6.3.1 Data Evaluation

Data to support quantitative assessment of risk at combustion units usually are limited, but some sources are available from which screening level data can be collected. Primary sources of data for the wastes managed include technical manuals prepared by the Military Services, data sheets on various munitions, data from MIDAS, and MSDSs. Data on residues is available from the BangBox Study. Field data collected during actual combustion testing or from test facilities, including concentrations of emissions and residues, can be used to make a more accurate estimate of exposure and concentrations of emissions. Perhaps the most site-specific data are analytical site characterization data on affected media. If such data are available from previous investigations, they might be applicable to the evaluation of risks for the permitting process. As an alternative, the data may be collected to support the permit.

It is important to realize that most data available for a screening level evaluation of a combustion unit would not meet the data quality objectives typically required for a risk assessment (EPA 1989). Risk assessments require the application of specific analytical methods and sample quantitation limits and the collection of quality control samples that produce data that can be used to adequately estimate exposures and to support statistical evaluations. The information listed above does not meet such requirements, nor are samples taken at the sites typically taken with that level of data quality in mind.

In general, the permit writer should expect that the applicant will use the most reliable data available to estimate the most likely and most conservative exposure concentrations for each medium. Doing so may require the use of measured concentrations, in soil at and around the combustion unit; modeled concentrations, such a those from an air dispersion model; or bioaccumulation equations, for uptake of chemicals into animals and plants from soil, sediment, groundwater, and surface water. Most risk evaluations involve some combination of measured and modeled data.

Screening Level Evaluation

Identification of COCs at a combustion unit begins with an inventory of chemicals that make up the waste identified in the application and the material used to initiate the OB or OD treatment process. The table at right presents some of the chemicals commonly found in energetic materials and combustion products that may be released during combustion. The table does not provide an exhaustive list, but illustrates the types of emissions and residues that the permit writer may encounter when reviewing the list of COCs. Other chemicals should be added to the list as necessary to characterize the initiating material used in the operation and the residues created as reaction by-products.

Once the preliminary list of COCs has been compiled, the exposure point concentrations can be estimated. The exposure point concentration is defined by EPA guidance as follows (EPA 1989):

> The concentration term in the exposure equation is the average concentration contacted over at the exposure point or points over the exposure period. When estimating exposure point concentrations, the objective is to provide a conservative estimate of this average concentration (e.g., the 95 percent upper confidence limit on the arithmetic mean chemical concentration).

Common Components and Reaction By-Products of Energetic Materials

Organic Chemicals	Metals and Other Inorganic Chemicals
Di-isopropylmethyl phosphate	Aluminum
Dimethyl methylphosphonate	Arsenic
1,3-Dinitrobenzene	Beryllium
2,4-Dinitrotoluene	Carbon dioxide
2,6-Dinitrotoluene	Carbon monoxide
Diphenylamine	Cyanide
1,4-Dithiane	Lead
Hexachlorobenzene	Mercury
Hexachloroethane	Nitrous oxide
HMX	Sulfur dioxide
Isopropyl methylphosphoric acid	White phosphorus
Nitrocellulose	Zinc
Nitroguanidine	Zinc chloride
Pentachlorophenol	
Polycyclic aromatic hydrocarbons	
RDX	
Trinitroglycerol	
2,4,6-Trinitrotoluene	

The guidance discusses general considerations in estimating exposure concentrations; it states that exposure concentrations may be estimated from monitoring data alone or through the use of a combination of monitoring data and environmental fate and transport models. For air risk assessments, such as those prepared for incinerators, it is common to use the maximum concentration as the exposure point concentration for air or soil model concentrations for off-site locations. That approach is recommended for most screening level evaluations because that concentration can be identified easily and the assumptions are conservative. If these assumptions are not used in a permit application the permit writer should prepare a NOD that requires a detailed justification.

The exposure point concentration must be estimated for each medium investigated. For air and soil in and around the combustion unit, exposure point concentrations must be calculated or estimated as the maximum detected or modeled concentration. For all other media that are affected by dispersion, runoff, or leaching, exposure point concentrations should be estimated (modeled) at the point of

exposure, as well. If uptake into plants and animals that are subsequently ingested (either by humans or other receptors), that too should be modeled, again using maximum concentrations as the exposure concentration for the end receptor. EPA guidance (1990, 1993, 1994, and 1998a) presents detailed instructions for estimating exposure concentrations in plants and animals on the basis of air-dispersed chemicals. Those documents should be consulted to obtain recommended equations to be used in estimating the exposure point concentrations.

A preliminary site investigation (essentially a site reconnaissance) should be conducted before the ecological screening evaluation to provide a general characterization of the site, focusing on qualitative rather than quantitative information. The objective of a site reconnaissance is to identify habitats and biota that require investigation (Maughan 1993). An experienced ecologist should conduct the on-site reconnaissance, including the preparation of a screening list of species likely to be exposed. In addition, information about the ecological setting, sensitive or endangered resources and organisms, and other deviations from expected conditions should be documented. EPA guidance provides checklists and additional guidelines for conducting a preliminary site investigation and formulation of problem statements (EPA 1994). Species present at the site should be placed in guilds (that is, groups of species that obtain food in a similar manner); feeding habits then should be considered, along with home range requirements, sensitivity to human exposure, habitat, reproductive habits, and other life history characteristics to select key species for a preliminary exposure calculation (Maughan 1993). Some of the concerns that the permit writer should expect to be addressed in the screening level site-investigation include:

- Are any threatened or endangered species likely to inhabit the area in the vicinity of the emission plume?

- Is habitat in the area suitable for threatened or endangered species? Are there sensitive habitats in the vicinity of the unit?

- What are the likely categories of receptors?
- Are there surface water bodies within the area of the emission plume from the unit?
- Could groundwater discharge into surface water?
- What are the off-site environmental setting and receptors?
- What are the complete exposure pathways?

The ecological risk assessment should discuss all the issues listed above. If those issues are not discussed in the application or not discussed adequately, the permit writer should issue a NOD requiring their inclusion.

Detailed Risk Assessment

If a detailed risk assessment is conducted, the exposure concentration may be refined to reflect more realistic conditions of exposure, rather than maximum concentrations. As described in EPA guidance (EPA 1989): "The assessor may wish to use the maximum concentration from a medium as the exposure concentration for a given pathway as a screening approach to place an upper bound on exposure. In these cases it is important to remember that *if a screening level approach suggests a potential health concern, the estimates of exposure should be modified to reflect more probable exposure conditions*" (Emphasis added.)

The recommended exposure point concentration for use in risk assessment is the 95 percent upper confidence limit (UCL). That concentration represents an upper bound of the average concentration. According to EPA (EPA 1992a), "*because of the uncertainty associated with estimating the true average concentration at a site, the 95 percent upper confidence limit (UCL) of the arithmetic mean should be used for this variable"* (Emphasis added.) The 95 percent UCL provides reasonable confidence that the true average

for the site will not be underestimated. However, estimating that concentration may require more monitoring or sampling data than are available. If that is the case, the 95 percent UCL probably will exceed the measured maximum concentrations for the site; the maximum measured concentration therefore should be used as the exposure point concentration.

The site investigation and problem formulation for a detailed ecological risk assessment are performed after the preliminary risk evaluation. If it is determined through the preliminary screening that adverse ecological effects are likely to occur, additional field investigations and an expanded literature review are conducted. In the expanded review, additional information is collected that will focus the risk assessment on the types and forms of chemicals detected on site, chemical toxicity, media of concern, and species present. To support more reasonable estimates of exposure, site- and species-specific bioavailability and exposure factors are gathered, and the most critical exposure pathways identified. Additional information about the life history, feeding habits, ingestion rates, diet composition, average body weight, home range size, and seasonal activities, for example, should be compiled for the species of concern. In addition, the list of chemicals present in concentrations that exceed benchmark levels should be refined, on the basis of fate and transport and ecotoxicity, to include only those chemicals that will be of greatest importance in the detailed risk assessment (EPA 1994).

The detailed problem formulation process also involves the selection of assessment endpoints. An assessment endpoint is defined by EPA (1994) as "...an explicit expression of the environmental value that is to be protected... Assessment endpoints for the detailed ecological risk assessment must be selected based on the ecosystems, communities, and/or species that are of particular concern at a site." According to Maughan (1993), "the ultimate goal in establishing the endpoints is not only to set the desired ecological character of the site, but also to identify the structural and functional requirements

critical to achieving the designated ecological site use." A detailed ecological risk assessment should include identification of the assessment endpoints. According to EPA guidance (1994), the selection of an assessment endpoint depends on the:

- Contaminants present and their concentrations
- Mechanisms of toxicity affecting the different groups of organisms identified at the site
- Species potentially present at the site
- Potential complete exposure pathways identified at the site

Following the identification of the assessment endpoints, additional information should be compiled to select the complete exposure pathways that will be evaluated in the detailed ecological risk assessment, and measurement endpoints are established. A conceptual site model should be developed that establishes the relationship between assessment endpoints and measurement endpoints.

A measurement endpoint is defined by EPA (1994) as "a measurable ecological characteristic that is related to the valued characteristic chosen as the assessment endpoint." According to Maughan (1993), endpoints selected should meet the following criteria:

- A defensible relationship to an assessment endpoint
- Ability to be measured
- Availability of existing data
- Relationship to known contaminants and pathways
- Degree of natural variability
- Temporal and spatial scale of the parameter

The exposure pathway and chemical ecotoxicity should be considered in the selection of measurement endpoints (EPA 1994). Appropriate data should be collected and studies conducted in the additional site investigation to be used in the assessment of the measurement endpoints. Concentrations of chemicals are not appropriate measurement endpoints; examples of measurement endpoints include mortality, growth, and reproduction (EPA 1994).

In evaluating detailed ecological risk assessments, the permit writer will need to determine the appropriateness of the information submitted in a number of areas:

- Whether sampling has been performed during all four seasons
- Whether there is a demonstrated relationship between the assessment endpoints and the measurement endpoints
- Whether adequate toxicity profiles have been prepared for the species of concern
- Whether the COCs identified include all constituents reasonably expected to be present based on the wastes managed in the unit

Should the permit writer determine that information in such areas is not adequate, a NOD should be prepared to require submittal of additional information, such as results of sampling.