

DRAFT
RCRA MISCELLANEOUS TREATMENT UNITS
ENCYCLOPEDIA X
TECHNICAL RESOURCE DOCUMENT

Prepared
by:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 4
RCRA PROGRAMS BRANCH

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Executive Summary

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1.0 INTRODUCTION

On December 10, 1987, under [52 FR 46946](#), EPA issued regulations that outlined procedures for issuing permits to miscellaneous units that treat, store, or dispose of hazardous waste. Those regulations, which were codified at 40 CFR Part 264, Subpart X, created a new category of hazardous waste management unit (known as the miscellaneous unit or Subpart X unit). Such units were defined as those that do not meet any of the definitions in Part 264 of other types of hazardous waste management units. The purpose of this document is to provide EPA and State permit writers and inspectors with guidance for reviewing permit applications, establishing enforceable permit conditions for, and conducting inspections of Subpart X units.

The primary element of the Subpart X permitting regulations requires that the permit applicant perform an environmental assessment to demonstrate that the operation of the proposed unit will be protective of human health and the environment. The assessment must consider the effects of the proposed unit on air, subsurface environment, and surface water and soils. The assessment must include information about the characteristics of the waste to be treated, the design and operating characteristics of the unit, and potential receptors of releases from the unit. For many types of Subpart X units, particularly mechanical units such as shredders, crushers and filter presses, an environmental assessment may not be necessary. This is especially true in cases where the unit is fully enclosed in a containment structure such as a building. The applicant must be able to justify that an environmental assessment is unnecessary. This document identifies the minimum requirements for such an assessment and provides guidance for evaluating information submitted by permit applicants and using that information to develop permit conditions.

Although the Subpart X permitting regulations rely to a great extent on an environmental performance standard (i.e., protection of human health and the environment), permit writers should attempt to

establish permit conditions for the units that include specific requirements governing location, design, operation, and maintenance. In general, the best way to accomplish this is to selectively apply the design and operating requirements for hazardous waste management units set forth under 40 CFR Part 264, Subparts I through O, that may apply to the unit under application (§264.601). Such an approach will allow the permit writer to use permit conditions that have been proven effective, protective of human health and the environment, and that are less vulnerable to challenge by permit applicants. Appendix A contains a permit review checklist. Appendices B - E provide model permit language and example permits for a variety of Subpart X units. Appendices F through H provides inspection checklists for a number of Subpart X units.

The Subpart X permitting process is unique under RCRA because the types of units being permitted may have obtained interim status as a number of different types of units as specified in Part 265 (e.g., units that are eligible to be permitted under Subpart X are open burning/open detonation (OB/OD) units, which would have obtained interim status as thermal treatment units and are currently operating under the requirements of Part 265, Subpart P).

The general approach for issuing permits to owners or operators that submit Subpart X permit applications is to permit these units as conventional hazardous waste management units whenever possible. Although not applicable to OB/OD units, this approach is preferred for other types of miscellaneous units because the design and operating standards contained in other Subparts of Part 264 are well understood by permit writers and applicants and are less likely to be challenged by a permit applicant than permit conditions developed specifically for Subpart X units. Even in cases where a permit writer cannot permit a unit under the standards applicable to one of the conventional units in Part 264, a permit writer may be able to use specific design and operating requirements from one or more of these Subparts in developing permit conditions. In many cases, the approach described above will

An overview of the key definitions and terms associated with 40 CFR Part 264, Subparts I through O is provided in the [Definitions](#) document.

minimize the time and effort required to issue a permit for a prospective Subpart X unit.

1.1 Applicability

Because Subpart X is an exclusionary category, a variety of treatment and disposal units are considered. Some of the types of operational units that are discussed in this document include open burn/open detonation (OB/OD) units, enclosed combustion devices, carbon and catalyst regeneration units, thermal desorption units, shredders, crushers, filter presses and geologic repositories. A number of innovative and emerging technologies for the treatment of hazardous wastes also may be considered for permitting under Subpart X.

1.2 Purpose of the Document

This document provides to permit writers guidance for evaluating information submitted by permit applicants addressing the information requirements specific to Subpart X units under §270.23. The specific information requirements for Subpart X permit applicants ensure that the environmental performance standard will be met, and includes a unit description; information about pathways of exposure and potential receptors; and, for treatment units, a demonstration of the effectiveness of treatment. The permit writer then develops permit conditions for the general facility standards in Part 264, Subparts A through H, as applicable, and the specific standards of Subpart X.

Although the Subpart X permitting process is unique under RCRA, Subpart X permit applicants must meet the same basic objectives as applicants for permits for other types of units. Permit writers should request information from applicants to demonstrate compliance with general standards governing TSDFs and require a thorough risk and environmental assessment to demonstrate that the operation of the unit will be protective of human health and the environment. Miscellaneous units can pose unique problems in the areas of waste characterization, modeling and monitoring of environmental effects, closure, and corrective action. This docu-

ment highlights those areas by providing information to assist permit writers with technical and policy issues associated with those areas.

Throughout the document, the reader is informed of a variety of other guidance and policy documents, tools and resources available to the regulator regarding Subpart X and other related topics. Many of the referenced documents will be directly applicable to the needs of the permit writer and/or inspector and should be evaluated carefully to determine how best they can be used. The reader can be directly linked to the referenced document or website by simply clicking on the blue highlighted text. References used in preparing this guidance are found at the end of the individual chapters.

2.0 SUBPART X UNITS

This chapter provides basic descriptions of the more typical units permitted as Subpart X units. The chapter also discusses circumstances when it may be appropriate to permit proposed miscellaneous units as conventional hazardous waste management units. Examples of patented or trademark technologies are discussed throughout this chapter. However, the Agency does not endorse the technology available from any specific company.

2.1 Types of Thermal Units Included Under Subpart X

2.1.1 Open Burning and Open Detonation Units

Many waste propellants, explosives, and pyrotechnics (PEP), and munitions items are unsafe to treat by conventional methods of hazardous waste management. Open burning and open detonation (OB/OD) remain the primary methods of treatment for these wastes. Currently, research is being conducted to develop alternative methods of treatment for PEP wastes. New technologies, such as enclosed detonation chambers, are likely to become more widely available in the next several years. Some of these new technologies may qualify for permitting under Subpart X.

The unit descriptions provided here focus on military OB/OD units, because the majority of the units are operated by the military. The design configurations and operational standards discussed in this section will, however, also be used at non-military facilities.

2.1.1.1 Open Burning: Physical and Process Description

Open burning (OB) is used primarily to destroy propellants, and is generally conducted on engineered structures such as concrete pads, or metal pans to avoid contact with the soil surface. Such structures may range in size from 3 to 5 feet wide by 5 to 20 feet long, and are 1 to 2 feet deep. OB pans should be made of a material sufficient to



View of burning pans on a secondary containment pad. Note that the pads do not appear to have berms around them.

withstand the burning process, and should be of sufficient depth and size to contain treatment residues. The pans may be elevated slightly above the ground to enhance cooling and to allow inspections for leaks. The pans should be covered when they are not in use to prevent precipitation from entering them. Pans may be equipped with ports for draining collected precipitation or cleaning solutions. Collected precipitation should not be discharged onto the ground unless the pan was decontaminated after its last use, or unless the precipitation is sampled and analyzed and determined not to contain hazardous constituents. A metal cage placed over the burn unit during treatment may be helpful to minimize the ejection of residues from the unit.

The ground beneath the trays or pans may be surrounded by berms to prevent runoff from the area; however, a well-designed and operated burn pan may not require berms. Ground cover around and beneath the pans should be prepared for ease of recovery of ejected treatment residues and for prevention of fire hazards that such residues may pose. Maintenance of a packed soil surface is the minimum preparation sufficient to accomplish those goals.

To prevent propagation of an accidental detonation from one device to another, DoD regulations require containment devices, trenches, and individual ground treatment units be spaced at least 150 feet apart. Detailed design specifications for containment devices, whether trenches, pans or other types of containment, should be included in the permit application.

Waste propellant to be treated is often contained in bags, which are placed directly into the unit. The waste may be primed (that is, an initiating device is placed in the waste material) either electrically or non-electrically with black powder squibs. The waste is then ignited and the established wait time is observed. If explosives are treated, a wait time of at least 12 hours typically is observed before site workers inspect the unit. A 24-hour wait time typically is observed between OB events to allow



Closeup view of burning pans on concrete slab. Note the white covers in the background which can be rolled over the pans to prevent precipitation from entering them.



To view a video of an open burning operation, double click on the image above.

the surface to cool. After the OB treatment, containment devices are cleaned of any residues. OB operations generally are restricted to daylight hours, and usually are not conducted during inclement weather.

2.1.1.2 Open Detonation Unit: Physical and Process Description

Open detonation (OD) is used primarily to treat munition items. OD typically is conducted in pits or trenches below ground to minimize the ejection of treatment residue, although surface detonations are performed under certain circumstances. Trenches vary in size depending on the quantity of material to be treated, and are usually 4 feet deep or greater, and can vary in size from 4 to 8 feet wide by 6 to 15 feet long.

The maximum quantities to be treated are measured by net explosive weight (NEW), which is the total weight of explosives in the munition. The NEW does not include the weight of the explosive charge used to initiate the detonation (donor charge). Military units often use Composition (C-4) (90 percent RDX and 10 percent plasticizer, such as polyisobutylene) as a donor charge for OD operations. The quantity of donor charge used is usually equal to the NEW of the munitions to be treated.

Open detonation involves placement of wastes at the bottom of the pit, along with the donor charge. The waste and charge are then covered with soil to the top of the pit. After detonation, any treatment residues should be removed to minimize the potential for releases of hazardous waste or hazardous constituents to the environment. Surrounding soils should be maintained in a manner that minimizes the potential for fire posed by dry vegetation or other hazards.

2.1.2 Enclosed Treatment Units

In recent years, DoD has encouraged the use of controlled thermal treatment units for the destruction of pyrotechnics, small arms ammunition and



View of open detonation.



Open detonation is usually conducted in an excavated pit to minimize the ejection of treatment residues, although surface detonations may be performed. Not the rain cover in the background which can be rolled over the area.

fireworks. Examples of enclosed thermal treatment units include the Donovan Blast Chamber, the Blast Containment Structure and the Hurd Burn Units.

2.1.2.1 Donovan Blast Chamber

The Donovan Blast Chamber is used to perform controlled thermal treatment of PEP in a room-size blast chamber. The explosion chamber consists of an elongated double-walled steel explosion chamber anchored by bolts to a reinforced concrete foundation. In the preferred design, the inside dimensions of the chamber are eight feet high, six feet wide and fifty feet long. The reinforced concrete foundation is preferably at least four feet thick. The chamber is equipped with a double-walled access door for charging batches of explosives and a double-walled vent door for discharging the products of detonation. The double-walls of the chamber, access door and vent door are filled with a granular shock-damping material such as silica sand and the floor of the chamber is covered with a shock-damping bed such as pea gravel. Within the chamber, plastic polymer film bags containing water are suspended from steel wires over the explosive material. Detailed drawings and design specifications for the unit are available in [United States Patent No. 5,613,453](#). Additional information can also be found at <http://www.demil.net>

Materials to be treated are placed in the unit through the access door and onto the granular bed. The suspended plastic bags contain an amount of water that approximates the weight of the explosive. An electrical blasting cap is attached to the igniter lead wires. The access and vent doors are interlocked with the electrical igniter to block ignition unless both doors are positively shut. When the doors are opened after a detonation, a vent fan is activated and the gaseous products of detonation are drawn through the vent door opening and discharged to a scrubber system or baghouse. The Donovan Chamber can be utilized to safely detonate explosive charges in a wide variety of sizes, ranging from two to fifteen pounds NEW. A smaller transportable version of the chamber called the T-10 can be used



To view a video of an open detonation operation, double click on the image above.



Exterior view of the Donovan Blast Chamber.

to treat up to 10 pounds NEW per shot. Stack tests have been conducted at units located at the Massachusetts Military Reservation and Blue Grass Army Depot. Performance data from these tests were outlined in *Pollutant Emission Factors for a Transportable Detonation System for Destroying UXO*.

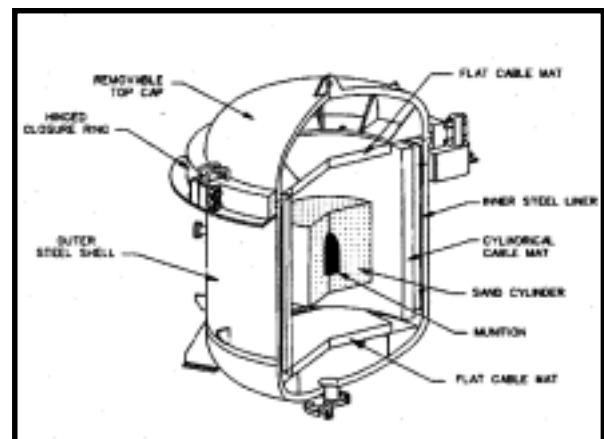
2.1.2.2 Blast Containment Structure

The Army Corps of Engineers, Engineering and Support Center in Huntsville, Alabama has developed a blast containment structure which is designed to capture all significant blast pressures for a total NEW of up to six pounds of TNT. The unit is also designed to capture all fragments from cased munitions including 57-mm and 75-mm recoilless rifle shells, 75-mm howitzer and 60-mm and 81-mm mortars. The container consists of a steel cylinder, six feet tall and three and one-half feet in diameter, with elliptical top and bottom caps. The top cap is removable and is held in place by a hinged steel ring. The bottom cap is permanently welded to the cylinder but it features a four-inch diameter drain port for cleanout and several one-inch diameter vent holes. The entire container is mounted on a steel framed skid. The skid includes a working platform, made of fiberglass grating, and a hoist for removing the top cap. All steel parts are cabled together in an electrically continuous fashion and are grounded.

The container utilizes a multi-layer fragment capture system to capture debris. Ordnance and a booster charge are placed in a sand-filled plastic cylinder. Just outside the sand layer, plastic bags filled with water are used to absorb much of the heat of the explosion and to reduce the blast pressures. Outside the sand layer is a steel cable mat shaped in the form of the cylinder, with a top and bottom mat to protect the end caps. The mat is similar to blasting mats used at construction sites. A steel plate liner is located between the cable mat and the outer steel shell. The liner is made in easily removable segments. The sand and water are replaced after each detonation. The cable mats are expected to last for up to ten detonations before being replaced. The liner plate may survive as many



Interior view of the floor of a Donovan Blast Chamber.



Schematic of Blast Containment Chamber.

as 50 to 75 detonations before requiring replacement. Additional information regarding this treatment device is available at <http://www.hnd.usace.army.mil/ow/tech/techindx.html>

2.1.2.3 Hurd Burn Units

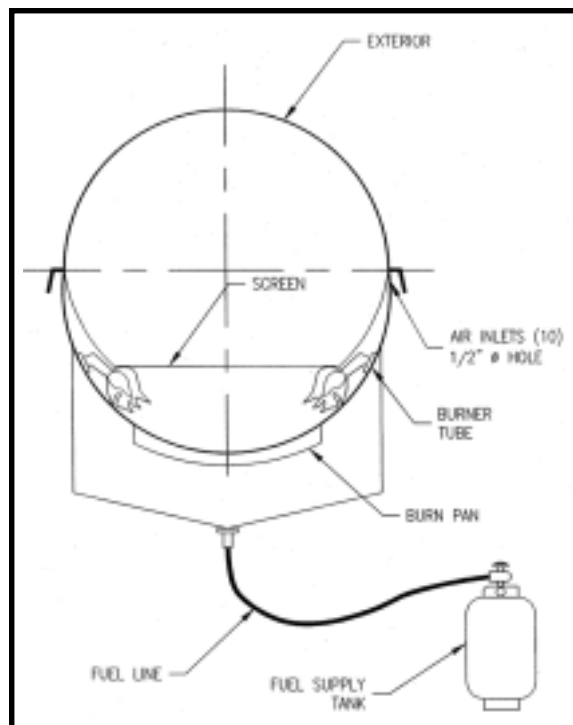
The unit consists of a quarter-inch thick steel, enclosed cylindrical box equipped with a hinged door on one end. The cylinder or barrel is mounted on a movable trailer which may be positioned on a concrete pad when in operation. The fuel source for the unit is a pair of propane tanks. Waste military munitions are placed onto screens in the barrel of the units. The door to the unit is closed and the propane fuel source is turned on and adjusted through a regulator. The application of a flame ignites the unit. Air holes located on both sides of the unit provide oxygen for the burn. Air emissions escape through the vent at the top of the unit, the air holes on the side of the unit, and through cracks in the doorway. A maximum of 25 pounds NEW may be placed into a single burn unit at any time. The maximum treatment time is 20 minutes. Situating the unit on a steel reinforced concrete slab will provide additional containment in the event of spillage of ash or kickout. However, the unit has no air pollution control features associated with it.

2.1.2.4 Confined Burn Facility

The U.S. Navy at Indian Head has designed a Confined Burn Facility (CBF) that uses a batch-feed chamber. Upon ignition of the wastes in the chamber, the hot gases that are generated are quenched with water and stored in a containment reservoir for subsequent scrubbing and treatment at a slow continuous rate before discharge. The five burn chambers of the CBF are connected via ducts, equipped with scrubbing and quenching sprays, to a central exhaust gas storage vessel. Each burn chamber can hold up to 1,200 pounds of explosive hazardous waste. All chambers are loaded at the beginning of the shift. Each chamber is ignited one at a time with 40 to 80 minutes between each ignition to allow processing of all gases. The design requires no additional pre-treatment, and it can burn



View of Hurd Burn Unit. This is a mobile unit which can be used for treating small quantities of PEP.



Schematic Diagram of Hurd's Burn Unit.

up to 6,000 pounds of energetics per shift. It includes redundant burn chambers of composite wall construction (inner wall is ablated during mass detonation to absorb shock waves, and it minimizes damage to the chamber should a mass detonation occur). It uses standard exhaust gas treatment technology, and it uses burn pans similar to present OB site operations.

Overview information regarding the Confined Burn Facility is available at <http://www.ih.navy.mil/environm.htm>

2.1.3 Carbon and Catalyst Regeneration Units

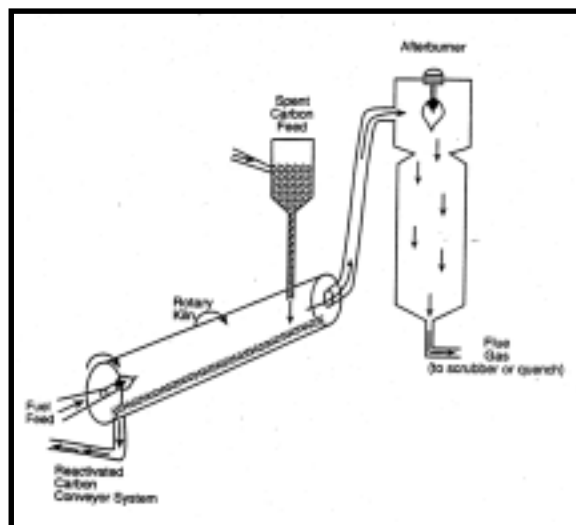
Carbon and catalyst regeneration units include both controlled-flame and non-flame devices. Since 1991, EPA has considered the regeneration or reactivation of spent carbon from a carbon absorption system, used in the treatment of a listed hazardous waste or used to capture emissions from a listed hazardous waste, to be thermal treatment under the interim status provisions of RCRA. The carbon, which contains absorbed organics, is classified as a hazardous waste under the “derived – from rule” (40 CFR §261.3 (c)(2)(i)). In that process, organic contaminants are desorbed from activated carbon at temperatures as high as 1,800 degrees (°) Fahrenheit (F). Carbon regeneration units that use thermal treatment include rotary kilns, fluidized-bed regenerators, infrared furnaces or multiple-hearth furnaces, all of which transfer heat to the contaminated carbon. The most prevalent furnace type is the multiple hearth furnace, followed closely by rotary kilns. As an alternative, steam may be used to desorb contaminants from the media in devices similar to tanks.

Refer to [August 8, 1991 Policy Memo](#) and [January 5, 1998 Policy Memo](#) regarding the regulatory status of Carbon Regeneration Units.

Catalyst regeneration processes can be similar to those used for carbon regeneration. However, the types of catalyst to be regenerated, the types and concentrations of contaminants to be desorbed, and the conditions under which the desorption takes place may alter the combustion chemistry significantly from that which is seen in carbon regeneration units.

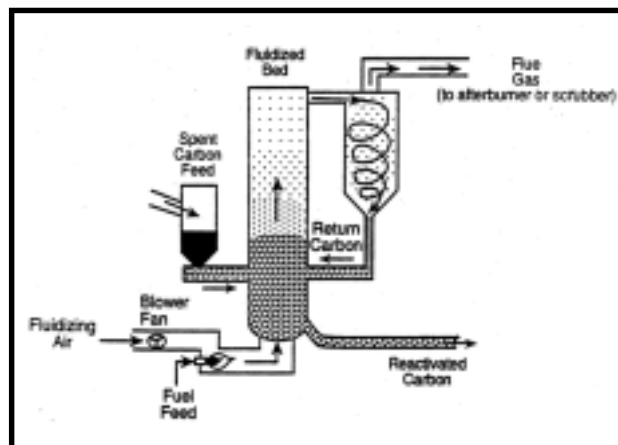
Controlled-flame devices used for carbon regeneration are similar to those used for incineration or for boilers and industrial furnaces (BIF). However, strict compliance with incinerator or BIF regulations may not be appropriate. Use of EPA's incinerator and BIF destruction and removal efficiency (DRE) standard and carbon monoxide and total hydrocarbon monitoring in the off gases may be appropriate for such units. Following are brief descriptions of some of the more common types of regeneration units.

A rotary kiln is an inclined rotating cylinder, lined with refractory brick and internally fired. The spent carbon is fed at the higher end of the kiln and moves, driven by gravity, down the length of the kiln as the kiln rotates. A heated air stream passes countercurrent with the waste, volatilizing the contaminants in the carbon. The exiting air stream contains desorbed contaminants and any combustion products that may have formed within the kiln. The rotational speed of the kiln can be varied. Peripheral speeds of 0.5 meters/minute (m/min) to 2 m/min are typical.



Schematic of Rotary Kiln.

A fluidized-bed furnace is a cylindrical vertical vessel with an air feed at the bottom of the unit. In fluidized-bed units, the granular material (the bed) is fluidized by directing air upward through the bed. Fuel is charged directly into the fluidized-bed or into the window box beneath the bed. The temperature in the freeboard area above the bed can be higher than that within the bed. Because of the airflow required to fluidize the carbon particles, fluidized-bed furnaces have a larger exhaust volume than other types of regeneration furnaces with the same carbon throughput rate.



Schematic of Fluidized-bed Furnace.

A multiple hearth furnace typically consists of a refractory-lined vertical steel shell. Inside is a series of flat hearths that are supported by the walls of the shell. A rotating shaft runs vertically through the center of the hearth. Rabble arms attached to the rotating shaft move the waste across each hearth. The hearths have holes, either in the center near the

shaft or near the outside edge through which the waste drops to the hearth below. Combustion air travels countercurrent to the waste flow.

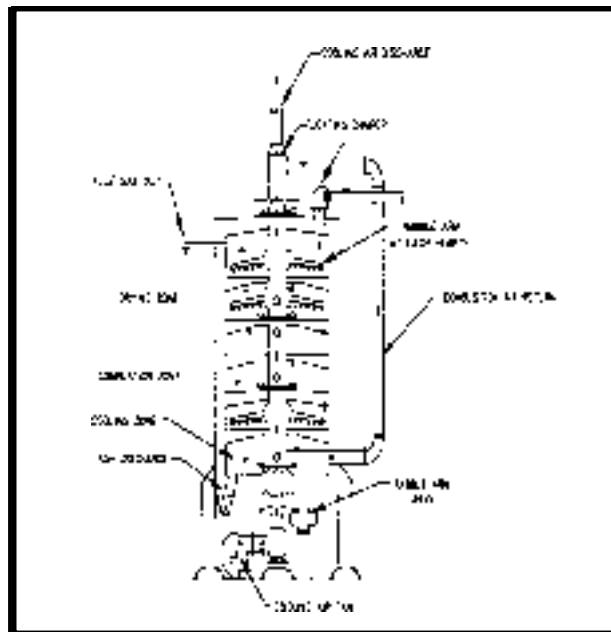
In an infrared furnace spent carbon is transported through the horizontal furnace via a metal grate. A series of heating elements above the metal grate are electrically heated to incandescence. The infrared radiation heats the carbon and a draft fan is used to draw air through the furnace and remove desorbed gases as they are released from the carbon.

These types of units may use a backflush of steam to desorb contaminants. The contaminated steam then is condensed and transferred to a decanter. In the decanter, a concentrated organic solvent phase is separated from the water phase. The water phase contains measurable concentrations of organic contaminants and must be treated as hazardous wastes.

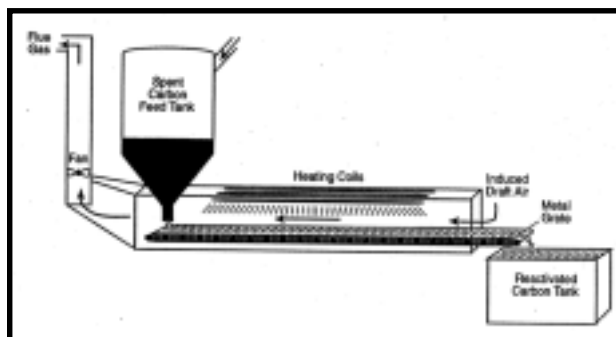
Some carbon regeneration tanks also may meet the definition of wastewater treatment unit under 40 CFR §260.10. Such units are used to adsorb contaminants from wastewaters. These units are exempt from permitting standards under RCRA when they are used to treat wastewater for discharge under National Pollutant Discharge Elimination System (NPDES) or publicly owned treatment works (POTW) standards.

2.1.4 Thermal Desorption Units

As outlined in a [June 12, 1998 Policy Memo](#), the EPA regulations do not define “thermal desorber”, but the term generally applies to a unit which treats wastes thermally to extract contaminants (i.e., volatile organics) from a matrix. A thermal desorber utilizing controlled flame combustion (e.g., equipped with a directly fired desorption chamber and/or a fired afterburner to destroy organics) would meet the regulatory definition of an incinerator. Alternatively, a thermal desorber that did not use controlled flame combustion (e.g., equipped with an indirectly heated desorption chamber and the desorbed organics were not “controlled”/destroyed with an afterburner) would be classified as a



Schematic of Multiple Hearth Carbon Regeneration Unit.



Schematic of Infrared furnace.

“miscellaneous unit”. Thermal desorption may oxidize organics but in some cases merely volatilizes organic compounds from the contaminated media and concentrates them in the desorber exhaust gas stream. Thermal desorption reduces the volume of the contaminated media, but the desorber exhaust gas stream typically still requires some form of treatment.

Additional Policy Memos regarding the applicability of the Subpart X regulations to Thermal Desorbers were issued on July 30, 1997, February 23, 1994, October 29, 1993 and May 18, 1988.

A typical thermal desorption unit includes feed processing equipment, such as hoppers, sieves, or shredders. The feed material then is transferred into the thermal treatment unit by such equipment as conveyor belts. The feed storage, preparation, and transfer system may be unenclosed, posing risks of releases during those steps. Emission controls for the ancillary equipment may be necessary to address significant risks.

The thermal treatment unit itself may consist of a rotary kiln, a fluidized-bed system, or a multiple-hearth system, as described above for regeneration units. Typically, the waste feed travels countercurrent to an air stream inside the desorber, where temperatures typically are between 400 and 1,000°F. The contaminated air stream is directed through air pollution control devices, such as afterburners, venturi scrubbers, electrostatic precipitators, or baghouses, before it is released into the atmosphere.

2.1.5 Vitrification Units

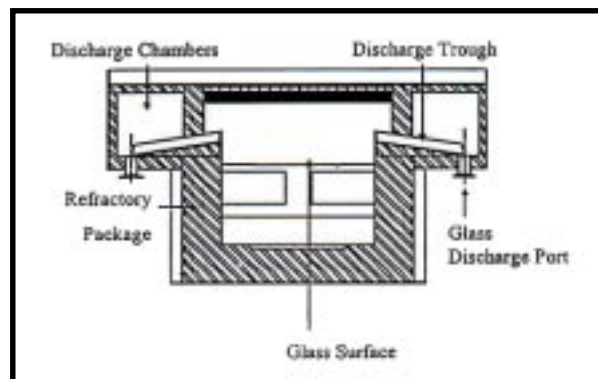
The development of vitrification technology has been promoted by the large volume of low-level and high level radioactive waste requiring treatment at U.S. Department of Energy (DOE) sites. Much of this waste includes RCRA hazardous constituents and is regulated as mixed waste.

There are two general categories of vitrification processes: those applied to site remediation (e.g., contaminated soils) and those applicable to treatment of waste streams from uranium/plutonium processing (e.g., tank wastes). Vitrification processes used in the treatment of wastes are typically conducted as ex-situ vitrification whereas

treatment of contaminated soils is generally conducted in-situ. A description of both ex-situ and in-situ vitrification processes follows.

2.1.5.1 Ex-Situ Vitrification

The ex-situ vitrification process is a thermal treatment process that both oxidizes and vitrifies wastes. It can treat wastes in the form of solids or as slurries. Typically waste and fuel are mixed in a pre-combustor before being transferred to a combustion chamber. Oxidation will take place in the combustion chamber. After the waste has been oxidized the ash is transferred to a vitrification chamber where it is mixed with glass making ingredients to create glass materials. In some systems, wastes treated this way are reportedly capable of passing the toxicity characteristic leaching procedure (TCLP).



Schematic of high level waste melter used for ex-situ vitrification.

2.1.5.2 In-Situ Vitrification

In-situ vitrification earth-melting technology was developed by Battelle Memorial Institute during the 1980s for DOE and is now commercially available as Geosafe Corporation's GeoMelt™ technology. In-situ vitrification treats contaminated materials where they presently exist. This method is preferred when it is necessary to avoid the risks associated with excavation of the waste. The vitrification process can simultaneously treat wastes with high concentrations of both organic and inorganic (e.g., heavy metal) contaminants. Organic constituents are thermally desorbed and then destroyed by thermal decomposition (pyrolysis) within the oxygen-depleted media being treated. Nonvolatile inorganics (metals) are typically incorporated into the melt and the resulting vitrified product. Such incorporation occurs within the framework of the glassy product itself, as opposed to simple encapsulation (being surrounded) by the glass. A large volume reduction (25-50% for soils) occurs due to elimination of void volume and vaporizable materials during processing. This process works best with treatment zones that are >10 feet in thickness.



In-situ vitrification hoods.

Off-gas hoods are used to cover an area of contaminated soil. The process works by melting soil in place using electricity applied between pairs of graphite electrodes. The process employs joule heating and typically operates in the range of 1,600 to 2,000° Celsius (C) for most earthen materials. A highly conductive starter path is placed between the electrodes to allow initiation of melting. As electricity flows through the starter path, the path heats up and causes the surrounding media to melt. Once the media is molten, it too becomes electrically conductive. Continued application of electricity results in joule heating within the molten media between the electrodes. After the melt is fully established, the melt zone grows steadily downward and outward through the contaminated volume. Successful melting is contingent upon the use of adequate electrical conductivity. Additives including lime, soda, ash, or pre-manufactured glass frit may be used to improve performance.

A low vacuum can be pulled on the hood in operation to capture emissions from the melt and send them to the off-gas treatment system, which may include a quencher, scrubber, demister, heater, particulate filter, blower, and optional activated carbon or thermal oxidation units. The entire ISV system can be monitored from a process control room.

2.1.6 Rotary Metal Parts Treatment Unit

Rotary metal parts treatment (RMPT) is used in the decontamination of empty projectile and mortar shells. The RMPT consists of a cylindrical structure rotating at a prescribed speed inside a cylindrical furnace. The dimensions of the RMPT are 4 feet, 8-inches inner diameter by 15 feet, 7-inches in length with design conditions of 15 psig/full vacuum at 1,500 °F. The inside cylinder contains 15 cages which are evenly distributed around a 36-inch outside diameter inner pipe, supported and strengthened by baffles. Each cage is constructed with three ½-inch diameter stainless steel rods, positioned at a 120-degree angle and parallel in the axial direction. The size of the cages is dependant on the different munitions and mortars to be treated.

The RMPT is heated by using external electric induction coils and superheated steam as the carrier gas.

Munitions that have been washed and drained are transported by a conveyor system and loaded into the cages on a unit feed basis. The furnace is heated by induction power supplied from a radio frequency generator. The entire furnace wall area must be heated and maintained at a temperature of 1,250° F. The furnace shell must have a high emittance in order to optimize performance. In addition, the shell must also have good chemical resistance to corrosion, in order to resist the acid gases that are generated during operation. The total residence time for each munition ranges from 75 minutes for 105-mm projectiles and 4.2-inch mortars to 105 minutes for 155-mm projectiles. At the same time as a munition is loaded on the front end of the unit, a treated munition is discharged at the opposite end of the furnace. A vent gas reheater is installed downstream of the RMPT to complete destruction of the agent. Downstream of the reheater, the vent stream is cooled and condensed in a quench condenser which is in contact with a recirculated brine stream. Noncondensable gases will be sent to a dedicated CATOX® offgas treatment system.

Internal parts removed from the 105-mm, 155-mm munitions and 4.2-inch mortars are processed in a smaller Batch Metal Parts Treatment (BMPT) unit. The internal parts consist of burster wells, burster tubes, fuzes, nose cones, lifting lugs and plugs. Similiar to the RMPT, the BMPT consists of a cylindrical furnace which uses external induction coils as the primary heat source and superheated steam as the carrier. The BMPT measures 4 feet, 8-inches in diameter by 11 feet in length with design conditions of 15-psig/full vacuum at 1,500 ° F. The internal parts are removed from the main bodies of the projectiles or mortars and collected into rectangular boxes. These boxes are placed on a rolling plane and fed into the furnace on a batch basis.

Detailed process flow diagrams and design specifications for the RMPT, the BMPT and the associated ancillary equipment are in provided in following document: [Rotary Metals Parts Treatment](#).

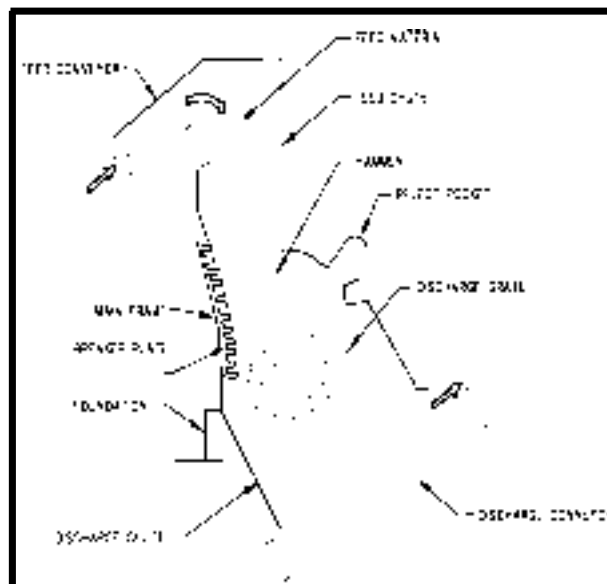
2.2 Types of Mechanical Units Included Under Subpart X

2.2.1 Shredder Units

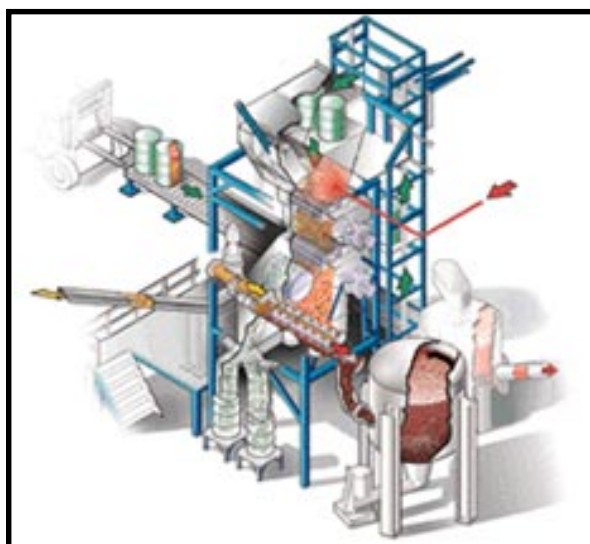
Shredders typically are used to make waste more amenable to subsequent treatment in other units, such as thermal desorbers, regeneration units, or incinerators, through reduction in size, and blending. Shredders may be regulated under Subpart X based on the material managed. Refer to [June 24, 1988 Policy Memo](#). Drum shredders are found at a number of facilities. If the unit is managing “RCRA empty” containers, then the unit is exempt from RCRA Subtitle C regulations. (Refer to [40 CFR §261.7](#) for the definition of RCRA empty). Several types of shredders are used, the major examples of which are hammer mills, shear shredders, and auger shredders.

A hammer mill is a type of shredder that reduces the size of the waste by impaction and that works best with friable materials. The mill can handle a wide range of solids but must be matched well with the waste to prevent problems related to excessive equipment wear and jamming. Stringy or sticky materials also can jam the mechanism. Shear and auger shredders use low-speed knives or counter-rotating augers to shred solid materials, such as drums.

A mechanical feed system, typically consisting of a feed hopper and some type of conveyance system, should be available to avoid the need for plant personnel to be near the opening of the hopper during operation. To prevent flying debris and to minimize emissions, the feed system should be enclosed. The shredder also must be designed to contain dusts and mists of toxic materials, as well as, in the case of hammer mills, particulate matter escaping the unit at high velocity. Dust and fumes can be controlled by drawing them into an air pollution control device associated with the shredder. In some cases, flame-suppression devices may be necessary to prevent explosion and fire in the feed hopper and the shredder.



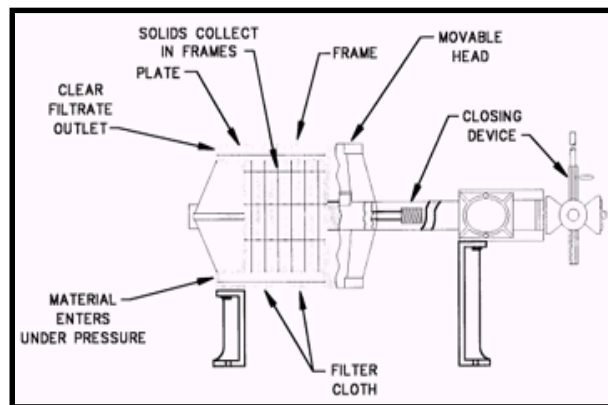
Schematic of Hammer Mill Shredder.



Schematic of Shear Shredder.

2.2.2 Filter Press Units

Filter presses are used to separate solids from fluids under pressure. The most basic type of filter press is the plate-and-frame press. As shown in the schematic to the right, the unit consists of alternating solid plates and hollow frames that are situated on parallel support bars. The filter medium is placed against each side of the solid plates, the surfaces of which are slotted or grooved. The entire collection of plates and frames is pressed together using a screw or hydraulic ram assembly, which should achieve essentially a fluid-tight closure. The filter medium between the plates and frames acts as a gasket. This schematic also shows the flow path within a plate-and-frame press. Although the figure shows filtrate exiting through a closed system, other designs discharge filtrate through cocks located at the base of each plate into open collection trays. A closed discharge system is essential to prevent toxic or volatile air emissions.



Schematic of Filter Press.

Filter presses often drip and leak. Emptying and cleaning of a filter press may include disassembly of the press and scraping of the filter cloth by hand. For such units, secondary containment (e.g., as required for tanks under 40 CFR §264.193) may be appropriate to minimize the potential for harm posed by releases that may occur during operation and maintenance of the units.

2.2.3 Drum Crushers

Drum crusher units that are eligible to be permitted under Subpart X, handle containers of hazardous wastes. Typically, a can or drum crusher handles one container at a time. The container's lid may be removed before it is placed in the crusher, or the lid can be left in place if an opening, such as a bung hole, is present. Some units are designed to cut off the top of the drum to allow easier access to the interior. After the container is conveyed into the unit and opened, the interior of the container may be sprayed with an appropriate solvent to mobilize hazardous waste residues.

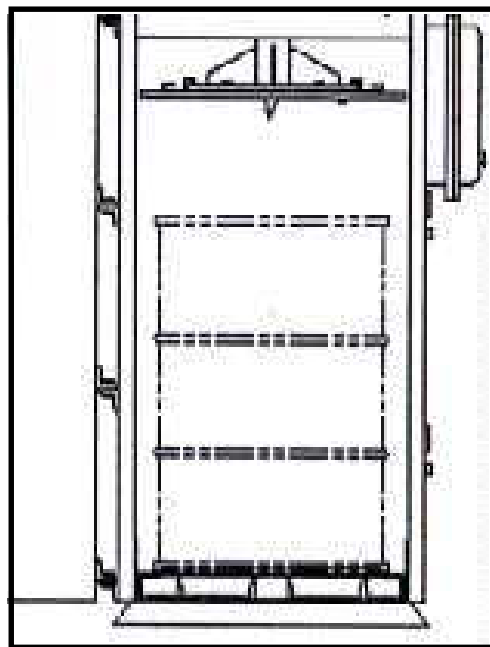
A Policy Memo concerning the applicability of Subpart X to Drum Crushers was issued on [May 21, 1991](#).

Within the unit, a perforated plate is clamped on the top of the container, and then the container is flipped over and crushed with a hydraulic ram. The hydraulic ram may be electric or pneumatic powered. The rinse solvent and residues are forced out of the container and down through the perforations. The solvent and rinsate drain from the bottom of the can crusher unit into a collection tank. The crushed container, which typically is approximately one-inch thick, is then conveyed out of the unit. The hazardous waste that drains into the collection tank may be thick and difficult to mobilize. The collection tank may have ancillary equipment for such processes as agitation, grinding, or addition of fluid to enhance removal of the hazardous waste.

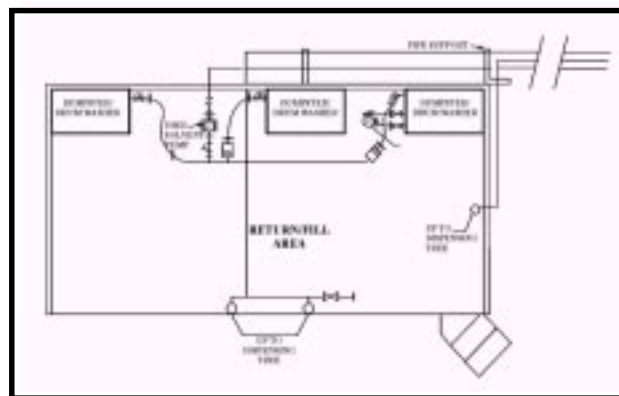
The drum crusher unit should be enclosed, so that a nitrogen or carbon dioxide blanket can be applied during crushing to minimize the risk of explosion. The unit also should be equipped with a flame-arrester vent that is connected to appropriate emission control equipment. Secondary containment may be necessary for the entire unit.

2.2.4 Drum Washer

Commercial drum washing systems are available from several manufacturers. These units are regulated as Subpart X units if the units are handling non-RCRA empty drums. The definition of RCRA-empty container is provided in 40 CFR §261.7. Drum washers may be fully automated with several stations to flush, rinse, purge, and siphon both poly and steel drums. In general, a drum washing system provides enclosed containment to capture the liquid solvent used to clean the interior and exterior of a drum. The solvent may be applied by a high-pressure spray wand or automated rotating brushes. The cleaning solvent may be as simple as high-pressure water, although it is common to use a commercial chemical solvent. Recovered solvent carries drum bottoms and may be recycled through a closed-loop solvent recovery system associated with the drum washer. The drum washer may also include an exhaust fan and air pollution control equipment (e.g., fume scrubber) to capture volatile organics and particulates evolved during drum



Schematic of Drum Crusher.



Schematic of Drum Washer.

cleaning. In addition to drum washers, systems are also available to clean smaller containers such as totes and pails. Examples of drum washing units are shown in the column to the right.

2.2.5 Mercury Bulb Crushers

Fluorescent lamps are widely used in businesses, as they provide an energy-efficient source of lighting. The commercial and industrial sectors dominate usage of fluorescent lamps, accounting for over 90 percent of total usage. Fluorescent lights are designed so that approximately half of them will operate after 20,000 hours of operation. Where these lamps are being used on a small scale, they are generally replaced as they burn out, one at a time. However, in large companies and industries, this method is not practicable, and, therefore, group relamping is done on a regular basis. Typically, group relamping is performed at 15,000 hours, or 75 percent of the lamp's rated life. This translates to replacement every two years for continuous operations, and every three to five years for noncontinuous operations, which are much more common. Approximately 20 percent of all lamps are currently replaced annually. Group relamping operations generate large quantities of lamps to be disposed of at a single time.

A typical fluorescent lamp is composed of a sealed glass tube filled with argon gas at a low pressure (2.5 Torr), as well as a low partial pressure of mercury vapor, thus the tube is a partial vacuum. The inside of the tube is coated with a powder composed of various phosphor compounds. Tungsten coils, coated with an electron emitting substance, form electrodes at either end of the tube. When a voltage is applied, electrons pass from one electrode to the other. These electrons pass through the tube, striking argon atoms, which in turn emit more electrons. The electrons strike mercury vapor atoms and energize the mercury vapor, causing it to emit ultraviolet radiation. As this ultraviolet light strikes the phosphor coating on the tube, it causes the phosphor to fluoresce, thereby producing visible light. The most commonly used fluorescent lamp is the 40-watt, 4-foot long tube, although smaller,



View of interior Drum Washer.

larger and differently shaped lamps are also used. The amount of mercury in fluorescent lamps varies considerably with manufacturer, and typically ranges from 27 to 41 mg of mercury per lamp. Many fluorescent, high-pressure sodium, mercury vapor and metal halide lamps exhibit the toxicity characteristic for mercury. In addition, some high-density discharge (HID) and incandescent lamps may contain lead solder at levels which exceed the toxicity characteristic regulatory level for lead. Fluorescent light fixtures may also contain hazardous constituents in their ballasts (i.e., polychlorinated biphenyls (PCBs) and diethylhexyl phthalate (DEPH)).

Historically, spent hazardous waste lamps were placed in landfills. On July 6, 1999 EPA added spent hazardous waste lamps to the list of federal universal wastes ([64 FR 36466](#)) in order to encourage recycling of these wastes. The Universal Waste Rule is codified in 40 CFR §273. The Universal Waste Rule for spent lamps became effective at the federal level on January 6, 2000. However, the rule is not effective in states that are authorized for the base RCRA program until the state chooses to adopt it. Some states may choose to not adopt the universal waste regulations but rather to regulate units which treat hazardous waste lamps under a Subpart X permit.

The simplest of crushers is essentially a single unit, with a crusher mounted on top of a barrel, usually a 55-gallon drum. This system is used in many industrial facilities to crush their fluorescent lamps as a means to reduce the solid waste volume before disposing the material in a landfill. In this version, light lamps are hand-fed to a feeder chute of variable length and diameter. This chute is not necessarily longer than the lamps being fed into it. The lamps pass to the crushing unit, typically consisting of motor-driven blades, which implode and crush the lamps. From here, the crushed powder drops into the barrel below the crusher. There are no air pollution controls on the device. The crushed lamps are collected in drums until they are full, and then the full drums are transported to one of several facilities. The crushed material may then be separated into



View of a barrel-mounted crusher utilizing a negative air exhaust system.

glass, metal, and powder components. Typically, the untreated powder is then deposited in a landfill. This is currently the most common method of disposing these lamps. Alternatively, the barrels may be transported to a mercury recovery facility, which will separate the mercury-containing phosphor powder from the crushed glass and aluminum endcaps, and recycle all the materials.

A more sophisticated version of this barrel-mounted crusher utilizes a negative air exhaust system to draw the crushed debris and prevent it from reemerging through the feeder tube. The drawn air is then passed through a High Efficiency Particulate Air (HEPA) filter to remove particulate matter from the exhausted airflow. The crushed material is then disposed in one of the manners discussed above.

Another model design consists of a hand fed apparatus with two feeder chutes. One chute is 5 feet long, to accommodate 4 foot lamps, and the other tube is 9 feet, in order to accommodate 6 to 8 foot lamps. Each chute is placed at an angle, and has a 9-inch by 12 inch opening, which can accommodate several lamps at a time. The lamps are delivered down this angled tube onto a motor driven blade made of heavy gauge hardened steel rotating at 2700 rotations per minute. The rotating blades implode and crush the lamps as they arrive. The crushing unit has an operating capacity of 62.5 lamps per minute. A vacuum system collects air from beneath the crusher, preventing mercury-laden air from exiting through the feed tube. Material collected in the vacuum system first passes through a cyclone separator. This removes glass particles, which drop into the drum. Air from the cyclone separator contains phosphor powder and some mercury vapor. After passing through the cyclone, the air is pulled through to a baghouse, where fabric filters trap particulate matter in the air stream. Every 45 seconds, these fabric filters are cleaned with a reverse pulse of air. The air leaving the baghouse is typically composed only of air and mercury vapor. This air and mercury vapor mixture continues through several more particulate matter and HEPA filters, to ensure that all particulates have been

removed. From here, the exhaust is delivered to two 250-pound activated carbon beds, which trap the mercury vapor.

The entire process is vacuum-sealed and monitored continuously for leaks and to ensure that air in the containment area is in compliance with OSHA regulations. Effectively, the only time where levels of mercury in the workplace may approach the OSHA limit of 0.05 mg/m^3 , is when lamps have been dropped and broken.

A third design is a completely enclosed system that feeds fluorescent lamps in one end to a crusher, passes the exhaust through an extensive filtering system, and delivers the powder to a thermal reduction unit (TRU), which recovers the mercury from the phosphor powder. Thus, this system carries out the entire mercury recycling process, from the crushing of fluorescent light lamps to the retorting and reclamation of mercury from phosphor powder.

Lamps are hand-fed into feeder tubes of different lengths, depending upon the size of the lamps being processed. The lamps are fed to the crusher, which implodes and crushes the lamps into small fragments. The operating capacity of the unit is 60 lamps crushed per minute. As with the second design, the entire process is conducted under negative airflow. The crushed debris is exhausted first to a cyclone, where the larger particles, such as crushed glass and aluminum endcaps, are separated out. At this point, much of the phosphor powder drops out into a cyclone hopper. From this collection hopper, the phosphor powder, containing mercury, is transferred to the TRU via an enclosed auger conveyer. After the cyclone, the airflow proceeds to a baghouse, where fabric filters continue to remove particulate matter from the airstream. The fabric filters are cleaned with a reverse pulse mechanism, and the powder that drops out here is also routed to the cyclone hopper. The air stream leaving the baghouse proceeds to a HEPA filter, and then to a potassium iodide-impregnated carbon filter. This removes the mercury vapor, by precipitating it in the form of mercuric iodide.

2.3 Other Types of Units Included Under Subpart X

2.3.1 Underground Mines, Caves, and Geologic Repositories

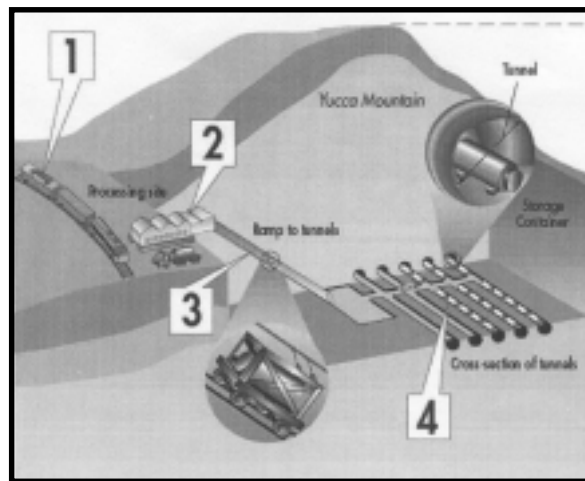
Placement of hazardous waste in subterranean features, such as mines, caves, and salt domes, is regulated under 40 CFR Part 264 Subpart X and constitutes land disposal. Hazardous waste placed in these units must be treated before disposal, in compliance with treatment standards promulgated under the land disposal restrictions (LDR), 40 CFR §268, unless the owner or operator demonstrates that there will be no migration of hazardous constituents from the unit, in accordance with 40 CFR §268.6.

The design considerations for these units are similar to those for landfills. Because of the depth of geologic repositories, it may be extremely difficult to implement groundwater monitoring. The stability of the underground formation also is an important consideration.

At cave and mining sites, infiltration of water should be evaluated carefully. The presence of caves in geologic formations indicates the presence of water within the formation at some time. The permit applicant must demonstrate that ground water is not expected to discharge into the unit for at least the time period of operation of the unit. That requirement can be met by demonstrating that there are no nearby aquifers above the level of the unit, or that aquitards exist above the repository level. Should the applicant be unable to demonstrate that condition, some form of infiltration control must be provided (a requirement similar in concept to that for leachate control for landfills).

2.3.2 Biological and Chemical Treatment Units

A permit writer may receive a permit application for a biological or chemical treatment unit that the applicant is attempting to permit under Subpart X. Many of these types of units may be more



Schematic of geologic repository at Yucca Mountain.

1. Canisters of waste, sealed in special casks, are shipped to the site by truck.
2. Shipping casks are removed, and the inner tube with the waste is placed in multilayered storage container.
3. An automated system sends storage containers underground to the tunnels.
4. Containers are stored along the tunnels, on their side.

appropriately permitted under either the tank or land treatment unit regulations, or should incorporate such standards as part of the Subpart X permit.

2.4 References

Additional information regarding these units described above can be found in the following documents:

EPA. 1992. *Alternative Control Document. Carbon Reactivation Processes. EPA 453/R-92-019*. December.

U.S. Patent Office. 1997. *Patent No. 5613,453. Donovan Chamber*.

EPA. 1994. *Evaluation of Mercury Emissions from Fluorescent Lamp Crushing. EPA 453/R-94-018*. U.S. EPA Control Technology Center. February.

3.0 SUBPART X REQUIREMENTS

This section discusses the general requirements for Subpart X units under 40 CFR Part 264. In addition, a discussion regarding other requirements which may be applicable to Subpart X units is provided.

3.1 Requirements Under 40 CFR Part 264

Subpart X does not specify minimum technology requirements or monitoring requirements for miscellaneous units. Subpart X specifies an environmental performance standard that must be met through conformance with appropriate design, operating, and monitoring requirements. The performance-based standard addresses the prevention of releases that exceed the environmental performance standard to (a) groundwater and the subsurface environment; (b) surface soil, surface water, or wetlands; and (c) air. The applicant must demonstrate that the environmental performance standards will be met during and after the active life of the unit by meeting information requirements specified in 40 CFR §270.23.

Subpart X requires that an environmental assessment and risk assessment be performed to meet the information requirements outlined above. For each assessment, different levels may be needed, depending on the findings of the initial or screening assessments. If the findings indicate little or no negative environmental effect or likelihood of release, the permit applicant may submit the initial findings in an attempt to satisfy the information requirements.

However, for many types of Subpart X units, particularly mechanical units such as shredders, crushers and filter presses, an environmental assessment may not be necessary. This is especially true in cases where the unit is fully enclosed in a containment structure such as a building. The applicant must be able to justify that an environmental assessment is unnecessary. To do this, the applicant must provide all design and operating information necessary to support their claim that an environmental assessment is not required. The permit writer must be able to assess whether adequate safeguards are

Additional information regarding the Subpart X regulations and determining whether or not they apply is outlined in the [Subpart X Overview](#) and [Big Issues](#) presentations from the February 2002 EPA Region 4 RCRA Miscellaneous Units Permitting and Compliance Training.

engineered into the system. Additionally, the permit writer may specify design and operating conditions considered appropriate for the technology and site, to ensure that the unit will not impact any environmental media.

3.2 Other Requirements **Appropriate for Subpart X Units**

3.2.1 Subpart I - Containers

Subpart I addresses the use and management of containers, and portable devices in which material is stored, transported, treated, disposed of, or otherwise handled. Portable, fabricated devices used for OB operations or operations at shredders or crushers may be similar to containers. Therefore, certain requirements of subpart I may be applicable to these devices. The necessity for secondary containment (40 CFR §264.175(c)) also should be evaluated, especially if the wastes treated in the unit contain liquids.

3.2.2 Subpart J - Tanks

Subpart J establishes requirements for tank systems. Certain types of miscellaneous units may resemble tanks, such as certain OB units or units performing physical handling operations such as drum shredders or crushers.

Tank-like devices designed for OB operations may require lining with refractory materials to insulate the metal walls of the tank from the extreme heat that may be generated during operation of the unit. The aboveground portions of the units should be inspected daily. If a tank-like unit is closed with wastes in place, the post-closure care must be performed as for a landfill (40 CFR §264.197). Assessment of the integrity of a unit that resembles a tank (40 CFR §264.191) can be addressed adequately by conducting inspections on a regular schedule (either daily, weekly, or monthly depending on the frequency of use).

3.2.3 Subpart K - Surface Impoundments

Subpart K establishes requirements for surface impoundments. Ponds used for underwater detonation may resemble surface impoundments. However, such ponds would not be designed in precisely the same manner as surface impoundments because they will be subject to extreme stresses resulting from repeated detonation of explosives. Those activities would destroy synthetic (or other types of) liners and leachate collection systems that usually are installed immediately beneath a surface impoundment. However, the necessity for monitoring of the ground water beneath the unit should be evaluated. The surface impoundment should be inspected weekly for evidence of any sudden drops in the level of the impoundment's contents and signs of deterioration in dikes or other containment devices (40 CFR §264.226(b)). The surface impoundment should be designed, constructed, and monitored, in such a way as to prevent overtopping and to prevent failure of any dikes (40 CFR §264.221(g) and (h)).

3.2.4 Subpart L - Waste Piles

Subpart L establishes requirements for waste piles. OB/OD units may resemble waste piles, especially if residual waste is left to accumulate on the ground surface or during temporary storage of the waste before it is treated by OB/OD. Standards for waste piles that may be applicable to the circumstances at an OB/OD unit described above include requirements for installing leachate collection systems and liners. The leachate collection and removal system must be chemically resistant to the waste managed in the pile and the leachate expected to be generated (40 CFR §264.251(a)(2)(i)(A)). The liner must be constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure due to pressure gradients, physical contact with the waste, climatic conditions, and the stresses of installation and daily operation (40 CFR §264.251(a)(1)(i)). Clay liners should be considered in particular for OB units that do not have containment devices; synthetic liners may not withstand the extreme temperatures generated in the OB unit. Further, detonation activities

conducted in OD units will destroy any kind of synthetic liner conventionally installed beneath the unit. Therefore, synthetic liners are not generally recommended for OD units.

Other requirements for waste piles that may be applicable and appropriate for OB/OD units include requirements for controlling run-on and run-off, and conducting ground-water monitoring if the environmental assessment indicates that there is potential for contamination of the ground water. The run-on control system should be capable of preventing flow onto the active portion of the waste pile during peak discharge from a 25-year storm (40 CFR §264.251(g)). The runoff management system should be capable of collecting and controlling the water volume resulting from a 24-hour, 25-year storm (40 CFR §264.251(h)). The pile should be managed to control any particulate matter subject to wind dispersal (40 CFR §264.251(j)). The waste pile should be inspected weekly and after storms (40 CFR §264.254(b)).

3.2.5 Subpart N - Landfills

Subpart N establishes requirements for landfills. In some cases, miscellaneous units may be closed as landfills if clean closure is not feasible. This is often the case for historical OB/OD units. Therefore, closure standards and requirements for post-closure care that are applicable to landfills may also be applicable to Subpart X units. Upon closure, the landfill must be covered with a final cover and must meet other monitoring requirements (40 CFR §264.310). Ignitable wastes must be disposed of such that they are protected from causes of ignition (40 CFR §264.312)

3.2.6 Subpart O - Incinerators

Subpart O establishes requirements for incinerators. Use of the Subpart O requirements may be appropriate for some thermal treatment units including carbon regeneration units and thermal desorbers. These requirements include waste analysis requirements (40 CFR §264.341), the potential need for a trial burn (40 CFR §264.340(d)), acceptable

operating limits for each type of waste feed (40 CFR §264.345(b)), control of fugitive emissions (40 CFR §264.345(d)), and monitoring and inspection requirements (40 CFR §264.347). A permit writer may require a trial burn for such thermal treatment units if the permit applicant cannot convincingly demonstrate in the risk assessment a lack of environmental effects.

3.2.7 RCRA Organic Air Emission Standards

3.2.7.1 Subpart AA - Process Vents

Subpart AA applies to process vents that may be associated with units that manage hazardous waste having concentrations of organic constituents of at least 10 parts per million by weight (ppmw). Applicants for Subpart X permits for carbon regeneration units and thermal desorption units must comply with the requirements of Subpart AA if the units are fitted with process vents like those described in Subpart AA. According to 40 CFR §264.1032, the owner or operator of a facility that has process vents associated with air or steam stripping operations that manage hazardous wastes having concentrations of organics of at least 10 ppmw must either (1) reduce total organic emissions from all affected process vents at the facility to a level below 1.4 kg/hr or (2) reduce, by use of a control device, total organic emissions from all affected process vents at the facility by 95 percent by weight. If the owner or operator installs a closed-vent system and control device to comply with provisions of 40 CFR §264.1032(a), the device must meet the requirements governing closed-vent systems and control devices specified in 40 CFR §264.1033.

One of the issues that has arisen in recent years is the issue of whether groundwater treatment units are subject to the RCRA organic air emission standards. Many believe that air strippers fall under the wastewater treatment unit exemption outlined in 40 CFR §264.1(g)(6). The June 21, 1990 preamble to the RCRA Subpart AA & BB Rule does make reference to wastewater treatment tanks as defined under 40 CFR § 260.10 being excluded from applicability

to these two Subparts. But, this is not the case when remediating groundwater in air stripping operations. 40 CFR §260.10 defines wastewater treatment units as receiving or treating an influent wastewater that is classified as hazardous waste as defined in 40 CFR §261.3. However, 40 CFR §261.3 does not address environmental media such as groundwater. Environmental media are not solid wastes. The Agency's position is that mixtures of environmental media and listed hazardous wastes must be managed **as if** they were hazardous wastes, an interpretation other words referred to as the "contained-in" policy and upheld in Federal court (ref. Chemical Waste Management Inc. v. U.S. EPA, 869 F.2d 1526; D.C. Cir. 1989). In summary, groundwater is not a hazardous waste and does not meet the criteria of 40 CFR §261.3. Thus, an air stripper treating groundwater contaminated with volatile organic compounds does not meet the definition of a wastewater treatment unit as mentioned in the 1990 preamble to the Subpart AA & BB Rule and is not excluded from applicability to the RCRA Organic Air Emission Standards. In accordance with the "Contained-in Policy", a corrective action unit treating groundwater contaminated with a listed hazardous waste should be addressed as a hazardous waste management unit - not as a wastewater treatment unit.

By statute, air emissions (as well as other environmental media releases) from units managing hazardous wastes with interim status, are subject to corrective action under 3008(h) authority. The statute requires environmental media contamination resulting from waste management be addressed to protect human health and the environment. Subpart AA & BB were promulgated under HSWA authority mandated by Section 3004(n) of the Solid Waste Disposal Act (refer to the [June 21, 1990 FR 25456](#), Section III, C. Air Standards Under RCRA Section 3004(n)). Section 3004(n) requires the monitoring and control of air emissions at units treating, storing or disposing of hazardous wastes as necessary to protect human health and the environment.

3.2.7.2 Subpart BB - Equipment

Subpart BB applies to equipment, such as pumps, valves, compressors, pressure relief devices, sampling connection systems, open-ended lines and valves, closed-vent systems, control devices, flanges and other connectors that contain or come into contact with hazardous wastes with concentrations of organics of at least 10 percent by weight that are managed in (1) units subject to the permitting requirements of Part 270 or (2) hazardous waste recycling units that are located at hazardous waste management facilities subject to permitting requirements under Part 270. Depending on the type of equipment and the associated service (i.e., gas, light-liquid or heavy liquid service), the owner or operator must either (1) periodically test the equipment using an organic vapor analyzer and repair any leaks detected within a prescribed time period or (2) follow certain prescribed equipment standards. Organic vapors vented to a control device must be reduced by 95% or meet the 20-ppmv total organic outlet concentration limit for a combustion device. Where applicable, permit applicants must submit information that demonstrates compliance with all requirements of Subparts AA and BB.

3.2.7.3 Subpart CC - Containers, Tanks and Surface Impoundments

Subpart CC applies to interim status and permitted TSD facilities that manage hazardous waste in containers, tank systems, surface impoundments or miscellaneous units and large quantity generators (LQGs) that accumulate hazardous waste in tanks and containers. Waste management units that contain hazardous waste with an average organic compound concentration of 500 parts per million by weight (ppmw) or greater are subject to the Subpart CC requirements. Type-specific equipment design and operating practices apply to each regulated waste management unit. In addition, any control device handling emissions from such units must meet the 95% minimum control or 20-ppmv total organic outlet concentration limit for a combustion device. Applicants must submit information that demonstrates compliance with those requirements if the

Additional information regarding the applicability of the RCRA Organic Air Emission Standards to Subpart X units is outlined in the [Case Study on Subpart X](#) presentation from the March 2002 EPA Region 4 RCRA Organic Air Emission Standards Permit and Compliance Training and in the [Subpart CC Fact Sheet](#).

units resemble the types of units regulated under Subpart CC, as described above.

3.2.8 Subpart EE -Military Munitions Rule

Section 107 of the Federal Facility Compliance Act of 1992 added a new subsection 3004(y) to RCRA, requiring EPA to issue regulations that identify when conventional and chemical military munitions become hazardous wastes subject to RCRA Subtitle C, and that provide for the safe storage and transportation of such waste. EPA published the final Military Munitions Rule on February 12, 1997 ([62 Federal Register 6622-6657](#)). This rule directly affects Subpart X OB/OD operations in three situations: (1) use of a product for its intended use, including the OD of bombs hitting the ground, the OD of explosives for mining or road clearing, and the training of military personnel in the OB/OD of military munitions, (2) the on-range OB/OD destruction of unexploded ordnance (UXO) during range clearance activities at active or inactive ranges, and (3) the OB/OD destruction of all munitions and explosives during an emergency response. In the first two situations the final rule specifies that these materials are not “solid waste,” and therefore the RCRA permitting standards do not apply. In the third case, regardless of whether the material is a “solid waste,” the final rule exempts the emergency OB/OD operations from RCRA permitting requirements. Except for the training of military personnel in the OB/OD destruction described in situation one, these situations apply to non-military munitions and explosives. For all other non-use OB/OD destruction of munitions or explosives, RCRA permitting or interim status is generally required. These situations are discussed in greater detail below.

The [Military Munitions Rule Fact Sheet](#) provides an overview of this regulation.

3.2.8.1 Training in Use of a Product

The final Military Munitions Rule, in 40 CFR §266.202 (a)(1)(i), states that a military munition is not a solid waste when it is used for its intended purpose, including use in training military personnel in the proper and safe OB/OD destruction of unused propellant or other military munitions as may be

required on the battlefield, and the training of military explosives and munitions emergency response specialists (i.e., explosive ordnance disposal (EOD) or technical escort unit (TEU) personnel) in the proper and safe OB/OD destruction of munitions and explosives. Such destruction training is not a RCRA-regulated activity because the material is a product and not a “solid waste.” That is, the product is being used to train personnel in the proper and safe use of the product, as contrasted to destruction of an excess or waste product in the absence of training, which is a RCRA-regulated activity.

“Military” is defined in the final rule to include the Department of Defense (DOD), the Armed Services, Coast Guard, National Guard, Department of Energy (DOE), or other parties under contract or acting as an agent for the foregoing, who handle military munitions. “Military munitions” is defined in the final rule to include all ammunition products and components made or used for national defense and security, including confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical warfare and riot control agents, smokes and incendiaries, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof. “Military munitions” do not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components thereof. The term does include non-nuclear components of nuclear devices, managed under DOE’s nuclear weapons program after all required sanitization operations under the Atomic Energy Act of 1954, as amended, have been completed.

Training (as distinguished from waste disposal) may be evidenced by the existence and use of detailed protocols or training manuals for training military personnel in the handling and burning of unused propellant, the presence of military trainees, and documentation of the training activities (e.g., number of personnel trained, date and time of training,

OB/OD destruction of excess propellants or other munitions and explosives in the absence of training is not a use for its intended purpose, but rather, is treatment of a solid waste requiring a RCRA permit under Part 264, Subpart X, or interim status under Part 265, Subpart P.

The preamble to the Military Munitions Rule provides information on documentation U.S. EPA prefers to see to justify training events.

military personnel attendance lists, and the amount of propellant used in training).

3.2.8.2 Range Clearance

The final Military Munitions Rule, in 40 CFR §266.202 (a)(1)(iii), states that the recovery, collection, and on-range destruction of unexploded ordnance and munitions fragments during range clearance activities at active or inactive ranges is included within the use of a product for its intended purpose and therefore is not a solid waste. Since the material is not a solid waste, a RCRA permit is not required for its on-range destruction by OB/OD.

The final rule defines “active range” as a military range that is currently in service and is being regularly used for range activities. “Inactive range” is defined as a military range that is not currently being used, but that is still under military control and considered by the military to be a potential range area, and that has not been put to a new use that is incompatible with range activities. “Military range” is defined to include firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, and buffer zones with restricted access and exclusionary areas.

The final rule clarifies, in 40 CFR §266.202(c)(1), that a used or fired military munition is a solid waste, and therefore subject to the RCRA permitting requirements, when transported off range or from a site of use, where the site of use is not a range, for the purposes of reclamation, treatment, disposal, treatment prior to disposal, or storage prior to reclamation, treatment, or disposal.

In the training and range clearance situations, a permitted RCRA OB/OD unit may still be used so long as the permit conditions are met.

3.2.8.3 Emergency Responses

The final Military Munitions Rule, in 40 CFR §§262.10(i), 264.1(g)(8), 265.1(c)(11), and 270.1(c)(3), states that immediate responses to actual or potential threats involving explosives and

munitions are exempt from RCRA generator and permitting requirements. Transportation during an emergency response to a safer location, such as an open space or EOD range for treatment or other means of rendering safe, is exempted, in 40 CFR §263.10(e), from RCRA transporter/manifesting requirements.

The final Military Munitions Rule includes three key definitions pertinent to explosives and munitions emergency responses that help clarify the scope of this exemption. “Explosives or munitions emergency” is defined as a situation involving the suspected or detected presence of unexploded ordnance (UXO), damaged or deteriorated explosives or munitions, an improvised explosive device (IED), other potentially explosive material or device, or other potentially harmful military chemical munitions or device, that creates an actual or potential imminent threat to human health, including safety, or the environment, including property, as determined by an explosives or munitions emergency response specialist. Such situations may require immediate and expeditious action by an explosives or munitions emergency response specialist to control, mitigate, or eliminate the threat.

“Explosives or munitions emergency response” is defined as all immediate response activities by an explosives or munitions emergency response specialist to control, mitigate, or eliminate the actual or potential threat encountered during an explosives or munitions emergency. An explosives or munitions emergency response may include in-place render-safe procedures, treatment or destruction of the explosives or munitions and/or transporting those items to another location to be rendered safe, treated, or destroyed. Any reasonable delay in the completion of an explosives or munitions emergency response caused by a necessary, unforeseen, or uncontrollable circumstance will not terminate the explosives or munitions emergency. Explosives and munitions emergency responses can occur on either public or private lands and are not limited to responses at RCRA facilities.

“Explosives or munitions emergency response specialist” is defined as an individual trained in chemical or conventional munitions or explosives handling, transportation, render-safe procedures, or destruction techniques. Explosives or munitions emergency response specialists include DOD emergency EOD, TEU, and DOD-certified civilian or contractor personnel; and other Federal, State, or local government, or civilian personnel similarly trained in explosives or munitions emergency responses.

When a munition lands off-range, it must be promptly rendered safe and/or retrieved, or if remediation is infeasible, a record of the event must be maintained as long as any threat remains. RCRA corrective action or Section 7003 imminent and substantial endangerment authorities, or CERCLA authorities, may be used to address the problem, including use of in-place OB/OD.

As stated earlier, an explosive or other munition posing or potentially posing an imminent and substantial endangerment threat are exempt from RCRA permitting under 40 CFR §§264.1(g)(8) and 270.1(c)(3). Non-time-critical emergency responses, however, are subject to the emergency permit requirements of 40 CFR §270.61. Emergency permits may be oral or written. If oral, it must be followed in five days by a written emergency permit. Emergency permits must be accompanied by a public notice per 40 CFR §270.61. Some states require notification prior to and/or after the emergency permit action is completed. Conditions in the permit should describe the type of communication necessary. The following is a listing of conditions that may be included in an emergency permits.

- Temporary EPA ID Number
- Verification of a threat to human health or the environment
- Type of waste(s) and amount
- Method of treatment
- Location and restrictions, isolation distances
- Time Limit: up to 90 days
- Notification of initiation and completion

- General permit conditions applicable to any permit
- Special conditions related to the permitted activity
 - Compliance with DOT
 - Rate of treatment
 - Treatment unit design
 - Discharges or emission compliance with other laws (CWA, CAA)
 - Preparedness and prevention
 - Inspection and disposal of treatment residues
- Corrective action provisions can also be applied as a standard condition.

Some states require sampling in emergency permits. Data quality objectives (DQOs) need to be considered in requiring sampling. EPA guidance on this topic is available in a document titled "[Field Sampling and Selecting On-site Analytical Methods for Explosives in Soils](#)" (EPA/540-R-97/501), November 1996.

Conditions requiring removal and management of all visibly affected soil and any popout, may be sufficient in some emergency permits. This provision would reduce risk from materials left on-site, which is common in emergency situations. Removal would also reduce future land use risk at the location of treatment. For thermal treatment of metal bearing wastes, air sampling may be required if pollution controls are not installed on the unit. [An example of an emergency permit is provided from the State of Nebraska.](#)

Emergency permits issued to the same facility or the same owner/operator on a routine basis may show a need for an operating permit. Routine is not defined, but over 3-5 times a year may show repetition. Agencies need to consider administrative processing, permitting fees, etc. in determining how many emergency permits should be issued to the same owner/operator. Emergency permits are meant for threats. If threats are becoming a problem it may be necessary for the State and other RCRA authorities to assess the facility and operations.

Additional information regarding emergency permits is outlined in the [Emergency Permits and RCRA Emergency Exemption](#) presentations from the February 2002 EPA Region 4 RCRA Miscellaneous Units Permitting and Compliance Training.

3.2.8.4 Other Changes Impacting OB/OD Units

40 CFR §266.203 (a)(1) provides a conditional exemption from the RCRA manifest requirements for the transportation of conventional munitions from one military installation to an OB/OD facility at another military installation, but not to a commercial OB/OD facility.

3.3 Subpart EEE - NESHAPS: Final Standards for Hazardous Waste Air Pollutants for Hazardous Waste Combustors

Section 264.601 was recently modified (refer to [64 FR 52993, September 30, 1999](#)) to include a reference to the new 40 CFR Part 63 Subpart EEE standards (NESHAPS: Final Standards for Hazardous Waste Air Pollutants for Hazardous Waste Combustors; Final Rule (HWC MACT Rule)). 40 CFR §264.601 now states that permit terms and provisions “must include those requirements of subparts I through O and subparts AA through CC of this part, part 270, part 63 subpart EEE, and part 146 of this chapter that are appropriate for the miscellaneous unit being permitted.” Refer also to the [March 10, 2000 Policy Memo](#) for additional clarification regarding Subpart EEE.

3.4 Endangered Species Act

The Federal Endangered Species act and similar State legislation require the determination that no threatened or endangered species will be affected adversely by proposed activities. The permit applicant must certify, either through a biological assessment or through a literature review, that no such species are present in the area of the unit. If such species are present, a plan must be developed to minimize any effects on those organisms.

In the case of a unit to be located along a migratory pathway of some animal, similar options are available. If, for example, a unit were to be located along a migration pathway used by elk, the permit

application should include a discussion of additional physical barriers that would exclude elk from the area and perhaps, a discussion of schedule modifications of the operating schedule of the unit to account for their migratory habits.

Dealing with an environmental impact statement (EIS) is far more complicated than handling any of the circumstances described earlier. If, based on the EIS, an applicant has not been able to obtain a finding of no significant impact (FONSI) or a categorical exclusion for the operation, the terms of the EIS are likely to add a new level of complexity to the application. The findings of any required EIS, and the mitigation and monitoring plans included in it, should be included with the permit application as an appendix. The permit applicant should discuss explicitly how the mitigation and monitoring plans will be implemented and how implementation will affect overall operations. Once again, the permit writer must evaluate the information against the mitigation and monitoring plans and determine whether it meets those requirements and whether the requirements cause unintended problems in the operation of the unit.

Refer to the [Specific Technical Issues](#) presentation (slides 65-68) from the February 2002 EPA Region 4 RCRA Miscellaneous Units Permitting and Compliance Training for additional information on Endangered Species issues.

4.0 INFORMATION REQUIREMENTS

A Subpart X permit applicant must provide both general and specific information about the miscellaneous units described in the permit application. General information requirements for all RCRA permit applications, including those for miscellaneous units, are specified in 40 CFR §270.14. The specific information requirements for Subpart X units, set forth in 40 CFR §270.23, include a detailed description of the unit, environmental settings, pathways of exposure and receptors, and demonstration of effectiveness of treatment.

The following subsections provide guidance for evaluating information submitted by permit applicants in response to the specific, and some of the general information requirements. [Appendix A](#) of this document contains a check list that summarizes the information requirements that must be addressed in a Subpart X permit application. Permit writers also should refer to the RCRA Miscellaneous Treatment Units Permitting and Compliance Training - [Available Information and Tools](#), [General Technical Issues](#) and [Specific Technical Issues](#) presentations for assistance in reviewing Subpart X permit applications. In addition, a number of states have also developed Subpart X guidance. In addition, a number of states have also developed guidance on reviewing permit applications for Subpart X units.

4.1 Physical and Chemical Characteristics of Waste and Residues

The permit application for a miscellaneous unit, must include waste characterization data that are sufficient to assure that the wastes managed by the facility can be (1) adequately and safely stored at the facility and (2) effectively treated in the miscellaneous unit. For each hazardous waste and hazardous debris treated, stored, or disposed of at the facility, the permit application must include a description of the waste and its EPA or state hazardous waste code, its hazard characteristics, the basis for its designation as hazardous, and the results of chemical and physical analyses of representative samples of the waste. However, certain types of wastes, such as

those that usually are treated at OB/OD units, may not be analyzed easily or safely, because of their reactivity. For such wastes, existing information such as published or historical analytical data, knowledge of the chemical substances used in the manufacturing process and product formulations, or data provided by off-site generators may be presented in the permit application to fulfill this requirement.

For all Subpart X units, waste characterization data must demonstrate that the wastes are compatible with the construction materials of the unit. For example, for Subpart X units that have geomembrane liners, methods described in [SW-846](#) can be used to demonstrate that hazardous wastes are compatible with the liner(s). For units that do not have secondary containment, the data also must demonstrate that the wastes do not contain free liquids. EPA's standard protocol for determining whether free liquids are present is the [Paint Filter Liquids Test method 9095 in SW-846](#).

For Subpart X units that employ thermal treatment (other than OB units), methods applicable to incinerators, boilers, or industrial furnaces may be used. For such units, waste characterization data must include the following, as appropriate for the type of controlled thermal treatment being conducted: physical form of the waste; viscosity of liquids; identification and approximate quantification of the Appendix VIII hazardous organic constituents reasonably expected to be present in the waste; concentrations of chlorine and metals; and ash content. If blending is to occur before firing, the permit application must identify the blending material and blending ratios and describe blending procedures.

Permit applications for units treating energetic wastes should clearly identify the waste item (e.g., name, munition item type, etc.), EPA waste code, waste composition data (including nonenergetic components), waste properties and waste treatment quantities. The waste description information should be provided as a function of energetic classification

and munition category. Example energetic classifications are presented below:

- Propellants are low explosive agents such as explosive powder or fuel that provides the energy for propelling ordnance to the target. Propellants include both rocket and gun propellants.
- Primary or initiating explosives are high explosives generally used in small quantities to detonate larger quantities of high explosives. Initiating explosives will not burn, but if ignited, they will detonate. In general, propellants are ignited by applying a flame, while bursting explosives are ignited by a severe shock. The initiating device used to set off a propellant is called a primer, and the device used to initiate the reaction of a bursting explosive is called a detonator.
- Auxiliary or booster explosives are used to increase the flame or shock of the initiating explosive to ensure that the burster charge performs properly. High explosives used as auxiliary explosives are less sensitive than those used in initiators, primers, and detonators, but are more sensitive than those used as filler charges or bursting explosives.
- Bursting explosives, burster charges, or fillers are high explosive charges that are used alone or as part of the explosive charge in mines, bombs, missiles, and projectiles.
- Pyrotechnics are low explosives used to send signals, to illuminate areas of interest, to simulate other weapons during training, and as ignition elements for certain weapons. Pyrotechnic compositions are considered low explosives because of their low rates of combustion. Examples of pyrotechnics are illuminating flares, signaling flares, smoke generators, tracers, incendiary delays, and photo-flash compounds.
- Small arms munitions contain projectiles that are 0.5 inches or less in caliber and no longer than

approximately 4 inches. Unexploded small arms munitions may explode if thrown into a fire or struck with a sharp object.

- Hand grenades are small explosive -or chemical -type munitions designed to be thrown at short range. All grenades are composed of three main parts: a body, a fuze with a pull ring and safety clip assembly, and a filler.

Small arms munitions are typically not appropriate for OB/OD treatment because they can generally be safely transported offsite for treatment by alternative technologies.

Many of the energetic waste to be treated by OB/OD units may be characterized by manufacturers and other sources. For example, the Munitions Items Disposition Action System (MIDAS) program, operated by the U.S. Army, includes a database of the composition of many military munitions. Although all of the military munition items are not currently included, a representative number of items have been characterized and additional items are routinely added. The MIDAS web site is at www.daciarmy.mil (registration is required for access).

However, there are major complicating factors regarding providing detailed waste description information for potential future OB/OD treatment as follows:

- Potential for a wide range of energetic items to be treated.
- Variability of waste composition between items and potentially even for the same items (because many of the military munition specifications are performance based, not composition based).
- Uncertainties for item-specific treatment quantities.

Thus, the permit application should include waste description information based on historical data (a minimum of 5 years) and for future OB/OD

operations. In order to address the uncertainties associated with the waste description information and quantities, the applicant should provide sufficient information in the permit application to demonstrate that OB/OD is the appropriate treatment for a waste and to establish risk-based levels for permit conditions. This approach is similar to defining the potential waste streams for a hazardous waste incinerator and or industrial furnace.

4.2 Waste Analysis Plan

The Subpart X permit applicant must submit a waste analysis plan, as required by §270.14(b)(3), which includes analytical parameters and the rationale for the selection of such parameters, test methods, and methods and frequency of sampling. The waste analysis plan should address pretreatment wastes as well as post-treatment wastes. Waste analysis plans for facilities that receive wastes from off-site sources must include descriptions of procedures to be used to verify identity of each shipment received.

The waste analysis plan must comply with the requirements specified in 40 CFR §264.13(b). Those standards were designed to apply to the types of wastes that are present in conventional hazardous waste management units. Some of the standards therefore may not be applicable to the types of wastes treated in miscellaneous units. For example, as mentioned previously, certain wastes treated in OB/OD units may not be sampled and analyzed safely or easily. However, because the chemical compositions of many such wastes are well known and historical data are available, additional sampling and analysis of the wastes may not be required to demonstrate successful treatment of them. However, if there is no existing information regarding the chemical compositions of the wastes to be treated in the miscellaneous unit, detailed sampling and analysis of the wastes must be conducted to characterize the waste and to demonstrate that the wastes can be treated successfully in the miscellaneous unit. If the wastes cannot be sampled and analyzed safely and there are no historical data, the permit writer may wish to require the applicant to conduct a trial test to

demonstrate the effectiveness of the treatment process.

Sampling procedures for soil and groundwater may also be required if treatment takes place directly on the ground surface or if an environmental assessment indicates that there are risks from soil contamination. It is EPA's policy that precision and accuracy be assessed on all monitoring and measurement projects. This includes waste analysis plans.

Additional guidance on preparing waste analysis plans can be found in [Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Wastes \(EPA/530-SW-84-012\)](#) dated April 24, 1994.

4.2.1 Analytical Parameters

The waste analysis plan must list the parameters for which analysis of the waste and the residues of waste treatment will be conducted. The parameters must be specific to the type of waste to be analyzed, and the rationale for their selection must be provided. In general, to present an adequate rationale, the permit applicant must provide a convincing discussion of how monitoring of the selected parameters will provide the best information regarding the fate of hazardous constituents. When establishing parameters, permit applicants should not use nonspecific categories of wastes, such as "other explosives" for an OB/OD unit. For reactive wastes, such as the wastes treated in OB/OD or enclosed thermal treatment units, the primary parameters may include flash point, stability test, and detonation test. Generator/user knowledge may also be adequate for characterizing waste reactivity.

Explosive reactivity test methods include:

- A stability test performed by heating the residue to 75 C for 48 hours. A waste is considered reactive due to instability if a sample of it detonates, deflagrates, or decomposes exothermically during the test. The test defines a forbidden explosive according to 49 CFR §173.51.*
- A detonation test, performed by inserting a blasting cap into a sample and observing the detonation. Reaction of the sample to a strong initiating source and Class A explosives as defined in 49 CFR §173.53 are tested in this manner.*
- A spark test, performed by inserting a time fuse or an electric squib into a sample and observing the waste for deflagration or detonation. This test explosive is defined in 49 CFR §173.53 and 49 CFR §173.88.*

4.2.2 Analytical Methods

The waste analysis plan must list test methods for evaluating wastes for the parameters of concern. When possible, the test methods must be taken from [SW-846, Test Methods for Evaluating Solid Wastes](#). In general, use of the sampling methods outlined in Appendix I of 40 CFR Part 261 is required for obtaining a representative sample of the waste. The waste analysis plan must specify test methods outlined in Part 261 Subpart C to determine whether samples exhibit any characteristics of hazardous waste, including the toxicity characteristic leaching procedure (TCLP). The permit applicant also must specify analytical

methods to demonstrate compliance with the land disposal restrictions set forth in Part 268. The methods likely will include, at a minimum, the TCLP and applicable methods for total waste analysis.

Standard EPA analytical procedures in SW-846 can be used to analyze most constituents identified in Part 264 Appendix VIII. However, for many constituents commonly found in wastes managed in Subpart X units, no test methods are specified in SW-846. For example, no approved test methods for solid and hazardous waste are specified for several explosive compounds typically managed in OB/OD units. In such cases, permit applicants must attempt to use other methods, established either by EPA (for example, test methods specified in EPA's *Test Methods for Analysis of Water and Waste*) or by nationally recognized authorities other than EPA (e.g., the American Society of Testing and Materials). Whenever an applicant proposes to use a test method that is not specified in SW-846, the applicant must explain the method in detail and provide justification for its use.

4.2.3 Frequency of Analysis

The waste analysis plan should specify the frequency with which analysis will be conducted to ensure successful treatment of the waste. Permit writers should specify the frequency of waste analysis based on (1) health and safety considerations, (2) variability in the types of wastes to be treated, (3) volume of waste treated or disposed of in the unit or frequency of treatment, or (4) any other factors that the permit writer determines might indicate a need for more or less frequent analysis. In the case of certain explosive wastes treated at OB/OD units, less frequent analysis may be warranted if the permit applicant can demonstrate that the waste is highly consistent or that analysis of the waste poses a threat to persons conducting the analysis through risk of fire, explosion, release of toxic vapors or gases, or other conditions that may pose unwarranted health and safety risks.

4.2.4 Analysis of Waste Generated Off Site

Additional requirements for analysis of wastes are applicable to facilities that receive waste from off-site generators. The waste analysis plan for such a facility must specify procedures for using information supplied by off-site generators in lieu of actual analysis of the waste at the site. The permit applicant must describe procedures for verifying that analytical data supplied by the generator of the waste are correct. The plan must also specify procedures to be implemented to ensure that the wastes received actually match the description of those wastes provided on the hazardous waste manifest. A permit writer may wish to require certain “fingerprint” analyses that will help verify that the waste is indeed what is claimed by the generator (e.g., analyses for specific gravity, flash point, total organic carbon, viscosity, and/or water and ash content).

4.2.5 Additional Requirements for Waste Analysis

The owner or operator that treats, stores, or disposes of ignitable or reactive waste or mixes incompatible wastes or incompatible wastes with other materials must provide documentation that demonstrates that the reactions involved in the mixing and treatment of the reactive wastes will not:

- Produce uncontrolled toxic mists, fumes, dusts, or gases in quantities sufficient to threaten human health and the environment
- Produce uncontrolled flammable fumes or gases that may pose a risk to human health or the environment
- Damage the structural integrity of the device or facility
- Through other like means, threaten human health or the environment

The documentation may be based on references to published literature, data from trial tests, waste

analyses, or the result of treatment of similar wastes by similar treatment processes and under similar operating conditions. Permit writers may refer to [Appendix V of Part 264](#) for examples of potentially incompatible wastes.

4.3 Waste and Residual Characterization

A permit writer should require that a Subpart X permit applicant characterize the waste that is to be treated or disposed of (as generated wastes) and, if applicable, the residues of the treatment process. Post-treatment waste for OB/OD units may include ash/residues, scrap and unexploded ordnance (UXO). For thermal units, stack emissions as well as any waste residues from pollution control equipment need to be characterized. Post-treatment residues from mechanical units include scrap metal which may be coated with hazardous constituents and waste residues from pollution control devices. The WAP should also address the waste analysis approach for these post-treatment wastes. Again, generator knowledge may be an appropriate approach for the evaluation of the explosive reactivity of OB/OD generated scrap and UXO (i.e., considering the dangers of reactivity tests). The concentration of energetics for a residue sample (e.g., burn pan ash) can be used to define an explosive reactivity criterion. Soils contaminated energetics have not been found to be reactive. However, OB/OD post-treatment wastes may have other hazardous waste constituents or characteristics of concern that should be addressed by the WAP (e.g., metals). Post-treatment waste analyses should be conducted at a minimum annually if the waste energetics treated are consistent in composition. Otherwise, the analysis should be done for each individual waste stream annually or each ash/residue accumulative container subject to disposal.

4.3.1 Munitions, Explosives, and Other As-Generated Wastes

There are two major issues of special interest to permit writers with regard to the analysis of wastes to be treated or disposed of in Subpart X units. First, many of the wastes that will be treated in

Subpart X units, and OB/OD units in particular, already may be well characterized in information provided by manufacturers and other sources. Because of this circumstance, in conjunction with the possibility of specific health and safety concerns and analytical problems associated with the characterization of the wastes, the permit applicant in many cases may be able to use information from alternative sources in lieu of data obtained from direct sampling and analysis. Second, only certain types of ignitable and reactive wastes are appropriate for treatment in OB/OD units. The two issues are discussed in the following subsections.

4.3.1.1 Use of DoD Data Sheets and Technical Manuals

DoD data sheets may be used to characterize some wastes that are treated in OB/OD units. The Secretary of the Army is the sole manager for the procurement, production, supply, and maintenance of conventional ammunition for all military services. The Army has developed technical manuals (TM) that provide data sheets for each class of munitions (for example, artillery ammunition, bombs, grenades, rockets, and land mines). Each data sheet provides a short compilation of information about the particular munition, including: dimensions, weight, explosive and propellant filler, and net explosive weight (NEW), along with illustrations and descriptions. In addition, the data sheets describe how the munition functions when fired. Each data sheet also provides a list of reference publications. The reference publications provide detailed information about storage, transportation, and demilitarization, along with drawings of individual components of the munition. The data sheets, although not necessarily a part of an OB/OD permit, may be referenced in the permit.

4.3.1.2 Waste Analyses for Ignitable and Reactive Wastes

Permit writers should allow treatment of ignitable and reactive wastes in OB/OD units only if such wastes cannot be managed safely in other units. To

that end, permit applicants are required to provide information on waste characterization information to justify use of OB/OD. Many types of waste streams that are ignitable or reactive can be managed safely in other types of units, such as incinerators (for example, popping furnaces for small arms ammunition) or BIFs.

The determination is based on the means by which the generator has classified the waste as ignitable. EPA's definition of an ignitable waste includes:

- Liquid wastes that have a flash point of less than 140°F (60°C)
- An oxidizer, as defined by Department of Transportation (DOT) in 49 CFR §173.151
- An ignitable compressed gas, as defined by DOT in 49 CFR §173.300
- A solid wastes capable under standard temperature and pressure of causing fire through friction, absorption of moisture, or spontaneous chemical changes and that when ignited, burn so vigorously and persistently that they present a hazard

EPA has approved SW-846 Method 1030 for determining whether a material “burns so vigorously and persistently that it creates a hazard.” However, the method is only guidance and it’s use is not required under 40 CFR §261.21(a)(2).

Wastes that fall into any of the first three categories listed above should not normally be treated in OB/OD units because they typically can be treated disposed of by more conventional hazardous waste treatment or disposal technologies, such as incinerators or BIFs. For wastes in the first category, permit applicants are required to use SW-846 Method 1010 to determine whether the waste is ignitable. Because Method 1010 applies only to liquid wastes, permit applicants may be required to use the paint filter liquids test (SW-846 method 9095) to determine whether a waste is a liquid. Ignitable wastes included in the second and third categories listed above are defined by DOT regulations as safe for transport. A waste that falls into the fourth category may be a candidate for OB. For such wastes, the permit writer should require that the applicant provide a convincing rationale for treating these wastes by OB.

The open burning of solvents is strictly prohibited per 40 CFR §265.832.

In contrast, treatment of OB/OD may be the only practicable methods of treatment or disposal for many types of reactive wastes. Because such wastes may be affected by unique handling considerations, conventional hazardous waste treatment technologies (for example, incineration) may not be capable of safely managing them. In addition, many commercial laboratories are not equipped for, and will not accept, certain types of PEP wastes that are classified as reactive.

SW-846 Test Methods can be found on-line at
<http://www.epa.gov/epaoswer/hazwaste/test/main.htm>

EPA classifies several types of wastes as reactive hazardous wastes, including any waste that meet any of the following criteria:

1. It is normally unstable and readily undergoes violent change without detonating
2. It reacts violently with water; forms potentially explosive mixtures with water; or, when mixed with water, generates toxic gases, vapors, or fumes in quantities that may threaten human health or the environment
3. It is a cyanide- or sulfide-bearing waste that, when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors, or fumes in quantities that may threaten human health or the environment
4. It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if it is heated under confinement
5. It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure
6. DOT defines it as a forbidden explosive (49 CFR §173.54), or a Class 1.1 through Class 1.3 explosive (49 CFR §173.53)

Permit writers should require that the permit applicants clearly state why a waste is considered reactive (which of the categories listed above applies to the applicant's wastes). Permit writers should not allow wastes in categories 2 and 3 that are capable

of generating toxic gases, mists, or fumes to be treated in OB/OD units because emissions from these units will be uncontrolled. Although EPA had established threshold concentration levels and test methods for evaluating potentially reactive cyanide- or sulfide-bearing wastes in 1985, that guidance has been rescinded. Until the agency issues replacement guidance, characterization of reactive cyanides and sulfides will be based on the generator's knowledge of the waste. The 6th criterion of a DOT classified forbidden explosive has also been modified. The DOT regulations (cited in 40 CFR §261.23(a)(8)) have recently been changed and expanded to conform with Department of Defense hazard classes, therefore presenting difficulties in implementing the federal regulatory definition of reactivity under RCRA. Until such time that §261.23(a)(8) is updated, those DOT regulations cannot be used for determining reactivity.

For all other types of potentially reactive wastes, the permit writer should require that the Subpart X permit applicant characterize the waste as one for which OB/OD is the only practicable treatment or disposal option before permitting treatment of the waste in that manner. Those wastes include those that exhibit explosive reactivity. Although no standard EPA methods are available for evaluating whether wastes would be appropriate for OB/OD, several methods are provided by other authorities are available. Those methods include:

- **A stability test** performed by heating the residue to 75°C for 48 hours. A waste is considered reactive due to instability if a sample of it detonates, deflagrates, or decomposes exothermically during the test. The test defines a forbidden explosive according to 49 CFR §173.51.
- **A detonation test**, performed by inserting a blasting cap into a sample and observing the detonation. Reaction of the sample to a strong initiating source and Class A explosives as defined in 49 CFR §173.53 are tested in this manner.

- A **spark test**, performed by inserting a time fuse or an electric squib into a sample and observing the waste for deflagration or detonation. This test explosives as defined in 49 CFR §173.53 and 49 CFR §173.88.

Reactivity tests are dangerous to conduct and generally not available commercially or at most DoD installations. The concentration of energetics for a sample can be used to define the reactivity criteria. Extensive tests conducted by the US Army using spark/gap tests for 36 sites have confirmed that soil/ground water samples are not reactive.

Examples of reactive wastes that may be treated or disposed of in Subpart X units include TNT, white phosphorous, and sodium and magnesium metals.

4.3.2 Residuals Characterization

Residues from the treatment of wastes in Subpart X units include solid wastes and air emissions. Permit writers should require that applicants provide a means for characterizing the hazardous constituents in such residues. The following subsections describe procedures that the permit writer may require of permit applicants and issues the permit writer should consider when evaluating information that permit applicants submit about characterization of residues.

4.3.2.1 Air Emissions

OB/OD thermal treatment methods are currently the primary means of demilitarization employed by DoD for the disposal of energetic materials. To meet the need for identification and quantification of emissions from these treatment methods, DoD instituted a comprehensive test program commonly referred to as the “BangBox” study. The primary objective of the program was to provide waste characterization data for Subpart X permit applications. The program consisted of two test phases: the controlled chamber (BangBox) test phase and the full-scale field-test phase.

In 1988, a DoD technical steering committee developed a list of volatile and semivolatile organic

compounds and metals that are potential contaminants of either soil or atmosphere from OB/OD processes. Between 1988 and 1989, chamber (BangBox) tests were conducted at Sandia National Laboratories to examine instrumentation, technology, methodology, and analytical procedures that were proposed for follow-on field tests. The field tests were required to obtain data to validate the technology and methodology for characterizing full scale OB/OD operations and establishing correlations between small-scale, controlled testing and full-scale operations. Representatives of EPA provided technical guidance and quality assurance and quality control support during all phases of planning and execution of the tests. EPA also reviewed data collection and analytical procedures throughout the program.

The BangBox tests evaluated emission factors (EF) from the open detonation of TNT, and the open burning of a double-based and a composite propellant. TNT was selected as a worst-case example because it is the most oxygen-deficient explosive and therefore the one most dependent on environmental oxygen. The carbon balancing method was used to calculate EFs because total volumes of clouds and total concentrations of products over the entire “volume” do not need to be known and only “grab samples” taken within the cloud by sampling aircraft were necessary. Supercritical-fluid chromatography and gas chromatography techniques were used to test for semivolatile organic combustion products. The BangBox tests confirmed the technologies, methodologies, and analytical procedures employed. The study also provided information about airborne particulate materials and polychlorinated dibenzodioxins (PCDD) and dibenzofurans (PRCF).

Emissions and residues from single-base, double-base, and composite propellants and from TNT, Explosive D, RDX, and Composition B were characterized during field tests conducted at Dugway Proving Grounds between 1989 and 1990. For these field tests, sampling instruments placed on a fixed-wing aircraft flying through OB and OD-generated plumes were used. Comparable EFs

The results of the BangBox tests and the development of the validated database are described in [Emissions Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation \(EPA/600/R-98/103\)](#). The emission factors for burns and detonations are contained in Appendices D and E, respectively.

were found during the BangBox testing and the field testing of TNT. Other similarities among EFs, combustion products, and concentration levels resulting from the OD of TNT, Composition B, Explosive D, and RDX also were observed. The relationships indicated that small-scale, chamber-type OD tests may be sufficient to provide the data needed to characterize large-scale field OD treatment operations and improve current OB/OD models.

Emissions from other types of thermal treatment units can be characterized using methodologies used for combustion devices. If emissions are vented, then stack testing methods can be used to determine emissions. Stack testing methods are available in the SW-846 Compendium and discussed in Appendix B of the Risk Burn Guidance for Hazardous Waste Combustion Facilities available at <http://www.epa.gov/epaoswer/hazwaste/combust.htm>. If emissions are released from process or process equipment, the emission factors presented in EPA's AP-42 can be considered. Speciality software is also available for some equipment and processes.

Information on [estimating emissions](#) is also available at EPA's CHIEF website.

4.3.2.2 Solid Residues

Permit applicants should provide permit writers with a description of the process to be used to characterize solid residues such as scrap metal generated by Subpart X treatment units. In general, the methods used to evaluate as-generated residues may be applicable to residues generated from the treatment process. In some cases, visual inspection and knowledge of a munitions expert may be sufficient to determine whether the materials should be subjected again to OD or whether they can be treated or disposed of by other means. In other cases, standard EPA methods may be used to characterize solid residues generated from treatment in Subpart X units. For example, ash removed from OB operations may be fairly innocuous and may be analyzed only for metals and organic constituents to determine treatment and disposal options, as mandated by the LDRs.

4.4 Prevention of Releases to Groundwater and the Subsurface Environment

This section discusses the areas the permit writer should focus on in reviewing the section of the permit application in which prevention of releases to ground water and the subsurface environment is discussed. This information is required to comply with regulations in §264.601(a). The discussion focuses primarily on OB/OD units because those units, which operate on or in the land, are most likely to present a potential for releases to ground water and the subsurface environment.

4.4.1 Volume and Physical and Chemical Characteristics of the Waste

The volume and physical and chemical characteristics of wastes have a direct bearing on the potential that contaminants will reach ground water or contaminate the subsurface environment. Information about those factors is crucial to the permit writer to support a determination of the potential to release. When reviewing applications, the permit writer should determine whether any of those factors in the wastes managed at the unit could enhance the possibility of release and if so what types of management alternatives or engineering controls can be put in place to minimize any release. Presented below is a brief discussion of the manner in which those factors may be considered in the review of applications for OB/OD units.

4.4.1.1 Open Burning Units

The wastes treated at OB units typically will have been well characterized and will be present in the unit itself for only a brief period before the burn is initiated. Residues from OB operations, such as ash and air emissions, are of the greatest concern in identifying the potential for release to ground water and the subsurface environment. Because the combustion process typically will destroy most of the waste, the volume of residue tends to be relatively small, compared with the original volume of the waste. The physical and chemical characteristics of the gaseous emissions cause them

to diffuse rapidly and to be transported away from the unit. However, particulates generated as part of the burn will fall immediately from the plume in close proximity to the unit. The permit writer may require the applicant to use dispersion modeling to determine where particulates are most likely to be deposited and where soil testing would be most appropriate.

Because it is difficult to determine the physical and chemical composition of waste products for each type of waste burned, the permit writer should require information from a trial burn or from the BangBox or a similar study be provided. The permit applicant also should provide the results of analysis of solid wastes generated from OB operations. Since most such units operate under interim status, the applicant should be able to develop site-specific data. The information should identify the chemical and physical characteristics of the particulates and provide an estimate of the amount of particulate matter that will dissolve and be transported into the subsurface and the ground water.

4.4.1.2 Open Detonation Units

The management of wastes before placement in OD units is similar to that for OB units. The wastes usually will be well contained (that is, in packages), and usually will remain in the unit only for a very short time before treatment. Although wastes entering the unit usually are well characterized, permit applicants are required to obtain and to provide to the permit writer information about the volume and physical and chemical characteristics of residues from OD. Because of their method of operation, OD units present a potential for release of residues from the treatment to the ground water and subsurface environment. The detonation usually occurs under several feet of soil, and the force of the blast is directed downward into the soil. Residues from wastes not completely destroyed during that process will be forced into the soil or dispersed above ground.

The permit writer should review all information about volume and physical and chemical

characteristics of the wastes after detonation. Because most of units will have been operating under interim status, there should have been more than ample opportunity for the applicant to have sampled some of the detonation points and to provide a description of the residues generated.

4.4.2 Potential for Migration through Soil, Liners, or Other Containment Structures

The permit applicant should use information pertaining to the volume and physical and chemical characteristics of the wastes managed at these units to assess the potential for migration of such wastes through, soil, liners, or other containment devices. The permit writer should be able to determine from the information provided in the application the potential for migration for each combination or class of wastes managed at a unit. That information should be stated explicitly, and a discussion of the mechanism that reduces the potential for migration also should be included.

4.4.3 Hydrologic and Geologic Characteristics of the Unit and the Surrounding Area

Like other land-based units, characterization of site-specific hydrology and geology at the facility is necessary to adequately define aquifer system(s), bedrock formation material(s), and subsurface soil. Information required for defining the hydrogeologic environment of the area in the vicinity of the Subpart X unit includes the quality, quantity, and gradient of the existing ground water; the locations of current and future ground water users; the current and potential rates of withdrawal of water; and local land-use patterns. Adequate baseline hydrogeologic data is needed for interpretation of monitoring data and to be used as input parameters for site-specific hydrogeologic models.

The permit applicant must characterize the hydrogeologic environment by defining (1) the hydrogeologic setting of the area in the vicinity of the unit; (2) the potential receptors for releases from the

unit into the ground water and subsurface environment; and (3) the expected migration and dispersion rates of potential releases from the unit into the subsurface environment, including groundwater.

The potential for physical and chemical interactions between the hydrogeologic materials and hazardous constituents that may be present in releases from the Subpart X unit also must be described. Biological and geochemical interactions may result in biodegradation or transformation products different from the original constituents released from the unit. The application should describe any potential for such interactions and the effects the geochemical and biological interactions may have on the subsurface environment.

4.4.4 Existing Quality of Groundwater, Quantity and Direction of Groundwater Flow, and Proximity to Current and Potential Withdrawal Rates of Groundwater Users

Once again, the permit writer should ascertain that the information provided by the permit applicant is complete. The permit writer must use best professional judgment in determining whether the information provided is adequate. The permit writer may wish to compare descriptions of ground water flow direction and quality with information found in state or United States Geological Survey hydrogeological surveys for the area. State and county organizations generally maintain lists of wells on a by-county basis that also may prove useful in validating the data provided by the applicant.

4.4.5 Potential for Deposition or Migration of Waste Constituents

Most of the information described above is intended to support a discussion of the potential for migration of wastes into the subsurface soil and ground water and subsequent migration into the rooting zones of food crops and other vegetation. The ecological portion of the risk assessment should discuss individually the reasons there is high or low potential

for release to the subsurface soil or ground water and the extent of the potential for migration to and uptake by food-chain crops or other vegetation. The discussion should bring information about the environmental setting together with the engineering information in the permit and synthesize the two types of information into a coherent examination of the potential for deposition or migration of waste constituents.

In cases in which the permit writer does not find the discussion persuasive, the permit writer may respond with a NOD in any of several areas. The permit writer may determine that:

- The overall discussion in the risk assessment is inadequate and more data or additional results of modeling are needed to defend the conclusions drawn
- The conclusion of the risk assessment that there is a high risk for release and migration of contaminants is sufficient reason to require additional engineering or operational controls on the unit

4.4.6 Potential for Occurrence of Health Risks Caused by Human Exposure to Waste Constituents

The human health risk portion of the risk assessment should address directly the potential for the occurrence of health risks associated with direct or indirect exposure to wastes released from the unit. [Chapter 6.0](#) provides a discussion of requirements for risk assessment in Subpart X permit. The discussion should include all pathways identified to be of concern and provide a rationale to support the determination that a pathway would not pose unacceptable human health risks.

4.5 Prevention of Releases to Surface Water or Wetlands or to Soil

The issues associated with prevention of releases to surface water, wetlands, or soil are similar to those related to releases to ground water or the subsurface

environment. In fact, the discussion in the section above applies to surface soil as well as subsurface soil. This information is required to be submitted by applicants to comply with regulations in 40 CFR §265.601(b).

4.5.1 Volume and Physical and Chemical Characteristics of the Waste

The issues associated with these factors were discussed in the section above and are essentially the same here.

4.5.2 Effectiveness and Reliability of Containing, Confining, and Collecting Systems and Structures in Preventing Migration

This part of the permit application should discuss the engineering and operational controls in place to minimize the potential for release from Subpart X units. Permit applications for OB units should provide a description of containment devices; such devices may include burn boxes or pans that contain the wastes and any refractory material (for example, soil) inside the box or pad to protect the containment from heat generated during OB. Permit writers should require containment for OB units, especially for those that treat liquid wastes and wastes that contain free liquids. Permit applicants also may propose the use of cages around the unit to minimize the spread of debris generated during OB.

It is unlikely that OD units will be provided with engineering controls; however, discussion of operations in the application should provide for a survey of the area after the detonation and for the removal of any obvious waste explosive as a method of minimizing any potential contamination of soil or runoff to surface water or wetlands. OD units may have extensive surface-water runoff controls. If such controls are in place, the application should include a discussion of how they minimize runoff and how they will be maintained.

Some problems a permit writer might encounter include:

- An insufficiently detailed wastewater management plan for managing runoff wastewater
- Lack of discussion of operational controls that minimize the amount of waste remaining on the ground
- Lack of adequate engineering drawings that indicate placement and design or materials of construction of controls

4.5.3 Hydrologic Characteristics of the Unit and the Area in its Vicinity, Topography of the Land in the Vicinity of the Unit, and its Proximity to Surface Water

This part of the permit application must discuss the general topography and hydrology of any surface water in the area of the unit and its location nearest the unit. It must provide detailed information about potential drainage areas within the unit that might discharge either to nearby surface water or to wetlands. The section also must discuss any ephemeral surface water or wetlands features in the area of the unit and provide the same information for those areas. Ephemeral features are especially important in the more arid parts of the country and often play an important part in ecosystem dynamics. If there are no nearby surface-water bodies or wetlands, the application must certify that to be the case.

Information deficiencies the permit writer may find in the application include:

- Inadequate description of surface topography
- Lack of a map of the locations of surface water and wetlands
- Lack of indication on the map of runoff pathways identified in the discussion

4.5.4 Pattern of Precipitation in the Region

Discussion of the pattern of precipitation in the region must rely on rainfall data from a nearby NOAA weather station, or from a privately maintained weather station. Many military facilities maintain their own weather stations.

4.5.5 Current and Potential Uses of Nearby Surface Waters and Water Quality Standards Established for Nearby Surface Waters

A Subpart X permit application must include a complete discussion of the potential uses of nearby surface waters and water quality standards that govern them. The permit writer should obtain information from the state about the water quality classification of such waters and their associated water quality standards. For certain types of rivers and streams, the classification and standards may be generic.

For any surface waters discussed in the permit application, a discussion of their use and water quality standards should be included. Of greatest importance are uses for drinking water, irrigation, and recreation.

4.5.6 Existing Quality of Surface Waters and Surface Soils, Including Other Sources of Contamination and Their Cumulative Effect on Surface Waters and Surface Soils

This information should be included in the environmental and risk assessments. The information presented probably will be a combination of information from state reports, USDA soil survey reports, and analytical data obtained from sampling and analysis upgradient and down gradient of the unit. The discussion must certify that there are no other sources of contamination or provide a detailed discussion of other sources of contamination and the types of hazardous constituents being released. The discussion also must include information about

interactions among hazardous constituents released by the units and other hazardous constituents and their effects on surface waters, wetlands, and soils.

Typical information deficiencies the permit writer may identify in the discussion provided include:

- A lack of discussion of potential cumulative effects of contamination from the unit on soil, surface waters, or wetlands
- A lack of adequate discussion of the current soil or water quality

4.5.7 Patterns of Land Use in the Region

The permit application also must discuss patterns of land use in the region. Typical sources of information for the discussion are county or city zoning and land-use maps and data from the Bureau of the Census. In reviewing the information, the permit writer should determine that complete and up-to-date information has been provided.

4.5.8 Potential for the Occurrence of Health Risks Caused by Human Exposure to Waste Constituents

The human health risk portion of the risk assessment should address directly the potential health risks associated with direct or indirect exposure to wastes released from the unit. [Chapter 6.0](#) provides guidance for permit writers in evaluating risk assessments submitted by permit applicants. The discussion should include all pathways identified as to be of concern and provide a rationale to support the determination that the pathway would not pose unacceptable human health risks.

4.6 Closure and Post-Closure Care

Under §270.14(b)(13), a Subpart X permit applicant must prepare and submit plans for closure and, if applicable, post-closure care, as part of the permit application. Section 264.601 requires that a Subpart X unit be closed in a manner that will ensure protection of human health and the environment.

Refer to Section 264.111(b) which sets forth a general performance standard for closure that is applicable to all TSDFs.

4.6.1 Requirements for Closure Plans

The general requirements of the closure plan are specified in §264.112(b). These requirements are applicable to all Subpart X units.

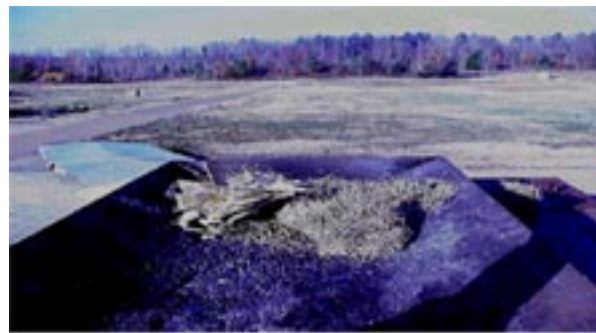
Clean closure of a Subpart X unit includes (1) decontamination or removal of all equipment and structures associated with the unit and (2) removal of all contaminated environmental media (i.e., soils and ground water) surrounding the unit.

Decontamination of a Subpart X unit, such as an OB unit that has a containment device, may be achieved by “flashing” the containment device. Flashing consists of using an appropriate fuel and oxidizer to heat the containment device to a temperature that exceeds the decomposition temperature of the explosive wastes that were treated in the unit. The Department of Defense Explosives Safety Board (DDESB) requires that materials that come in contact with explosives be flashed or burned.

(Refer to *DOD Ammunition and Explosives Safety Standards*, DOD 60055.9-STD, July 1999.) DDESB has various levels of certification of contamination free. The facility should have records established on where these wastes are coming from and show contact has actually occurred. If contact occurs the material may be considered a hazardous waste due to the mixture or residue rule. Otherwise the materials should be handled as a solid waste and not burned in the hazardous waste treatment area.

To achieve clean closure, the soils in the vicinity of the unit, which may be contaminated by the ash or wastes ejected from the unit, also may be removed and disposed of on site or off site. The permit writer should ensure that the closure plan provides for specific sampling and analysis to verify that all contaminated soils have been removed.

Descriptions of such sampling and analysis should specify analytical methods, depths of sampling, and sample collection methods. If it is not possible to remove all contaminated soils, the OB unit should be



The flashing issue has been a concern for scrap metal entering the recycling system. The permittee needs to address these materials in waste analysis and risk assessments.

closed as a landfill, which will be subject to post-closure monitoring requirements. An OD unit also may be closed as landfills, because it may be impossible to remove all contaminated soil in the vicinity of the unit.

OB/OD units located within the boundaries of impact ranges may present problems with regard to attribution of contamination and monitoring of releases. Such units can present complications during closure or corrective action, because it is often difficult to determine whether the source of contamination is the unit or the active impact range. Usually, there are problems in the installation of ground water monitoring equipment around such units, particularly ground water monitoring wells and devices that monitor the unsaturated zone, because such equipment may be damaged by ongoing activities at the range and because of the hazards from activities (e.g., drilling) associated with the installation of monitoring devices.

Existing OB/OD units located within active impact ranges may be allowed to continue to operate, but new units should not be located within the boundaries of an active impact range. The decision whether to allow such existing units to continue to operate should be based on several factors, including precipitation and runoff at the site, hydrogeologic and geologic factors, intensity of the training activities carried out at the range, and location of the OB/OD activities. Permit writers should decide whether it will be feasible to monitor the unit for releases of hazardous waste constituents as part of the environmental assessment; if monitoring is not feasible, the unit should be relocated.

4.6.2 Post-Closure Care Requirements

Requirements for post-closure care are specified in 40 CFR §§264.117 through 264.120. The requirements will apply if the Subpart X unit will leave wastes in place after closure (e.g., a geologic repository). The requirements also will apply to Subpart X units used for storage or treatment from which it is not possible to remove all contaminated

structures or soils at closure. For miscellaneous units, such as OB/OD units, post-closure care will be required only if the unit must be closed as a landfill. After the unit has been closed, 40 CFR §264.119 requires that the owner or operator of the closed unit submit a notice to the appropriate local authorities and make a notation in the property deed to the facility of the disposal of hazardous waste at the facility. The owner or operator also must submit certification to the EPA or authorized state that the deed notification has been recorded.

4.7 Environmental Performance Standards

This section provides permit writers guidance for determining compliance with standards for siting, design, construction, operation, and maintenance of miscellaneous units. It also describes the information that must be included in a Subpart X permit application to demonstrate protection of human health and the environment.

4.7.1 Location Requirements

A miscellaneous unit, such as an OB/OD unit, must be constructed at a remote location to protect personnel and property from the potentially destructive effects of explosions. The unit must be separated adequately from off-site inhabited buildings and public roads and railways. The Department of Defense Explosives Safety Board (DDESB) provides guidance for determining adequate distances between OB/OD units and public highways, passenger railways, and inhabited buildings DoD-Ammunition and Explosives Safety Standard (DoD 1978). In the case of a military OB/OD unit, the manual will be the primary source of the necessary information, while either the DDESB manual or commercial information may be used for nonmilitary OB/OD units. Factors that must be considered in siting OB/OD units include (1) the maximum quantity of explosive wastes that will be treated in the unit at any one time, (2) the number of burning pads used by the facility, and (3) wind direction. In addition, 40 CFR §265.382 provides guidance on acceptable minimum distances between OB/OD units and other properties, such as

roadways and inhabited properties. Permit writers should require that OB/OD activities be conducted in accordance with the minimum safety distances specified in 40 CFR §265.382.

In the case of an OB/OD unit that has multiple burning pads, the pads must be separated adequately to prevent detonation of the explosives on one pad by the unexpected detonation of explosives on another pad. If any two or more pads that will have explosive wastes present at the same time are not separated adequately from each other, such two or more pads must be managed as a single burning pad.

To satisfy the location requirements, the permit applicant should provide a map that shows the location of the OB/OD unit and the area in its vicinity, including buildings and public highways, railways, and inhabited buildings. Much of the necessary information may already be included in the general information section of the application. The applicant should indicate in this section where the information can be found.

4.7.2 Design and Construction

The applicant for a Subpart X permit must provide detailed information about the design and construction of the unit. A detailed description of the unit being used or proposed for use must be provided in the Subpart X permit application. The information required is more detailed than that required in the general description portion of the permit application. A description of the unit that is sufficiently detailed should provide all the information required to evaluate adequately the potential affect of the unit on the environment, particularly surface and ground water. In addition, the need for monitoring, and the types of monitoring required, will depend partly on the characteristics and design features of the unit. Where appropriate, information required for an OB unit might include:

- Descriptions of the physical characteristics, construction materials, and dimensions of each device, and appurtenance uses at the unit

- Engineering drawings
- Specifications for liners within or below the device
- A description of leak detection equipment
- Descriptions of methods to control runoff and runoff
- A description of procedures to control releases of PEP ashes and residues during and after OB operations
- A description of methods to control deterioration and maintain the integrity of fabricated devices
- A description of measures to prevent accumulation of precipitation in the unit (for example, a precipitation cover) and procedures for handling any accumulation of precipitation in fabricated devices
- A plan for managing ash and residue
- A construction quality assurance plan

4.7.3 Operation and Maintenance Procedures

According to §270.23(a)(2), the applicant for a Subpart X permit must describe in the permit application how the unit will be operated and maintained to comply with the environmental performance standards set forth under Part 264 Subpart X and all other relevant provisions of Part 264. For OB/OD units, the information required includes:

- Identification of meteorological conditions under which burning or detonation will be permitted or restricted
- A description of the procedures for transporting the waste to the unit

- A description of procedures for placing the waste in the unit
- Identification of supplemental fuels, if any, to be used to initiate the reaction and measures to minimize release of those fuels to the environment
- Identification of the time expected to be necessary to complete burning
- Identification of the location of protection or shelter to be used by personnel during burning or detonation
- A description of procedures for management of residual ashes and for sampling and analysis of the ashes and any contaminated soils to determine whether they are hazardous wastes and whether they are prohibited from land disposal under the LDRs
- A description of procedures for inspection and maintenance of the unit
- A description of procedures for complying with requirements under Parts 262, 263, and 264 governing manifesting, recordkeeping, and reporting

Relevant portions of the SOP should be included in the permit application. The permit application should also indicate that the SOP will be reviewed and updated whenever necessary.

4.7.4 Detection and Monitoring Requirements

Detection and monitoring procedures must be developed to ensure protection of human health and the environment. Location of the site, design of the unit, quantity of wastes to be treated in the unit, and hydrogeologic characteristic at the site are some of the factors that must be evaluated to determine whether surface water or ground-water monitoring is required at the unit, both during the operating life of the unit and, for Subpart X disposal units, during

post-closure care. For example, ground water monitoring is less likely to be required if one or more of the following applies: (1) containment structures will be used and waste residues will not be in contact with the ground surface, (2) precipitation that collects in the unit will be collected and disposed of regularly, (3) the unit is equipped with a leak detection system, (4) the unit is inspected regularly, (5) the ground water table is deep, (6) the composition of the soils beneath the unit will not facilitate leaching of contaminants through the soil into the ground water, or (7) the unit is located in a low rainfall area where evaporation significantly exceeds precipitation. Conversely, ground-water monitoring is more likely to be required if (1) the unit is not equipped with secondary containment structures, (2) wastes contain free liquids, or (3) the ground water table is shallow.

If the environmental assessment indicates that ground-water monitoring will be required at the unit, the ground-water detection and monitoring programs described in [Chapter 5.0](#) must be implemented. Ground-water monitoring wells should be located at a sufficient distance from the OB/OD unit to prevent damage to them as a result of burning or detonation of waste. The list of monitoring parameters must be developed carefully to reflect the chemical composition of the wastes treated in the unit and their decomposition products, as discussed in [Chapter 5.0](#).

If the environmental assessment indicates that there is a risk of soil contamination, the Subpart X permit application also should include plans for periodic monitoring of the soils beneath and in the vicinity of the unit. If there is a risk of soil contamination, the Subpart X permit application must include a contingency plan to close the unit as a landfill in the event the unit cannot be clean-closed by removal of all contaminated soils from the unit and nearby areas. If the unit will be closed as a landfill, the Subpart X permit application also must include a description of procedures for post-closure care, including post-closure ground-water monitoring in accordance with the closure and post-closure requirements set forth in Part 264 Subpart G.

4.7.5 Effectiveness of Treatment

Based on BangBox and full scale field testing, the effectiveness of OB/OD treatment is dependent on a number of factors:

Types of Method: In general, OD results in slightly greater destruction and removal efficiency (DRE) for energetics than OB (although DREs for either type of method exceed 99 percent). The principal reason for this is that OD results in less residue in the unit following treatment. (The mechanism for greater DRE is secondary combustion in the fireball resulting from the detonation as well as ejected material.) For example, the detonation of trinitrotoluene (TNT) results in a DRE of 99.9996 percent with the residue consisting of 2,4-dinitrotoluene and soot. Approximately 2 percent of the OD residue was recovered within 225m of the detonation site. Open burning of propellants containing 2,4-dinitrotoluene result in DREs of between 99.9 and 99.98 percent.

Type of Energetic: Energetic materials with a higher oxygen content resulted in higher DREs. That is, molecules that contained most of the oxygen required for complete combustion have higher conversion efficiencies. For example, OB of propellants containing 2,4-dinitrotoluene resulted in DREs of between 99.9 and 99.98 percent, whereas OB of a triple base propellant containing nitroglycerine and nitroguanidine resulted in DREs of 99.9997 and 99.9998 percent, respectively. In general, propellants have higher oxygen balances and resulting conversion efficiencies than explosives.

Interaction with Soil: The presence of soil interferes with the flame zone for OB or the flow of ambient air into the fireball region of the detonation for OD. For this reason, use of burn pans for OB results in higher flame temperatures and correspondingly higher DREs. Similarly, suspended detonations of explosive result in higher DREs than surface OD. Further evidence of the mechanism of secondary combustion can be found in the higher DREs of fallout material. For example, although the DREs for OB of propellants containing 2,4-

dinitrotoluene is between 99.9 and 99.98 percent, the DREs rise to between 99.9996 and 99.9991 percent in the fallout material, indicating secondary propellant conversion and destruction is occurring in the smoke plume from the burning propellant.

Although OD generally results in less residue in the treatment unit than OB, BangBox testing indicates that OB combustion products are more completely treated or converted than OD combustion products. Open detonation results in 97 percent of the carbon in the explosives being converted to carbon dioxide whereas OB results in greater than 99.6 percent conversion to carbon dioxide. Similarly, higher percentages of carbon monoxide, volatile organic compounds (VOC), semivolatile organic compounds (SVOC), and soot are generated by OD than by OB. (The soot undoubtedly contains “exotic” polynuclear aromatic compounds combustion product such as acenaphthene as well as other high molecular weight compounds.)

Comparison between BangBox and full-scale field test data indicate that the conversion of TNT carbon to carbon dioxide is more efficient under the controlled conditions of the BangBox than in large-scale detonations in the field. Specifically, more VOCs are generated under field conditions than in BangBox Testing. However, SVOC generation appears to be very similar under either BangBox or full-scale testing conditions.

Because combustion products may be present as residues in the treatment unit or ejected soils, the collection and analysis of sample is required to characterize contaminants and determine the concentrations of compounds in the treatment residue for subsequent management and disposal. In general, OB/OD will render energetic materials nonreactive. (The Bureau of Mines reactivity test classifies energetic concentrations of 30,000 mg/kg or less as not reactive.)

The [Region 9 Preliminary Remediation Goals \(PRGs\)](#) present health based criteria for potential contaminants. [SW 846 Methods](#) 8320 and 8330 determine the concentrations of 14 energetic

compounds for soil and water. Method 8330 uses ultraviolet detection whereas Method 8320 uses mass spectrometry.

For mechanical units, sampling and analysis of the output streams can be used to demonstrate treatment effectiveness. Permit applicants managing containers in mechanical units such as drum crushers and washers will need to demonstrate that the containers meet the definition of “empty” per 40 CFR §261.7.

4.8 Remediation and Performance Criteria

This section discusses the appropriateness of the phasing of remediation activities under the closure schedule. It also discusses the development of data quality objectives for both monitoring and remediation programs. Finally, the section briefly discusses the use of innovative technologies in the cleanup of residues from OB/OD operations.

4.8.1 Phasing of Remediation Activities

Because of the process operations of the OB/OD units, remediation usually will be required before the closure of such units. It is likely that the units will not be closed until the facility at which they are located itself is closed or its mission altered substantially. Many OB/OD units are collocated with weapons ranges. It therefore is quite possible that range cleanup activities will take place during the same time period as closure of such units. Presented below is a discussion of some of the implications related to the closure of OB/OD units during range remediation activities.

Range remediation activities likely will be regulated under DoD’s range rule (32 CFR 178). It is important to remember that, even though the OB/OD unit may be part of a range, the unit is subject to closure requirements under RCRA and must be remediated in accordance with those requirements, not the requirements of the range rule. However, there may be reason to allow the closure of a unit to take place over a longer time frame than the regulatory standard.

EPA has written numerous policy memos providing clarification regarding the definition of “RCRA empty”. These memos are available on the [RCRA Online](http://www.epa.gov/oswer/rcraonline) website at <http://www.epa.gov/oswer/rcraonline>.

The primary reason a permit writer may wish to include closures activities in a larger range remediation, and therefore a longer time period, is related to safety. The OB/OD unit may be located on what is currently a inactive portion of a range; however, the area may have been part of the active range at an earlier time. Since it is often difficult to determine the earlier status of areas within weapons ranges, it is appropriate to perform surveys of the unit to determine whether UXO is present from earlier range activities. If UXO is found at the unit, it would be necessary to remove the UXO and render it safe before closure activities begin at the unit.

UXO detection surveys are time consuming, labor intensive, and expensive. It would be reasonable to allow a survey at an OB/OD as part of a larger effort if several requirements are met. These requirements are:

- The range remediation activities take place in the same approximate time frame as closure of the unit
- There are no issues associated with leaving waste in place at the unit for a longer than normal period of time (that is, the permit writer is not aware of any circumstances that would lead to damage to human health or accelerated damage to the environment)
- The closure plan makes explicit reference to the range remediation activities and provides a schedule for implementation

The permit writer may recognize other site- or unit-specific requirements that are more appropriate for the facility of concern. Should the permit writer decide to allow a longer time for closure, he or she has the authority to do so under 40 CFR §264.113.

4.8.2 Data Quality Objectives

EPA has developed detailed guidance on the development and implementation of DQOs (EPA 1994). When reviewing plans for remediation, the permit writer should insist that the DQO are explicit and that plan provide for actually making use of them. Sources of information about DQOs include the *Guidance for the Data Quality Objective Process* (EPA 1994b), and *EPA Requirements for Quality Assurance Project Plans* (EPA 2001).

4.8.3 Innovative Technologies

There are few innovative technologies specifically designed for the remediation of explosives contaminated soil and ground water contaminated with explosives. Most of those that do exist are designed to manage UXO or soil contaminated with high-concentration explosives contaminated soil; neither of which is to be expected at OB/OD units. Many of the innovative technologies developed to treat soils and ground water contaminated with semivolatile organic compounds are likely to be of use in treating those media at OB/OD units.

There are several sources the permit writer can use to identify innovative remedial technologies. They include the Superfund Innovative Technology Evaluation (SITE) series, *The Remediation Technologies Screening Matrix and Reference Guide, (RTSM)* (EPA 1994c) and the Vendor Information System for Innovative Treatment Technologies (VISITT). The permit writer can consult such sources to obtain information for the applicant or to determine the appropriateness of a selected technology. Table 2-5 on page 2-35 of the RTSM provides a list of technologies and their current status.

4.9 References

Department of the Army (DA). 1996. *Munitions Items Disposition Action System*.

DoD. 1978. *DoD Ammunition and Explosive Safety Standards*. Pamphlet 385-64.

Additional information regarding the management of UXO is provided in the documents:

- *Interservice Responsibilities for Exposure Ordinance Disposal Joint Army Regulation (75-14)*. February 1992.
- *Handbook on the Management of Ordinance and Explosives at Closed, Transferred, and Transferring Ranges (EPA 505-B-01-001)*. June 2001.
- *U.S. Army Explosives Safety Program. Army Regulation 385-64*.

EPA. 1994a. *Test Methods for the Analysis of Waste*. EPA/SW-846.

EPA. 1994b. *Guidance for the Data Quality Objective Process*. EPA QA/G-4.

EPA. 2001. *Requirements for Quality Assurance Project Plans*. EPA QA/R-5.

EPA. 1994d. *The Remediation Technologies Screening Matrix and Reference Guide*. EPA/542/B-94/013.

5.0 ENVIRONMENTAL ASSESSMENTS, MONITORING, AND MODELING UNDER SUBPART X

This section discusses approaches to monitoring and modeling potential releases from Subpart X units. Some emphasis is placed on OB/OD units because of the difficulty in monitoring and modeling air emissions from such units. The chapter consists of three major sections: environmental assessments, monitoring, and modeling. The monitoring and modeling sections include subsections on air and groundwater.

View the slide presentation from the [February 2002 Region 4 Advanced RCRA Miscellaneous Units Permitting and Compliance Training](#).

5.1 ENVIRONMENTAL ASSESSMENTS (Characterization of Media)

Environmental assessments are performed to characterize the potential effects on each of the environmental media (air; groundwater and the subsurface environment; and surface water, wetlands, and surface soils) caused by releases from a Subpart X unit. The assessment should demonstrate that the unit will be operated in a way that will be protective of human health and the environment, and demonstrate compliance with the specific performance standards for each environmental medium. Specific performance standards are set forth in 40 CFR §264.601.

An environmental assessment evaluates the possible impacts of a Subpart X unit on environmental media, and describes preventative measures that have or will be taken.

The environmental assessment information required of permit applicants includes:

- Detailed hydrologic, geologic, and meteorologic assessments and land-use maps for the area surrounding the site that address and ensure compliance of the unit with the environmental performance standards set forth under 40 CFR §264.601
- Information about the potential pathways of exposure of humans or environmental receptors to hazardous constituents and about the potential magnitude and nature of such exposures

- For any treatment unit, a demonstration of the effectiveness of treatment that is based on laboratory or field data
- Any additional information determined by the EPA Regional Administrator to be necessary for evaluation of the compliance of the unit with the environmental performance standards set forth under 40 CFR §264.601

40 CFR Section 270.23(b) allows a permit applicant to submit a preliminary hydrologic, geologic, and meteorologic assessment if an adequate demonstration can be made that the Subpart X unit will not violate performance standards under 40 CFR §264.601. The permit writer should accept a preliminary assessment only if the applicant can demonstrate convincingly that releases from the unit will be minimal.

Hint:

Having an applicant develop a conceptual site model (CSM) as part of the environmental/risk assessment will help in understanding potential exposure pathways associated with each unit.

The permit applicant can make that demonstration through a combination of data that indicates the efficacy of the treatment, a discussion of release controls for the unit and other information related to process operations at the unit, and environmental parameters specific to the site. Permit writers should use the available information on unit design, wastes that might be treated at the unit, and other permit application information that must be submitted with the permit application to determine whether a preliminary assessment is acceptable.

Compared with detailed assessments, preliminary air assessments require significantly less information. A preliminary air assessment should include information about the atmospheric, meteorological, and topographic characteristics of the areas in the vicinity and how those characteristics will affect any releases of contaminants from the Subpart X unit. The characteristics are important factors in the transport and dispersion of contaminants. For example, wind conditions will determine the direction in which contaminants are transported from a source and the speed at which they are transported. A knowledge of topographic features in the area also is important in evaluating how potential air releases may interact with the terrain. A permit applicant should submit

topographic maps of the site and all neighboring areas that may be affected by an air release. At a minimum, an applicant submitting a preliminary air assessment should provide the following information:

- A wind rose
- Seasonal mean humidity
- Annual and 24-hour precipitation data
- Atmospheric stability data
- Population (e.g., census) data
- Topographic maps of neighboring areas

These data may be available from a variety of sources. The permit writer should evaluate the data and the source of the data to determine whether the data are valid and representative of the site. The most likely sources of meteorological data include on-site measurements, the National Weather Service, the National Climatic Data Center, and nearby military or civilian airports. Sources of population data include the U.S. Bureau of the Census and local city and county census information.

National Weather Service (NWS) meteorological input data are normally obtained either from the National Climatic Data Center

<http://www.ncdc.noaa.gov/ol/ncdc.html> or SCRAM - <http://www.epa.gov/ttn/scram/menu.htm>

Typically, EPA Region 4 requires a detailed assessment for OB/OD units and for regeneration and thermal desorption units that vent to the atmosphere. For a detailed assessment, the permit applicant is required to provide more information about the operation of the unit and its potential effects. When conducting a detailed assessment, a permit applicant may choose to use worst-case assumptions, rather than collect complex site-specific data for the analysis. That type of detailed assessment is referred to as a “screening” assessment. A “refined” assessment is one in which various site-specific data are collected to provide a more realistic evaluation of the potential effects on human health and the environment resulting from the release of a contaminant.

A screening air assessment typically includes less site-specific information than a refined air assessment, but uses conservative default values in analyses performed to determine the magnitude of potential effects. Permit applicants prefer screening assessments because they reduce the cumbersome task of collecting sufficient data to perform the analyses. It is important that the permit writer assess whether the permit application makes a defensible case for using the screening assessment approach. If a permit applicant can provide, through a screening air assessment that uses conservative assumptions, an adequate demonstration of compliance a refined assessment is not necessary. Before accepting a screening assessment as an appropriate approach, the permit writers should be careful to ensure that assumptions made for screening analyses actually are conservative values.

Refined air assessments are more complex than screening assessments because they rely less on assumptions about the fate and transport of air emissions and require that the applicant use more site-specific data. Refined assessments provide a more realistic estimate of effects on air. Examples of detailed site-specific data that may be required for a refined air assessment include site-specific meteorological data, detailed terrain data on the terrain in the vicinity of the installation, and actual source release measurements of releases from the source.

Both preliminary and detailed assessments are conducted separately for each of the three environmental media groups listed in 40 CFR §264.601; air; groundwater and the subsurface environment; and surface water, wetlands and surface soils. Specific requirements for assessments of each medium are discussed separately below.

5.2 Monitoring of Air and Groundwater

Monitoring focuses on the actual gathering of data relevant to the operation of a unit. The data obtained is used in characterizing the risk to human health and the environment. The permit applicant will have obtained basic environmental data on the

Three Types of Site Assessments

- **Preliminary assessments - based largely on a qualitative consideration of risk.**
- **Screening assessment - based on “worst-case” modeling data and, if available, monitoring data.**
- **Detailed assessments - require site-specific monitoring and modeling.**

soils and nearby surface water, hydrogeologic environment, and air to describe the current environment. Those data will be used as a baseline for the risk assessment and future monitoring.

Monitoring of surface water and wetlands is not discussed in this chapter because the media present no special challenge in the evaluation of risk posed by Subpart X units. The following sections discuss air, groundwater, and soil monitoring, respectively.

5.2.1 Air Monitoring

When considering releases to the air from a Subpart X unit, several factors must be examined in determining the fate and transport of contaminants. Contaminants released to the air behave very differently in different atmospheric conditions. Because atmospheric dispersion processes are complex, it can be difficult to perform air pathway analyses. Unlike releases to some other pathways, air releases can have an immediate effect, and the location of such effects can change quickly with changing atmospheric conditions. The most obvious concern resulting from a release to the air is the concentration of contaminants in the air downwind of a source. However, deposition from the air to soil surfaces or surface water is another important concern. Other potentially important interactions among media include resuspension of contaminated soil in the air and volatilization of contaminants from soil and water to the air.

Some Subpart X units will emit toxic particles and gases that can settle out of the air onto soil or water surfaces, be drawn out by aerodynamic processes, or be scavenged by precipitation. Those processes, usually termed dry and wet deposition, reduce the concentration of a contaminant in a plume, but also increase the concentration in another medium. Characterization of deposition values may be an important part of an overall risk assessment (EPA 1994a) that the permit applicant should address, depending on the characteristics of the source and the atmospheric and topographic characteristics of the area in which the unit is located.

5.2.1.1 Emissions Quantification

Generally, two types of analyses are employed to quantify emissions from a Subpart X unit: emission monitoring and emission modeling. The results of emission quantification analyses are used in dispersion modeling analyses to determine downwind impacts and can be used to determine compliance with emission standards.

Two kinds of emission monitoring usually are typically used to quantify emissions from Subpart X units: emission source monitoring for point sources, and area source monitoring for area sources or open sources.

Emission Source Monitoring

For such subpart X units as regeneration units, emission source monitoring can be used at sources at which the release exits to the atmosphere through a stack or an opening and the release can be isolated. There are many different methods of quantifying stack-type emissions that differ according to several factors, including, but not limited to the compound of concern, the characteristics of the effluent, the detection limits required, and the precision required. Most methods use a probe that is exposed to the effluent through a sampling port. Samples of the effluent are analyzed on site or at a laboratory. Analyses of the results of emission source monitoring for Subpart X units that have stacks should be performed using EPA-approved methods. Examples of emission source monitoring methods recommended by EPA for specific purposes are set forth in [40 CFR Part 60, Appendix A](#).

Area Source Monitoring

Techniques of area source monitoring are important for OB/OD units because many sources have emissions that are difficult to measure, release emissions over an open area, and have fugitive emissions. In such cases, it is often necessary to measure emissions indirectly by measuring the atmospheric concentration of the emitted

Emission Characterization for Mechanical Units

- **Measurements can be taken at emission points (i.e., stacks vents or other discharge points)**
- **AP-42 Methods may be used to characterize some fugitive emission sources.**
- **If no data is available, then assume that what goes into the treatment unit is emitted to the environment.**

contaminant and then calculating an emission rate from the concentration data. A disadvantage of such an analysis is that it is highly dependant on meteorological parameters. Unacceptable meteorological conditions often invalidate a sample (EPA 1989). Techniques are available for both screening and refined area source monitoring, each of a different degree of sophistication. Discussed below are some approaches to area source monitoring that may be used to determine emissions from Subpart X sources. The discussion presented is not an exhaustive treatment of such techniques, but provides some of the common approaches that a permit writer may encounter.

Source monitoring for OB/OD treatment can be a technical challenge for these non-stack, typically instantaneous and infrequent quasi-releases.

It should be noted that area source monitoring, due to the inability to control atmospheric conditions and the inherently rapid, intermittent and unstable nature of OB/OD operations, will not provide as accurate results as BangBox testing. Where possible, BangBox test data should be used over field data.

Upwind/Downwind Monitoring

The upwind/downwind emission quantification technology can be used as a screening technique to estimate emissions from area sources. The technique is useful for obtaining approximations of concentrations of emissions from OB/OD sources from which emissions are difficult to measure. The monitoring approach uses at least one monitor located upwind of the area source, and at least one monitor located downwind of the source. Some analyses use four monitoring locations: upwind of the source, downwind at the boundary of the unit, downwind at the boundary of the facility, and downwind at a location outside the boundary of the facility. The upwind monitor is used to determine the background concentration of the contaminant at the site. The upwind concentration is subtracted from the downwind concentration to determine the average emission flux over the column of air. Use of this technique also requires equipment to measure the wind speed and wind direction.

The type of monitors used in application of this technique depends on the contaminant of interest. If particulate species are to be measured, high-volume samplers typically are used. For volatile species, SUMMA canisters (EPA Method TO-13) are the most common type of monitor; tenax tubes (EPA Method TO-1/TO-17) may also be used. Another type of monitor that may be used for upwind/downwind monitoring is optical remote sensing. Optical remote sensors detect atmospheric species by sensing the interaction of propagating electromagnetic energy and the specific constituent along a certain path (AWMA 1993). An example of an optical remote sensing technology is Fourier Transform Infrared Spectroradiometer-Source Augmented Radiometer (FTIR SAR).

Measurements from the upwind/downwind approach are applicable only under certain conditions. The measurements are valid only when the actual wind direction is consistent with the expected wind direction that determined the selection of the monitoring locations. If the actual wind direction is not from the upwind monitor toward the downwind monitor, a false reading of the source emissions and the background concentrations will result. While reviewing monitoring results, the permit writer should pay careful attention to the actual wind conditions during the monitoring period. If the wind direction did not flow from the upwind sampler(s) toward the downwind sampler(s), the results are invalid. Monitoring should not be conducted under unstable or calm wind conditions. In addition to wind direction, the monitor inlet locations are a very important factor in upwind/downwind monitoring. The inlet to the sampling device should be placed in such a manner that the plume from the area source encompasses the inlet. In some cases, it may be difficult to locate the inlet in the path of the plume. For example, plumes from OB/OD units may be well above ground level near the release point, making it difficult to capture the plume with a monitoring device. Nevertheless, the upwind/downwind technology is a valuable screening technique for a variety of area sources, and may be useful for obtaining estimates of emissions from OB/OD operations.

Additional information regarding the FTIR technologies can be found at
<http://www.epa.gov/ttn/amtic/longpath.html>

The permit writer should verify that results have been collected under the appropriate atmospheric conditions and that monitoring locations are adequate for the type of release. If any of these conditions appear to be questionable, the permit writer should issue a NOD that describes the precise nature of the problem and sets forth the proposed (or mandatory) solution.

Additional guidance may be found in “Detection and Identification of Multiple Hazardous Air Pollutants of Extended Distances” available at the SERDP webpage
<http://www.serdp.org/research/compliance.html>

Transect Monitoring

The transect technology is a refined approach to measuring fugitive particulate and gaseous emissions from an area source. Transect monitoring is accomplished by measuring concentrations of a contaminant at several locations downwind of a source. The type of monitor used depends once again on the types of contaminants present, but monitors should be similar to those used for the upwind/downwind monitoring technology. The monitors are aligned perpendicular to the anticipated centerline of the plume (EPA 1989). Several sampling probes are located downwind of the plume, and one is located upwind of the plume. The probes are used to characterize the concentrations in the plume. Meteorological measurement equipment also is necessary to determine the monitoring conditions.

After concentrations in the plume have been measured, numerical integration techniques are used to calculate emission fluxes from the measured concentrations. The meteorological conditions at the time of monitoring are important factors to consider when using the transect method. The wind conditions must be such that the plume travels to the locations of the monitoring equipment, or the measurements will be invalid. In addition, the monitoring equipment must be located properly so that the equipment captures the contents of the plume. At some sources where vertical dispersion occurs quickly (for example, OB/OD sources), additional samplers may be required to characterize the plume adequately. If additional samplers cannot account for the vertical extent of the plume, the monitoring technique is not appropriate for the source. As is the case when evaluating with upwind/

downwind monitoring, the permit writer should verify that data have been collected under the appropriate atmospheric conditions and from an adequate number of monitoring locations for the type of release.

BangBox Tests

“BangBox” is a term used for the Propellant, Explosive, and Pyrotechnic Thermal Treatment Evaluation and Test Facility. Because of the large amounts of heat and energy that are released from OB/OD operations, it is difficult to use standard emission monitoring techniques for such operations. The BangBox measurement technique, which was developed specifically for OB/OD processes, addresses the problems associated with measuring emissions from such sources. The BangBox consists of a large rubber-coated fabric hemisphere on a concrete pad supported by air (Howell and Tope 1994). Air samples are collected inside the hemisphere after munition items have been detonated. BangBox tests have been documented to provide reliable air emission results for the specific munitions used in the tests (Howell and Tope 1994).



View of the Bang Box Facility

Permit applicants having OB/OD sources may use BangBox tests to quantify releases of contaminants. BangBox data from previous tests at other locations also may be used if the munitions disposed of in the tests are similar to the munitions that the permit applicant is to dispose of.

EPA has recently compiled a database of emission factors obtained from Bang Box testing. Entitled *Emission Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation (OB/OD)*, the database provides emission factors for 16 energetics that were burned and 23 that have been detonated. Emission factors are presented in terms of mass of constituent emitted per mass of net explosive weight (NEW) treated.

For an example, consider a facility that treats TNT by open detonation. One thousand pounds of NEW are treated during each detonation of TNT. To

determine the emissions of TNT, the emission factor for TNT is extracted from the Table in Appendix E of the validated database and multiplied by the total amount of NEW being treated:

$$\begin{aligned}\text{Emissions} &= 0.5 \text{ lb/(lb NEW)} \times (1,000 \text{ lb new}) \\ &= 500 \text{ lb}\end{aligned}$$

The validated database is available on-line at <http://www.hnd.usace.army.mil/oew/tech/EmissFac/emissfac.pdf>

Evaluation of Emission Monitoring Programs

For each type of air monitoring program, there are two levels of detail: screening sampling and refined air monitoring. Screening air sampling is conducted initially to characterize releases from the Subpart X unit. To characterize air emission levels screening air sampling should be conducted near the OB/OD site at expected high-impact locations (determined through dispersion modeling) or at critical receptors of concern during operations. Those locations will have been previously determined.

If the screening sampling fails to characterize areas of potential concern, a more detailed air quality network (refined sampling) should be established to show compliance. Such a network would include sampling locations upwind (background) and downwind of the OB/OD operations to characterize the area of concern. To define the operation, additional sampling locations would be planned, including locations at the boundaries of the site to evaluate off-site health concerns.

When evaluating an applicant's emission quantification monitoring program, the permit writer should verify that the applicant has provided enough information to perform the evaluation. At a minimum, the applicant must provide the following information:

- Detailed description of the monitoring technique(s) used, including justification for the design of the monitoring program, and type of monitors used

Limitations of the Bang Box Emission Factors

- Only a limited number of energetic materials have been tested.
- The fate of sulfur and metals needs further study to more fully characterize emissions from OB/OD operations.
- Dioxins and furans were not target analytes for most of the Bang Box tests.

- Location and height of monitors
- Physical and chemical characteristics of the contaminants measured
- Detection limits of the equipment used
- Frequency and duration of monitoring

The monitoring program must be designed so that air emissions from the Subpart X unit can be characterized adequately. Permit writers should determine whether the techniques used and the design of the program will provide representative emission measurements for the site and whether the constituents of concern are addressed properly. Siting considerations for the monitors are vital to the success of the program. The location and height of the monitors must be clearly identified in the plan. The locations should be consistent with the location of the emissions to be measured. The detection limits of the equipment also must be provided. They must be low enough to detect emissions that could affect health-based risk levels. The frequency and duration of monitoring must ensure that the emission cycle of the unit and any other variables that affect the measurements are taken into account.

Permit applicants having units with stack-type emissions usually will use mass balance, emission modeling, or stack test data to quantify the emissions. If stack testing is performed, the permit writer should verify that the test is conducted while the source is operated at the maximum capacity at which it realistically would be operated under normal conditions. Such data as the input load into the system or the operating temperature can be used to make that determination. A reference method approved by EPA must be used in performing all source emission monitoring. The contaminant and release conditions must be among those for which the specific sampling and analysis methods used by the applicant were developed.

Permit applicants having OB/OD units often must conduct area source monitoring to quantify airborne emissions. As discussed earlier, OB/OD releases

EPA guidance for ambient air monitoring of both criteria and toxic air pollutants is available from the TNN Web-Ambient Monitoring Technology Information Center (<http://www.epa.gov.tnn/amtic>)

are difficult to monitor because of the large amount of heat and energy released during such operations; the permit writer must examine monitoring plans carefully. Special attention should be paid to the location of the monitoring equipment in relation to the source, as well as the local meteorology. The permit writer must determine whether the monitoring plan is adequate for characterizing releases of contaminants from the OB/OD unit.

5.2.1.2 Meteorological Monitoring

A permit applicant should collect on-site meteorological data, if possible. However, if this is not possible, representative data may be available from a nearby facility, a university, or a governmental agency. On-site meteorological data should be collected in accordance with procedures set forth in the following documents:

- *Meteorological Monitoring Guidance for Regulatory Modeling Applications*. (EPA 2000).
- *Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD)*. (EPA 1987).

The amount and level of detail of meteorological data required will vary, depending on an applicant's specific circumstances. Generally, meteorological data for use in air dispersion modeling analyses must be complete and accurate. Summarized below are the requirements for on-site meteorological data for use in an air dispersion modeling analysis. If meteorological data are collected for a purpose other than modeling, the permit writer should assess the specific needs and determine the associated data requirements. For example, if on-site precipitation data are needed to evaluate leaching potential, and other meteorological variables are available and adequate to characterize the atmospheric conditions at the site, an applicant may collect only the on-site precipitation data. However, the guidelines presented below generally can be applied to all meteorological monitoring requirements.

Siting and Exposure

The primary goal of collecting on-site data is to obtain valid, representative data on the atmospheric conditions at the facility and at locations where exposure to contaminants is expected to occur. There are four main criteria for determining the representativeness of on-site meteorological data: (1) the proximity of the station to the facility and exposure areas, (2) the topography of the area, (3) the exposure of the instrument, and (4) the time period of data collection. The data should be evaluated against criteria to determine whether the data are representative of the site.

The location of the meteorological station should be such that measurements made represent the atmospheric conditions at the site. If a monitoring station is located too far from the site, the data may not represent the atmospheric patterns at the site adequately.

Topography can change the meteorological variables drastically if complex terrain is present, or in coastal areas. The local terrain must be considered in selecting the location of the station. In some cases, when atmospheric conditions differ considerably over the area of interest, more than one meteorological station should be used for data collection. For example, if complex terrain influences meteorology in the immediate vicinity of the facility, the airflow patterns in the complex terrain may require evaluation, in addition to the patterns at the facility.

The location of instruments relative to terrain, obstructions, and the elements is referred to as exposure. Standard exposure parameters have been developed to ensure that meteorological parameters are represented comparably from site to site. Generally, instruments should be located away from the influence of buildings, trees, towers, or other obstructions. The standard exposure of wind instruments is 10 meters above ground, with obstructions located a distance of at least 10 times the height of the obstruction. If such positioning is not possible, the anemometer may be located above

the obstruction. Temperature gauges usually should be located 2 meters above the ground, away from obstructions, and must be protected from direct thermal radiation. The protective equipment must provide adequate ventilation. Precipitation gauges should be located on level ground, horizontal to the sky, and away from obstructions.

Data Requirements

The type and amount of meteorological data necessary will depend on the needs for a specific site. Data requirements should be determined on a case-by-case basis. However, the minimum requirements for most refined dispersion modeling analyses include collecting data over a period of a year for the following atmospheric parameters: wind speed, wind direction, temperature, temperature differential, solar radiation, and precipitation. Other common variable factors for which data are collected at on-site stations include atmospheric water vapor, barometric pressure, cloud cover, and cloud ceiling. Upper air measurements also are required to calculate mixing heights for dispersion modeling, but those data usually are obtained from the nearest National Weather Service station rather than collected on-site. Recent technological developments, however, allow collection of upper air measurements by remote sensing. One such remote sensing device that has become popular is the Doppler Sound Detection and Ranging (SODAR). Remote sensing is a practicable means of collecting data that should be evaluated on a case-by-case basis. The cost of remote sensing, however, may make other methods of data collection more desirable.

System Performance

The accuracy of meteorological instruments is highly dependent on their quality. EPA has developed recommendations for system accuracy (EPA 2000) for on-site meteorological monitoring. Table 5.1 lists the recommended accuracies, along with recommended measurement resolutions for the

meteorological parameters. The values listed in Table 5.1 apply to digital systems (analog systems are permitted 50 percent additional error).

Quality Assurance

For data collected on site, adequate quality assurance (QA) records should be provided that demonstrate that the data were collected properly. Typically, a QA plan is developed for the monitoring effort. A QA plan should include the following information (EPA 1987):

- Project description, that is, how the meteorological data are to be used
- Project organization, that is, how validity of the data is supported
- QA objective, that is, how QA will document validity
- Calibration method and frequency for each piece of equipment
- Data flow from samples to archived valid values
- Validation and reporting methods for meteorological data
- Audits, both performance and system
- Preventive maintenance
- Procedures for implementing QA objectives, in detail
- Management support for corrective action and reports

Should the permit writer determine that either the meteorological sampling or the QA program is inadequate, he or she should issue a NOD to specify the appropriate corrective action necessary. Areas that the permit writer might address include:

TABLE 5.1
RECOMMENDED SYSTEM ACCURACIES AND RESOLUTIONS

| Meteorological Parameters | System Accuracy | Measurement Resolution |
|---|---|-------------------------------|
| Wind Speed (horizontal and vertical) | $\pm (0.2 \text{ m/s} + 5\% \text{ of observed})$ | 0.1 m/s |
| Wind Direction (azimuth and elevation) | $\pm 5 \text{ degrees}$ | 1 degree |
| Ambient Temperature | $\pm 0.5^\circ\text{C}$ | 0.1 $^\circ\text{C}$ |
| Vertical Temperature Difference | $\pm 0.1^\circ\text{C}$ | 0.02 $^\circ\text{C}$ |
| Dew Point Temperature | $\pm 1.5^\circ\text{C}$ | 0.1 $^\circ\text{C}$ |
| Precipitation | $\pm 10\% \text{ of observed}$ | 0.3 mm |
| Pressure | $\pm 3 \text{ millibar (mb) (0.3 kPa)}$ | 0.5 mb |
| Radiation | $\pm 5\% \text{ of observed}$ | 10 W/m ² |
| Time | $\pm 5 \text{ minutes}$ | - |

Source: *Meteorological Monitoring Guidance for Regulatory Modeling Applications*

- The location of the station
- The use of separate historical data sources for particular parameters
- The sampling frequency
- The period of time represented by the data set from the station
- The adequacy of various aspects of the QA plan or its components

5.2.1.3 Compliance Monitoring

Detection and Monitoring Requirements

Procedures for and frequencies of monitoring, testing, collection of analytical data, inspections, response, and reporting must ensure compliance with 40 CFR §264.601. The permit applicant must follow appropriate guidance in monitoring for air quality and meteorologic parameters, as needed. Estimation of the air emissions from an OB/OD unit can be accomplished through emissions calculations to determine the incremental effects of operation of the unit on the overall air quality in the area. For OB/OD units, air compliance monitoring will be required for gaseous emissions, at the least. Concerns about hazardous particulates can be addressed through periodic soil sampling of areas downwind of the OB/OD operations. All EPA guidelines establishing the appropriate methods should be followed, including those governing the appropriate equipment for each type of sampling, such as that for particulates, VOCs, SVOCs, and other specific compounds of concern. Each situation must be evaluated separately because the wastes to be treated differ.

The design of a network for measurement of criteria and noncriteria air pollutants for compliance will be affected by many factors, such as topography, climatology, population, and other existing emission sources. The ultimate design of a air quality network to be used for risk assessment must be determined

on a case-by-case basis. EPA's *Ambient Monitoring Guidelines for Prevention of Significant Deterioration* (EPA 1987) provides guidance for siting an air quality monitoring network. Presented below are some general guidelines for reviewing plans for siting such networks.

Air quality monitors should be located at a height of approximately three meters for monitoring human health concerns. Locations should be chosen at areas of expected maximum air concentrations of pollutants and boundaries of the site as well as upwind locations to determine background air quality. To the extent possible, the area chosen should be free of obstructions within a reasonable distance of the unit. The permit writer should be able to review a map that provides all siting locations (based on wind direction) that the applicant believes will be affected. The plan must discuss how the sampling stations will be selected for a given burn or detonation and, if sufficient stations are not provided to cover all potential downwind locations, how sampling equipment will be transported to and set up at new locations.

Frequency of sampling will be based on OB/OD operations and meteorological conditions specific to each situation. The permit writer must determine that the frequency of sampling matches the frequency of OB/OD operations.

All ambient air quality monitoring for particulates, VOCs, SVOCs, and any other compounds of concern for OB/OD operations must follow approved reference methods. The permit applicant must provide detection limits for each contaminant for which analysis is to be conducted. The permit writer should determine that the contaminants identified are those expected from the OB/OD operation, particularly when several types of waste are to be treated.

Generally, the number of monitors will increase as the expected spatial variability of the pollutant in the area(s) of study increases.

5.2.2 Groundwater Monitoring

A hydrogeologic assessment must be submitted as part of the Subpart X permit application to demonstrate compliance with environmental performance standards related to potential effects on groundwater and the subsurface environment (EPA 1986; 1992). Specific performance standards that must be addressed in the hydrogeologic assessment are set forth in 40 CFR §264.601(a).

Permit applicants may avoid conducting a detailed assessment for groundwater or the subsurface environment if the applicant can demonstrate through a preliminary assessment that releases to those media will not have adverse effects on human health and the environment. Preliminary assessments may be completed separately for each medium or conducted for a single medium only. The permit writer should evaluate the adequacy of preliminary assessments, using information submitted by the applicant to characterize the Subpart X unit.

A preliminary groundwater and subsurface assessment must describe the regional geology and hydrogeology, the depth to aquifers, yields of aquifers, locations and uses of regional aquifers, and locations of the nearest drinking water wells. There are numerous sources from which those data can be obtained. The permit writer should evaluate the data and the sources of the data to determine whether they are valid and representative of the site. In addition, the permit writer should evaluate the application for conformity with the following criteria:

- Will environmental controls (such as secondary containment) be used?
- Was sufficient information provided about the quantities of wastes and concentrations of hazardous waste constituents in the wastes entering the unit?
- Was adequate information provided about the process conducted at the unit, including reaction rates, temperatures, pressures, and residence time?

- Was adequate justification provided to support the conclusion that hazardous waste constituents will not be released from the unit?
- Were data supplied to support the conclusion that no release of hazardous waste constituents at levels above health-based standards has occurred from the facility?
- Is there evidence of complaints to the facility by neighbors about potential releases from the facility?
- Was adequate information provided about regional geology and hydrogeology?

EPA's Handbook of Groundwater Protection and Clean-Up Policies for RCRA Corrective Action (September 2001) is posted at <http://www.epa.gov/correctiveaction>

This document provides general information on groundwater issues and contains links to many other guidance documents.

If the answer to any of the above key questions is no, the permit writer should issue a NOD to require that the applicant conduct a detailed assessment of the groundwater and subsurface environment.

Once determined necessary, groundwater monitoring is a straightforward process. Monitoring systems similar to those of land disposal units (40 CFR Part 264, Subpart F) should be proposed because of the potential that OB/OD units will be closed with waste in place. The permit writer should review EPA's *Groundwater Monitoring Technical Enforcement Guidance Document* (EPA 1986) and *RCRA Groundwater Monitoring: Draft Technical Guidance* (EPA, 1992) documents.

These documents provide extensive guidance for the placement and operation of such systems, when evaluating groundwater monitoring plans submitted by the permit applicant. These documents and the *Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action (September 2001)* are available via the internet at <http://www.epa.gov/correctiveaction>.

5.2.3 Soil Monitoring

The permit application must address sampling of surface and subsurface soils in, and around, the Subpart X unit, specifically OB/OD unit(s). The soil sampling program must, at a minimum, address sampling frequency, location, quantity, and the

elements identified in 40 CFR §§ 264.601(a)(1), 264.601(a)(7), 264.601(b)(2), 264.601(b)(8), 270.23 (b) and 270.23 (e). Sampling frequency must be sufficient to determine whether the OB/OD operation is having an impact on the surrounding soils. The sample(s) must be collected from the area impacted by the operation; the number of samples must be statistically significant for the area of impact. Surface soil sampling locations should include coverage of the following areas based on the potential for contamination:

1. Treatment source zone (e.g., pit/crater areas for OD, ground-based burn area for OB, as applicable, or within 1-3 m of burn pans)
2. Ejecta zone (to be determined on a site-specific basis)
3. Remainder of OB/OD unit, including any drainage pathways
4. Prevailing downwind location areas associated with maximum predicted gravitational settling/deposition potential (as practical)
5. Natural background

For open burning treatment, the area of impact (distance from center of treatment) may extend as far as 1,800 feet, based on the burning of 10,000 pounds of reactive wastes. In situations where the facility treats explosive hazardous waste, by open burning, in volumes greater than 10,000 pounds, the applicant will be required to present a minimum safe setback distance in the application. The applicant must provide justification for the proposed safe setback distance. For open detonation treatment, the area of impact may extend as far as, but not farther than, the minimum safe distance specified in Section 5.2.2.4 (page 35) of [Approaches for the Remediation of Federal Facility Sites Contaminated with Explosive or Radioactive Wastes](#), (EPA, 1993a). For non-fragmenting explosive material, the minimum distance is either 1,250 feet or the explosive's actual maximum debris and fragment range. For fragment-producing materials, the

minimum distance is 2,500 feet. For bombs and projectiles with a caliber greater than 5 inches, the minimum distance is 4,000 feet. The minimum distance can be calculated using the empirical formula:

$$D=300 \times (NEW)^{1/2}$$

Where D is the minimum distance and NEW is the net explosive weight of the munitions in pounds. If the facility believes that its area of impact is different, justification must be provided in the permit application.

The sample collection procedure, number of samples within each of these areas, and statistical analysis approach should be based on standard EPA guidance (e.g., SW-846). The heterogeneity of explosives in soils is frequently observed in duplicate sample analytical results which differ by more than an order of magnitude. Based on surface soil sampling tests for energetics conducted by the U.S. Army at several OB/OD units and military ranges, the following recommendations were made to improve site characterization of soils.

- Increase the number of samples
- Collecting composite samples
- Use of a stratified sampling design
- Reduce within-sample heterogeneity by either homogenization and extraction or analysis of a larger sample.

Discrete surface soil samples for energetics (even those used to obtain a composite sample) should be collected from a small area (i.e., within a 4-ft diameter). In general, the number of subsurface soil sampling locations can be limited to those needed to characterize natural background and those surface soil sampling locations that exceed screening or risk-based criteria. However, a minimum of two to three soil borings within the OB/OD unit (at least one

within the source treatment zone) should be obtained. Subsurface soils sampling depths should include the following (at a minimum):

- Every 1 ft from the surface to a depth of 4 ft
- Every 4 ft from a depth of 4 ft to 16 ft
- Every 8 ft beyond 16 ft

The maximum subsurface soil sampling depth required is the depth of the uppermost aquifer or bedrock (whichever occurs first).

5.3 Modeling Air and Groundwater

When conducting a detailed media assessment, a permit applicant may use either monitoring or modeling, or a combination of the two, to determine concentrations of contaminants that are the result of releases from a Subpart X unit. There are no inflexible criteria for determining when to use monitoring and when to use modeling. Each technique has strengths and weaknesses that the permit writer should evaluate for each Subpart X unit before deciding which to require.

The major advantage of monitoring is that the results are real measurements rather than estimates. However, monitoring can be conducted at only a limited number of points; further, it may be difficult to ensure the selection of monitoring locations at which maximum concentrations occur. In addition, monitoring may not be technically feasible in some areas.

In such cases as those discussed above, modeling may be preferable. Modeling techniques allow the preparation of calculations at almost any location under many environmental conditions. But, because modeling involves the use of assumptions, results may be subject to interpretation. Often, a combination of modeling and monitoring will best characterize releases from Subpart X units. The permit writer should consider the following factors when determining which approach to require of a permit applicant:

- If monitoring is technically impracticable, modeling is preferable to no action. For example, because of the unconfined nature of air releases from such units, permit applicants historically have had difficulty in capturing the entire plume from OB/OD units through the exclusive use of air monitoring.
- Permit applicants that propose the exclusive use of monitoring should be required to conduct modeling to verify that the full extent of releases from a unit are captured at the monitoring locations selected.
- Permit applicants that propose the exclusive use of modeling should, where feasible, be required to conduct monitoring to provide a comparison to the results of air modeling.

Presented below are specific details about monitoring and modeling techniques for each environmental medium.

5.3.1 Air Dispersion and Emission Modeling

The models that simulate the transport and dispersion of air contaminants from the point of release to potential receptors use known data on the characteristics of a contaminant release and the atmospheric conditions as input to calculate air concentrations and deposition values at almost any location specified by the user. Dispersion models can be used when monitoring is impractical or infeasible. Models also can be used to supplement air monitoring programs by filling in data gaps or interpreting monitoring results, or to assist in designing an air monitoring program. Dispersion modeling is an important tool for determining potential exposure by the air pathway.

Although dispersion modeling is a valuable tool for an air assessment, the permit writer should recognize the considerable limitations that exist when evaluating a modeling analysis. The accuracy of the models is limited by the ability of the model algorithms to depict atmospheric transport and dispersion of contaminants and by the accuracy and

validity of the input data. For example, most refined models require the input of representative meteorological data from a single measuring station. In reality, a release will encounter highly variable meteorological conditions that change constantly as the release moves downwind. EPA's [Guideline on Air Quality Models - Revised \(EPA 2001\)](#) describes two types of uncertainty related to modeling. Inherent uncertainty involves deviations in concentrations that occur even if all data used for the model are accurate. Reducible uncertainty is associated with the model and the uncertain input values that will affect the results. While it is important to represent actual conditions accurately by selecting the right model and using accurate and representative data, it should be recognized that the results of all modeling are subject to uncertainty. Nevertheless, models generally are considered reasonably reliable in estimating the magnitude of highest concentrations that result from a release, although the estimate will not be necessarily time- and space-specific (EPA 2001). When applied properly, air dispersion models typically are accurate to ± 10 to 40 percent and can be used to develop a best estimate of concentrations of air pollutants (EPA 2001).

In general, a modeling analysis should follow closely the EPA modeling guidelines presented in [Guideline On Air Quality Models](#), as well as information presented in user's guides and EPA risk assessment documents (e.g., [Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities](#)). Permit writers should refer to these documents when evaluating an approach to modeling. The permit applicant should identify clearly and justify any deviations in the application from the guidelines. Other helpful resources that aid in reviewing a modeling approach include:

- EPA. 1994. Air/Superfund National Technical Guidance Study Series. [Volume V - Procedures For Air Dispersion Modeling At Superfund Sites](#). Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. February.

- EPA. 1994. *Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities*. (EPA530-R-94-021). Office of Solid Waste and Emergency Response. April.
- EPA. *Suggestions for Auditing Assessment Air Modeling Studies following the 1998 U.S. Office of Solid Waste Human Health and Ecological Risk Protocols*. U.S. EPA Region 6 Center for Combustion Science and Engineering.

The following sections discuss criteria for the selection of the model, the data that are required for a modeling analysis, and evaluation of the results of modeling. These sections describe for the permit writer how to evaluate a modeling analysis and provide information about recommended air dispersion models. Each section addresses the requirements for both screening air modeling analyses and refined air modeling analyses.

Emission Modeling

Emission modeling is a method that uses known information and assumptions about an emission source to predict the emission rate of a given contaminant. The information and assumptions used in emission modeling are incorporated into emission factors or emission equations that then are used to calculate emissions. Often, the factors and equations are based on monitoring and modeling results from several similar sources. Emission modeling should not be confused with dispersion modeling. Unlike dispersion modeling, which estimates concentrations and deposition rates of contaminants, emission modeling (or emission factors and equations) estimates the rate of release of contaminants from a source, in units of mass per time. Emission factors and equations have been developed for a wide variety of emission sources and a wide variety of release conditions. Most emission factors and equations include a built-in bias toward conservatism, so that estimated emission rates will represent the worst-case scenario. The

permit writer should verify that any emission factors or emission equations used by an applicant are credible and result in conservative estimates.

Under certain circumstances, emission modeling may be used instead of emission monitoring to estimate emission rates from Subpart X units. When well-developed emission factors or equations are available for the specific type of unit and wastes, those factors may be used to estimate emissions from a unit. Use of emission modeling may be necessary when monitoring would be difficult or impossible. The most comprehensive collection of emission factors and equations is found in EPA's *AP-42 Compilation of Air Pollutant Emission Factors* (EPA 1995c). Existing "BangBox" data for OB/OD operations as presented in *Emission Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation (OB/OD)* are generally acceptable for use in estimating emissions, as long as the composition of material being burned or detonated at the unit is the same as the composition of material for which the BangBox data were collected.

Another type of emission modeling technique is the mass balance technique. Mass balance is a screening technique that uses the mass of material entering a system with the mass of material leaving the system. The difference between those two known parameters is assumed to be the air emissions. This technique is applicable only to emission sources for which the mass of material both entering and leaving the system is known. A permit applicant may measure those values so that the mass balance technique can be applied.

Selection of the Dispersion Model

Selection of the proper dispersion model for analyzing the release of a contaminant to the atmosphere is crucial to the success of the modeling analysis. Dispersion models are developed for specific types of sources, atmospheric conditions, terrain, locations of receptors, and chemical and

physical processes involved. Only models that are capable of assessing conditions against site-specific criteria should be used in a modeling analysis.

Dispersion models are developed for either screening or refined analyses. Screening models are easier to use and require less site-specific data than those for refined analysis. Refined models require more data, but produce more realistic results. Table 5.2 presents preferred screening dispersion models for Subpart X units and outlines each model's capabilities and features. Also provided below are summary discussions of each preferred screening model. It should be noted that Table 5.2 is not intended to be an exhaustive list of appropriate screening models for Subpart X permitting, but provides the most commonly used and most accepted screening models that may be applied to a Subpart X unit. Because of their versatility and ease of use, the SCREEN3 and TSCREEN models are the most commonly used screening models. However, the models can simulate releases only from a single source; therefore, another screening model or a refined model must be used to model sites at which there are more than one source. The CTSCREEN model is especially useful in cases in which complex terrain and multiple point sources are present.

Table 5.3 lists preferred refined dispersion models for Subpart X permitting and outlines each model's capabilities and features. Also provided below are summary discussions of each preferred refined model. As is true of the list of screening models, the list of refined models in Table 5.3 is not intended to be an exhaustive compilation of appropriate refined models for Subpart X permitting.

It should be noted that a dispersion model has been developed at the U. S. Army Dugway Proving Grounds to specifically address release and dispersion characteristics from OB/OD sources. The model is a gaussian puff model, and is called the Open Burn and Open Detonation Model (OBODM). EPA Region 4 recommends the use of the OBODM model for open burn and detonation

TABLE 5.2
PREFERRED SCREENING AIR DISPERSION MODELS
AND THEIR USES

| MODEL CHARACTERISTIC | SCREEN3¹ | TSCREEN² | CTSCREEN³ |
|--|----------------------------|----------------------------|-----------------------------|
| Source Types | Point, Area, Volume, Flare | Numerous | Point |
| Terrain Types | Simple, Complex | Simple, Complex | Complex |
| Release Mode | Continuous | Continuous, Instantaneous | Continuous |
| Averaging Time | 1 Hour | 15 Minutes to Annual | 1 Hour to Annual |
| Land Use | Rural or Urban | Rural or Urban | Rural or Urban |
| Contaminant Type | Gas or Particulate | Gas, Particulate | Gas or Particulate |
| Applicable Range | ≤ 100 km | ≤ 100 km | ≤ 50 km |
| Generic or Real Meteorological Data? | Generic | Generic | Generic |
| Model Chemical Reactions? | No | No | No |
| Model Building Wake Effects? | Yes | Yes | No |
| Dry Deposition Calculations? | No | No | No |
| Wet Deposition Calculations? | No | No | No |
| Model Negatively Buoyant Gases? | No | Yes | No |
| Single or Multiple Sources per Simulation? | Single | Single | Multiple |

1 SCREEN3 dispersion model for a single source.

2 TSCREEN screening model for a single source.

3 CTSCREEN model for complex terrain.

units. For this reason, OBODM is included in this document as a preferred dispersion model for Subpart X Permitting.

SCREEN3

The SCREEN3 model is a Gaussian, steady-state dispersion model used for making simple screening evaluations for neutrally buoyant, continuous emissions from a single source. The model uses built-in worst-case meteorological conditions to predict concentrations from either point, area, volume, or flare sources. The SCREEN3 model can simulate dispersion from only one source at a time. The model is capable of simulating dispersion of gases or particulates in simple or complex terrain. Only one-hour averaging periods are calculated, so if different averaging periods are desired, generic adjustment factors must be used. (Note that reference doses and other health criteria do not require exposures of less than 1 year.) SCREEN3 is recommended for simple screening evaluations of a single, continuously emitting source.

SCREEN3 is available on [EPA's Support Center for Regulatory Air Models \(SCRAM\)](#) bulletin board, which is part of the OAQPS Technology Transfer Network:

Telephone Number: (919) 541-5742

Baud Rate: 200, 9600, or 14.4K baud

Line Settings: 8 data bits, no parity, 1 stop bit

Terminal Emulation: VT100 or ANSI

Internet TTN site: <http://ttnwww.rtpnc.epa.gov>

SCRAM site: <http://134.67.104.12/html/scram/scram.htm>

TSCREEN

TSCREEN is a screening modeling system for toxic releases that consists of four different dispersion models: 1) SCREEN3 for neutrally buoyant, continuous releases; 2) PUFF for neutrally buoyant, non-continuous releases; 3) RVD for dense gas jet releases; and 4) the Britter-McQuaid Model for continuous or puff dense gas area sources. When executing TSCREEN, the user enters parameters for

the source and receptors, and the appropriate model is selected within the modeling program.

TSCREEN uses generic, worst-case meteorological data to calculate downwind concentrations. The modeling system is versatile in its ability to simulate dispersion from many different types of toxic emission sources. As in the case of SCREEN3, only one source can be entered in the model per simulation. TSCREEN is recommended for screening evaluations of single sources of toxic air contaminants. TSCREEN is available on EPA's SCRAM bulletin board. See the SCREEN3 summary for details on access to SCRAM.

CTSCREEN

CTSCREEN is the screening mode of the CTDMPLUS model for calculating downwind concentrations from point sources in complex terrain. CTSCREEN and CTDMPLUS are identical, except that CTSCREEN uses generic, worst-case meteorological data rather than the extensive site-specific meteorological data used in CTDMPLUS. CTSCREEN can be used in a screening analysis for point sources when complex terrain affects dispersion of contaminants. See the individual listing below for information about CTDMPLUS. CTSCREEN is available on EPA's SCRAM bulletin board.

ISC3

The Industrial Source Complex 3 (ISC3) model is a Gaussian plume model that can predict short- or long-term concentrations of pollutants from continuous emissions of point, area, and volume sources. The model can simulate the downwash effects of buildings on point sources, can simulate multiple sources per run, and is appropriate for use to a distance of 50 kilometers. The model recently has been modified to include dry and wet deposition, an algorithm for complex terrain, and an improved algorithm for modeling area sources.

ISC3 is preferred for most refined modeling applications when there are continuous emissions of neutrally buoyant, nonreactive pollutants. The ISC3

model is not the best model in cases in which a release of a pollutant is instantaneous or intermittent or those in which the pollutant is significantly heavier than air. ISC3 treats chemical reactions only by simulating exponential decay of a pollutant. If complex chemical reactions of a pollutant in the atmosphere are important, a different model may be more appropriate.

ISC3 requires entry of detailed data on the source and receptors and preprocessed hourly meteorological data. Depending on the features used, additional data are required, such as information about building dimensions and particle size. Because ISC3 requires entry of complex data to use various model features, analyses should be performed by an experienced modeler. The ISC3 model is available on the SCRAM bulletin board.

RAM

The RAM model (Gaussian-plume multiple source air quality algorithm) is a steady-state Gaussian plume model capable of predicting concentrations of contaminants from point or area sources. The model assumes level terrain and can assess concentrations for short-term averaging periods (from one hour to one day). RAM can estimate concentrations in rural or urban areas, but is recommended specifically for use in urban areas. Although use of the RAM model is acceptable, within those limiting conditions, the ISC3 model generally is preferred because of its updated features and algorithms. RAM is available from the National Technical Information Service (NTIS).

CTDMPLUS

CTDMPLUS is a refined point source Gaussian air quality model for use in all stability conditions for complex terrain applications. The model requires entry of considerable surface and upper air meteorological data, and uses extensive data on terrain to define the shapes of individual hills. The model associates each receptor with a particular hill. CTDMPLUS is recommended specifically for continuous, elevated point sources near terrain that

is higher than the top of the source's stack.
CTDMPLUS is available on EPA's SCRAM bulletin board.

INPUFF

INPUFF is a Gaussian integrated puff model for evaluating downwind concentrations or deposition fluxes from continuous or noncontinuous sources. INPUFF is capable of modeling multiple sources at as many as 100 receptors and for as many as 144 meteorological periods. Moving or stationary sources may be simulated with puffs that disperse over a gridded wind field. The puffs from a source are released in a series of user-specified time steps. INPUFF usually is applied to noncontinuous sources and is the most common model for use for OB/OD operations. INPUFF is a suitable model for OB/OD releases under most circumstances, but it does have significant limitations including: use of dispersion parameters for long-term releases, rather than short-term releases; use of plume rise equations for continuous sources; and unrealistic simulation of atmospheric turbulence. Unfortunately, there are few alternative models available to address OB/OD releases. The limitations of INPUFF should be recognized when evaluating a modeling plan that uses the model.

INPUFF can be used for OB/OD releases but it was not developed to model OB/OD type processes. The limitations of INPUFF should be recognized when evaluating a modeling plan.

When INPUFF is used to model OB/OD operations, source parameters should be input into the model to best fit the actual release characteristics of the source. Because INPUFF is not able to specifically address OB/OD type releases, the input parameters must be modified to fit the input requirements of another source type, and still exhibit the release and dispersion characteristics of the OB/OD operation.

Open burn operations are usually characterized as point sources so that buoyancy plume rise can be taken into account. When running the model for open burn sources, the buoyancy-induced dispersion option should be selected. Input values will vary depending on the type of material being burned, and the location and construction of the burn pan. As a guide, the checklist gives typical

open burn values of 3700 °K for exit temperature and 0.1 to 10 meters per second for exit velocity. An open burn operation may be considered a continuous release if the burn lasts for a long time (1 hour or longer), but will usually be considered a short-term release.

Open detonation sources should be characterized as a volume source with initial lateral and vertical dimensions equivalent to the expected maximum extent of the blast cloud. There are several methods for identifying the extent of the cloud. Stoner and Kirkpatrick (1995c) suggest one method for determining the cloud size by first calculating the initial source volume using the POLU model, which estimates total detonation gases and initial temperature. These results are entered into INPUFF as a ground-level source with plume rise. As part of this method, the cloud is limited to a maximum height using estimates made from high-explosive algorithms developed by the Defense Nuclear Agency. Other methods for determining the cloud extent may also be used. In general, any method used to determine the cloud dimensions should be well documented and justifiable.

When an OB/OD source is located in complex terrain, a model such as CALPUFF should be used to properly address the terrain issues. However, for screening analyses, INPUFF may be used if conservative assumptions are incorporated into the analysis to account for the complex terrain. One example of this is to assume that the cloud height is ground level and all the receptors are at ground level. INPUFF is available from NTIS.

CALPUFF

The CALPUFF model is a complex modeling system that can estimate concentrations of pollutants from non-steady-state emission sources. This model can simulate the effects of meteorological conditions that vary according to time and space, chemical transformation, and physical removal. CALPUFF is also capable of simulating building downwash and transport over complex terrain and over water, or coastal transport. It can be used for point, area,

volume, or line sources. The CALPUFF modeling system has several modules, each intended for performing a separate operation. One recently added module treats buoyant rise and dispersion from area sources. This module may be useful for modeling OB/OD sources. Because CALPUFF is a complicated modeling system, and because EPA has not fully recommended its use, review of a CALPUFF analysis by experts is recommended. CALPUFF is available on EPA's SCRAM bulletin board.

OBODM

The Open Burn/Open Detonation Dispersion Model (OBODM) is intended for use in evaluating the potential air quality impacts of the open air burning and detonation (OB/OD) of obsolete munitions and solid propellants. OBODM uses cloud/plume rise, dispersion, and deposition algorithms taken from existing models for instantaneous and quasi-continuous sources to predict the downwind transport and dispersion of pollutants released from OB/OD operations. The model can be used to calculate gravitational deposition for emissions from multiple OB/OD sources for either a single event of up to a year of sequential hourly source and meteorological inputs. The program is designed for use on IBM-compatible PCs using the MS-DOS (Version 2.1 or higher) operating system with keyboard and optional mouse-control. It will also run under most WINDOWS environments.

OBODM is available on EPA's SCRAM Bulletin Board <http://www.epa.gov/scram001>

DEGADIS

The Dense Gas Dispersion Model (DEGADIS) uses mass and momentum balances and laboratory and field scale data to simulate the release and transport of pollutants (EPA 1995). It is used for negatively or neutrally buoyant releases of toxic, nonreactive gases or aerosols. It is applicable for ground-level, low-momentum area releases; or upwardly directed stack releases. The release may be instantaneous, continuous, or of finite duration, or may vary over time. The model simulates only one set of meteorological conditions, so the modeled time frame should not exceed one to two hours. Another

limitation affecting the model is that dispersion is assumed to take place over flat, unobstructed terrain. DEGADIS is not equipped to address terrain that is complex or that has extensive surface roughness.

DEGADIS requires entry of the characteristics of the release and its chemical and physical properties, data on receptors, and standard meteorological data. If an aerosol release is being modeled, the density of the release also must be entered into the model. Although DEGADIS is appropriate for a wide range of sources, it is particularly valuable in characterizing releases of pollutants that are very dense compared with air. An external input file or an interactive computer program can be used to run DEGADIS. DEGADIS is available on EPA's SCRAM bulletin board.

HGSYSTEM

HGSYSTEM is a computer program that incorporates several different dispersion models for various types of toxic releases. The modeling package can estimate one or more consecutive phases between a spill of a toxic substance and near-field and far-field dispersion of a pollutant. The pollutant being modeled can be a two-phase, multicomponent mixture of nonreactive compounds or hydrogen fluoride. The modeling system can simulate chemical reactions only for hydrogen fluoride. HGSYSTEM assumes flat, unobstructed terrain and can be used for continuous, finite-duration, instantaneous, and time-dependent releases. HGSYSTEM can be used to determine short-term (one hour or less) concentrations of toxic releases under one set of ambient conditions. HGSYSTEM is available from the American Petroleum Institute.

SLAB

The SLAB model is used for modeling the dispersion of dense gas releases from a ground-level evaporating pool, an elevated horizontal jet, a stack or elevated vertical jet, or an instantaneous volume source. If two or more different types of releases

require evaluation, they must be processed in separate model simulations. The SLAB model uses only one set of meteorological conditions, so only short-term concentrations can be calculated. The model assumes that the release consists of nonreactive dense gases or aerosols and that no deposition occurs. SLAB calculates concentrations by using numerical integration in space and time to solve the basic conservation equations. SLAB is available on EPA's SCRAM bulletin board.

Source Type Specification

In part, selection of the proper dispersion model depends on the type of emission source or sources that must be modeled. Each source must be classified as a point, area, volume, or line source. Some models allow for identification of other types of sources that are subsets of the four types listed above. An example of such a sub item is a flare, which is a type of point source. In addition, each source must be classified as a continuous, instantaneous, or intermittent source; as a vapor-phase or particulate emission source; and, when modeling gaseous contaminants, as neutrally buoyant or negatively buoyant. These determinations will affect the selection of a model.

Releases from point sources are those from stacks or vents; they exhibit well-defined exit parameters such as temperature, flow rate, and stack height. Releases from area sources are emitted at or near ground level and over a given surface area. Area source emissions are entered into a model in units of mass per time per area. Releases from volume sources are those that occur over a given area (like area sources), and also within a certain depth. Volume sources can be ground level or elevated sources. When entering data for a volume source, a model requires the initial lateral and vertical dimensions of the source. Releases from line sources are releases from roadways or other sources that emit over a long and narrow space. Some models simulate line sources with a series of volume or area sources adjacent to one another.

In general, a permit writer should evaluate the description of a source or proposed source and decide whether an applicant's representation of the source in a modeling analysis is reasonable. As can be anticipated, the choice of the type of source to be used sometimes can be left to professional judgment and based on how a source best fits into the definition of a given type of source.

Sources must also be classified as continuous, instantaneous, or intermittent. The most common dispersion models are Gaussian, steady-state models, such as ISC3. These types of models can simulate dispersion from continuous sources. For instantaneous or intermittent releases, a "puff" model may be used. This differentiation is of particular importance for OB/OD operations, from which emissions occur over a very short period during OD operations and from a few minutes to one hour during OB operations. TSCREEN incorporates a puff model into its screening system, and INPUFF and CALPUFF and OBODM are puff models that can be used for screening or refined analyses. A puff model should be used when the travel time of the plume from the source to a receptor is longer than the duration of the emissions.

If a gaseous contaminant cloud emitted by a source has a significantly higher density than air, it will be negatively buoyant and should be modeled with a dense gas model (DEGADIS, HGSYSTEM, or SLAB). When uncertain whether a vapor cloud should be modeled with a dense gas model, the vapor cloud's Richardson Number (Ri) should be calculated. A cloud that exhibits $Ri > 10$ should be modeled with a dense gas model (Trinity 1996).

Contaminants emitted from Subpart X units may include NO_x , SO_x , particulates (including metals), VOCs, and SVOCs. Most of the preferred models listed in this document are capable of simulating transport of both particulate matter and vapor-phase emissions.

[Table 5.3](#) and the model descriptions of models provided in this document should be helpful to a permit writer in determining whether a permit applicant has selected the appropriate model.

Meteorological Parameters

It is important that the permit writer ensure that appropriate meteorological data have been included in a modeling analysis. For screening analyses, the information usually is straightforward because most screening models use generic, worst-case meteorological conditions. Usually, the meteorological conditions that produce the highest modeled concentrations are low wind speeds and stable atmospheric conditions. For models that require the entry of a single set of conditions, such as dense-gas models, the permit writer should verify that reasonable worst-case conditions have been entered. Reasonable worst-case conditions may be modified to reflect proposed operating restrictions. For example, OB/OD operations may be confined to daylight hours; therefore, worst-case stability might be the worst-case daylight stability conditions, since the atmosphere tends to become more stable at night.

If a refined modeling analysis requires entry of real meteorological data, either on-site meteorological data for one year, or off-site data for five years are needed for a refined analysis. If on-site data for five years are available, all those data should be used. Off-site data can be obtained from nearby National Weather Service stations, military facilities, or industrial facilities. The permit writer should examine the location from which any off-site data were collected to ensure that location resembles the site being modeled. Parameters to review include distance of the station from the site, unique features of the terrain that may change the wind flow patterns, and the exact location of the monitoring equipment. National Weather Service data from many stations nationwide are available on the SCRAM Bulletin Board System or from NTIS. Of the models listed in [Table 5.3](#), those that use detailed meteorological data include ISC3, RAM, CTDMPPLUS, INPUFF, CALPUFF, and

Tip:

Procedures for creating multi-year files can be found in the User's Guide for the air dispersion model. Procedures for the ISCST3 model are also presented in Section 3.7.4 of the Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (HHRAP).

OBODM. The dense-gas models (DEGADIS, HGSYSTEM, and SLAB) accept only one set of ambient conditions.

If existing representative data are not available, a permit applicant must collect data from the site. Those data should be collected in accordance with the guidelines set forth in *Meteorological Monitoring Guidance for Regulatory Modeling Applications* (EPA 2000). More information about the collection of on-site meteorological data is presented below in the discussion of monitoring.

Locations of Receptors

Any modeling analysis must define the locations of receptors for which concentrations of contaminants will be calculated. For Subpart X permitting, the point of compliance (POC) receptors must be evaluated in a modeling analysis. POC receptors must be chosen to evaluate both direct exposure and indirect exposure from an air release (indirect exposure may result when hazardous constituents are present in soil or water through deposition of particulates or gases). Permit applicants should identify locations of potentially exposed individuals; the potentially maximum exposed individual (MEI); potential ecological receptors, such as local plants and animals; and other sensitive environments and endangered species.

Dispersion models vary in the amount of detail they require in information about receptors. Some screening models (for example, SCREEN3 and TSCREEN) do not require entry of an exact location, but only the distance to a receptor. For such models, the direction is not important because the models conservatively assume that meteorological conditions will be such that dispersion is in the exact direction of the chosen receptor.

Other models allow a user to enter discrete locations of receptors or a gridded receptor field. Models that evaluate considerations related to terrain also require entry of elevations for receptors. Modeling analyses for Subpart X permitting should include

receptor points at all POC locations. In some cases, when POC locations are uncertain or when the maximum concentration must be determined for a given region, a full receptor grid may be necessary. The permit writer should evaluate, on a case-by-case basis, whether the modeled receptor locations are adequate to characterize potential effects to human health and the environment.

Features of the Terrain

Incorporation of features of the terrain is an important factor in modeling analyses, especially when buoyant plumes are being modeled. When there are significant terrain features in the vicinity of a site, a model should be used that can simulate a plume's transport over or around such features. For modeling a point source in complex terrain, CTSCREEN (for screening analyses) and CTDMPPLUS (for refined analyses) are preferred. The two models require extensive information and significant sophistication on the part of the person operating the model. If the permit writer wishes to rerun the model to check results, he or she may require assistance from staff experienced in operating the models. The ISC3 model includes the complex terrain algorithm from the Valley model and can be applied in areas of complex terrain. When using a model that cannot address complex terrain an applicant may also choose to apply conservative assumptions to account for such terrain. Modeling analyses that make assumptions to account for features of the terrain should be considered screening analyses. In any case, the permit writer should verify that a modeling analysis has addressed problems related to complex terrain and that permit applicant has used the best model practicable under the circumstances.

If a facility is near a coastline or next to a large body of water, dispersion differs from that over land, and a model particularly suited for dispersion and transport over water may be necessary. The CALPUFF model incorporates algorithms for offshore and coastal dispersion. Other models that address offshore or coastal dispersion that are not

listed in [Table 5.3](#) include the Offshore and Coastal Dispersion Model (OCD) and the Shoreline Dispersion Model (SDM).

Deposition

Deposition of contaminants onto land or water surfaces may result in indirect exposure and risk to human and environmental receptors. Deposition may increase risk by exposure pathways other than air. A refined model with deposition capabilities can be used to model deposition, or modeled concentrations can be multiplied by calculated deposition velocities to estimate deposition. A third option, which the permit writer must consider at operating facilities on a case-by-case basis, is to estimate deposition by taking soil samples.

Chemical Transformation

Chemical transformation of contaminants after they have been released into the air is difficult to quantify; and most dispersion models do not address it, except in a limited fashion. Chemical reactions in the atmosphere from releases of contaminants depend on many different factors and cannot be incorporated easily into a modeling analysis. However, chemical transformations take time to occur in the atmosphere, so the processes generally are not considered significant when travel times are limited to a few hours (EPA 1995a). One exception is in urban areas, where photochemical models are applied to address complex chemical mechanisms. The models typically do not evaluate individual sources, but are used for regional modeling analyses.

Some of the models listed in [Table 5.3](#) are capable of limited calculations of chemical transformations. ISC3 and RAM allow the user to enter an exponential decay factor to address breakdown of chemicals. CALPUFF is able to model pseudo-first-order chemical reactions and is based on algorithms from the MESOPUFF II model, which is a long-range puff model (EPA 1995b). Last, HGSYSTEM can calculate chemical transformation for releases of hydrogen fluoride.

Transformation of NO_x to NO₂ can be estimated by postmodeling calculations. Usually, a conservative assumption is made that all the NO_x converts to NO₂ in the atmosphere. If a permit applicant has included a transformation calculation from NO_x to NO₂ in the modeling analysis, the permit writer should refer to [*Guidelines On Air Quality Models*](#) for details on review of this process.

Other available dispersion models estimate chemical reactions in the plume (EPA 1995a) and may be used as determined appropriate on a case-by-case basis. Modeling calculations that include chemical transformations should be reserved for refined analyses. Screening analyses should use worst-case assumptions for chemical transformation.

Background Concentrations

Under the Subpart X permitting requirements listed in 40 CFR §264.601(c)(5), a permit applicant must provide information about existing air quality in the area. The information must include the effects of other sources of contamination. Other sources of contamination may be natural sources, nearby sources, or unidentified sources. The information is important in understanding the overall air quality at the site and in its vicinity. When an air dispersion modeling analysis is conducted, the existing concentrations of air contaminants (or background) must be determined so that total effects on air quality can be evaluated. Modeled effects from individual sources are added to the background concentration to obtain the total concentration of a contaminant at a given receptor location. In many cases, existing background concentrations measured in the vicinity of a Subpart X source may be obtained from local regulatory agencies, universities, or nearby industrial facilities. If the Subpart X unit is an isolated, single source and no data exist for the area, a regional background site may be used that is not nearby, but that is affected by similar natural and distant sources. However, if the site at which regional background data were collected is not affected by similar sources, those data should not be used. In general, the permit writer should evaluate the background data submitted by an applicant carefully to determine

whether they adequately characterize the air quality in the vicinity of the unit. In cases in which Subpart X units are located near other sources that are expected to have a significant concentration gradient in the area, the nearby sources should be modeled explicitly. The effect expected from all other sources (natural and distant sources) then should be added to the results of modeling.

It is important that the background concentrations that are added to the results of modeling have the same averaging period as those results. For example, if the eight-hour average concentration of a contaminant is modeled, an eight-hour average background concentration should be added to determine the total eight-hour concentration.

If no representative background data are available, monitoring may need to be conducted to determine the existing air quality. Section 5.2.1.2 discusses collection of on-site air quality data.

Evaluation of Selection and Application of the Model

Selection and application of a suitable air dispersion model is to a great extent dependent on the application of site-specific criteria. Several of the principal criteria for selecting a model were discussed in preceding sections. They include type of source, meteorological data, locations of receptors, features of the terrain, deposition, chemical transformation, and background concentrations. Permit writers should evaluate the details about the site, the available data, and the process by which the applicant selected the site to determine whether the modeling analysis is appropriate.

In some cases, site-specific or source-specific characteristics of a Subpart X unit may be such that no screening models are capable of simulating their effects on the transport and dispersion of a contaminant. In such cases, a refined modeling analysis must be required. The permit writer should evaluate the capabilities of the screening model used in a permit applicant's screening analysis and

compare those capabilities with the characteristics of the source and site to determine whether the model selected is appropriate. In cases in which the permit writer determines that the screening model selected is inadequate, he or she should issue a NOD to indicate the reasons for such inadequacy.

The permit writer should evaluate carefully any screening models that are not in Table 5.1 or in Appendix A or B of *Guidelines On Air Quality Models* to determine whether such models are suitable for the task at hand. In such cases, it is recommended that the permit writer seek the advice of modeling experts to determine whether the alternative model is suitable for the specified task.

If a permit applicant cannot demonstrate compliance with appropriate standards through the use of a screening model, or if the site-specific details require use of a more sophisticated model, the permit writer should issue a NOD to indicate that a refined modeling analysis must be conducted. Use of site-specific data will result in more accurate modeling results. Since refined models use more detailed data, the permit writer should verify that the model used in a refined analysis is appropriate for the special features of the site and the data available.

Of the refined models listed in Table 5.3, ISC3 is the most commonly used and accepted for regulatory applications. Other models in Table 5.3 can be applied for specific purposes. For example, releases from OB/OD units are usually intermittent or near instantaneous, and are not stack-type sources. In such cases, use of ISC3 would not be appropriate because it can simulate only continuous releases. The INPUFF model has been used for OB/OD operations and its results have been found acceptable. However, INPUFF has some limitations, and other models may be better suited for OB/OD applications. The limitations of INPUFF are discussed briefly in the model summary section of this guidance. The CALPUFF model can be used for OB/OD applications and has more extensive capabilities than INPUFF, but the model requires additional data and is more difficult to use. As discussed in the previous sections, OBODM

was developed specifically to model OB/OD emissions. The OBODM algorithms address the unique dispersion characteristics associated with open burn and detonation operations.

Evaluation of Results of Modeling

A permit writer must consider several factors when evaluating results of modeling. Averaging time, background concentrations, and an overall perspective of the data entered and results produced must be taken into account in interpreting results to determine whether they make sense. The permit writer should compare the model results with the data entered to determine whether the results are realistic.

Often, model analyses must estimate maximum short-term as well as long-term effects. Some models calculate concentrations for only one averaging period (usually one hour), while others calculate concentrations for several averaging periods. If a model is limited to one averaging period, permit applicants may use modeled concentrations to estimate concentrations for other averaging periods. Adjustments may be made to reflect how long the unit emits hazardous constituents, and for variations in meteorological conditions. Any averaging time factors used by permit applicants should be well documented and justified.

5.3.2 Groundwater Modeling

This section provides information regarding hydrogeological characterization and model selection to assist permit writers in evaluating modeling results submitted by Subpart X permit applicants.

Groundwater modeling can be used when monitoring is impractical or to supplement and verify monitoring data. Groundwater modeling has several applications in the permitting process for Subpart X units. The groundwater model can be used (1) to predict conservative, “worst-case” scenarios during a detailed groundwater assessment, (2) to assist in

Reviewing the Results of Air Modeling: Items to Check

- **Spot check source characterization data input files.**
- **Compare building down wash parameters to the output from BPIP.**
- **Spot check several modeled receptor elevation against USGS map.**
- **Review receptor lists or files to ensure that the elevation array contains non-zero values.**
- **Check the anemometer height to ensure that it is correct for the station and years used in the analysis.**
- **Ensure that the GEP stack height determined by BPIP was not used in the air modeling analysis.**

Additional guidance on reviewing air modeling results can be found in EPA Region 6’s “Suggestions for Auditing Assessment Air Modeling Studies”.

the placement of groundwater monitoring wells, and (3) to provide data to estimate the magnitude and extent of contamination in the subsurface (vadose zone) once a release has occurred from a facility. Several hundred models for groundwater flow, vadose zone, and solute transport currently are on the market. Permit writers and reviewers cannot be expected to thoroughly understand the requirements, intricacies, and specific uses of each model. However, certain standards can help permit writers evaluate models used by the permit applicants. In addition, a permit writer should consult with personnel of Regional or State groundwater protection offices who have expertise in the field application of the specific model used by an applicant during review of the model.

Groundwater models generally can be divided into two main groups: groundwater flow models and solute transport models. Groundwater flow models solve for the distribution of hydraulic head in the hydrogeologic system. Solute transport models solve for the concentration of solute as affected by advection (movement of the solute with the average groundwater flow); dispersion (spreading and mixing of the solute); and chemical reactions, which slow down or transform solutes (Anderson and Woessner 1992). The level of effort required for the model and the decision to choose a specific model depend upon the specific objects of the modeling exercise.

Groundwater flow and solute transport models are valuable tools for the conduct of groundwater assessments. However, like air dispersion modeling, considerable limitations are inherent in the modeling process and the permit writer should recognize such limitations when evaluating a modeling analysis.

Technical Standards for the Mathematical Modeling of Groundwater Flow and Contaminant Transport at Hazardous Waste Sites (Technical Standards) (State of California 1990) presents the minimum requirements a groundwater model must meet to be considered valid and for a facility to be considered in compliance with applicable regulations. During the review of the permit applicant's model, the permit

writer can consult that document, which contains much of the information summarized in Table 5.4 and Table 5.5 on the following pages.

5.4 Air References

EPA. 1995a. "*Guideline on Air Quality Models (Revised)*." EPA-450/2-78-027R. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. August.

EPA. 1995c. "*Compilation of Air Pollutant Emission Factors*." Fifth Edition. AP-42. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. January.

EPA. 2000. "*Meteorological Monitoring Guidance for Regulatory Modeling Applications*." EPA-454/R-99-005. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. February.

5.5 Groundwater References

California Department of Health Services. 1990. *Technical Standards for the Mathematical Modeling of Ground Water Flow and Contaminant Transport at Hazardous Waste Sites*. Department of Health Services. Toxic Substances Control Program. July.

EPA. 1992. *RCRA Ground-water Monitoring: Draft Technical Guidance*. Office of Solid Waste. EPA/530-R-93-001. November.

EPA. 1986. *RCRA Ground-water Monitoring Technical Enforcement Guidance Document*. Office of Waste Programs Enforcement. OSWER-9950.1. September.

EPA. 1992. *Ground-Water Modeling Compendium. Model Fact Sheets, Descriptions, Applications, and Assessment Framework*. Office of Solid Waste and Emergency Response. EPA/500/B-92/006. October.

TABLE 5.4
REPRESENTATIVE GROUNDWATER FLOW MODELS

| Flow Model | Saturated Zone | | Unsaturated Zone | Pathlines/Capture Zones |
|------------|----------------|-----------|------------------|-------------------------|
| | Analytical | Numerical | Numerical | Numerical |
| GWFLOW | ● | | | |
| THWELLS | ● | | | |
| WHPA | ● | ● | | ● |
| FLOWPATH | | ● | | ● |
| MODFLOW | | ● | | |
| PLASM | | ● | | |
| SUTRA | | ● | ● | |
| HYDRUS | | | ● | |
| MODPATH | | | | ● |

TABLE 5.5
REPRESENTATIVE SOLUTE TRANSPORT MODELS

| Solute Transport Model | Saturated Zone | | Unsaturated Zone | Fracture Flow |
|------------------------|----------------|-----------|------------------|---------------|
| | Analytical | Numerical | Numerical | Numerical |
| PLUME | ● | | | |
| PLUME 2D | ● | | | |
| SOLUTE | ● | | | |
| BIOPLUME II | | ● | | |
| FTWORK | | ● | | |
| MOC | | ● | | |
| MT3D | | ● | | |
| RANDOMWALK | | ● | | |
| SUTRA | | ● | ● | |
| CHEMFLO | | | ● | |
| VLEACH | | | ● | |
| GREASE | | | | ● |
| NETFLO | | | | ● |

EPA. 2001. *Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action*. Office of Solid Waste and Emergency Response. EPA/530/R-01/015. September

6.0 RISK ASSESSMENT

Risk assessments can be extremely complex and encompass numerous variables and areas well outside the expertise of many permit writers. It is therefore recommended that the permit writer consult with risk assessment staff early and often in the permit process, so that the risk assessment may be focused towards solving the appropriate questions and conducted in the most expedient and efficient manner. The information provided in this chapter is intended as a primer for those permit writers who have little or no experience in this area and as a resource for those with more extensive knowledge.

Whenever possible, specific examples are provided of the kinds of requirements a permit writer might specify in an NOD to assist permit writers in identifying the types of requirements they may impose. Because a wide variety of issues are associated with the interpretation of risk assessments, the examples provided are not exhaustive.

For many types of Subpart X units, particularly mechanical units such as shredders, crushers and filter presses, a risk assessment may not be necessary. This is especially true in cases where the unit is fully enclosed in a containment structure such as a building, which could essentially prevent releases to environmental media. The applicant must be able to justify that an risk assessment is unnecessary. To do this, the applicant must provide all design and operating information necessary to support their claim that an risk assessment is not required. The permit writer must be able to assess whether adequate safeguards are engineered into the system. Additionally, the permit writer may specify design and operating conditions considered appropriate for the technology and site, to ensure that the unit will not impact any environmental media. Because a risk assessment is generally required in all cases for Subpart X combustion units, and there is ample risk assessment guidance for combustors, this chapter will primarily focus on risk assessment at Subpart X combustion units.

6.1 Overview of Assessment of Ecological and Human Health Risk

As set forth in 40 CFR §264.601, “Permits for miscellaneous units are to contain such terms and provisions as necessary to protect human health and the environment...” Assessment of potential risk to human health and the environment for permitting of a combustion unit includes assessment of releases of chemicals through air emissions and migration of waste or residues to groundwater, surface and subsurface soil, surface water, and wetlands. The guidance provided herein for assessment of human and ecological risk for permitting of a combustion unit is consistent with that provided by other EPA guidance for incineration and combustion units (EPA 1985, 1989, 1990, 1993, 1994, 1998a, 1999c), while incorporating information specific to operations of combustion units, the waste streams they generate, and the hazards they pose. The most recent EPA risk assessment guidance documents for combustion facilities are *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (HHRAP)* (EPA 1998a) and its *Errata* (EPA 1999a) and *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities (SLERAP)* (EPA, 1999c).

A tiered, risk-based approach to screening is recommended for evaluation of potential human and ecological risks attributable to emissions, leachate, and runoff released from combustion units, as well as to residual chemicals in the soil. The risk-based screening approach is a hierarchical decision-making strategy that incorporates increasing levels of complexity to facilitate and expedite the permitting process. The first tier is a risk-based screening assessment, and the second is a detailed risk assessment.

The risk-based screening evaluation is designed to estimate risks to human health and the environment on the basis of non-site-specific, default exposure assumptions and maximum exposure concentrations. Calculation of risks and hazard indices (HIs) is

based on potentially complete direct and indirect exposure pathways, according to EPA's standard default exposure parameters for relevant exposure scenarios, such as off-site residential, occupational, and recreational receptors. Information necessary for the estimation of risks and HIs in the screening evaluation is specified under each of the subsections of the risk assessment components. If risks and HIs affecting humans calculated in the screening level evaluation are below 10^{-5} and **0.25**, respectively, no further evaluation is necessary (EPA 1994, 1998b). If estimated risks and HIs exceed acceptable levels, the site should be assessed through a detailed risk evaluation.

The first tier of an ecological assessment is a preliminary screening that uses conservative assumptions to ensure that potential ecological risks are not underestimated. HIs are calculated directly through the use of maximum chemical concentrations and ecological benchmarks or, key species, indirectly through the use of conservative assumptions and information obtained through an initial reconnaissance survey.

In a detailed ecological risk assessment, additional site-specific information is collected, and risks and HIs are recalculated through the application of more sophisticated statistical and contaminant fate and transport analyses than those used in a screening assessment, as well as site-specific parameters. Additional site-specific information may include hydrogeologic and geologic characteristics, measured concentrations of chemicals of concern (COC) in media of concern, and refinements of site-specific estimates of parameters that improve the accuracy of models. For an ecological assessment, additional site-specific information can include a comprehensive list of species and trophic web, refined estimates of site-specific parameters and relevant exposure pathways, and further evaluation of the environmental fate and transport and bioavailability of chemicals at the site. In addition, measurement endpoints are developed that link the existing conditions at the site to the assessment endpoints.

A facility may elect to conduct a detailed human health or ecological risk assessment instead of a screening level evaluation if sufficient site-specific information is readily available. If risks or HIs do not exceed acceptable levels, the risk evaluation is complete. However, if risks or HIs exceed acceptable levels, the permit writer must require the applicant to (1) change the engineering or operational approach for the unit to reduce emissions or (2) implement containment strategies to reduce the indices to acceptable levels. If such changes are not made, the permit writer must deny the permit.

How Ecological Risk Assessment Differs from Human Health Risk Assessment:

- Protects populations rather than individuals
- Investigator must determine values and species to protect
- More professional judgement is necessary

This section will provide guidance for determining which media may require evaluation; identifying data needs; and evaluating screening level and detailed risk evaluations. It will outline the information necessary for the permit application and identify applicable EPA guidance for reviewing each section of the risk assessment. The section also discusses optional information that may be considered in the risk management process and identifies some multimedia assessment software that can assist in the evaluation of fate and transport and site-related risks.

6.2 Evaluation of Media for Inclusion into a Risk Assessment

From the combustion unit, chemicals may be transported through storm-water runoff, volatilization, wind-suspended particulates, and infiltration and percolation. Direct releases to the soil also are considered. The media potentially affected by those release mechanisms are surface water, sediments, air, groundwater, and soil. Both human and ecological receptors may be exposed to each medium through a variety of exposure pathways. For example, air emissions may present a direct exposure (by inhalation), as well as several indirect exposures (through deposition to soil, subsequent contact with the soil, or ingestion of plants affected by the deposition). The importance of identifying potentially affected media, therefore, is that their identification determines in part the

completed exposure pathways and the potential risks associated with the combustion unit.

As described in previous sections, measured or modeled concentrations of chemicals can be used to evaluate potentially affected media. For some units, data may be available from such past activities as soil samples or air monitoring. Coupled with the historical records of the combustion unit, that data may provide for establishing accurate release parameters and, therefore, risks associated with the planned combustion activity. However, even if site data are available, modeling may be necessary to estimate runoff to surface water bodies or leaching to groundwater.

The evaluation of on-site areas in close proximity to the combustion unit begins with examination of analytical data obtained from air and soil samples, if available. Results of air modeling also can be used to assess direct exposures. As described in Chapter 5, air modeling also predicts deposition rates, and therefore soil concentrations, at areas downwind of the combustion site. Although field measurements generally are preferable to modeled concentrations, the cost of sampling usually limits the amount and extent of sampling that the permit applicant performs. Should the permit writer find that the amount of sampling data is insufficient to support the model operation or provides information counter to model outputs, they must prepare an NOD indicating the deficiencies and requiring additional sampling.

Surface water and groundwater also may be affected by combustion operations through deposition of airborne particulates or leaching and runoff of contamination. These transport pathways are affected by the amount of rainfall in a region, the distance to the surface water body, the depth to groundwater, the type of soil, and local geological and hydrogeological conditions. Another consideration related to the transport of chemicals that may be included in a detailed risk assessment is chemical degradation. Sunlight, the organic content of the soil, and natural microbial biodegradation all can attenuate concentrations of chemicals between

the point of release and the point of contact with the receptor.

Although air and on-site soil are affected by combustion operations, the occurrence of effects on off-site soil, surface water, and groundwater vary from site to site. For example, if no surface water bodies are located within the extent of the air plume, groundwater is extremely deep, and the area receives little precipitation, effects on surface water or groundwater are unlikely. The following list presents general concerns that should be addressed when identifying media of concern.

- Does the application demonstrate that the combustion unit is sufficiently distant from surface water bodies to have no effect from air emissions on surface water (that is, surface water bodies are outside the maximum extent of the air plume)?
- Do the results of air modeling submitted with the application indicate significant off-site deposition?
- Does the annual amount of rainfall indicate the potential for runoff to a surface water body or to off-site soils?
- Does the description of site geology, hydrogeology, and rainfall indicate a potential for leaching of chemicals from soil to groundwater?
- If the application indicates that groundwater is likely to be affected by leaching of chemicals, does the description of the hydrogeology indicate probable migration of groundwater to surface water bodies?

A permit writer must ascertain whether all potentially affected media will be included in the risk evaluation. Justification of exclusion of any medium from the risk evaluation should be well documented, with convincing reasons presented to indicate that the medium will not be affected or that receptors will not come into contact with the medium.

6.3 Evaluation of Risk Assessments

This section consists of several subsections that outline direct and indirect exposures to both human and ecological receptors that permit writers must consider when reviewing permit applications, for combustion units, as well as a methodology that should be followed to ensure consistent evaluation of such units. Each subsection describes risk assessment components necessary to support the permit application for a combustion unit and provides specific tools and information required to support both screening and detailed human health risk assessments. The final subsection describes the uncertainty assessment that should be conducted for the permitting process.

EPA's Risk Assessment Guidance for Superfund (EPA 1989), identifies the following components of a human health risk assessment:

- Data evaluation and identification of chemicals of concern
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Uncertainty assessment

Together, the components present a complete evaluation of the human health risks associated with combustion activities or those risks associated with other Subpart X units. However, while all components of a risk assessment must be addressed consistently, the outcome and extent of investigation at any combustion unit will be site-specific. Each part of the risk evaluation is a combination of information about the site, default assumptions, and modeled or measured data. Because those elements are interdependent, all components must be included and described thoroughly. Therefore, a coherent description of risks from combustion activities can be given only when all site-specific information,

assumptions, and uncertainty about the information and assumptions have been communicated.

The following components of an ecological risk assessment are described in [EPA's Ecological Risk Assessment Guidance for Superfund \(EPA 1994\)](#) and in *Ecological Assessment of Hazardous Waste Sites* (Maughan 1993), and illustrated in the figure at right:

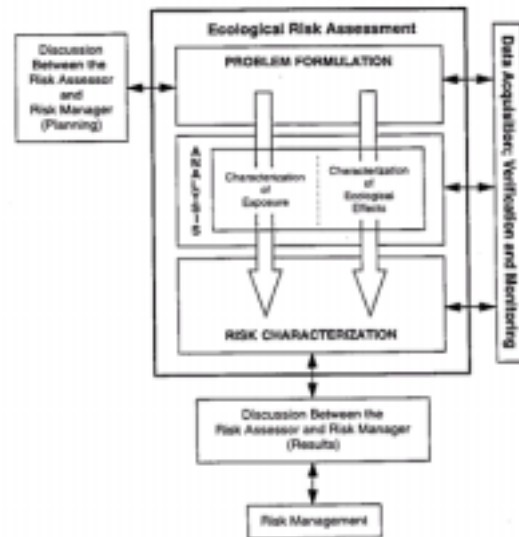
- Preliminary site investigation
- Problem formulation
- Exposure assessment (characterization of exposure)
- Toxicity assessment (characterization of ecological effects)
- Risk characterization

The components will differ in complexity according to conditions at the site and the nature and extent of contamination present. Often the components are repeated in a detailed risk assessment, at increasing levels of complexity, until the following objectives, described in the ecological risk assessment guidance (EPA 1994), are obtained:

- Identifying and characterizing the current and potential threats to the environment posed by releases of hazardous substances
- Establishing cleanup levels that will protect those natural resources at risk

All the components should be included in the risk assessment and discussed thoroughly so that a complete description of ecological risks from combustion activities is communicated. The following subsections describe the general information required for each component of ecological and human health assessments and provide specific recommendations for screening level and detailed risk assessments.

Components of Ecological Risk Assessment



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

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.

6.3.2 Exposure Assessment

A key component of conducting a risk-based screening evaluation is identification of potential exposures. An exposure assessment includes an evaluation of potential human and ecological receptors that may contact chemicals originating from the site, as well as routes, magnitude, frequency, and duration of exposure. An evaluation of all possible human and ecological exposures is necessary to identify receptors that currently are in contact with contaminants at the site or at off-site

locations affected by emissions, leaching, or runoff. The principal objective of the screening evaluation is to identify exposures that represent the maximally exposed individual (MEI) at the site. The MEI represents the maximum exposure for each receptor, based on maximum concentrations of COCs, maximum default exposure factors, and the assumption that all pathways are potentially complete, without regard to the likelihood that the pathway is complete. This standard differs from the reasonable maximum exposure (RME) commonly used in risk assessments (EPA 1989, 1992b). Use of the MEI provides an extremely conservative estimate of human and ecological risks, so that, if the risks and hazards calculated are within acceptable limits, no further investigation of the unit is required.

The concept of reasonable, as opposed to maximum, scenarios underlies the concept of RME developed by EPA. As defined by EPA (1989), the RME is the maximum exposure that is reasonably expected to occur at a site. It should be emphasized, however, that the RME exposure is for the same receptor as the MEI and that, before risks are calculated, it must be determined whether “it is likely that the same individual would consistently face the RME.”

It is also important that intake parameters for each RME exposure pathway be “selected so that the combination of all intake variables results in an estimate of the reasonable maximum exposure for that pathway” (EPA 1989). In other words, the most conservative intake variables for each parameter for a given pathway are not used exclusively. A combination of average and upper-bound values should be used to estimate exposures that are meaningful and that represent the actual RME for the site.

To collect the information, the exposure assessment should consist of the following steps:

- Characterize the exposure setting and identify potential human and ecological receptors

- Identify pertinent exposure pathways and exposure routes
- Estimate exposure point concentrations
- Quantify chemical intake for exposures for specific pathways for each potential receptor

According to EPA guidance (1989), all complete exposure pathways should be selected for further evaluation unless it can be justified that:

- Exposure from the excluded pathway is much less than that from another pathway that involves the same medium at the same exposure point.
- The potential magnitude of exposure from a pathway is low.
- The probability that exposure will occur is very low, and the risks associated with the pathway are low.

In general, such judgments should be made only in a detailed risk evaluation in which relative risks, assumptions, and uncertainties are described fully.

Characterization of the exposure setting and identification of potential receptors is the first step in evaluating current or potential chemical exposures. The process includes an evaluation of the physical characteristics of the site, such as climate, vegetation, soil type, and hydrology of surface water and groundwater, that are pertinent to the risk assessment (EPA 1989). For ecological risk assessments, the evaluation also should include the presence of any threatened and endangered species.

Human receptors that may be exposed to chemicals released during combustion include on-site workers performing combustion operations and residential and recreational receptors in the vicinity of the site. Both direct and indirect exposure pathways are considered for workers on site, since direct contact with residues from combustion operations in soil and air may occur, and indirect exposure through deposition and storm water runoff also is possible.

Both direct and indirect exposure pathways are considered for residential and recreational receptors in the vicinity of the site. Direct exposures may occur via inhalation of vapors and particulates from the combustion source. Indirect contact with chemicals generated from combustion may occur through ingestion of produce, meat, dairy products, or fish that have been exposed to chemicals from the combustion unit through deposition to soil, surface water, and plants and through biological uptake. In addition, residents and recreational receptors in the area may contact indirectly with chemicals present in soil, air, groundwater, sediment, and surface water in which chemicals generated from combustion are present through wind suspension, deposition, storm-water runoff, infiltration, or percolation.

Once receptors and exposure scenarios have been identified, exposure pathways must be defined. According to EPA guidance (1989), an exposure pathway consists of four elements:

- A source and mechanism of chemical release
- A retention or transport medium (or media in cases involving transfer of chemicals)
- A point of potential contact with the contaminated medium (referred to as the exposure point)
- An exposure route (such as inhalation) at the contact point

Lacking any of the four elements, the exposure pathway is incomplete. Therefore, if no receptors exist that would contact the source or transport medium, the pathway is incomplete and need not be further evaluated.

In the risk-based screening evaluation, all potentially complete exposure pathways are considered and evaluated. In fact, EPA Regions 3, 6, and 9 have developed risk-based concentrations that include exposure to soil, water, and air through a combination of pathways for residential and occupational receptors. Those values can be used

Default Exposure Scenarios Recommended by the HHRAP (EPA, 1998a)

- Adult and Child Resident
- Subsistence Farmer and Child
- Subsistence Fisher and Child
- Acute Risk

to screen sites if the pathways are representative of on- and off-site exposures in the vicinity of the combustion unit. However, additional site-specific information is used in the detailed risk assessment to identify exposure pathways that are most likely complete.

It should be noted that the exposure pathways described above may not be complete at all facilities. In general, a permit writer should decide whether the screening level and detailed assessments include all relevant exposure pathways, and if any pathway has been excluded, that exclusion is justified. The permit writer should consider the following concerns when making such a determination:

Screening Level Evaluation:

- Do occupational receptors have direct contact with the combustion unit?
- Are work areas located within the emission plume from the unit?
- Are there off-site residential areas within the emission plume from the unit?
- Are agricultural activities conducted in areas within the emission plume from the unit?
- Is groundwater used as a potable or domestic water supply? As an agricultural water supply?
- Are surface water bodies located within the emission plume from the unit? If so, is such surface water used for recreational purposes? For occupational purposes? As a water supply? Could rainwater runoff from the unit enter a surface water body (as indicated by distance, annual rainfall, and gradient)?

Detailed Risk Evaluation:

For every receptor and exposure pathway considered potentially complete, the following issues should be addressed:

- Do the exposure parameters reflect reasonable assumptions about the site? If not, what are reasonable exposure parameters for the site and why?
- Were exposure point concentrations appropriately determined (that is, using the 95 percent UCL)?
- Which pathways seem least likely to be complete (for example, homegrown produce or dairy products for an off-site resident)? Are these pathways currently complete? Should they outweigh calculated risks or hazards related other pathways?

After complete exposure pathways have been identified in either the detailed or the screening level approach, chemical intakes for exposures through each pathway for each potential receptor should be quantified. Chemical intake rates should be estimated for all complete exposure pathways, on the basis of the exposure point concentrations and the estimated magnitude of exposure to contaminated media.

Exposure is based on “intake,” which is defined as the mass of a substance taken into the body per unit of body weight per unit of time. Intake from a contaminated medium is determined by the amount of the chemical in the medium, the frequency and duration of exposure, the body weight of the receptor, contact rate, and the averaging time. Below is a generic equation that is used to calculate chemical intake:

$$CDI = (C \times CR \times EF \times ED) / (BW \times AT)$$

where:

CDI = chronic daily intake (milligram per kilogram body weight - day, [mg/kg-day])

C = chemical concentration (mg/kg or milligram per liter [mg/L])

CR = contact rate or ingestion rate (milligrams soil per day or liters per day)

| | | |
|----|---|---|
| EF | = | exposure frequency; how often exposure occurs (days per year) |
| ED | = | exposure duration; how long exposure occurs (years) |
| BW | = | body weight (kilogram, [kg]) |
| AT | = | averaging time; period over which exposure is averaged |

Chemical intake by ingestion and inhalation is quantified as an administered dose. Contaminant intake from dermal exposure is estimated as an absorbed dose. Equations for estimating dermal contact include additional exposure parameters of adherence and absorption factors or permeability constants. Adherence factors indicate the amount of soil that adheres to the skin. Absorption factors reflect the desorption of the chemical from soil and absorption of the chemical across the skin. Permeability constants represent the rate at which a chemical in water penetrates the skin.

Two approaches to an ecological assessment that may be used for the screening exposure assessment are direct and indirect assessment. Exposure to ecological receptors may be assessed directly by comparing maximum concentrations of chemicals on site to protective ecological benchmark concentrations for appropriate media. Field data collected during combustion testing, screening level data from MSDS sheets, or other sources may be used for the initial screening. Maximum detected concentrations of chemicals on site should be compared with ecological benchmark concentrations to eliminate chemicals that are not likely to pose an ecological risk. EPA publications are the preferred source for ecological benchmarks. Some EPA regions, including Region 4 (EPA, 1999b), have established ecological benchmarks for various media. EPA water quality criteria (EPA 1986) may be used as screening benchmarks for aquatic ecosystems. The National Oceanic and Atmospheric Administration (NOAA) has developed benchmark concentrations for chemicals in sediment (NOAA 1991). Soil screening benchmarks are available through the Oak Ridge National Laboratory (Will and Suter 1995). A statistical background comparison for inorganic

chemicals also should be conducted to eliminate naturally occurring chemicals or those not related to the site from further consideration. Concentrations of chemicals that exceed ecological benchmark concentrations and background levels are considered to pose a potential ecological risk and should be further evaluated in the detailed ecological risk assessment. Ecological benchmark concentrations may not be available for all chemicals detected at a site or for all media. Chemicals for which benchmark values are not available should not be eliminated from further consideration. Their potential effects instead must be discussed qualitatively.

An indirect evaluation of ecological exposure involves selection of a key species from each guild, on the basis of information collected during the site reconnaissance; characteristics of the chemicals that were identified in the benchmark screening; and the physiological, behavioral, and ecological factors related to potentially exposed species. Exposure should be assessed for key species that are susceptible through one of the three exposure pathways: inhalation, ingestion, or dermal contact.

More information is generally available to quantify exposure levels for terrestrial animals through ingestion pathways than for dermal and inhalation exposures. Although the results for exposure routes other than ingestion may be less certain, for the preliminary screening, all complete routes should be evaluated, with conservative assumptions applied. For example, conservative assumptions for parameters such as exposure duration, extent of contact, and surface area.

Conservative assumptions (such as maximum chemical concentrations and upper-bound exposure parameters) are made in evaluating exposures for each receptor. All potentially complete pathways are included, without regard for the likelihood that the pathway is complete. Assuming maximum exposure for the preliminary screening requires less site-specific information, thereby expediting the combustion permitting process for both permit writers and reviewers. It also provides an extremely

conservative estimate of ecological risks. Therefore, if calculated HIs are below 1.0, no further unit investigation is required.

As with human risk assessments, exposure for ecological risk assessment is based on “intake.” Intake from a contaminated medium is determined by the amount of the chemical in the medium, the contact rate, and body weight. Following is a generic equation that is used to calculate chemical intake:

$$I = C \times IR \times 1/BW$$

where:

| | | |
|----|---|--|
| I | = | Intake (mg/kg-day) |
| C | = | Chemical concentration (mg/kg or mg/L) |
| IR | = | intake rate (mg/day soil or food or L/day) |
| BW | = | body weight (kg) |

Additional site-specific exposure parameters -- for example, proportion of diet that is contaminated, area use factor, bioavailability, dermal adherence, dermal absorption, permeability constants, and other factors should be incorporated into the generic algorithm, as appropriate.

Bioconcentration and bioaccumulation are the two primary mechanisms that must be considered in estimating chemical uptake by aquatic species (Maughan 1993). Simplified aquatic exposure models that account for both bioaccumulation and bioconcentration may be used for the preliminary screening (Maughan 1993). Exposure pathways of concern for aquatic species include direct contact with water and ingestion of sediment and contaminated food.

According to the EPA’s ecological risk assessment guidance (EPA 1994 and 1999c), the maximum concentration of a chemical in each medium should be used to calculate the preliminary exposure estimate, using conservative assumptions in the absence of site-specific information. For air risk

assessments, such as those for incinerators, it is common to use the maximum concentration as the exposure point concentration for air or soil and model concentrations for off-site locations. That approach generally is recommended for most screening level evaluations because those concentrations are identified easily and represent conservative assumptions regarding exposure point concentrations. EPA guidance (EPA 1990) presents detailed information about estimating exposure point concentrations in plants and animals on the basis of air-dispersed chemicals.

If a detailed risk assessment is conducted, the exposure concentration may be refined to reflect more realistic exposure conditions, rather than a maximum concentration. As in the detailed human health risk assessment, the recommended concentration for use in the ecological risk assessment is the 95 percent UCL, which is an upper bound of the average concentration. If the 95 percent UCL concentration exceeds the maximum measured concentration for the site, the maximum measured concentration should be used. The 95 percent UCL concentration can be used to calculate off-site modeled exposure and uptake concentrations.

The exposure assessment in the detailed ecological evaluation uses information from the detailed site investigation and problem formulation (EPA 1994), including:

- Ecological setting of the site
- Inventory of contaminants that are or may be present at the site
- Extent and magnitude of the contamination present, along with the spatial and temporal variability of that contamination
- Environmental fate and transport of contaminants

In the detailed ecological exposure assessment, the most critical exposure pathways are identified and

evaluated in detail, and pathways determined to be insignificant or unlikely to be complete can be ignored. Justification must be provided, however, for the exclusion of pathways. Complex mathematical models may be applied to estimate concentrations of chemicals in environmental media, and a combination of average and upper-bound species-specific exposure parameters obtained from literature and additional field investigation may be used to determine the extent of exposure. In addition, trophic webs should be developed to identify primary routes of energy flow and identify organisms that have the potential of exposure at the site (Maughan 1993).

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 Effects 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):

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

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

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

6.3.4 Risk Characterization

Risk characterization combines exposure estimates and toxicity values to calculate numerical estimates of risk and hazards to human health. Risk characterization comprises the following steps:

- Review toxicity and exposure assessment results
- Quantify risks for individual contaminants in each medium
- Quantify risks from exposure to multiple contaminants for each pathway
- Combine risks from the various exposure pathways, when appropriate, to quantify total risk for each exposure scenario
- Evaluate and present uncertainties that underlie risk estimates

For both the human health and the ecological risk characterizations, the permit writer should decide whether the correct toxicity values have been used for each receptor and exposure pathway, whether risks and HIs have been summed for all exposure pathways for each receptor, and whether total risks and HIs also have been presented for each COC.

The method described in EPA 1989 should be used to calculate the ILCR for carcinogens. Quantifying total excess cancer risk requires calculation of risks associated with exposure to individual carcinogens and summing risks associated with simultaneous exposure to several carcinogens for the same human receptor. Risks associated with exposures to single carcinogens should be calculated as follows:

$$\text{Risk} = \text{CDI} \times \text{CSF}$$

where:

$$\begin{aligned}\text{Risk} &= \text{A unitless probability of an individual} \\ &\quad \text{developing cancer over a 70-year} \\ &\quad \text{lifetime} \\ \text{CDI} &= \text{Chronic daily intake of the} \\ &\quad \text{contaminant averaged, over 70} \\ &\quad \text{years (mg/kg-day)} \\ \text{CSF} &= \text{Carcinogenic slope factor expressed} \\ &\quad \text{in (mg/kg-day)}^{-1}\end{aligned}$$

The ILCR for an individual will be calculated by summing chemical-specific risks across all appropriate pathways. The exposure pathways and chemicals that pose the greatest risk should be identified.

Unlike carcinogenic effects, noncarcinogenic effects are not expressed as a probability. Instead, adverse effects caused by noncarcinogens are expressed as the ratio of the CDI to the RfD (or RfC), when both values are based on similar exposure periods. The ratio is termed a hazard quotient and is calculated as follows:

$$\text{Hazard Quotient} = \text{CDI/RfD}$$

where:

$$\begin{aligned}\text{CDI} &= \text{Estimated exposure} \\ &\quad \text{level (or intake)} \\ \text{RfD} &= \text{Reference dose}\end{aligned}$$

The CDI and RfD are expressed in the same units and are based on the same exposure period. If the CDI exceeds the RfD, the hazard quotient will be greater than one, indicating that a potential health hazard may exist.

Noncarcinogenic risks should be aggregated for each exposure pathway into a noncarcinogenic hazard index as follows:

$$HI = \frac{CDI_1}{RfD_1} + \frac{CDI_2}{RfD_2} + \dots + \frac{CDI_i}{RfD_i}$$

where:

CDI_i = Exposure level or intake for the i^{th} toxicant

RfD_i = Reference dose for the i^{th} toxicant

Risk characterization also is a concern in an ecological risk evaluation. Because of the complex nature of ecological assessments, the risk characterization often is conducted through a weight-of-evidence approach, under which different types of data are evaluated together (EPA 1994). For example, the screening risk calculation is repeated in the detailed risk assessment, with site-specific intakes calculated for the exposure assessment and toxicity values from the literature both used. Hazard quotients (HQ) are summed for all chemicals and pathways, if appropriate. In addition to the risk calculation, conclusions should be drawn from studies or tests conducted for additional site investigations to establish links between assessment endpoints and measurement endpoints (EPA 1994). In the risk characterization, all available information should be reviewed and conclusions presented.

For all complete exposure pathways, ecotoxicity values compiled from a literature search should be compared with the calculated exposure estimates, using the HQ method. As stated previously, the ecotoxicity threshold value should be based on the documented and best conservatively estimated chemical-specific NOAEL for the screening level and detailed risk calculations (EPA 1994). An HQ for a direct exposure assessment is a ratio of the maximum environmental concentration (mg/kg) to an ecological benchmark (for example, EPA water quality criteria). An HQ for an indirect exposure assessment is the estimated chemical intake (mg/kg-day) to an ecotoxicity screening value (for example, a NOAEL). HQs should be calculated as follows:

$$\begin{aligned}
 \text{HQ} &= \text{EEC}_1/\text{TRV}_1 + \text{EEC}_2/\text{TRV}_2 + \\
 &\quad \dots + \text{EEC}_i/\text{TRV}_i \\
 &\text{or } \text{CDI}_1/\text{NOAEL}_1 + \text{CDI}_2/\text{NOAEL}_2 \\
 &\quad + \dots + \text{CDI}_i/\text{NOAEL}_i
 \end{aligned}$$

where:

| | |
|--------------------|---|
| HQ | = Hazard quotient for a given chemical, potentially complete exposure pathway, and selected ecological receptor |
| EEC _i | = Expected environmental concentration (mg/kg or mg/L) |
| TRV _i | = Toxicity reference value for a given chemical and ecological receptor (mg/kg or mg/L) |
| CDI _i | = Estimated chemical intake (mg/kg-day) |
| NOAEL _i | = No-observed-adverse-effect-level (mg/kg-day) |

According to EPA guidance (1994), it is necessary to sum the HQs to account for simultaneous exposure. If the resulting hazard index (HI), which is equal to the sum of the HQs, is less than 1.0 in the screening level risk assessment, it is concluded that there is little or no ecological threat at the site.

However, if the resulting HIs exceed 1.0, adverse ecological effects are likely to occur, and a detailed ecological risk assessment should be conducted.

6.3.5 Uncertainty Assessment

Because risk characterization is a bridge between risk assessment and risk management, it is important that the major assumptions, professional judgments, and estimates of uncertainties be described in the risk assessment. According to EPA guidance (1989), evaluations of uncertainty should be presented in tables that indicate whether each assumption used in the analysis is likely to overestimate or underestimate risk or whether the effect of uncertainty on the risk estimates is unknown. The potential magnitude of the effect of each source of uncertainty should be assessed and expressed as low, moderate, or high. The following

paragraphs describe some of the areas of uncertainty that are inherent in risk assessment methodology.

Some uncertainties expected to be associated with the selection of COCs include:

- Risks associated with chemicals intentionally excluded from the risk assessment
- Risks associated with chemicals unintentionally excluded from the risk assessment

Some uncertainties associated with the exposure assessment that may influence the risk evaluations include, but are not limited to:

- Assumptions used in developing exposure point concentrations
- Difficulties in accurately characterizing current land use
- Risks associated with pathways excluded from the risk assessment
- Data limitations and data gaps

When uncertainties cause overestimation of exposure, the risks predicted from such exposures also likely will be overestimated. The degree of uncertainty associated with such estimates will depend, in part, on the extent and quality of available data, other information, and modeling efforts.

Uncertainties associated with the toxicity assessment include:

- The quality of studies as the basis for toxicity factors
- Potential differences in toxicity and absorption efficiency between humans and laboratory animals

- The applicability of studies conducted on experimental animals dosed at high levels to human exposures at lower concentrations
- The validity of the crucial underlying assumption in the dose-response model for carcinogens (linearized multistage model) that there is no threshold for carcinogenesis (that is, there is no dose of a carcinogen that is not associated with a risk of cancer)

The confidence of the calculated estimate of risk depends on the underlying uncertainties in each step of the risk assessment process. In addition, aspects of the risk characterization process itself introduce uncertainties, including those associated with adding risks or HQs for multiple chemicals and compounding of upper bound estimates in the exposure assessment.

A discussion of the major assumptions, professional judgments, and estimates of uncertainty must be described in the ecological risk assessment. As in the human health assessment, evaluations of uncertainty should be presented in tables that indicate whether each assumption made in the analysis is likely to overestimate or underestimate risk, or whether the effect of uncertainty on the risk estimates is unknown (EPA 1989). Because of the level of effort required for each type of assessment, with the screening assessment having a higher degree of uncertainty, the screening and detailed evaluations will differ with regard to uncertainty. Some sources of uncertainty in a screening level ecological risk assessment are (EPA 1996):

- The use in the exposure analysis of maximum contaminant concentrations detected in environmental media as exposure concentrations for potential ecological receptors
- The assumption that an exposure area use factor for potential ecological receptors is 100 percent (i.e., 100 percent of the diet and home range lies within the exposure area)

- The ecological effects analysis applies Toxicity Reference Values (TRV) and NOAELs that are estimates of potential adverse effects derived from laboratory studies and extrapolated to site conditions
- The assumption that 100 percent of the chemicals are bioavailable
- The potential that adverse effects on ecological receptors will differ during different life stages.

Screening Level Risk Evaluation

Discussions of uncertainty in screening level assessments should be comprehensive enough to describe all important sources of uncertainty, conservatism, and variability in the results, but generally should not include quantitative analyses of uncertainty. All assumptions must be documented. According to EPA guidance (EPA 1989), “it is important to fully specify the assumptions and uncertainties inherent in the risk assessment to place the risk estimates in proper perspective. Another use of uncertainty characterization can be to identify areas where a moderate amount of additional data collection might significantly improve the basis for selection of a remedial alternative.” In the case of a permit application, discussions of uncertainty may identify areas in which additional data could improve the risk analysis significantly, if a screening evaluation indicates unacceptable risks.

The guidance identifies several sources of uncertainty that should be addressed “in risk assessments in general, and in the exposure assessment in particular” (EPA 1989):

- The definition of the physical setting
- The applicability of the model and its assumptions
- The transport, fate, and exposure parameters

- The tracking of uncertainty or how uncertainties are magnified through the various steps of the assessment

At a minimum, the permit applicants should address these four sources of uncertainty qualitatively. The potential magnitude of the effect of each source of uncertainty also should be assessed and expressed as low, moderate, or high.

Detailed Risk Evaluation

The evaluation of uncertainty for a detailed risk evaluation should include all of the points described above for screening level evaluations. The description of uncertainty in a detailed risk evaluation is likely to be more in-depth than that for a screening level evaluation, because more site-specific information is used and more modeling may be conducted. In addition, the permit applicant may elect to conduct a quantitative analysis of uncertainty. One method for quantitatively assessing risk is Monte Carlo simulation. Monte Carlo simulation is a statistical technique that can be used to simulate the effects of natural variability and informational uncertainty that often accompany “real-world” situations. It is an effective tool for quantitative evaluation of uncertainty associated with point estimates. It is a process whereby an outcome is calculated repeatedly for many “what if” scenarios, using in each iteration randomly selected values for each of the variable or uncertain parameters from a predetermined probability density function that describes distribution of the variable.

EPA has not developed national guidance on performing Monte Carlo analyses, but regional EPA offices have developed regional guidance documents that can be consulted for input variables. EPA Regions 3 and 8 have instituted guidance for Monte Carlo simulations. Because of the complex nature of the assessments, a statistician and risk assessor should review the results.

In reviewing risk assessments to evaluate their treatment of uncertainty, the permit writer may wish to focus on the last four points covered in the

discussion of the screening level assessment as a way to structure comments in the NOD. Without adequate discussion of those points, neither the screening level assessment nor the detailed risk assessment will provide the level of information about uncertainty that is required. Typically, a screening level assessment that includes a discussion of those points also will include an adequate discussion of uncertainty in general, while a discussion that does not include those points will be inadequate.

6.4 Computer Software for Multimedia Assessments

EPA has published modeling equations for estimating concentrations of chemicals in plants and animals, as well as transfer between media. The equations range from simple to complex, as more site-specific information is used or the need for a more precise estimate is recognized. For example, detailed models are available to estimate concentrations of contaminated airborne particulates suspended from surface soil. This approach may be preferable to dividing soil concentrations of a chemical by a default emission factor to estimate an airborne concentration.

Because of the increasing interest in integrating fate and transport modeling into risk evaluations, several models that can provide risk estimates based on multimedia exposures have been developed over the past several years. While the software has the advantage of easy application, care should be taken to select the one model, or combination of models, that adequately represents site conditions. In addition, both the information entered and that produced will vary; consideration of available data, results desired, and default assumptions is vital in the selection of an appropriate software modeling package. As in any risk evaluation, all assumptions made and parameters and equations used in the model should be provided for review and acceptance. The user must verify that all parameters in the computer model are current, particularly toxicity values used to calculate risks and HIs.

Regardless of whether a computer model is used to perform the risk assessment, a section on uncertainty must be included in the risk evaluation, as described above. Few models will include a quantitative analysis of uncertainty but, if desired, the uncertainty software described above can assess the results of a computer-modeled multimedia risk evaluation.

The Multimedia Environmental Pollutant Assessment System (MEPAS) model is discussed here as an example of the models that are available. The MEPAS software was developed by Pacific Northwest Laboratory (Whelan and others, 1992). According to the authors, MEPAS “is a physics-based risk computation code that integrates source-term transport, and exposure models.” It was designed to use readily available information for site-specific health assessments of both carcinogenic and noncarcinogenic chemicals. The authors state that “the system has wide applicability to a range of environmental problems using air, groundwater, surface water, overland, and exposure models” (Whelan and others 1992). The software is said to be applicable to both screening level and detailed assessments.

The software uses a source term that is entered by the user. The source term describes the mechanism and rate of release of the contaminant. It may be entered directly into the program, or the user can enter site- and release-specific data and allow MEPAS to compute the source term. A source term is entered for each medium of interest (Whelan et al 1992).

MEPAS assesses multiple exposure routes and scenarios, including inhalation and ingestion of soil particulates; ingestion of water and inhalation of chemicals in water; and ingestion of crops, fish, and animal products contaminated by surface water, groundwater, or soil. MEPAS also evaluates external exposure to radionuclides. While the exposure pathways evaluated are applicable to many sites, dermal exposures to soil, surface water, and groundwater do not appear to be included in the program. If those pathways are complete at the combustion unit or off-site areas of concern, they

must be evaluated in addition to those in the MEPAS program, if that program is used in developing the risk assessment.

One of the issues associated with use of models such as MEPAS is the recency of their design. As a rule, risk assessment models designed in the 1980s do not offer the level of sophistication necessary for risk assessments under Subpart X. Among the materials submitted when a model is used should be a discussion of how the model was selected. As always, documentation of performance of the model with the data used is required.

6.5 References

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7.0 ENFORCEABLE PERMIT CONDITIONS

7.1 Subpart X Permit Conditions

Permit writing for a Subpart X unit should be similar to that for any other hazardous waste management unit. The general process and format are the same. The permit should consist of a permit cover which identifies the owner and operator; the name, location and EPA identification number of the facility; and the general operation that is being permitted (e.g., Miscellaneous Treatment Unit). The cover should restrict the permit to only the units identified in the permit and should explain the authority that the permit is being issued under. In addition, the cover should specify the length of the term of the permit (5 or 10 years).

Additional information regarding drafting permit conditions is included in the [Special Technical Issues](#) presentation from the February 2002 EPA Region 4 RCRA Miscellaneous Units Permitting and Compliance Training.

7.1.1 Standard Permit Conditions

The permit writer should carefully check the original Part A application and verify with the owner/operator the identity of the person/company that is legally responsible for operating the regulated units that the permit is issued for, and the legal owner of the property. This is an area where errors are common, especially in the context of who owns the actual property. Standard permit conditions will include:

1. Effect of Permit
2. Permit Actions
3. Severability
4. Duties and Requirements
5. Signatory Requirement
6. Confidential Information
7. Documents to be Maintained at the Facility

The permit writer will typically reference the regulatory citation of these conditions exactly, with the regulation reference number. Reference numbers are included in case the rule is self-implementing and it can be automatically updated during the term of the permit. Reference numbers also require compliance with the rule in the event typographical errors are present in the permit.

General facility conditions include provisions applicable to all hazardous waste management units. These include:

- Waste Minimization
- Land Disposal Restrictions
- Toxicity Characteristics
- Air Emission Requirements (Subparts AA, BB, and CC, if applicable)
- Corrective Action

The permit writer needs to determine the applicability of these regulations to the operating units being permitted. If only portions of the regulations apply, they should be singled-out so the conditions are specific to the waste management process. As an example, if a facility only manages ignitable wastes, then the land disposal restrictions section should only reference issues related to ignitable wastes. If the facility also accepted solvents, then the land disposal restrictions for solvents would also be referenced. This illustrates why it is critical for the permit writer to identify with the Permittee what wastes will be managed in the unit and addressed in the waste analysis plan. It is not appropriate to vaguely reference the entire regulation. Instead, the permit should specify which portion of the regulation is applicable. If an entire regulation does not apply, the permit writer should provide text in the fact sheet which explains why a particular regulation is not applicable.

7.1.2 Waste Minimization

Waste minimization is one of the most important components of a Subpart X permit, especially for OB/OD units. Permit conditions should address how the facility will be working on new or existing demilitarization technologies, and working towards developing better methods of OB/OD or replacement technologies. The OB/OD permit application should have included a Waste Minimization Plan (WMP). The WMP should

identify measures to minimize the input waste stream to the OB/OD unit. The goal of the WMP should be to minimize annual OB/OD treatment quantities (i.e., both in terms of gross and net explosive weight [NEW]). This should involve an evaluation of potential offsite treatment options as well as alternative treatment technologies. Alternative technologies such as disassembly and separation should be considered to reduce the OB/OD gross weight treatment quantities (since the ratio of energetic to inert composition can be large for many waste munition items). The permit application also should include an accounting of waste treated by OB and OD (separately) for the most recent 5-year period for units with interim status. The information should include annual treatment quantities in terms of gross weight and the NEW. This accounting information and the WMP will be used to establish waste reduction procedures/requirements for each permit. It should be noted that certain munitions must be treated by OB/OD because there are no current technologies available to treat massive quantities of explosives. However, the intent is to reduce the generation of wastes while maintaining safe operational practices.

The permit should also require that the facility demonstrate how technological advances in the design of other miscellaneous units (e.g., mechanical units including shredders and compactors) will result in waste minimization and a reduction in air emissions. Waste minimization can differ between States and facilities. U.S. EPA has required the following items to be completed by a Permittee. The details are industry specific.

- Annual Certification Condition
- Hazardous Waste Reduction Plan
 - Updated every 2 years
- Waste Reduction Implementation Report
 - Yearly on specific date

Example conditions for waste minimization at a military base are given in [Attachment 7-1](#) (from U.S. EPA Region 5 permit).

7.1.3 Land Disposal Restriction (LDR) Requirements

LDR conditions are applicable to Subpart X Units because the Land Disposal Regulations apply treatment technologies to munitions and other wastes. Subpart X units are treatment units and not final land disposal units. The Treatment Standards for Hazardous Waste table (40 CFR §268.40) and the Universal Treatment Standards table (40 CFR §268.48) should be reviewed to determine the appropriate treatment standards for each waste managed by a specific unit. The permittee will have to document that treatment was performed correctly for the applicable waste types.

Example LDR permit conditions are provided in [Attachment 7-2](#).

General LDR permit conditions can include:

- Self-Implementation
- Mixture Rule
- Dilution Prevention
- Maintenance of Hazardous Waste Codes Lists

Permit conditions should also address testing and related requirements that were outlined in the Waste Analysis Plan contained in the permit application. The conditions can include:

- Testing Requirements or Generator Knowledge of Wastes
- TCLP Testing
- Treatment Technology
- Treatment Concentrations
- Record Keeping

Compliance schedules should repeat the LDR record keeping timeframes, so the inspector and the Permittee can easily plan a schedule of submittals for review.

Storage prohibitions should be added, if the facility stores munitions or other wastes in containers, or tanks, or bunkers. These conditions are not needed

if only OB and/or OD is being addressed and the facility is shipping any hazardous waste residues off-site. If the facility performs mechanical treatment, this will not apply if storage is not included at the facility.

7.1.4 Toxicity Characteristics (TC)

The permit writer must evaluate whether TC wastes will be managed in the unit. However, caution is urged since some waste types might have multiple listings. OB/OD units may require TC permit conditions to address metals and explosives, and mechanical units may require TC permit conditions to address solvents and metals.

Permit conditions should include waste identification specific to the type of management and type of unit. The waste name, waste code number and the maximum volume per unit (capacity) should be included. Some permits present this data in a table format. Waste characterization may be based on testing or generator knowledge. If process knowledge is used for characterization, then the WAP (included as an attachment to the permit) must include the documented process knowledge which details the waste(s) properties and accurately characterizes all wastes that are stored and treated under the permit. Material Safety Data Sheets (MSDS), historical data and other types of published data must be presented in the permit application to support characterization of wastes through process knowledge. Detailed information on the wastes provided from existing published or documented waste analysis data or studies conducted on hazardous wastes generated by a process similar to that which generated the wastes may be included. Permit conditions which address the information and records that must be kept to document process knowledge should be specified.

For facilities that accept off-site generated wastes, the WAP must outline the procedures that will be performed to ensure that a detailed description of each generator's processes contributing wastes to the facility will be obtained, updated and kept in the files as part of the operating record. The permit

application should also have indicated how the process information provided by off-site generators would be verified. If periodic audits are conducted to verify generator information, then a permit condition should be included which specifies the audit documentation that needs to be maintained as part of the operating record.

An issue that arises with carbon and catalyst regenerations units is that spent refinery catalyst and chemically impregnated spent activated carbon containing organic sulfur may be capable of generating a sufficient amount of heat to cause a fire. Therefore, a permit condition may be written which requires that waste screening procedures include an exotherm potential test.

Example TC permit conditions are presented in [Attachment 7-3](#).

Permit conditions must also identify the unit specific management of the TC wastes and include operating conditions and closure plans.

7.1.5 Air Emission Requirements (Subparts AA, BB and CC)

Air emission conditions should only be included if they are applicable to the unit design. Subpart X units need to be considered from a total emissions or mass-balance standpoint when evaluating controls. A single waste stream into a Subpart X unit can create several waste, air or other side streams which need to be evaluated for the unit's impact on human health and the environment. For example, if the Subpart X unit is similar to a tank, and the tank standards (only) are applied, the permit writer may be ignoring the air emissions from the side streams which would not exist if it were not for the Subpart X unit. Under these circumstances, the permit writer has the authority to require control of the emissions, which in many cases are quite significant. Quantification of all emissions by the facility may identify side streams which require air emission control, which can then be controlled by specific language in the RCRA permit.

The air emissions associated with waste transfers need to be considered in detail when establishing permit conditions. Waste transfers can be a large

source of air emissions, and both Subpart X and the Omnibus authority give permit writers the authority needed to control the emissions. Due to the significant potential for leaks from units operated under pressure, leak detection monitoring should be required on a frequent basis, and repair of leaks required consistent with the schedule in Subpart BB. This will result in greater human health and environmental protection at RCRA facilities.

Remember that Subpart X requires that all media be addressed for impacts, so if the air emission standards are not appropriate toward the unit but releases may be a concern, then the air assessment can address the issues. General self-implementation conditions can be written to cover future new standards that are promulgated. Specific permit conditions should be written rather than making a general condition which states that the permittee must comply with the Subpart AA, BB and CC conditions.

Example Subpart AA, BB and CC permit conditions are presented in [Attachment 7-4](#).

7.1.6 Corrective Action

Corrective Action conditions should address any past contamination from the operation of the Subpart X Unit(s). Ground water monitoring of Subpart X areas should be covered under the ground water (40 CFR Part 264 Subpart F) provisions that are applicable to the unit(s). Remember to include all potential constituents from the waste, any casing materials, and degradation and treatment constituents. This is important since corrective action hazardous constituents may not include all the types of munition by-products or components. Maintenance problems can also be addressed by corrective action if there is a potential for releases of hazardous constituents.

Permit conditions should include compliance with Corrective Action at the Facility (General RCRA Section 3004(u)) and Corrective Action Beyond the Facility Boundary (RCRA Section 3004(v)). All Solid Waste Management Units (SWMUs) should be addressed on all contiguous property owned and/or operated by the Permittee(s). The administrative record should identify all SWMUs in the RCRA

Facility Assessment. The record should identify what type of corrective action is determined necessary for each unit, including no corrective action required at this time. The permit should address only those units requiring corrective action at the time the permit is issued. Conditions should include sections for “Newly Identified SWMUs or Releases”, “Corrective Action for New SWMUs or Releases” and “Dispute Resolution” for any corrective action activities.

Corrective Action and Subpart X requirements may also need to address conditions concerning future land use provisions. This is necessary to provide for risk assessment recommendation implementation, thus, locking in the land use for the term of the permit. Land use changes can be addressed through permit modifications. Institutional controls may also need to be addressed in the permit conditions.

7.1.7 Compliance with Other Laws

The permit writer must perform an evaluation for compliance with other laws prior to permitting the facility. This includes evaluations for the Endangered Species Act, Wild and Scenic Rivers Act, and Historical Preservation Act. Documentation to support these evaluations needs to be included in the Administrative Record. Example permit language for a facility that is not impacted by those regulations at the time of permitting is included in [Attachment 7-5](#). Since species migrate or expand their domains, re-evaluations during the 5 or 10 year permit term may be necessary.

7.1.8 Unit-Specific Conditions

Specific unit conditions need to be written for the Subpart X unit. These conditions should address:

Waste Identification (identify each type of waste in each unit and the maximum capacity)
Location Information (of each Subpart X unit and treatment area)
Design, Construction and Operation
Monitoring, Maintenance, Safety and Inspection
Plans

Surveying and Record Keeping
Closure and Post-Closure
Financial Assurance
Environmental Monitoring
Ground Water (40 CFR 264 Subpart F Program)
Soil (Routine sampling to address accumulation and ensure ground water protection)
Surface Water (Clean Water Act Coordination)
Air (Verification of model, Clean Air Act coordination, monitoring, and pollution control devices)
Risk Assessment (Controls required, management plan)
Land Use Provisions (Record keeping, control implementation, safety issues)

Special operating conditions may be considered in some cases where munitions are involved due to safety issues. Worker safety with munitions should be considered in writing permit conditions. Permit conditions for geologic repositories need to address staging issues above ground as ancillary with environmental controls. Additional guidance on drafting permit conditions for carbon regeneration units is outlined in a [Region 3 Guidance on Minimum Permit Conditions for Carbon Regeneration Units \(June 1998\)](#). The Subpart X WorkGroup compiled example permit conditions for mechanical units in the document entitled [Part B Permit Applications, Mechanical Unit Information \(1998\)](#). Appendices B-F contain example permits for a variety of Subpart X unit types including OB/OD, carbon regeneration, combustion incinerator, and shredders.

EPA Region 4 convened a workshop in February 2002 to address the development of permit conditions for both thermal and mechanical units. Permit conditions and inspection requirements were developed for the 5 separate unit types. The results of the exercises are provided in the [Subpart X Case Studies](#).

7.1.9 Schedule of Compliance

The compliance schedule should be sorted by regulatory issues as they are addressed in main text of the permit. Enforceable language should include specific due dates and conditions that request information “Within __ Days of . . .” Time deadlines are always on the Permittee, not the Agency. Establish a timetable for all Permittee actions. Extension modifications can always be written in. Require submitted plans, proposals, etc. and make them subject to Agency approval. The only plans

the Agency does not formally approve are Health and Safety Plans. These may be required by the Agency but the Permittee approves their own plans and complies with the Occupational Safety and Health Administration (OSHA) requirements. The type of information required and how that information is collected and presented should also be described in the permit.

When establishing schedules of compliance with the Permittee, be realistic in timeframes established as conditions. If something needs notification immediately, define what is meant by “immediately”. A permit writer may establish a phone call within a certain number of hours after the event, with a follow up report in writing. Remember many facility operations run 7 days a week, 24 hours a day, and not just during Agency operating hours. Identify after hour contacts and indicate who receives notifications if the permit writer is not available.

7.2 Permit Attachments

The permit writer should make sure all relevant documents are attached. Attachments are taken from the approved Part A and Part B permit application. Because the application is “cut and pasted” into the permit, it is important to ensure that the language in the application is enforceable and does not have any conflicting information. If there is language that needs changing, the permit writer should either obtain an electronic version of the text and highlight changes or redline the document and insert changes. The permit writer should make the Permittee aware of any changes in the permit application text. Attachments may include the following, if applicable:

- Part A Application
- Facility Description
- Waste Characteristics
- Process Information (including weather operating conditions)
- Risk Assessment Information and Land Use Conditions
- Ground Water Monitoring
- Surface Water Monitoring

- Soil Monitoring
- Air Monitoring
- Procedures to Prevent Hazards
- Contingency Plan
- Financial Assurance
- Personnel Training
- Closure and Post-Closure Plans
- Inspection Schedules
- Air Treatment Limit Tables

7.3 Writing the Draft Permit

A permit is a legally binding document; as a result, the permit conditions must be explicitly clear and understandable for all stakeholders. Enforceable language is critical to both the Agency and the Permittee. Both parties must have a clear understanding of what is required under the permit. If the language of the permit is too vague, the Agency enforcing the permit might not have the legal strength to require compliance. The Permittee also may have problems understanding the intent of what is required from permit conditions. Over the 5 to 10 year term of the permit, there may be staff changes at Agency, facility or both. The permit should be written to ensure that there is no confusion regarding the intent when the original parties are no longer involved.

Conditions in the permit should require everything the Agency needs to evaluate the Permittee's compliance with the applicable regulations. This includes any data collected as part of ongoing or proposed environmental monitoring. If the data is not adequate, it is up to the Permittee to defend the plan and data. 40 CFR §270.14(c) requires the Permittee to submit all required data, or have it available for inspection. If the Agency does not require data, the Permittee is unlikely to volunteer it. The permit conditions need to be in place at issuance in order to avoid permit modifications.

By using terms that are mandatory, the language will be explicit in identifying the substantive tasks for Permittee compliance. Good enforceable language will retain Agency flexibility while constraining that of the Permittee. The permit writer should provide the

rationale why a permit condition is necessary. “Based on ...EPA guidance...” is not appropriate for justifying a permit condition. It is important to keep in mind that guidance is not law or regulation, and therefore is not enforceable. The rationale discussion should reference the underlying regulation that the guidance was based upon.

In order to ease the job of the inspector, the language in the permit should provide clear details of what the Permittee must do, what records need to be maintained, a compliance schedule and enforcement triggers (e.g., the Permittee can not burn in excess of 50 pounds of ignitable waste in each burn pan). If the specified level is exceeded, non-compliance is triggered. Record keeping is used to verify that these values are being met. Site inspections during a treatment event will also verify compliance. General inspection items can be created for Subpart X facilities. Inspection checklists will need to be formed on a site by site basis so the permit language needs to be clear for the inspector to understand compliance requirements. Specifics will include areas such as weather operating conditions, feed rates that will comply with risk assessments, and inspection points.

It is the responsibility of the permit writer to organize standard conditions required of all facilities, and recommendations from other Agency review team members such as the toxicologist, ecologist, meteorologist, chemist, engineer, geologist, inspector, and legal counsel. Combining recommended conditions and resolving conflicts in conditions is one of the hardest tasks of permit writing. An example might be that the geologist requests a ground water monitoring well within 20 feet of the unit, but the engineer recommends further distances because the operation of the unit could potentially destroy the integrity of the well under worst case treatment conditions. It is up to the permit writer to resolve the conflict. In many cases the permit writer might be making the decisions for several scientific areas due to staffing restrictions. Justifications for decisions should be included in the permit fact sheet or within the record. Areas to justify may include environmental monitoring, extra

Keys to Enforceable Permit Conditions

- Avoid words/phrases such as “substantially”, “reasonably”, “should”, “may”, “as appropriate”, and “after considering”. These are unenforceable terms.
- Avoid vague or general language
- Conditions should identify enforcement triggers (i.e., “if this level is exceeded then the facility is out of compliance”)
- Specify the data needed to demonstrate compliance
- Cite the underlying regulation to justify the permit condition, not the guidance. Guidance is not a regulation.

provisions for safety or maintenance. When finalizing environmental monitoring based on risk assessments, make sure everyone understands what the numbers mean and what triggers non-compliance and further corrective action or shut down. This may mean technical experts in human, ecological, and air assessments should be involved in meetings to discuss final goals. The permit writer has the final decision of conditions in the permit. Make sure the numbers can realistically be monitored and enforced.

It also helps to bring together the Agency and the Permittee early on in the permit writing process to make sure that obligations on both sides are clearly understood. This does not mean that the Permittee must be shown the entire draft permit, since the public comment period gives them the same opportunity as the general public to view and comment on the draft. Conditions where there are operational or monitoring concerns would be areas that could be discussed to ensure future compliance, reduce conflicts, and obtain realistic reporting and scheduling requirements. Major conflict resolution is easier prior to public notice but may not be avoidable in all cases.

When a draft of the permit has been prepared, it is a good idea to visit the facility with an experience inspector and conduct an inspection of the Subpart X unit(s) based upon the draft permit. This will help identify any ambiguous language or any additional conditions that may need to be added. After the inspection, the draft permit can be revised to improve the clarity and enforceability.

Once the draft permit is approved by the Agency, the public comment period begins and changes are made in relation to any significant comments to the final permit. If there are public groups concerned about the facility, the permit writer may decide to use a broader public information exchange during the permit writing and public comment periods. RCRA public information guidance can be utilized for expanded programs.

Additional information regarding drafting Subpart X permits is outlined in the [Subpart X Case Study](#) presentation from the March 2002 RCRA Organic Air Emission Standards Permit and Compliance Training.

ATTACHMENT 7-1

**Example Waste Minimization Permit Conditions
(From Naval Surface Warfare Center, Crane, Indiana)**

H. WASTE MINIMIZATION

This condition applies to NSWC Crane and all other tenant activities. A combined report for both the Navy and the Army may be submitted.

1. Waste Minimization Certification

The Permittee shall certify at least annually that the Permittee has a program in place to reduce the volume and toxicity of hazardous waste that the Permittee generates to the degree determined by the Permittee to be economically practicable; and the proposed method of treatment, storage, or disposal is that practicable method currently available to the Permittee which minimizes the present and future threat to human health and the environment, in accordance with 40 CFR 264.73(b)(9) and Section 3005(h) of RCRA, 42 U.S.C. Section 6925(h). The certification shall be recorded and maintained in the operating record until closure of the facility.

2. Hazardous Waste Reduction Plan

The Permittee shall develop a Hazardous Waste Reduction Plan (HWRP) that will be the basis of the program referred to in I.H. 1. above. The Permittee shall submit the HWRP to U.S. EPA within 180 days of the effective date of this permit. The HWRP shall be updated and submitted to U.S. EPA at least every other year by April 1st in order to reflect changes in the hazardous waste operations or in other operations described in the HWRP. At a minimum, the HWRP shall:

- a. Identify amounts and types of all hazardous waste generated, by waste stream;
- b. Describe source of generation and waste management method for each stream;
- c. Develop a block and/or flow diagram for each process that generates hazardous waste;
- d. Identify the costs associated with hazardous waste generation, including, but not limited to, disposal costs, insurance costs, liability costs, and costs associated with wasted raw materials;
- e. Provide a list of technically feasible and economically practicable waste reduction measures, addressing both source reduction (including, but not limited to, improved housekeeping practices) and recycling options; and

ATTACHMENT 7-1

Example Waste Minimization Permit Conditions (continued)

- f. Provide a program plan and schedule for implementing technically feasible and economically practicable waste reduction over time. This plan shall:
- (1) Be certified by a professional engineer and a knowledgeable Company representative prior to submittal to U.S. EPA for review;
 - (2) Evaluate the potential for the transfer of hazardous waste and/or hazardous constituents from one environmental medium to another, and potential for substituting a less hazardous substance for a more hazardous one, and insure that subsequent implementation of the plan will result in a net decrease in the risk of an adverse impact to human health and the environment;
 - (3) Include quantifiable goals for waste reduction and identify methods for tracking waste minimization results (measurement should be in the form of measurement index that relates hazardous waste/constituent generation to production); and
 - (4) Be revised to incorporate waste minimization/reduction options for all changes and additions to facility production.

The following guidance documents should be used in developing the HWRP:

Waste Minimization Opportunity Assessment Manual*

EPA/625/7-88/003, July 1988. Available through: EPA, Region 5
Office of RCRA, 77 W. Jackson Blvd., Chicago, Illinois 60604
Telephone 312/353-0398

Facility Pollution Prevention Guide*

EPA/600/R-92/088, May 1992. Available through: NTIS
5285 Port Royal Road, Springfield, Virginia
Telephone 212/264-0505.

**Region 5 Hazardous Waste Reduction Plan (HWRP)/Waste Reduction
Implementation (WRIR) Guidance**

Region 5 guidance document. Available through: EPA Region 5
Office of RCRA, 77 W. Jackson Blvd., Chicago, Illinois 60604
Telephone 312/353-0398

ATTACHMENT 7-1
Example Waste Minimization Permit Conditions (continued)

Additional U.S. EPA Requirements

Any newly developed U.S. EPA guidance documents that are applicable.

Industry-Specific Information

Industry-specific manuals available from CERI, Technology Transfer, U.S. EPA, P.O. Box 19963, Cincinnati, Ohio 45219-0963:

| Title | EPA Number |
|--|--------------|
| Guides to Pollution Prevention | |
| The Fabricated Metal Industry | 625/7-90/006 |
| The Printed Circuit Board Manufacturing Industry | 625/7-90/007 |
| The Photoprocessing Industry | 625/7-90/012 |
| The Automotive Repair Industry | 625/7-90/013 |

3. Waste Reduction Implementation Report (WRIR)

The Permittee shall implement the feasible waste reduction techniques in accordance with the schedule in the HWRP and submit a WRIR to the U.S. EPA. The Permittee shall submit an implementation report by April 1st every year. In the years when both an updated HWRP and WRIR are due, the Permittee may submit one report that includes all the required elements of both reports. The WRIR shall include the following information:

- a. The certification (as described in I.H. 1. above) signed by the owner or operator of the facility or his authorized representative;
- b. A description of the efforts undertaken during the year to reduce the volume or quantity, and toxicity of wastes generated;
- c. A description of the changes in volume or quantity and toxicity of wastes actually achieved during the year in comparison to the previous years. (Information for the years prior to 1984 is only required to the extent such information is available.) The measurement of these changes shall be in the form of a measurement index that relates hazardous waste/constituent generation to production (see page 3 of the Region 5 Hazardous Waste Reduction Plan (HWRP)/Waste Reduction Implementation Report (WRIR) Guidance Document).

ATTACHMENT 7-1

Example Waste Minimization Permit Conditions (continued)

The description shall address all media, and should ensure that there is a net reduction of risk of an adverse impact to human health and the environment. The changes in volume or quantity and toxicity shall be compared to the goals that were outlined in the HWRP;

- d. A brief explanation of the reasons that certain options did not meet the expected goals for waste reduction, if this is the case; and
- e. The waste reduction options which are identified as implementable in the plan, but have not been implemented, along with the factors inhibiting their implementation.

4. Biennial Report

The Permittee's biennial report shall contain the information in I.H.3.a-c. above, as required by 40 CFR 264.75(h)-(j).

5. Submittal of Plans/Reports

The HWRP and the WRIR shall be submitted by the due dates above to the address indicated in I.D.17.

- * It is important to note that the Waste Minimization Opportunity Assessment Manual was developed to assist facilities to reduce the volume and/or the toxicity of the RCRA hazardous wastes generated. More recently the Facility Pollution Prevention Guide was developed and made available to industries. This guide addresses all waste types and activities that contribute to pollution. Facilities are encouraged to use either, or both of the documents as an aid in the planning process.

Naval Surface Warfare Center Permit Modification Language, 1995

G. WASTE MINIMIZATION

The Permittee shall certify at least annually that the Permittee has a program in place to reduce the volume and toxicity of hazardous waste that the Permittee generates to the degree determined by the Permittee to be economically practicable; and the proposed method of treatment, storage, or disposal is that practicable method currently available to the Permittee which minimizes the present and future threat to human health and the environment, in accordance with 40 CFR §264.73(b)(9) and Section 3005(h) of RCRA, [42 U.S.C. §6925(h)]. The certification shall be recorded, as it becomes available, and maintained in the operating record until closure of the facility.

ATTACHMENT 7-1
Example Waste Minimization Permit Conditions (continued)

In addition, the Permittee's biennial report shall contain the following:

1. A description of the efforts undertaken during the year to reduce the volume and toxicity of waste generated, as required by 40 CFR §264.75(h);
2. A description of the changes in volume and toxicity of waste actually achieved during the year in comparison to previous years, as required by 40 CFR §264.75(i). Information for the years prior to 1984 is only required to the extent such information is available; and
3. The certification signed by the owner or operator of the facility or his authorized representative, as required by 40 CFR §264.75(j).

ATTACHMENT 7-2

**Example Land Disposal Restriction Conditions
(From U.S. EPA Region 5, 1995)**

LAND DISPOSAL REQUIREMENTS

A. GENERAL CONDITIONS

1. The Permittee shall comply with all the applicable self-implementing requirements of 40 CFR Part 268 and all applicable land disposal requirements which become effective by statute (42 U.S.C. §6924).
2. A mixture of any restricted waste with nonrestricted waste(s) is a restricted waste under 40 CFR Part 268.
3. The Permittee shall not in any way dilute a restricted waste or the residual from treatment of a restricted waste as a substitute for adequate treatment to achieve compliance with 40 CFR Part 268, Subpart D, to circumvent the effective date of a prohibition in 40 CFR Part 268, Subpart C, to otherwise avoid a prohibition in 40 CFR Part 268, Subpart C, or to circumvent a land disposal prohibition imposed by Section 3004 of RCRA.
4. The Permittee shall prepare and maintain a current list of the hazardous waste codes handled by the facility that are identified in 40 CFR 268, Subparts B and C. The list shall include all waste codes handled by the facility, and any associated treatment standards, and shall be updated through the inclusion of new treatment standards, as promulgated or amended. This list shall be provided to the U.S. EPA representatives, or their designees, upon request.

B. TESTING AND RELATED REQUIREMENTS

1. The Permittee must test, in accordance with 40 CFR 268.7(a), any waste generated at the facility, or use knowledge of the waste, to determine if the waste is restricted from land disposal.
2. For restricted wastes with treatment standards expressed as concentrations in the waste extract, as specified in 40 CFR 268.41, the Permittee shall test the wastes or waste treatment residues, or extracts of such residues developed using the test methods described in Appendix II of 40 CFR Part 261 (Toxicity Characteristic Leaching Procedure, or TCLP) to assure that the wastes or waste treatment residues or extracts meet the applicable treatment standards of 40 CFR Part 268, Subpart D. Such testing shall be performed as required by 40 CFR 264.13.

ATTACHMENT 7-2

Example Land Disposal Restriction Conditions (continued)

3. A restricted waste for which a treatment technology is specified under 40 CFR 268.42(a) is eligible for land disposal after it is treated using that specified technology or an equivalent treatment method approved by the Administrator under the procedures set forth in 40 CFR 268.42(b).
4. For restricted wastes with treatment standards expressed as concentrations in the waste, as specified in 40 CFR 268.43, the Permittee shall test the wastes or waste treatment residues (not an extract of such residues) to assure that the wastes or waste treatment residues meet the applicable treatment standards of 40 CFR Part 268, Subpart D. Such testing shall be performed as required by 40 CFR 264.13.
5. The Permittee shall comply with all the applicable notification, certification, and recordkeeping requirements described in 40 CFR 268.7(a) and (b).

NOTE: *The following condition only applies to Storage in Tanks and Containers at the Facility. Do not use this language if there is no storage.*

C. STORAGE PROHIBITIONS

1. The Permittee shall comply with all the applicable prohibitions on storage of restricted wastes specified in 40 CFR Part 268, Subpart E.
2. Except as otherwise provided in 40 CFR 268.50, the Permittee may store restricted wastes in tanks and containers solely for the purpose of the accumulation of such quantities of hazardous wastes as necessary to facilitate proper recovery, treatment, or disposal provided that:
 - a. Each container is clearly marked to identify its contents and the date each period of accumulation begins; and
 - b. Each tank is clearly marked with a description of its contents, the quantity of each hazardous waste received, and the date each period of accumulation begins, or such information for each tank is recorded and maintained in the operating record at the facility.
3. The Permittee may store restricted wastes for up to 1 year unless the U.S. EPA or its authorized agent can demonstrate that such storage was not solely for the purpose of accumulating such quantities of hazardous waste as are necessary to facilitate proper recovery, treatment or disposal.

ATTACHMENT 7-2
Example Land Disposal Restriction Conditions (continued)

4. The Permittee may store restricted wastes beyond 1 year; however, the Permittee bears the burden of proving that such storage was solely for the purpose of accumulating such quantities of hazardous waste as are necessary to facilitate proper recovery, treatment or disposal.

5. The Permittee shall not store any liquid hazardous waste containing polychlorinated biphenyls (PCBs) at concentrations greater than or equal to 50 ppm unless the waste is stored in a storage facility that meets the requirements of 40 CFR 761.65(b). This waste must be removed from storage and treated or disposed as required by 40 CFR Part 268 within 1 year of the date when such wastes are first put into storage. Condition ____C.4. above, which allows storage for over 1 year with specified demonstration, does not apply to

ATTACHMENT 7-3

**Example Toxicity Characteristic Permit Conditions
(From U.S. EPA Region 5 Model, 1995)**

____. TOXICITY CHARACTERISTIC

A. WASTE IDENTIFICATION

The Permittee may store a total of (Capacity of Unit) gallons in (Type of Unit) at the facility.

EXAMPLE: *3120 cubic yards in waste piles, and 278 cubic yards in Containment Building unit Bin 6*

| | |
|-----------------------------|-----------------------------------|
| EPA Hazardous Waste Code | Description of Hazardous Waste |
|-----------------------------|-----------------------------------|

| | |
|---------------------|------------------------|
| (Waste Code) | (Name of Waste) |
|---------------------|------------------------|

EXAMPLE: *D008* *Characteristic of Toxicity for Lead*

B. WASTE CHARACTERIZATION

The Permittee must use the Toxicity Characteristic Leaching Procedure (TCLP) (Appendix II of 40 CFR Part 261), and applicable SW-846 analytical test methods as contained in the Waste Analysis Plan found in Attachment _____. Use of the TCLP does not exempt the Permittee from also using the Extraction Procedure (EP) toxicity test if required by the State permit conditions.

C. CONDITIONS REGARDING UNITS

All units described in Condition _____.A. above shall be operated in accordance with the State permit conditions pertaining to those units.

IV. TOXICITY CHARACTERISTIC

A. WASTE IDENTIFICATION

[This section should identify the type and amount of waste that may be handled and the units in which the wastes may be treated, stored, or disposed. For example:]

ATTACHMENT 7-3

Example Toxicity Characteristic Permit Conditions (continued)

The Permittee may _____ [specify store, and/or treat and/or dispose of] the following wastes in _____ [specify type(s) of unit(s)] at the facility subject to the terms of the RCRA permit.

| | | | |
|-----------------------------------|-------------------------------|-------------------|---------------------------|
| Description of Hazardous Waste | EPA Hazardous Waste Number | Maximum Volume | Description of Unit(s) |
|-----------------------------------|-------------------------------|-------------------|---------------------------|

B. WASTE CHARACTERIZATION

The Permittee must use the Toxicity Characteristic Leaching Procedure (TCLP) (Appendix II of 40 CFR Part 261), or use knowledge of the waste to determine whether a waste exhibits the characteristic of toxicity, as defined in 40 CFR 261.24. Use of the TCLP does not exempt the Permittee from also using the Extraction Procedure (EP) toxicity test if required by the State permit conditions.

C. CONDITIONS REGARDING UNITS

[This section applies to facilities managing TC waste in existing units. If the facility is handling TC waste in both existing and new units, include the following Condition C.1. and Condition C.2. below.]

1. The Permittee shall manage toxicity characteristic wastes (based on the TCLP) in the following units in accordance with the State permit conditions pertaining to those units:

| | |
|------------------------|-------------------------------|
| Description Unit(s) | EPA Hazardous Waste Number |
|------------------------|-------------------------------|

[If all TC wastes at the facility are managed in existing units, the following condition may be used as an alternative; no Condition C.2. is necessary:]

1. All units described in Condition IV.A. above shall be operated in accordance with the State permit conditions pertaining to those units.

[Condition C.2. applies to facilities managing TC waste in newly regulated units not included in the State portion of the permit. In this case, the Federal portion of the permit must identify the units and include all applicable permitting standards from the Model RCRA Permit for Hazardous Waste Management Facilities (Modules III-XI and Module XIII) for containers, tanks, or other pertinent units. These conditions should appear in Section VII (and subsequent sections, if necessary) of the permit.]

ATTACHMENT 7-3

Example Toxicity Characteristic Permit Conditions (continued)

2. The Permittee shall manage toxicity characteristic wastes (based on the TCLP) in units not included in the State portion of this permit in accordance with Section(s) of this permit.

[Condition C.3. should appear if the plans included in the State permit do not cover TC waste. Regardless of whether TC waste is managed in newly regulated units or units covered by the State permit, Permit Writers must make sure that conditions and/or plans in the State permit (Waste Analysis, Closure, Post-Closure, Financial Assurance, Inspection, Training, Contingency, etc.) reflect the inclusion of TC wastes. If TC wastes are not included, the Federal portion must include the omitted information. (See Model Permit Module II for appropriate language.) This information should appear in attachments.]

3. The Permittee shall follow the [select waste analysis, closure, etc., as appropriate] procedures required in 40 CFR Part 264, and as described in the [select Waste Analysis, Closure, etc., as appropriate] plan(s) found in Attachment(s) .

[The following condition is required if the Permittee is managing TC waste in a land disposal unit. This paragraph should be included in the section containing specific conditions for land disposal units. The Schedule of Compliance should include the September 25, 1991 certification date. Also note that this condition applies to permits issued before September 25, 1991.]

As required by 40 CFR 270.42(g)(1)(v), if the Permittee is managing newly regulated waste in previously unregulated land disposal unit(s), the Permittee must certify to the Regional Administrator by **September 25, 1991**, that such unit(s) are in compliance with all applicable 40 CFR Part 265, Subparts F and H groundwater monitoring and financial responsibility requirements.

ATTACHMENT 7-4

**VII. Treatment, Storage, & Disposal Facility (TSDF)
Organic Air Emissions Requirements**

The Permittee must comply with the applicable requirements of 40 CFR Part 264, Subparts AA, BB, and CC as modified by the operating requirements specified below.

VII.A. Bulk Solids Tanks:

The bulk solids tanks (T404 A/B and T403) will normally comply with tank level 2 control requirements specified by 40 CFR 264.1084(d)(5), for a tank located inside an enclosure that is vented through a closed vent system to an enclosed combustion device. However, when the incinerator afterburner chamber (ABC) is less than 1400 degrees F., a backup carbon adsorption system must be used. The sludge receiving tank (T406) shall comply with the tank level 2 control requirements specified by 40 CFR 264.1084(d)(3). The Permittee shall operate the bulk solids building and tanks and the associated carbon adsorption system as follows:

1. The roll up doors of the bulk solids building must remain in the closed position at all times except for the following conditions: a) unloading waste into tanks b) managing waste with external equipment c) emergencies, and maintenance activities.
2. All other doors and openings in the bulk solids building, except designated Natural Draft Openings (NDOs), must be kept closed at all times except for maintenance and operations activities and emergencies. The list of designated NDOs is attached to this Permit (Attachment 1 of this Permit).
3. The doors on the sludge receiving tank (T406) must be kept closed at all times except for adding waste, sampling, cleaning of grizzly screens, and performing maintenance and operations activities. When pumping waste into the tank, the smallest opening that is feasible must be used to minimize fugitive VOC emissions.
4. The VOC emissions from the bulk solids tanks (T404 A/B and T403) must be captured and controlled at all times (except as allowed elsewhere in this Permit). When the incinerator is in operation at a temperature greater than or equal to 1400 deg. F. as measured in the afterburner chamber (ABC), these tanks shall be vented to the incinerator. When the temperature in the ABC is less than 1400 deg. F. (for greater than 10 minutes), the tanks must be vented through a closed vent system to the bulk solids carbon adsorption unit. This condition supersedes the requirements of 40 CFR 264.1084(d)(5). The periods when the carbon adsorption unit is utilized must be noted in the operating record.

ATTACHMENT 7-4

**VII. Treatment, Storage, & Disposal Facility (TSDF)
Organic Air Emissions Requirements (continued)**

5a. The sludge receiving tank (T406) shall be ventilated through a closed vent system to the kiln and ABC during normal plant operations (when ABC temperature is 1400 deg. F. or greater), as required under 40 CFR 264.1084(d)(3) (tank level 2 control - tanks that are vented through a closed vent system to a control device).

5b. During backup operations (when the ABC temperature is less than 1400 deg. F.) the sludge receiving tank shall not be vented through the combustion air system, but instead, shall be vented through the bulk solids carbon adsorption unit. The sludge receiving tank (T406) shall comply with the tank level 2 control requirements specified by 40 CFR 264.1084(d)(3).

6. The bulk solids carbon adsorption unit is a duplex, single stage design. The duplex arrangement (two single-stage absorbers in parallel operated one at a time) allows for changing out or regenerating the spent carbon of one unit, while the other unit is in operation.

The Permittee must replace Calgon BPL carbon (or equivalent specification) on an interval not to exceed the following:

43 days (1,032 hours) of operation if any operating day occurs in the months of June, July, or August.

61 days (1,464 hours) of operation for all other months.

The Permittee must replace Calgon React carbon (or equivalent specification) on an interval not to exceed the following:

22 days (528 hours) of operation if any operating day occurs in the months of June, July, or August.

37 days (888 hours) of operation for all other months.

The carbon replacement frequency is based on the April 7, 1998 Engineering Design Analysis for Backup Emissions Control Unit Report. The Permittee is prohibited from using any other type of carbon specification, unless authorized by a permit modification approved by EPA.

ATTACHMENT 7-4

**VII. Treatment, Storage, & Disposal Facility (TSDF)
Organic Air Emissions Requirements (continued)**

7. Procedure “T” testing to verify that the bulk solids building meets the criteria for a Permanent Total Enclosure, must be conducted in accordance with the procedure specified in 40 CFR 52.741, Appendix B. This testing, initially conducted on April 14, 1998, must be re-conducted annually, as specified by 40 CFR 264.1084(i)(1).

8. Carbon adsorption unit inlet VOC concentrations must be monitored by an FID detector annually to verify that the inlet VOC concentration remains similar to the concentration used in the April 7, 1998 Design Analysis Report. The annual monitoring shall consist of daily one-hour tests for a period of one week.

9. All spent carbon shall be incinerated on-site in the kiln/ABC, or at another approved incineration or recycling facility. Records of the dates the carbon is removed, placed in permitted storage, and treated must be maintained in the operating record.

10. The Permittee is not allowed the 240 hours of control device downtime for planned maintenance specified in 40 CFR 264.1087(c)(2)(i). During planned maintenance either the ABC or the carbon adsorption system must be operational and on-line.

VII.B. Liquid Tanks (T-321, T-322, T-323, T-324, T-301, T-302, T-303, T-304, T-305, T-306, T-307, T-308, T-309, T-310, T-311, T-312, and T-401):

The liquid tanks must comply with the control requirements specified by 40 CFR 264.1084(d)(3) (tank level 2 controls - tanks that are vented through a closed vent system to a control device). Two control devices will be used, the ABC and carbon adsorption canisters. When the incinerator afterburner chamber (ABC) is less than 1400 degrees F. or when the fume management system cannot accept the volume of vapor generated from the liquid tanks, the backup carbon adsorption canisters must be used.

1. The carbon adsorption canister outlets must be monitored for breakthrough every three hours of accumulated control device operation. This includes periods when vapors from the liquid tanks are vented to both the ABC and the carbon canisters. A result of 100 ppm or greater of total hydrocarbons will indicate breakthrough.

ATTACHMENT 7-4

**VII. Treatment, Storage, & Disposal Facility (TSDF)
Organic Air Emissions Requirements (continued)**

2. The Permittee must immediately replace (not to exceed 30 minutes) any carbon adsorption canisters in which breakthrough has occurred.

VII.C. Container Storage Areas

1. Level 2 containers not in DOT approved containers must be verified as having no detectable emissions (as defined in 40 CFR 265.1081) within 24 hours of receipt and every 3 months thereafter. Containers that have been demonstrated, within the preceding 12 months, to be vapor-tight, as specified by 40 CFR 264.1086(h), are exempt from this condition (e.g., tankers, direct burn vessels, etc.).
2. The addition of solidification agent to containers must not involve the active mixing of waste and agent, unless authorized by a permit modification approved by EPA.

VII.D. Inspection and Monitoring Requirements

1. The closed vent system between the outlet of the bulk solids and sludge receiving tanks and the inlet of the ID fans (both kiln/ABC combustion air fans and bulk solids carbon adsorption unit ID fan) will be inspected in accordance with the requirements of 40 CFR 264.1033(l)(2). These sections of the closed vent system are operated below atmospheric pressure.
2. The closed vent system between the outlet of the ID fans (both kiln/ABC combustion air fans and the bulk solids carbon absorption unit ID fan) and the control devices (ABC and carbon adsorption unit) will be inspected in accordance with the requirements of 40 CFR 264.1033(l)(1). These sections of the closed vent systems are operated at, or above, atmospheric pressure.
3. The closed vent system between the outlet of the liquid tanks(T-321, T-322, T-323, T-324, T-301, T-302, T-303, T-304, T-305, T-306, T-307, T-308, T-309, T-310, T-311, T-312, T-401) and the control devices (carbon adsorption canisters and the ABC) will be inspected in accordance with the requirements of 40 CFR 264.1033(l)(1). These sections of the closed vent systems are operated at, or above, atmospheric pressure.
4. Any defects detected by inspections and monitoring conducted under conditions VII.D.1 through 4 must be repaired in accordance with the requirements of 40 CFR 264.1033(l)(3).

ATTACHMENT 7-4

**VII. Treatment, Storage, & Disposal Facility (TSDF)
Organic Air Emissions Requirements (continued)**

VII.E. Record Keeping Requirements

1. The air emission control equipment design documentation must be maintained in the operating record until it is replaced or otherwise no longer in service.
2. The Permittee must maintain the records specified by 40 CFR 264.1089 (b) and (e) in the operating record for a period of at least three years.

VII.F. Reporting Requirements

1. As specified by 40 CFR 264.1090(b), the Permittee must submit a written report within 15 calendar days of the time that the Permittee becomes aware of any instances in which hazardous waste is managed in tanks not in compliance with the air emission controls of subpart CC,.
2. As specified by 40 CFR 264.1090(b), the Permittee must submit a semi-annual written report describing each occurrence of non-compliance with the operating values specified by 40 CFR 264.1035(c)(4). A report is not required for the six month period if no non-compliance with 40 CFR 264.1035(c)(4) has occurred.

ATTACHMENT 7-5

Example Permit Conditions for Compliance with Other Laws

I. COMPLIANCE WITH OTHER FEDERAL LAWS (40 CFR 270.3)

The Permittee must comply with the following Federal Laws, if applicable to the conditions of this permit:

1. The Wild and Scenic Rivers Act (16 U.S.C. 1273 et seq., Section 7);
2. The National Historic Preservation Act of 1986 (16 U.S.C. 470 et seq., Section 106, and implementing regulations 36 CFR Part 800);
3. The Endangered Species Act (16 U.S.C. 1531 et seq., Section 7, and implementing regulations 50 CFR Part 402); and
4. The Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.).

If the Permittee finds that any of these laws may be applicable to the issuance, modification, or conditions of this permit, the Permittee must notify the Regional Administrator within 30 days of discovery. Any noncompliance with these other Federal laws may be grounds for enforcement action, permit termination, revocation and reissuance, modification, denial of a permit renewal application, or other appropriate action.

8.0 INSPECTIONS

Once the permit is issued, compliance begins. The facility may be inspected by a RCRA enforcement inspector or a RCRA permit writer. Other specialty staff may also inspect the facility for compliance with portions of the permit they reviewed (i.e., ecological issues). The inspector can utilize other inspection checklists from the U.S.EPA Office of Enforcement and Compliance (OECA). Subpart X checklists have been developed on a site by site, permit by permit basis. A model checklist is included as [Attachment 8-1](#). While this checklist may be used as a starting point for Subpart X inspections, it should be modified as required with facility-specific data from the Subpart X permit. An attempt was made to formulate general provisions at the U.S.EPA Region 4, RCRA Miscellaneous Units Permit and Compliance Training held in February 2002. Participants in the training developed permit conditions and inspection requirements for five different Subpart X units. The results of their efforts are presented in the following case studies:

[Open Burn Unit Case Study](#)
[Open Detonation Case Study](#)
[Hurd Burn Unit Case Study](#)
[Shredder Case Study](#)
[Crusher Case Study](#)

Subpart X units are required to maintain proof that impacts are not occurring to the various environmental media. Visual inspection of the facility will confirm this. Record keeping reviews alone might not satisfy this decision. Split sampling during media sampling may be appropriate to ensure compliance. Areas that an inspector should concentrate on for Subpart X include:

- Maintenance of the unit: The inspector should verify that the Subpart X unit is maintained in accordance with the appropriate regulations and permit. In particular, the inspector should verify whether leaks, spills or releases of emissions have occurred, or are occurring from the unit. Inspect the unit when it is in operation to obtain a clearer picture of potential emission points. Leaks and spills often



Click on the photograph to view a video clip of an open burn case study conducted

occur during the transfer of wastes to and from the unit. Leaks can also occur around seals (e.g., around agitator seals) and manways in tank-like units. Releases of emissions can also occur during waste transfer operations. For example, emissions can be released when the wastes from a shredder or drum crusher unit are transferred to a rolloff box, hopper or other container. The physical condition and integrity of the unit should also be assessed. In particular, metal and concrete structures should be inspected for signs of stress, warping, cracking or breaches around seams. In addition, the base of the unit should be inspected for signs of erosion and uneven settlement. Any liners within or below the unit, and any associated pads, berms, or secondary containment structures should also be inspected for integrity. A review of the maintenance logs can provide information on chronic problems with certain pieces of equipment. Maintenance and operational records which should be inspected for the unit includes all available operating logs, inspection and maintenance logs, standard operating procedures, and environmental monitoring reports.

- **Operation of the unit:** The inspector should verify that the Subpart X unit is operated in accordance with all appropriate regulations, permit requirements, standard engineering practices, and applicable standard operating procedures. If the unit is not operated according to the design specifications, the likelihood of upset conditions increases, which could result in unpermitted releases from unit. The inspection should also verify that the vegetation around the unit is properly maintained, that any windblown ash or kickout residues are properly managed, that any fire prevention buffer zones (e.g., non-vegetated corridors) are properly maintained, and that security devices (including fences, gates, warning signs, cameras, road blocks, and barriers) are in good working condition.

- **Operating conditions:** The inspector should verify that the Subpart X unit is operated within the time periods and weather conditions specified in the permit. For example, it should be noted whether OB operations are occurring at times that allow for proper inspection and/or cool-down as required by



Note the warping of the steel from burning operations. Also note debris on ground surrounding pan - evidence of kickout or spillage of ash.

the permit. In addition, it should be noted whether OB is occurring during periods of inclement weather or high winds, which could result in a greater likelihood of residue runoff or wind-transport of contaminants. Operational logs and weather records should be inspected to determine compliance with these conditions.

- Groundwater monitoring: If there is a likelihood for wastes to be expelled during treatment (e.g., kickout during OB or OD operations), a groundwater monitoring system should be installed in accordance with the 40 CFR Part 264 Subpart F requirements. If a groundwater monitoring system is required for a Subpart X unit, groundwater sampling and inspection of the system should occur in accordance with the Subpart F requirements and permit conditions.
- Soil monitoring: If soil sampling is required, the inspector should verify that soil samples are collected at the locations and frequency specified in the Sampling and Analysis Plan (SAP). In addition, the inspector should verify that the samples are analyzed for the parameters required by the permit, and determine whether the locations are still appropriate with the passage of time.
- Surface water monitoring: If surface water monitoring is required, the sampling and monitoring program should be reviewed to ensure compliance with the permit. The inspector should also note whether different flow and weather conditions are being tracked in accordance with the sampling program.
- Waste analysis: The inspector should review whether the wastes treated by the Subpart X unit are analyzed in accordance with the procedures specified in the Waste Analysis Plan. Any deviations observed should be cited and corrective action should be required. Review operating record to ensure that permittee is maintaining documentation of an audits conducted at off-site generators.

- Residuals management: The inspector should verify whether all residuals from the Subpart X unit are removed in a timely manner and managed in accordance with the permit requirements.
- Air modeling: If air modeling was conducted as part of the permitting process for the Subpart X unit, it should be determined whether there have been any significant changes in the operation of the unit that warrant new model simulations for the time period of the permit (e.g., 5 to 10 years).
- Safety issues: The inspector should evaluate whether there have been any safety issues of concern during the operation of the unit. Any significant safety issues should be documented and reviewed to determine if corrective actions are necessary. The inspector should also consider whether the permit modifications are necessary as a result of these issues. Safety items which should be evaluated during the inspection include the communication system employed at the unit, the presence and condition of personal protective equipment, emergency showers and eye washes, and the condition of all fire-fighting equipment.
- Land use restrictions: The inspector should review all appropriate sources to verify that the land use surrounding the Subpart X unit has not changed since the last inspection. Furthermore, the inspector should verify that the appropriate records are being maintained.
- Precipitation and run-on/run-off controls: The inspection should determine if precipitation and run-on/run-off controls are being maintained at the Subpart X unit. In particular, the inspector should determine whether the precipitation controls (e.g., building roofs, container lids, tank covers) and run-on/run-off management devices (e.g., berms, ditches, stormwater collection system) for the unit are in good working condition. If failures are occurring, corrective action should be required and documented.



Residues remaining on the ground after a open burning operation that was not properly managed.



To view this movie clip, click on [Rocket Blast.mpg](#) Note that the cover of the unit flies off during the burning of rocket components. This and other safety issues should be evaluated during the inspection.

These are some of the major areas of concern which should be evaluated during a Subpart X inspection. Details on the specific conditions need to be taken from the permit and incorporated into a checklist format and maintained with the facility file. The Permittee's inspection and training program can also be utilized as a source for developing a good inspection checklist.

APPENDIX A
Subpart X Checklist

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| A.1 Units | Checklist for the Technical Review of RCRA Part B Permit Applications for Subpart X Subpart X Checklist.pdf |
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APPENDIX B
Example Permits for OB/OD

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| B.1 | Copperhead Chemical Company Permit | Copperhead Permit.pdf |
| B.2 | Eglin Air Force Base Permit | Eglin.pdf |
| B.3 | Eglin Air Force Base Permit Modification | Egl-mod.pdf |
| B.4 | Kings Bay Naval Submarine Base Permit | draft permit Naval Sub Base.pdf |
| B.5 | Martin Electronics, Inc. Permit | martin.pdf |
| B.6 | Olin Corporation Permit | olin.pdf |
| B.7 | Sierra Army Depot Permit | sierradraft1.pdf |

APPENDIX C
Example Permits for Enclosed Combustion

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| C.1 | AET Destruction Facility Permit | AET draft permit.pdf |
| C.2 | DeMil International, Inc. and Donovan Commercial Industries, Inc. Permit | DCI permit.pdf |

APPENDIX D
Example Permit for Carbon Regeneration

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APPENDIX E
Example Permit for a Sludge Dryer

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E.1 Transuranic (TRU) Waste Remediation Facility Permit [TRU waste permit.pdf](#)

APPENDIX F
Example Permit for a Crusher

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| F.1 | Generic Crusher Permit | crusher permit.pdf |
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