6.3.3 Toxicity Assessment

The toxicity assessment focuses on chemicals that pose the greatest threat to human and ecological receptors. Standard toxicological methodologies for assessing the toxicity of contaminants require quantification of dose-response relationships for adverse human health effects associated with exposure to specific chemicals. For carcinogenic effects, carcinogenic slope factors (CSF) are used to estimate the incremental lifetime cancer risk (ILCR) that corresponds to exposure point concentrations. CSFs are applied to specific routes of exposure. The potential for the occurrence of noncarcinogenic adverse health effects from oral exposures typically is evaluated by comparison of estimated daily intakes with reference doses (RfD) that represent daily intakes at which no adverse health effects are expected to occur. Reference concentrations (RfC) present the same information for inhalation exposures.

Qualitative and quantitative toxicity values and specific information should be gathered for all COCs. Detailed toxicity profiles also should be generated. Sources of toxicity values include Integrated Risk Information System (IRIS) (EPA 1996) and Health Affects Assessment Summary Tables (HEAST) (EPA 1995). IRIS is a computerized EPA database that contains verified toxicity values and up-to-date toxicological and regulatory information about commonly used

chemicals; it is updated monthly. HEAST is a source of unverified provisional toxicity information to be used when toxicity information is not available from IRIS; it is updated annually. If information on toxicity of chemicals is not provided by an applicant, permit writers should issue an NOD requiring the applicant to look at information in IRIS and HEAST.

Carcinogenic chemicals and their associated risks should be evaluated and presented separately. The following information should be presented for each carcinogenic COC:

- The current CSF from toxicology databases
- Weight-of-evidence classification
- Type of cancer for Type A carcinogens
- Concentration above which the dose-response curve is nonlinear and pharmacokinetic factors influence the dose-response curve

Toxicity equivalency factors (TEF) provided by EPA for dioxins and polycyclic aromatic hydrocarbons (PAH) should be used to adjust toxicity values for those chemicals relative to 2,3,7,8-tetrachlorodibenzo-p-dioxin and benzo(a)pyrene, respectively.

The following information should be gathered from all available sources for all noncarcinogenic COCs and included in the permit application:

- Current RfDs and RfCs and the toxicological basis for those values
- Overall database and critical study on which the toxicity value is based
- Target organ(s) and uncertainty factors
- Possible biochemical mechanism(s) of toxicity

Permit applicants should be required to obtain information about COCs that do not have toxicity

values derived by EPA for exposure routes relevant to site exposures. For example, EPA has derived only a limited number of RfCs for the inhalation route of exposure, and few RfDs or CSFs have been derived for the dermal route of exposure. EPA guidance suggests, however, that in the case of dermal exposure, toxicity values may be derived from oral toxicity values. It is necessary to adjust the oral RfD and CSF to take into account differences between gastrointestinal and dermal absorption. To derive a dermal toxicity value for an absorbed dose from an oral toxicity value based on an administered dose, the oral toxicity value must be adjusted by the fractional oral absorption value. RfDs are multiplied by and CSFs are divided by the fractional oral absorption values, respectively. The following oral absorption values should be used in the absence of chemical-specific values: 80 percent for volatile organic compounds, 50 percent for semivolatile organic compounds, and 20 percent for inorganic chemicals (EPA 1994b).

Screening Level and Detailed Human Health Risk Evaluations

Toxicity assessment is a concern in both tiers of risk evaluation. There are no differences between the two tiers in the level of effort required for toxicity assessment. Both the screening level and the detailed risk evaluations should include a table that presents each chemical being evaluated for the unit, the applicable toxicity values, critical effects and target organs, uncertainty factors, and the source of the toxicity value (IRIS, HEAST, or other suitable source). EPA guidance (EPA 1989) provides a detailed explanation of the derivation of toxicity values and important information about toxicity that should be related in a risk assessment. Permit writers should make sure that applicants use current toxicity values and that the applicant adequately describes the health effects of each COC.

Screening Level and Detailed Ecological Risk Evaluations

Like human health risk assessments, there are no differences between the two tiers in the level of

effort required for toxicity assessment. The objective of the toxicity assessment is "to establish the quantitative relationship between ecological effects and the concentration, dose, or exposure of a contaminant of concern" (Maughan 1993). Both screening level and the detailed risk evaluations should include tables that present the chemicals being evaluated at the unit, applicable toxicity values, and the sources of the toxicity values. Methodologies for assessing the toxicity of contaminants involve comparisons of estimated intakes with published data on the toxic effects of chemicals or conduct of original toxicity testing for individual combustion units. Qualitative and quantitative ecotoxicity values and chemical-specific information should be gathered for all COCs. Detailed toxicity profiles also should be prepared. In the absence of ecotoxicity information, conversions for species-to-species extrapolation may be applied to published data (EPA 1994).

Ecotoxicity values are compared with estimated exposure levels in both the screening level and the detailed toxicity assessments. Ecotoxicity values appropriate for both a screening level and a detailed risk calculation include the no-observed-adverse-effect-level (NOAEL) or lowest-observed-adverse-effect-level (LOAEL). NOAELs are more appropriate than LOAELs in an initial screening to ensure that potential risk is not underestimated (EPA 1994). When NOAELs are not available, the following conversion factors may be used to extrapolate to NOAEL values (EPA 1996):

- NOAEL = Acute or subchronic LOAEL/10
- NOAEL = Chronic LOAEL/5
- NOAEL = $(LD_{50}/5)/10$
- NOAEL = $NOAEL_{\text{different family-same order}}/2$ (for nonprotected species)
- NOAEL = $NOAEL_{\text{different order-same class}}/2$ (for nonprotected species)

- $NOAEL = NOAEL_{related\ nonprotected\ species}/2$ (for protected species)

Additional information that addresses species-to-species extrapolation is also available in Suter (1993).