertical Dimension	
Surface-Based Source ($h_e \sim 0$)	σ_{zo} = (vertical dimension of source in feet)/2.15
Elevated Source ($h_e > 0$) on or Adjacent to a Building	σ_{zo} = (building height in feet)/2.15
Elevated Source ($h_e > 0$) not on or Adjacent to a Building	σ_{zo} = (vertical dimension of source in feet)/4.3

2.2.5 Line Sources
Examples of line sources are conveyor belts and rail lines. ISC does not have a default line source type. However, ISC can simulate line sources through a series of volume sources. If line sources are necessary, follow the methodology outlined in the "Line Source Represented by Separated Volume Sources" as described in Volume II of the EPA ISC User's Guide (Reference 3).

2.3 Building Impacts and Area of Influence
Buildings and other structures near a relatively short stack can have a substantial effect on plume transport and dispersion, and on the resulting ground-level concentrations that are observed. Building downwash for point sources that are within the Area of Influence of a building must be considered. A building is considered sufficiently close to a stack to cause wake effects when the distance between the stack and the nearest part of the building (Area of Influence) is less than or equal to five (5) times the lesser of the building height or the projected width of the building.

$\text{Distance}_{\text{stack-bldg}} \leq 5L$
where, L = Lesser of the Building Height (PB) or Projected Building Width (PBW)

2.3.1 Defining Buildings
The following information is required to perform building downwash analysis:

- UTM coordinates for all building corners (including easting and northing).
- Height for all buildings (meters). For buildings with more than one height or roofline, identify each height (tier).
- Base elevations for all stacks and buildings. **The base elevation for buildings must be included in the *Facility and Emissions* module of HARP. The DEM files will not populate this information in the *Dispersion Analysis* module.**

2.4 UTM Coordinate System
The coordinate system used for ISC is Universal Transverse Mercator (UTM). Ensure all model objects (sources, buildings, receptors) are defined in the same horizontal datum. Defining some objects based on

a NAD27 (North American datum of 1927) while defining others within a NAD83 (North American datum of 1983) can lead to significant errors in relative locations.

2.5 Terrain

Terrain elevation is the elevation relative to the facility base elevation. Terrain elevations can have a large impact on the air dispersion modeling results. The following elevation options shall be used in the dispersion model:

- For facilities with all neighboring parcels graded to the same level, the dispersion model may be run with "FLAT" terrain heights.
- If there are elevation changes surrounding the facility, choose "ELEV" for terrain heights and "BOTH" for the terrain model, with the appropriate Digital Elevation Model (DEM) files.

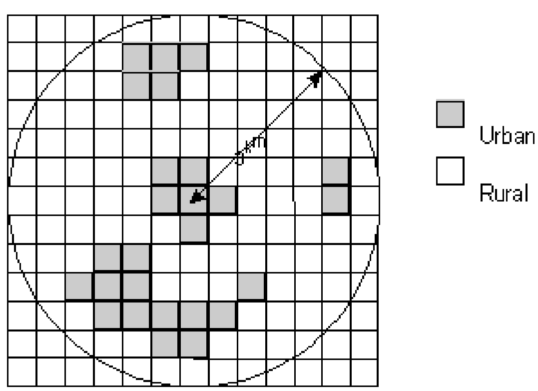
Keep in mind that the USGS DEMs can be in one of two horizontal datums. Older DEMs were commonly in NAD27 (North American Datum of 1927) while many of the latest versions are in NAD83 (North American Datum of 1983).

Elevation data should be obtained from Digital Elevation Model (DEM) files. USGS DEMs are available for California from ARB at (http://www.arb.ca.gov/toxics/harp/maps.htm) in 7.5-minute format for use in the ARB HARP program.

2.6 Defining Urban and Rural Conditions

The classification of a site as urban or rural can be based on the Auer method specified in the EPA document *Guideline on Air Quality Models (40 CFR Part 51, Appendix W) (see reference 4).* Follow the Auer method, explained below, for the selection of either urban or rural dispersion coefficients:

1. Draw a circle with a radius of 3 km from the center of the emission source or centroid of the polygon formed by the facility emission sources.
2. If land use types are industrial, commercial, dense single/multi-family, and multi-family, two-story account for 50 % or more of the area within the circle, then the area is classified as urban, otherwise the area is classified as rural.
3. To verify if the area within the 3 km radius is predominantly rural or urban, overlay a grid on top of the circle and identify each square as primarily urban or rural. If more than 50 % of the total number of squares is urban then the area is classified as urban; otherwise the area is rural.



From the Auer method, areas typically defined as Rural include:

- Residences with grass lawns and trees
- Large estates
- Metropolitan parks and golf courses
- Agricultural areas
- Undeveloped land
- Water surfaces

Auer defines an area as Urban if it has less than 35% vegetation coverage or the area falls into one of the following use types:

Table 2.6 - Urban Land Use	
Use and Structures	**Vegetation**
Heavy industrial	Less than 5%
Light/moderate industrial	Less than 5%
Commercial	Less than 15%
Dense single / multi-family	Less than 30%
Multi-family, two-story	Less than 35%

2.7 *Meteorology Data*

The APCD has compiled meteorological data for use in ISC. If multiple years exist for more than one station, use all years in analysis. You may request the data by emailing the APCD at: engr@sbcapcd.org. Please contact the APCD if you wish to use alternative meteorological data or are performing a risk assessment for an area not listed below.

Table 2.7 Available meteorological data sets for Santa Barbara County						
File Name	**Station Name**	**Site No.**	**Station No.**	**Year**	**Location**	**Area for Use**
Bat88.asc□	Battles	1	93214	1988	Battles Gas Plant	Eastern Santa Maria
Bat89.asc□	Battles	1	93214	1989	Battles Gas Plant	
Car88.asc□	Carpinteria	18	93111	1988	Carpinteria	Inland Carpinteria
Car89.asc□	Carpinteria	18	93111	1989	Carpinteria	
Gav88.asc□	Gaviota West	19	93111	1988	Gaviota	Gaviota
Gav89.asc□	Gaviota West	19	93111	1989	Gaviota	
LFC489.asc□	LFC Site 4	4	93214	1989	Los Flores Canyon	Los Flores Canyon
LFC88.asc□	Exxon Site 10	30	93111	1988	UCSB West Campus	Coastal Areas (e.g., Ellwood, coastal Carpinteria)
LFC89.asc□	Exxon Site 10	30	93111	1989	UCSB West Campus	
Lom88.asc□	Lompoc H St	3	93214	1988	Lompoc	Lompoc
Lom89.asc□	Lompoc H St	3	93214	1989	Lompoc	
Sbc63.asc□	Santa Barbara	23190	23190	1963	Santa Barbara Airport	Santa Barbara
Smx63.asc□	Santa Maria	23273	23273	1963	Santa Maria Airport	Santa Maria

2.8 Receptors

Receptor selection is critical to capturing the point of maximum impact. The proper placement of receptors can be achieved through several approaches as discussed below.

The receptor network must provide adequate coverage to capture the maximum pollutant concentration. The receptor network should include a Cartesian grid, property boundary receptors, and any sensitive receptors in the area. Polar coordinates may also be used to ensure that maximum concentrations are obtained. (Polar coordinates may be added via sensitive receptors in HARP, but at this time require a separate utility to generate the polar grid.) Tall stacks could require grids extending 1 to 3 km while the point of maximum impact from shorter stacks (10 - 20 m) may be obtained using grids extending 1 km or less from the property line.

2.8.1 Sensitive Receptors

All sensitive receptors within 1 km of the proposed site, unless otherwise determined by the APCD, should be included in any modeling runs. A sensitive offsite receptor is defined as the following:

- Schools
- Daycare facilities
- Hospitals
- Care facilities (adult/elderly)
- Residential or commercial (if not covered by another grid receptor)
- Air intakes on nearby buildings
- Parks

2.8.2 Onsite Receptors

In special situations, there will be sensitive receptors within the facility boundary. For example, if a boarding school would like to install a diesel generator and a risk assessment is required, the onsite dorms must be considered in the risk assessment. Other cases like this include schools, daycare facilities, hospitals and care facilities (adult/elderly). In these situations, the building in which people sleep (e.g., dorms) or spend the majority of their day (e.g., day care building) must be included as a receptor.

2.8.3 Cartesian Receptor Grids

HARP will create a grid of Cartesian receptors that are defined by an origin with receptor points in x and y directions. For small property boundaries like gas stations, the grid points must be no greater than 20 meters apart. For facilities with very large property boundaries (e.g., oil and gas leases), the grid points must be no greater than 100 meters apart. If it appears that the grid receptors are not close enough to capture the point of maximum impact, the APCD will require the HRA to be rerun with a finer grid. For facilities with a large number of emitting sources and a large property boundary, fine grid spacing will significantly impede the ISC run time. It may be necessary to run the HRA with a course grid to determine the areas of highest risk and then rerun the HRA with a finer grid in those areas. If this method is used, finer grids should be used for all areas with high concentrations, not just the single highest area. Until HARP allows for multiple grids, this may require numerous runs.

The grid shall extend at least 1 km from the property boundary. If there are significant impacts near the edge of the grid, the grid must be extended farther.

2.8.4 Property Boundary Receptors

Receptors shall be placed along the property boundary and may be used to determine the point of maximum impact. The spacing of these receptors depends on the distance from the emission sources to the facility boundaries. For cases with emissions from short stacks or vents and a close property line, a receptor spacing of 10-25 meters may be required. For larger facilities, like oil and gas leases, a spacing of 50-100 meters is more practical. A second run may be required with a finer spacing if the point of maximum impact is at or near the property boundary.

3. Risk Assessment

3.1 Analysis Method

The 70 year (adult resident) exposure duration with the Derived (Adjusted) Method shall be used to determine the cancer risk for any parcels that are not zoned commercial. For parcels zoned commercial, the 40 year worker exposure point estimate may be used. The Derived (OEHHA) Method shall be used to determine the chronic hazard index.

3.1.1 Worker Exposure – Commercial Zoning

If the parcels surrounding your facility are zoned commercial, the cancer analysis may be run with a worker exposure duration of 40 years instead of the residential exposure of 70 years. Alternatively, the applicant may choose to run the 70 year residential exposure for all areas. If the residential exposure shows there is no significant risk, it is not necessary to run the worker exposure scenario.

3.1.2 Worker Exposure – Ground Level Adjustment Factor

When the worker exposure scenario is used, it may be necessary to use a ground level concentration (GLC) adjustment factor. If the annual average concentration of pollutants from the emitting facility (determined by the air dispersion model) is different than the air concentration that the worker breathes when present at the site, then the annual average concentration for the worker inhalation pathway will need to be adjusted. For example, if the offsite worker and emitting facility are on concurrent schedules (i.e., the worker has a standard working schedule of eight hours per day, 5 days a week, and the facility emits the same 5 days a week, 8 hours per day), then the annual average air concentrations for the worker inhalation pathway would need to be approximated by adjusting it upward using a factor of 4.2 (7/5 x 24/8). The annual average determined by the air modeling program is a 24 hour per day, 7 days per week, 365 days per year regardless of the actual operating schedule of the facility. The adjustment simply reflects the air concentration that the worker breathes. If the worker is only present some or none of the time that the facility is operating, then the average concentration that the worker breathes over his or her working day may be used. For example, if the facility emits during the day, five days a week, and the offsite worker is working only at night, then no inhalation exposure would occur.

3.2 Site Parameters for Multipathway Analysis

If your facility emits any multipathway pollutants, a multipathway analysis is required. Use all the pathways that are recommended below. HARP will determine the appropriate pathway for each pollutant based on the pathways you specify for the HRA. The specific pathways than can be evaluated for multipathway pollutants may be found in Table 5.1 of OEHHA's *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* (http://www.oehha.ca.gov/air/hot_spots/pdf/HRAguidefinal.pdf).

- **Dermal.** Always include this pathway. No default information is required.
- **Soil Ingestion.** Always include this pathway. No default information is required.
- **Mothers Milk.** Always include this pathway. No default information is required.
- **Home Grown Produce.** Include this pathway for initial HRA. Use the default fraction consumed values listed in HARP unless site specific information is available. If the risk is significant, determine if there are residences within the isopleth. If there are no residences in

the isopleth[1], or the residences clearly do not have a garden (e.g., dorm), rerun HRA without this pathway.

- **Chicken/Eggs.** Include this pathway for initial HRA. Use the default fraction consumed values listed in HARP unless site specific information is available. If the risk is significant, determine if there are residences within the isopleth. If there are no residences in the isopleth, or the residences clearly do not have chickens (e.g., apartments, dorms), rerun the HRA without chickens/eggs. If it seems possible that the residences have chickens, the source may have the opportunity to prove that there are no chickens in the isopleth (e.g., citing regulations/city ordinance that farm animals are not allowed in that area).
- **Drinking Water.** Do not include this pathway for initial HRA. Rerun the HRA with this pathway only if there is a pond or other water source that is used directly for drinking water (i.e., municipal water sources should not be included) within the isopleth. The fraction consumed and the location, area, volume and number of volume changes per year of the pond/water source are required information to use this pathway.
- **Fish.** Do not include this pathway for initial HRA. Rerun the HRA with this pathway only if there is a fish pond or lake within the isopleth. The fraction consumed and the location, area, volume and number of volume changes per year of the pond/lake are required information to use this pathway.
- **Beef/Dairy, Pigs.** Do not include these pathways (separate pathways) for initial HRA. Rerun the HRA with this pathway only if there is a pasture or pig farm in the isopleth. The fraction consumed and the location, area, volume and number of volume changes per year of the pasture's water source are required information to use the beef/dairy pathway. For pigs, use the default fraction consumed and feed fraction values listed in HARP unless site specific information is available.

3.3 Point of Maximum Impact

The offsite Point of Maximum Impact (PMI) must be reported. This value will be compared to the APCD's significant risk threshold to determine if the project creates a significant risk to the surrounding community. To further clarify, the offsite PMI may be a boundary receptor, grid receptor or a sensitive receptor. No residence or business is required to occupy the offsite PMI.

3.4 Health Effects

Health effects are divided into cancer and non-cancer risks. "Cancer risk" refers to the increased chance of contracting cancer as a result of an exposure, and is expressed as a probability: chances-in-a-million. The values expressed for cancer risk do not predict actual cases of cancer that will result from exposure to toxic air contaminants. Rather, they state a possible risk of contracting cancer over and above the background level.

For non-cancer health effects, risk is characterized by a "Hazard Index" (HI), which is obtained by dividing the predicted concentration of a toxic air contaminant by a Reference Exposure Level (REL) for that pollutant that has been determined by health professionals. RELs are used as indicators of the potential adverse effects of chemicals. A REL is the concentration at or below which no adverse health effects are anticipated for specific exposure duration. Thus, the HI is a measure of the exposure relative to a level of safety and is appropriately protective of public health.

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[1] Any reference to isopleth refers to the isopleths of 1 in a million for cancer risk and a hazard index of 0.1 for both chronic and acute.

3.5 Significant Risk Thresholds

In June 1993, Santa Barbara County Air Pollution Control Board of Directors (APCD's Board) adopted health risk notification levels. The risk notification levels were set at 10 per million for cancer risk and a Hazard Index of 1.0 for non-cancer risk. Risk reduction thresholds were adopted by the APCD's Board on September 17, 1998. These risk reduction thresholds were set at the same level as the public notification thresholds.

If any of the above significant risk thresholds are met or exceeded, the APCD will require public notification and risk reduction. If the HRA was submitted for a new project, the project will be denied or be required to be revised to include measures that reduce the risk below the significance thresholds.

4. Report for Health Risk Assessment

The applicant is required to perform the health risk assessment and submit a HRA report and electronic files for the APCD's review. A $1500 deposit is required for the APCD to review the HRA. The following is required as part of the Health Risk Assessment:

1. A health risk assessment report that complies with the Office of Environmental Health Hazard Assessment's (OEHHA) guidelines as discussed in Chapter 9, *Summary of the Requirements for a Modeling Protocol and a Health Risk Assessment Report*, of OEHHA's HRA guidance document, *Air Toxics Hot Spots Program Risk Assessment Guidelines*. This document is available at: http://www.oehha.ca.gov/air/hot_spots/pdf/HRAguidefinal.pdf

2. Submit the following HARP files in electronic format:

   - Transaction file with facility and emission inventory data (filename.TRA)
   - ISC workbook file with all ISC parameters (filename.ISC).
   - ISC input file generated by HARP when ISC is run (filename.INP)
   - ISC output file generated by HARP when ISC in run (filename.OUT)
   - ISC binary output file; holds X/Q for data for each hour (filename.BIN)
   - List of error messages generated by ISC (filename.ERR)
   - Sources receptor file; contains list of sources and receptors for the ISC run; generated by HARP when you set up ISC (filename.SRC)
   - Point estimate risk values generated by HARP; this file is updated automatically each time you perform one of the point estimate risk analysis functions (filename.RSK)
   - Average and maximum X/Q values for each source-receptor combination; generated by ISC (filename.XOQ)
   - Plot file generated by ISC (filename.PLT)
   - Representative meteorological data used for the facility air dispersion modeling (filename.MET)
   - Site-specific parameters used for all receptor risk modeling (filename.SIT)
   - Map file used to overlay facility and receptors (filename.DEB)
   - Digital Elevation Map (DEM) file(s) used (filename.DEM)
   - Meteorology data file(s) used (filename.MET or filename.ASC)

If the health risk assessment or HRA report fail to comply with these guidelines, the health risk assessment and report will be returned to the applicant for revision.

5. References

1. U.S. Environmental Protection Agency, 1995. User's Guide for the Industrial Source Complex (ISC3) Dispersion Models (Revised), Volume 1. EPA-454/B-95-003a. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

2. U.S. Environmental Protection Agency, 1997. Addendum to ISC3 User's Guide – The Prime Plume Rise and Building Downwash Model. Submitted by Electric Power Research Institute. Prepared by Earth Tech, Inc., Concord, MA.

3. U.S. Environmental Protection Agency, 1995. User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volume II – Description of Algorithms. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. Available from website http://www.epa.gov/scram001 as of January 2003.

4. U.S. Environmental Protection Agency, 2001. Appendix W to Part 51 Guideline on Air Quality Models, 40 CFR Part 51. U. S. Environmental Protection Agency, Research Triangle Park, NC.

6. Contacts

For questions on the APCD's requirements for modeling, contact the APCD at:

phone: 805-961-8800
email: engr@sbcapcd.org

The APCD does not provide technical support for the ISC or HARP models. For questions on the HARP model, contact ARB at:

phone: (916) 323-4327
email: harp@arb.ca.gov
web: http://www.arb.ca.gov/toxics/harp/harp.htm

Appendix A

1. Special Considerations in Air Dispersion Modeling

During some air quality studies, modelers may encounter certain emitting scenarios that require special attention. Some examples include horizontal sources or special operating schedules. The following sections outline modeling techniques to account for the special characteristics of such scenarios.

1.1 Horizontal Sources and Rain Caps

Both horizontal flues and vertical flues with rain caps have little or no initial vertical velocity. Plume rise calculations in ISC take into account both rise due to vertical momentum of the plume as it leaves the stack and the buoyancy of the plume. This may result in an over prediction of the plume rise, and resulting under prediction of ground-level concentrations, in these models.

This problem can be alleviated by modifying the source input parameters to minimize the effects of momentum while leaving the buoyant plume rise calculations unchanged. An approach to modeling this is to modify the source input parameters to minimize the effects of momentum while leaving the buoyant plume rise calculations unchanged. The U.S. EPA outlines such an approach in its Model Clearinghouse Memo 93-II-09[2], and the approach is expressed, in part, in Tikvart[3]. This approach is to reduce the stack gas exit velocity to 0.001 m/s, and calculate an equivalent diameter so that the buoyant plume rise is properly calculated. To do this, the stack diameter is specified to the model such that the volume flow rate of the gas remains correct. In the case of horizontal flues, there will be no stack tip downwash, so that option should be turned off for that case. In the case of vertical flues with rain caps, there will be frequent occurrences of stack tip downwash, however the effect of the stack tip downwash (reduction of the plume height by an amount up to three times the stack diameter) may be underestimated in the model. This can be corrected, somewhat conservatively, by turning off the stack tip downwash option and lowering the specification of the stack height by three times the actual stack diameter (the maximum effect of stack tip downwash).

With the above references in mind, it should be noted that lower exit velocities could cause issues with ISC PRIME. This exit velocity still effectively eliminates momentum flux and can produce parameters that will not impede model execution. Furthermore, for cases where exit temperature significantly exceeds ambient temperature the APCD may consider use of effective diameter or effective temperature values to account for buoyancy flux.

A sample step-by-step approach is as follows. In this discussion,

V = actual stack gas exit velocity
V' = stack gas exit velocity as entered into the model (ISCST3)
D = actual stack inside diameter
D' = stack inside diameter as input to the model
H = actual stack height
H' = stack height input to the model
For the source of consideration, modify its parameters as follows:

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[2] U.S. EPA, 1993. Model Clearinghouse Memo 93-II-09. A part of the Model Clearinghouse Information Storage and Retrieval System (MCHISRS). Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711

[3] Tikvart, J.A., 1993. "Proposal for Calculating Plume Rise for Stacks with Horizontal Releases or Rain Caps for Cookson Pigment, Newark, New Jersey," a memorandum from J.A. Tikvart to Ken Eng, U.S. EPA Region 2, dated July 9, 1993. Available from website http://www.epa.gov/scram001/guidance/mch/cfym89.txt, as of April 2003.

1. Set V'=0.01 m/s
2. Set D'=D*SQRT(V/V')
3. If the source is a vertical stack with a rain cap, account for the frequent stack tip downwash by reducing the stack height input to the model by three times the actual stack diameter: H'=H-3D

1.2 Variable Emissions

The ISC model contains support for variable emission rates. This allows for modeling of source emissions that may fluctuate over time. Emission variations can be characterized across many different periods including hourly, daily, monthly and seasonally.

1.2.1 Non-Continuous Emissions

Sources of emissions at some locations may emit only during certain periods of time. Emissions can be varied within the ISC model by applying factors to different time periods.

For example, for a source that is non-continuous, a factor of 0 is entered for the periods when the source is not operating or is inactive. Model inputs for variable emissions rates can include the following time periods:

- Seasonally
- Monthly
- Hourly
- By Season and hour-of-day
- By Season, hour-of-day, and day-of-week
- By Season, hour, week

1.2.2 Plant Shutdowns and Start-Ups

Plant start-ups and shutdowns can occur periodically due to maintenance or designated vacation periods. The shutdown and subsequent startup processes impact emissions over the related time periods. As an example, process upsets in the combustion units or air pollution control system can also impact emissions; these upsets can often result in the release of uncontrolled emissions through the emissions sources. As a result, over short periods of time, upset emissions are often expected to be greater than normal source emissions[4].

These emission differences can be accounted for by the application of variable emission factors.

For Example:

Assume that a turbine operates 14 hours per day (1 startup, 1 shutdown, and 12 hours of normal operation

Given:
Modeled Emission Rate = 1 g/s (normalized emissions rate)
Operation Schedule = 6 AM – 7PM
Startup/Shutdown Emissions are twice that of normal operating emissions

[4] U.S. EPA - Office of Solid Waste and Emergency Response, July 1998. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. EPA530-D-98-001A. U. S. Environmental Protection Agency, Research Triangle Park, NC.

The model will calculate a new emissions rate using the data found in the table below:

Calculation : Modeled Emissions Rate * Emission Rate Adjustment Factor

Emissions Rate for when not operating = 1 g/s * 0 = 0 g/s
Emissions Rate for during shutdown or startup = 1 g/s * 2 = 2 g/s
Emissions Rate during normal operations = 1 g/s * 1 = 1 g/s

Non-Continuous Emissions (Hours of Day):

Morning Hours		Afternoon Hours	
Hour of the Day	**Emissions Rate Adjustment Factor**	**Hour of the Day**	**Emissions Rate Adjustment Factor**
1	0	1	1
2	0	2	1
3	0	3	1
4	0	4	1
5	0	5	1
6	2	6	1
7	1	7	2
8	1	8	0
9	1	9	0
10	1	10	0
11	1	11	0
12	1	12	0

Appendix B

1. Modeling Specific Source Types

This appendix will be updated with additional source types in the future.

1.1 Gasoline Dispensing Facilities

See APCD Form-25T (http://www.sbcapcd.org/eng/dl/appforms/apcd-25T.pdf) for specific modeling instructions for gas stations.

1.2 Liquid Storage Tanks

Storage tanks are generally of two types—fixed roof tanks and floating roof tanks. In the case of fixed roof tanks, most of the pollutant emissions occur from a vent, with some additional contribution from hatches and other fittings. In the case of floating roof tanks, most of the pollutant emissions occur through the seals between the roof and the wall and between the deck and the wall, with some additional emissions from fittings such as ports and hatches.

Approaches for modeling emission impacts from various types of storage tanks are outlined below.

Fixed roof tanks:

- Model as a point (stack) source.
- The point source inputs should represent the tank vent (usually in the center of the tank).
- The tank should also be represented as a building for downwash calculations.

There is virtually no plume rise from tanks. Therefore, the stack parameters for the stack gas exit velocity and stack diameter should be set to near zero for the stacks representing the emissions. In addition, stack temperature should be set equal to the ambient temperature. This is done in ISC by inputting a value of 0.0 for the stack gas temperature.

Note that it is very important for the diameter to be at or near zero. With low exit velocities and larger diameters, stack tip downwash will be calculated. Since all downwash effects are being calculated as building downwash, the additional stack tip downwash calculations would be inappropriate. Since the maximum stack tip downwash effect is to lower plume height by three stack diameters, a very small stack diameter effectively eliminates the stack tip downwash.

Table B.2 - Stack parameter values for modeling tanks.

Velocity	Diameter	Temperature
Near zero i.e. 0.01 ft/min	Near zero i.e. 0.01ft	Ambient – 0.0 sets models to use ambient temperature

Floating roof tanks:

- Model as an area source.
- The area source inputs should represent the diameter of the tank and the height of the tank.
- The tank should also be represented as a building for downwash calculations.

Appendix C

1. APCD Approved Emission Factors

This section is reserved for future use. Contact the APCD for approval of your proposed emission factors prior to performing the HRA.