RCRA
40 CFR PART 264, SUBPART X
PERMIT WRITERS
TECHNICAL RESOURCE DOCUMENT

(Version 2.0)

Prepared
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and

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June 1997

FIGURES

TABLES

Acronyms/abreviations used in this document

DQO	data quality objective
DRE	disposal and removal efficiency
IED	improvised explosive device
OB/OD	open burning and open detonation
SOP	standard operating procedure
UXO	unexploded ordnance

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 with guidance for reviewing permit applications and establishing permit conditions for 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. This document identifies the minimum requirements for such an assessment and provides guidance for evaluating information submitted by permit applicants.

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 that end is to selectively apply the design and operating requirements for hazardous waste management units set forth under 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 provides model permit language for a subpart X permit.

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., most 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 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 as permit conditions than unique 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 select design and operating requirements from one or more of these subparts in developing permit conditions. In many cases, the approach described above will minimize the time and effort required to issue a permit to a prospective subpart X unit.

1.1 APPLICABILITY

As of the preparation of this document, 90 percent of the more than 200 units that qualify for permitting as subpart X units are units at which open burning or open detonation (OB/OD) is conducted. Such units are used primarily for the treatment of waste propellants, explosives, and pyrotechnics (PEP) that cannot be managed safely or effectively in other types of hazardous waste management units. However, because subpart X is an exclusionary category, a variety of treatment and disposal units are considered. Some of those types of operations that are briefly discussed in the document are carbon and catalyst regeneration units, shredders, can crushers, and thermal desorption units. 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 writers 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 document highlights those areas by providing information to assist permit writers with technical, and policy issues associated with those areas.

1.3 INFORMATION REQUIREMENTS

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) 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 §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.

1.4 OTHER GUIDANCE MANUALS

Throughout the document, the permit writer is informed of a variety of other guidance documents that EPA has developed for other purposes. Much of this guidance will be directly applicable to the needs of the permit writer and should be evaluated carefully to determine how best it can be used. References used in preparing the guidance are found at the end of the individual chapters; chapter 8 provides additional general references potentially useful to the permit writer.

1.5 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 don't apply. In the third case, regardless of whether the material is or is not 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 also. 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 more detail below.

1.5.1 Training in Use of a Product

The final Military Munitions Rule, in §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 excess 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.

On the other hand, 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.

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

1.5.2 Range Clearance

The final Military Munitions Rule, in §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 contol 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 §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 (described in section 2.1 and this section, respectively), a permitted RCRA OB/OD unit may still be used so long as the permit conditions are met.

Regarding the OB/OD of munitions that land off-range, see the next section.

1.5.3 Emergency Responses

The final Military Munitions Rule, in §§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. Non-time-critical emergency responses, however, are subject to the emergency permit requirements of §270.61. 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 §263.10(e), from RCRA transporter/manifesting requirements.

The final 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.

1.5.4 Other Changes Impacting OB/OD Units

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

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.

2.1 TYPES OF 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 are likely to become available in the next several years, some of which 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. Figure 2-1 provides a plan view of a typical OB/OD unit

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 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 collected precipitation is sampled and analyzed and determined <u>not</u> to contain hazardous constituents. Metal cage placed over the burn unit diring 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 runon and 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. 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 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 adverse weather conditions (high winds, rain, electrical storms, etc.).

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 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 then are 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 Carbon and Catalyst Regeneration Units

Carbon and catalyst regeneration units include both controlled-flame and non-flame devices. The regeneration process is considered thermal treatment under the interim status provisions of RCRA. In that process, organic contaminants are desorbed from activated carbon at temperatures as high as 1,800°F. Carbon regeneration units that use thermal treatment include rotary kilns, fluidized-bed regenerators, or multiple-hearth furnaces, all of which transfer heat to the contaminated carbon. As an alternative, steam may be used to desorb contaminants from the media in devices similar to tanks.

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. 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. In fluidized-bed units, the granular material (the bed) is fluidized by directing air upward through the bed. Figure 2-2 shows a schematic rendering of a fluidized bed. Fuel is charged directly into the fluidized bed or into the windbox beneath the bed. The temperature in the freeboard area above the bed can be higher than that within the bed. The freeboard slows the velocity of the fluidizing gas, keeping particulate matter from escaping the unit.

Figure 2-3 shows a multiple-hearth furnace. It 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 hearths. 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.

Some carbon regeneration units that resemble tanks also may meet the definition of a wastewater treatment unit under 40 CFR 260.10. Such units would be used to adsorb contaminants from wastewater. Such units are exempt from permitting standards under RCRA when they are used to treat wastewater for discharge under NPDES or POTW standards.

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.

2.1.3 Shredder Units

Shredders typically are used to make waste more amenable to subsequent treatment in other units, such as thermal desorbers, regenerator units, or incinerators, through reduction in size, and blending. Several types of shredders are used, the major examples of which are hammer mills, shear shredders, and auger shredders.

Figure 4-4 shows a hammer mill, 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.

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.

2.1.4 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. Shown in Figure 2-5, 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. Figure 2-5 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.

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 §264.193) may be appropriate to minimize the potential for harm posed by releases that may occur during operation and maintenance of the units.

2.1.5 Can Crushers

Can crusher units that are eligible to be permitted under subpart X, handle containers of hazardous wastes. Typically, a can 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 bunghole, 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 is sprayed with an appropriate solvent to mobilize hazardous waste residues.

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 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 can 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.

2.1.6 Thermal Desorption Units

The thermal desorption process primarily involves the thermal treatment of wastes to volatilize organic contaminants or to remove water. The major difference between thermal desorption and incineration is that incineration promotes oxidation of organic compounds and formation of carbon dioxide and water. 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.

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, venturis, electrostatic precipitators, or baghouses, before it is released into the atmosphere.

2.1.7 *Ex Situ* Vitrification Units

The *ex situ* vitrification process is a thermal treatment process that both oxidizes and vitrifies wastes. Typically, it can treat wastes in the form of solids or as slurries. Typically waste and fuel are mixed in a pre-combustor and 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).

2.1.8 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 Part 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 ground-water 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).

2.1.9 Biological and Chemical Treatment Units

A permit writer may receive a permit application for a biological or chemical treatment unit that the applicant is trying to permit under subpart X. Many of these types of units may be more appropriately permitted under either the tank or land treatment unit regulations, or should incorporate such standards as part of the subpart X permit..

2.2 AREAS OF SPECIAL CONCERN TO PERMIT WRITERS

This section, although by no means exhaustive, provides permit writers with an overview of some special situations they might encounter when reviewing subpart X permit applications. One of the areas of emphasis in this section is the issue of permitting subpart X units under other subparts established under regulations in part 264 (for example, as a tank under part 264, subpart J). There are several good reasons for permitting potential subpart X units as conventional hazardous waste management units: larger body of experience in permitting other types of units, the lesser likelihood of permit challenges, and the lesser chance that extensive enforcement issues will arise. All such issues are much more likely to arise if a unit is permitted as a subpart X unit. For example, a permit applicant may propose as a subpart X unit an above ground unit that involves an innovative form of treatment (for example, cavitation in conjunction or with oxidation). In this situation, the permit writer should attempt to permit the unit as a tank because (1) the design and operating requirements for tanks (for example, integrity assessments, secondary containment, and inspections) are applicable and well understood by the regulated community, (2) permit conditions such as those for tanks are unlikely to be appealed, and (3) Regional and state enforcement personnel have extensive experience with enforcing the part 264, subpart J standards.

Discussed below are areas of special concern related to all miscellaneous units. Some units have been grouped because they are affected by the same issues.

2.2.1 Areas of Special Concern in the Review of Permit Applications for OB/OD Units

A number of areas are of particular concern to the permit writer reviewing a permit application for an OB or OD unit. Those concerns are:

- Operation and location concerns
- Process operations of the unit
- Methodology of waste analysis
- Minimization of releases of hazardous waste or constituents from the unit
- Closure of the unit
- Approach taken to the environmental human and ecological risk assessments

Following is a discussion of some of the areas a permit writer may wish to focus on when reviewing permit applications.

2.2.1.1 Operation and Location Concerns

There are several factors affecting the design and subsequent construction of OB and OD units that a permit writer should be careful to check to determine whether they are adequate for the proposed purpose. Some of the factors that will have an effect on the design and construction of the unit are the depth to ground water, the distance to the nearest surface water, the distance to the nearest place of human habitation, and the type of environmental setting.

Depth to ground water is a very important factor in both design and construction of OB and OD units. In the case of OB units, the presence of shallow ground water would suggest that additional care must be taken that the area under and immediately surrounding the unit is impermeable. (The rationale for focusing on the area nearest the unit is that the majority of particulate fallout will take place in this area -- the farther from the unit, the less concentrated the emissions.) To ensure impermeability, a layer of rolled clay can be installed and regular maintenance provided, or a reinforced concrete pad could be an even better solution. In cases in which the native soil is relatively impermeable, it would be possible to simply compact the soil and use the compacted soil as a cap. However, it sometimes is difficult to use this approach because of the heterogenous nature of soil. In areas in which ground water is deeper and the climate more arid, it would be appropriate to allow a less permeable surface in the area of the unit, as long as provisions are made to remove obvious particulate matter within a short time after the burn.

In the case of OD units, shallow ground water could be cause to deny the permit. The typical depth of excavation for OD operations is about four feet below ground surface. In many parts of the country, ground water often is present within 10 feet of the ground surface. The permit writer should require that the applicant demonstrate that ground water contamination will not occur, particularly in areas with shallow ground water. While ground water contamination is not likely in arid areas where aquifers are deep, it can be of great consequence in areas with significant precipitation. In some areas of the country, depth to ground water can change by several feet over a season or even a tidal cycle. When the permit writer believes that to be the case or even potentially the case, the applicant should be required to determine the shallowest depth of the ground water, either by monitoring at the proposed site or by providing other data judged adequate by the permit writer, such as local boring logs. In those cases where shallow ground water may pose a problem, the applicant may be able to add sufficient fill in the area to elevate the base of the unit a safe distance above the ground water.

The distance to the nearest surface water or place of human habitation also can affect the design and construction of OB and OD units. The placement of an OB or OD unit should be such that it is physically as far away as practicable from either receptor. The OB/OD unit also should be located down wind from the prevailing wind direction, as depicted in the wind rose submitted with the permit application. In addition, if there is a potential for runoff from an OB or an OD unit to nearby surface water, provision should be made to control such runoff.

The environmental setting in which the unit will operate also can have important effects on the design and construction of OB and OD units. The most obvious example is operation of such units in prairie environments. Designs should include the removal of large areas of grassland in the vicinity of unit operations to minimize the possibility of fire.

The presence of shallow ground water may necessitate the installation of an impermeable cap in the area of OB units. If such a cap is installed, controls will be necessary to manage runon and runoff. The applicant must provide for sampling of the runoff to determine whether it is contaminated and to explain how such runoff will be managed if it is found to be contaminated. The presence of shallow ground water at OD units may require a change in the design to add sufficient fill at the unit to minimize or eliminate any effects on ground water. In such cases, management of the fill to minimize loss from slumping or erosion will be a necessary part of unit operations. For both OB and OD units, the applicant must provide explicitly in the permit application for the removal and disposal of contaminated soils and debris.

Should pathways to nearby surface water be evident, runoff controls (for example, berms) will be necessary. It also is important to remember that runon controls for OB units also are necessary under such circumstances. Typically, such controls cannot be established at OD units because of their nature.

Operational concerns related to units located near places of human habitation include noise abatement and control of emissions from burns or detonations. Noise abatement measures may include restriction of operations to business hours and weekdays, or advance notice to local residents of the times of detonation. Measures that are deemed necessary should be included in the application.

The applicant must provide for monitoring of wind direction and speed as part of the decision-making process for the initiation of a burn or detonation. The permit should provide for conditions that stipulate that operations must be postponed if (1) the wind speed is too high or (2) the wind direction is toward nearby receptors that would be adversely affected by OB/OD activities. In the review process, the permit writer should determine whether the placement of the monitoring station will allow such monitoring to provide real-time indication of wind direction and speed. Obtaining such data is especially difficult when there is a great deal of relief in the surrounding topography. The permit writer should require a demonstration that the winds at the reporting site are representative of local winds. That determination is a subjective one, and the permit writer should seek appropriate guidance in making it. As a rule of thumb, if meteorological stations are located at approximately the same altitude as, and within a few miles of the location of the unit, they likely will provide sufficient quality of data to support the necessary decisions.

The environmental setting in which a unit operates also can have implications for process operations. To continue the example of an OB or OD unit operating in a prairie, the risks of fire typically is higher in the dry summer period than in other seasons. It therefore may be necessary that the permit application include a discussion of conditions under which firefighting apparatus will be required on site during the operations, and to require that inspections after operation be performed more often than proposed under wet conditions. Other operational changes might include a wetdown of the area around the unit before it is operated, a decrease in the net explosive weight (NEW) to be treated, or a ban on all but emergency operations during dry periods.

Three other aspects of the environmental setting have the potential to affect unit operations: the presence of any endangered plant or animal species, the migratory pathways of animals, and the level of environmental impact. Some conditions related to these factors might require that significant changes be made in operations.

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.

2.2.1.2 Methodology of Waste Analysis and Emissions Characterization

With the exception of improvised explosive devices (IEDs), which by their nature are unknown, the waste to be burned or detonated will have been identified by the type of explosive, munitions, or other energetic material listed. Care should be taken to ensure that the permit application's list of types of explosives, munitions, and energetic material is complete. Permit applications sometimes will list only one or two types of waste that will be managed, when in fact many other types are expected to be treated at the unit. The permit writer may wish to discuss this issue directly with the applicant before the permit application is submitted to ensure that the applicant understands that all waste types to be managed at the unit must be listed.

The applicant must indicate the chemical composition and EPA waste code of for the types of explosive, munition, or other energetic materials listed. For explosives and many other energetic materials, that information is provided in MSDS sheets. In the case of ammunition, the information is available in fact sheets about each type of ammunition, in various military manuals, and in the Munitions Items Disposition Action System (MIDAS) database. Although still in the process of development, MIDAS provides a reliable list of the types of materials found in many munitions. Enough information should be provided to accurately describe the wastes being treated and the estimated emissions.

Characterization of emissions from OB/OD operations typically is far more difficult a task than waste characterization. The "BangBox" study developed for U.S. Army includes most of the major research done on emissions from OB or OD operations. The study focused on a limited number of explosives and is useful to approximate the types of emissions from these operations. It may be necessary, in some cases (i.e., where wastes are dissimilar to those tested in the bang box study), to allow the unit to operate for a brief period to determine the types of emissions generated by the wastes. A monitoring system and analysis of the emissions will be required to make a complete determination of emissions. As an alternative, the facility may be able to submit studies of similar OB/OD activities that provide information about emissions. It is important to stress to the applicant that emissions change with changes in the waste feed and that the applicant is responsible for determining all emissions from wastes treated at the unit.

2.2.1.3 Minimization of Releases of Hazardous Waste or Constituents From the Unit

Minimization of releases from OB and OD units, a responsibility of every permit applicant, is discussed in greater detail in Chapter 5.

The presence of shallow ground water or nearby surface water both increase the importance that treatment residue ejected during OB or OD operations be removed from the soil surface as soon and as safely as possible. The permit applicant should provide a description of process operations providing for a cleaning of the treatment area of visible pieces of debris. In cases where runoff controls have been installed, the permit applicant should describe how collected liquids are managed, including a sampling and analysis program to determine whether such runoff is contaminated.

In the case where an OD unit is suspected of significant soil contamination, it is essential to determine the extent of contamination in the soil. The description of unit operations should provide for periodic sampling and analysis of the soil in and around the craters formed by OD operation. The application also should provide for the excavation and disposal of soil found to be contaminated at a level above an explicitly stated action level. Where soils are not likely to be contaminated below the surface, and where surface runoff is not a concern, less frequent sampling and analysis of soils is needed.

2.2.1.4 Closure of the Unit

Closure of OB/OD units typically will proceed in a manner similar to closure of other land-based units, such as land treatment units. Issues related to ground water, surface water, nearby places of human habitation, and environmental setting again have effects on closure activities.

At some military installations, an OB or OD area will be the last range operation to close. Upon shutdown of the range(s) at these installations, the cognizant military authority will develop a plan to "close" the ranges so that they do not present a hazard to human health. That closure initially involves the removal of UXO from the range. OB and OD units that are located at active ranges may have UXO on site that must be rendered safe before any remedial action can begin. In these cases, the permit writer should review the closure plan presented in the permit application in light of such considerations and either suggest or require that closure operations commence after the area under and around the unit has been rendered safe. UXO will not likely be an issue at OB/OD units located at depots and ammunition plants.

2.2.1.5 Approach Taken to the Environmental and Risk Assessments

It is likely that preparation of detailed environmental assessments, and subsequent detailed risk assessments, will be the norm in the case OB and OD units, because of the large number of variables associated with such operations and the high level of public concern.

One approach to the determination the adequacy of such assessments is to review the conceptual site model (CSM) information included in the risk assessment and determine whether all of the pathways identified the CSM have been addressed in the environmental assessment. In a similar approach to reviewing detailed assessments, the permit writer should determine that the data gathered in the environmental assessment actually have been used in the risk assessment. Doing so requires comparison of various pieces of environmental data with the data used in the risk assessment.

Results of air dispersion, ground water, and multimedia modeling typically are used in the risk assessment when the applicant is attempting to extrapolate the data that already have been collected using various monitoring techniques. However, models can easily be misapplied and the results obtained from them misused. When the results of modeling are used to support a risk assessment, the application must include validation data for the models used and a discussion of the operating parameters of the model and how those parameters compare with the phenomena the applicant is attempting to model. Comparison of that information sometimes will yield evidence that the model selected was not appropriate for the task. Discussions of models and their use are presented in Chapters 4 and 5.

2.2.2 Areas of Special Concern for the Review of Permit Applications for Regeneration and Thermal Desorption Units

Areas of particular concern to the permit writer reviewing a permit application for regeneration or thermal desorption units are:

- Design of the unit
- Operation of the unit
- Management of emissions from the unit

These areas are of special concern because sufficient information can be obtained by considering them to allow the permit writer to determine whether such units would be more appropriately permitted under another standard, such as those for BIFs or tanks.

The discussion below first will focus on some issues associated with making the determination to permit a unit under some authority other than subpart X. The permit writer should understand that simply meeting one of the rationales below may not be sufficient to allow permitting of the unit as something other than a subpart X unit, but that meeting two of three probably would allow such permitting. In the end, it is at the discretion of the permit writer whether to require permitting under subpart X or under some other standard. The discussion then focuses on characterization and management of emissions from such units.

2..2.2.1 Design of the Unit

Many regeneration units are designed as rotary kilns, fluidized-bed reactors, multiple-hearth furnaces, or tank systems. In the past, such units were permitted as miscellaneous units, rather than as BIFs, because they managed different waste streams than BIFs and presented issues related to permitting that were sufficiently different that the units should be addressed differently. In some cases, this circumstance still exists; however, a permit writer should look carefully at the design of the unit to determine to what extent, if any, it is different from a BIF or a tank system. Waste type differences are not normally the deciding factor. If no significant differences can be identified, it is probably appropriate to consider the unit a good candidate for permitting under another standard subpart of part 264, thereby removing some uncertainty from the permitting process by providing more specific design and operating standards.

2.2.2.2 Operation of the Unit

Part of the process of determining whether it is appropriate to permit the unit under another requirement is comparison of the description of the unit's operation with the requirements for BIFs or tanks determine whether the operations qualify for subpart X permitting. If the description of the operation is similar to the description of a conventional hazardous waste management unit, that fact supports permitting such treatment under the appropriate subpart of part 264. Typically, the design is also similar; it therefore would be appropriate to permit the unit under the alternative standard.

2.2.2.3 Management of Emissions From the Unit

Regeneration units are not intended to destroy the wastes managed in them, but rather to strip them from adsorption media, so that the media can be reused. Therefore, there is potential that emissions from such units can cause environmental problems.

The permit applicant should characterize the waste that the adsorptive medium was being used to treat. The applicant can then use kinetic models to predict the concentration of the waste on the medium and the consequent emissions, based on operating temperature and time in the process. While this approach is a reasonable one, it must be verified for each waste to determine that variables affecting the operating system, such as temperature and desorption efficiency, are within the appropriate parameters.

Emissions from regeneration units often are of low concentration because of the adsorptive capacity of the medium and the concentration of the waste stream. Nevertheless, the applicant must demonstrate to the permit writer that (1) the unit is equipped with sufficient emission controls to minimize emissions and maintain them at levels below the concentrations determined under the risk assessment. In the case of organic wastes, such controls may include afterburners or scrubbers, while for metals, the control more often will be a scrubber.

3.0 INFORMATION REQUIREMENTS

A subpart X permit applicant must provide both general and specific information about the miscellaneous units described in the application. General information requirements for all RCRA permit applications, including those for miscellaneous units, are specified in §270.14. The specific information requirements for subpart X units, set forth in §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 Model Permit for Hazardous Waste Management Facilities, the RCRA Permit Quality Protocol, and draft Permit Writers' Guidance Manual for Hazardous Waste Land Treatment, Storage, and Disposal Facilities, EPA 1983, for assistance in reviewing subpart X permit applications.

3.1 PHYSICAL AND CHEMICAL CHARACTERISTICS OF WASTES AND RESIDUES

The permit application for a miscellaneous unit, such as an OB/OD 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 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.

3.2 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. 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 §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 about 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.

3.2.1 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 about 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 units, the primary parameters may include flash point, stability test, and detonation test. Generator/user knowledge may also be adequate for characterizing waste reactivity.

3.2.2 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.

3.2.3 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.

3.2.4 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 actually received 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).

3.2.5 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.

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

3.3.1 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. To achieve clean closure, the soils in the vicinity of the unit, which may be contaminated by the ash 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 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, if the permit applicant is unable to differentiate between releases from the OB/OD operations and those of the range. 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.

3.3.2 Post-Closure Care Requirements

Requirements for post-closure care are specified in §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, section 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.

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3.4 WASTE AND RESIDUALS 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. The following subsections describe methods that may be used to characterize wastes treated in subpart X units and subsequent residues from subpart X treatment processes.

3.4.1 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.

3.4.1.1 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.

Subpart X permit applicants also may use technical manuals to characterize wastes. Technical Manual 9-1300-214, *Military Explosives*, is a comprehensive manual on military energetic materials. The permit writer may require that permit applicants use the manual to obtain additional detailed information about the chemical and physical characteristics of explosive fillers and propellants. TM 9-1300-214 also provides information about the toxicity of energetic materials, along with procedures for detection, identification, disposal, and decontamination. Table 3.1 presents a list of military TMs that include data sheets.

Table 3.1 Military Manuals Containing Explosives Information

Publications	
Technical Manual	**Army Ammunition Data Sheets**
TM 43-0001-27	Small Caliber Ammunition
TM 43-0001-28	Artillery Ammunition, Guns, Howitzers, Mortars, Recoilless Rifles, Grenades Launchers, and Artillery Fuzes
TM 43-0001-29	Grenades
TM 43-0001-30	Rockets, Rocket Systems, Rocket Fuzes, and Rocket Motors
TM 43-0001-36	Land Mines
TM 43-0001-37	Military Pyrotechnics
TM 43-0001-38	Demolition Material
TM 9-1325-200	Bombs and Bomb Components

3.4.1.2 Use of Material Safety Data Sheets (MSDS) and Other Information From the Explosives Industry

MSDSs from manufacturers of explosives can be good sources of information to be used as a starting point for the formulation of a waste analysis plan for an OB/OD unit. MSDS for energetic materials contain information including physical description, other names, chemical formula, health hazards, exposure limits and effects, and reactivity data and flashpoint.

Although MSDSs may be useful in characterizing explosives that are proposed to be treated in an OB/OD unit, to date, there have been no studies performed for or by commercial explosives manufacturers about the characterization of residues from OB/OD operations. Nor is there a single document that contains all the MSDSs for explosive and energetic materials. Permit applicants could request such MSDSs from individual manufacturers; however, if a permit applicant is using such materials, the applicant must provide MSDSs in conjunction with other information when discussing the safety and toxicological aspects of the residue being generated from OB/OD operations.

3.4.1.3 Munitions Items Disposition Action System (MIDAS)

The Munitions Items Disposition Action System (MIDAS) Program is an ongoing project of the U.S. Army Defense Ammunition Center and School that provides support to the military services for the demilitarization and disposal of ammunition. The MIDAS team has developed on CD-ROM, demilitarization and disposal information for ordnance, including:

1) Relational databases of munitions, components, constituents, and current inventories

2) Alternatives for demilitarization, recovery, and recycling

3) Cutaway images detailing munition configuration and relative size

4) Mathematical representations of 28 shapes for use in estimating weights of explosives, parts, metal paintings, and paint finishes

5) A database of information on OB/OD, incineration, removal, and environmental permits issued to military installations

6) A database of 85 emerging technologies for disassembly, removal, recovery, and reuse of munitions and treatment of wastestreams.

The MIDAS databases are periodically updated as additional data becomes available. The MIDAS team recently developed a waste stream analysis program for incineration of munitions and currently is working on a similar program for OB and OD units. The permit writer should be aware that the MIDAS database is limited, and does not provide summaries of munitions families, but only individual items. For more information about the MIDAS program, and availability of the program on CD-ROM, visit the MIDAS Internet site at "http://206.39.34.252/midas/index.html."

3.4.1.4 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

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.

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.

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. EPA has developed an approved test method for category 3. The method defines a waste as exhibiting the characteristic of reactivity if it generates more than 250 mg of hydrogen cyanide gas or 500 mg of hydrogen sulfide gas per kilogram of waste. If the toxic emissions from the unit cannot be characterized by this method, the permit writer should require that the applicant describe how the waste will be managed to protect human health and the environment.

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 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 tests 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.

3.4.2 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 emissions. 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.

3.4.2.1 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 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.

3.4.2.2 Solid Residues

Permit applicants should provide permit writers with a description of the process to be used to characterize solid residues 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 only need to be analyzed only for metals and organic constituents to determine treatment and disposal options, as mandated by the LDRs.

3.5 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.

3.5.1 Location Requirements

A miscellaneous unit, such as an OB/OD unit, must be located in a manner 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) and in Tables 4.1 and 4.2 of the RCRA part B Permit Writer's Guidance Manual for Commercial Explosives Industry, prepared by the Institute of Makers of Explosives. 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 the commercial information may have been 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, §265.382 provides the acceptable minimum distances between OB/OD units and other properties.

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.

3.5.2 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. A description of the unit that is sufficiently detailed should provide all the information required to evaluate adequately the potential affect of the unit’s operation on the environment. 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 runon and runoff

- A description of procedures to control releases of 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

3.5.3 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.

3.5.4 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 (discussed in Sections 6.3 and 6.4) 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 6 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 6.

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.

3.5.5 Effectiveness of Treatment

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

<u>Types of Methods:</u> 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.

<u>Type of Energetics:</u> 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 (See Table 3.2 and 3.3). Similarly, higher percentages of carbon monoxide, volatile organize 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.)

Table 3..2
Distribution from Carbon-Containing Species Measured From TNT

Species	**Percent**
Carbon Dioxide	97.20
Carbon Monoxide	0.50
C1 to C10 volatile hydrocarbon and other organics	0.57
Elemental carbon (soot)	1.71

Table 3.3
Carbon-Containing Species Measured from Propellant Burns

	Percent Double-Base	**Percent Composite**
Carbon Dioxide	99.64	99.88
Carbon Monoxide	0.15	0.11
Organic Carbon	0.21	0.00

	Percent Double-Base	Percent Composite
Elemental carbon (soot)	0.00	0.01

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 indicated in Table 3.3. 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.)

Table 3.4 presents health based criteria for potential contaminants. Table 3.5 presents threshold concentrations for RDX for various media adopted by Region 9. 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.

Table 3.4
Health Criteria for Potential Contaminants

Constituent	Criteria (mg/L)
RDX	0.4[a]
HMX	20[a]
DNT	0.02[a]
DNB	0.00005[b]
Lead	0.004[b]
Silver	0.05[b]
Chromium	2.0[b]
Potassium	0.1[b]

[a] Drinking Water Health Advisory
[b] RCRA Action Level

Table 3.5
EPA Region 9 Threshold Concentrations for RDX

Residential soil	4 mg/kg

Residential soil	4 mg/kg
Industrial soil	17 mg/kg
Tap water	0.61 mg/L
Ambient air	0.061 mg/n3

3.5.6 Other Appropriate Requirements for subpart X Units

This section provides guidance to the permit writer in determining which standards specified in subparts I through O are pertinent to miscellaneous units, such as OB/OD units. Regulations in §264.601 state that the terms and provisions of subpart X permits are to include those requirements of subpart I through O of part 264, part 270, and part 146 that are appropriate for the miscellaneous unit being permitted.

3.5.6.1 Application of Subparts I Through O to OB/OD Units

Subpart I - Containers
Subpart I addresses the use and management of containers, 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 need for secondary containment (§264.175(c)) also should be evaluated, especially if the wastes treated in the unit contain liquids.

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 refracting 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 such 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 (§264.197). Assessment of the integrity of a unit that resembles a tank (§264.191) can be addressed adequately by conducting inspections on a regular schedule (either daily, weekly, or monthly depending on the frequency of use).

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 need for monitoring of the ground water beneath the unit should be evaluated. The surface impoundment should be inspected weekly to detect evidence of any sudden drops in the level of the impoundment's contents and signs of deterioration in dikes or other containment devices (§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 (§264.221(g) and (h)).

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 leachate expected to be generated (§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 (§264.251(a)(l)(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 runon and for runoff and conducting ground-water monitoring, if the environmental assessment indicates that there is potential for contamination of the ground water. The runon control system should be capable of preventing flow onto the active portion of the waste pile during peak discharge from a 25-year storm (§264.252(g)). The runoff management system should be capable of collecting and controlling the water volume resulting from a 25-hour, 25-year storm (§264.252(h)). The pile should be managed to control any particulate matter subject to wind dispersal (§264.252(j)). The waste pile should be inspected weekly and after storms (§264.254(b)).

Subpart N - Landfills

Subpart N establishes requirements for landfills. OB/OD units should be clean closed, if possible. If clean closure is not feasible, the closure standards and requirements for post-closure care that are applicable to landfills are applicable to these units. Upon closure, the landfill must be covered with a final cover and must meet other monitoring requirements (§264.310).

Subpart O - Incinerators

Subpart O establishes requirements for incinerators. Use of the subpart O requirements may be appropriate for some thermal treatment units, such as carbon and catalyst regeneration units. These requirements include waste analysis requirements (§264.341), the potential need for a trial burn (§264.340(d)), acceptable operating limit for each type of waste feed (§264.345(b)), control of fugitive emissions (§264.345(d)), and monitoring and inspection requirements (§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.

3.5.6.2 Application of Subparts AA Through CC

These subparts establish standards for air emissions from such sources as vents, pumps, and units such as tanks.

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). For example, 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 §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 §264.1032(a), the device must meet the requirements governing closed-vent systems and control devices specified in §264.1033.

Subpart BB applies to equipment, such as pumps, 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. Where applicable, permit applicants must submit information that demonstrates compliance with all requirements of subparts AA and BB.

Subpart CC applies to owners or operators that store or treat hazardous waste in containers, tank systems, or surface impoundments. Applicants should submit information that demonstrates compliance with those requirements if the units resemble the types of units regulated under subpart CC, as described above. Examples of units subject to subpart CC may include tank-like devices such as drum crushers and shredder units.

3.6 PREVENTION OF RELEASES TO GROUND WATER 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.

3.6.1 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.

3.6.1.1 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.

3.6.1.2 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.

3.6.2 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.

3.6.3 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 ground water.

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.

3.6.4 Existing Quality of Ground water, Quantity and Direction of Ground water Flow, and Proximity to and Current and Potential Withdrawal Rates of Ground water 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.

3.6.5 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

3.6.6 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. Section 7 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.

3.7 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 §265.601(b).

3.7.1 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.

3.7.2 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 refactory 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

3.7.3 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

3.7.4 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.

3.7.5 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.

3.7.6 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

3.7.7 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.

3.7.8 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 7 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.

3.8 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.

3.8.1 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.

The primary reason a permit writer may wish to include closures activities in a larger range remediation, ard 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 §264.113.

3.8.2 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 *RCRA Facility Investigation Guidance* (EPA 1989), *Guidance for the Data Quality Objective Process* (EPA 1994b), and *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (EPA 1994 c).

3.8.3 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.

3.9 REFERENCES

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

DA. 1984. *Military Explosives*. TM 9-1300-214.

DA. 1982. *General Instructions for Demilitarization/Disposal of Conventional Munitions*. TM 9-1300-277.

DA. 1973. *Ammunition and Explosives Standards*. TM 9-1300-206.

DA. 1969. *Ammunition Maintenance.* TM 9-1300-250.

DoD. 1978. *DoD Ammunition and Explosive Safety Standards*. DoD 5154.4.

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. 1994c. *Requirements for Quality Assurance Project Plans for Environmental Data Operations.* EPA QA/R-5.

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

EPA. 1989. *Interim Final RCRA Facility Investigation Guidance Volumes I through IV*. EPA 530/SW-89-031

EPA. 1982. *Financial Assurance for Closure and Post-Closure Care: Requirements for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities.* SW-955.

4.0 ENVIRONMENTAL ASSESSMENTS, MONITORING, AND MODELING UNDER SUBPART X

This section discusses approaches to monitoring or modeling potential releases from subpart X units. Its focus is on OB/OD units because typically they represent the majority of subpart X units, and 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.

4.1 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 specific performance standards for each environmental medium. Specific performance standards are set forth in §264.601.

The environmental assessment information required of permit applicants includes:

- Detailed hydrologic, geologic, and meteorologic assessments and land-use maps for the region in the vicinity of the site that address and ensure compliance of the unit with each factor in the environmental performance standards set forth under §264.601

- Information about the potential pathways of exposure of humans or environmental receptors to hazardous waste or hazardous constituents and about the potential magnitude and nature of such exposures

- For any treatment unit, a report on a demonstration of the effectiveness of the 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 §264.601

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 §264.601. Typically, a detailed assessment should be required for OB/OD units and for regeneration and thermal desorption units that vent to the atmosphere. The permit writer should accept a preliminary assessment only if the applicant can demonstrate convincingly that releases from the unit will be minimal.

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.

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 in this guide 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.

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

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

4.2.1 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, other important concerns may be deposition from the air to soil surfaces or surface water. 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, will reduce the concentration of a contaminant in a plume, but will 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. Under the requirements of subpart X, air quality and meteorological assessments are required by §§270.23 (a) and (b), and 264.601(c).

If a permit applicant can demonstrate without conducting a detailed air assessment that air releases from the subpart X unit will be minimal and will not exceed acceptable levels, only a preliminary air assessment is required. 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.

The permit applicant will use either a screening assessment or a refined assessment to perform detailed air assessments. 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.

Presented below is a discussion of the appropriate approaches and techniques for monitoring and modeling releases to air for both screening and detailed air assessments.

4.2.1.1 Emissions Quantification

Generally, two types of analyses are used to quantify emissions from a subpart X unit: emission monitoring and emission modeling. The results of emission quantification analyses can be used in dispersion modeling analyses to determine downwind concentrations and can be used to determine compliance with emission standards. This section provides the permit writer with background information to assist in evaluating an applicant’s analysis.

Two kinds of emission monitoring usually are 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 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 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.

It should be noted that area source monitoring, due to the inability to control atmospheric conditions and the inherently rapid, intermittant 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 Sprectroradiometer-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. 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 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.

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.

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).

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.

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 (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

- 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 manufacturer's emission test data to quantify the emissions, rather than conducting source emission monitoring. If source emission monitoring is done, 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 monitoring method used by the applicant was developed. subpart X units for which there may be emission source test data are carbon desorption units and carbon and catalyst regeneration units.

Permit applicants having OB/OD units often must conduct area source monitoring to quantify airborne emissions. As discussed earlier, OB/OD releases 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. In addition, unless existing emission data from other sites match the munitions and characteristics of releases at the applicant's site, those data should not be used.

4.2.1.2 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:

- *On-Site Meteorological Program Guidance for Regulatory Modeling Applications*. (EPA 1987).

- *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 a 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 1987) for on-site meteorological monitoring. Table 4.1 lists the recommended accuracies, along with recommended measurement resolutions for the meteorological parameters. The values listed in Table 4.1 apply to digital systems (analog systems are permitted 50 percent additional error).

TABLE 4.1
RECOMMENDED SYSTEM ACCURACIES AND RESOLUTIONS

Meteorological Parameters	System Accuracy	Measurement Resolution
Wind Speed (horizontal and vertical)	± (0.2 m/s + 5% of observed)	0.1 m/s
Wind Direction (azimuth and elevation)	± 5 degrees	1 degree
Ambient Temperature	± 0.5°C	0.1 °C
Vertical Temperature Difference	± 0.1°C	0.02 °C

Meteorological Parameters	System Accuracy	Measurement Resolution
Dew Point Temperature	± 1.5°C	0.1 °C
Precipitation	± 10% of observed	0.3 mm
Pressure	± 3 millibar (mb) (0.3 kPa)	0.5 mb
Radiation	± 5% of observed	10 W/m^2
Time	± 5 minutes	-

Source: *On-Site Meteorological Program Guidance for Regulatory Modeling Applications*

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:

- 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

4.2.1.3 Compliance Monitoring

This section discusses the requirements for compliance monitoring programs.

Detection and Monitoring Requirements
Procedures for and frequencies of monitoring, testing, collection of analytical data, inspections, response, and reporting must ensure compliance with 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. Typically, 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.

4.2.2 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 §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?

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 (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), which provides extensive guidance for the placement and operation of such systems, when evaluating groundwater monitoring plans submitted by the permit applicant.

4.3 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.

4.3.2.1 Air Dispersion and Emission Modeling

This section provides information to assist permit writers with the evaluation of air dispersion and emissions modeling proposed by permit applicants.

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 1995a) 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 1995a). 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 1995a).

In general, a modeling analysis should follow closely the EPA modeling guidelines presented in *Guideline On Air Quality Models*. Permit writers should refer to the document when evaluating an approach to modeling. The permit applicant should identify clearly and justify any deviations in the application from the guideline. 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.

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 conservativism, 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 *Compilation of Air Pollutant Emission Factors* (EPA 1995c). Existing "BangBox" data for OB/OD operations 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 4.2 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 4.2 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 4.3 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 4.3 is not intended to be an exhaustive compilation of appropriate refined models for subpart X permitting.

TABLE 4.2
PREFERRED SCREENING AIR DISPERSION MODELS
AND THEIR USES

MODEL CHARACTERISTIC	SCREEN3[1]	TSCREEN[2]	CTSCREEN[3]
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

MODEL CHARACTERISTIC	SCREEN3[1]	TSCREEN[2]	CTSCREEN[3]
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.

TABLE 4.3
PREFERRED REFINED AIR DISPERSION MODELS AND THEIR USES

MODEL CHARACTERISTIC	REFINED MODELS								
	ISC3[1]	RAM[2]	CTDMPLUS[3]	INPUFF[4]	CALPUFF[5]	OBODM[6]	DEGADIS[7]	HGSYSTEM[7]	SLAB[9]
Source Types	Point, Area, Volume	Point, Area	Point	Point, Area	Point, Area, Volume, Line	Open burn, Open detonation	Point, Area	Point, Liquid Pool	Point, Liquid Pool, Volume
Terrain Types	Simple, Complex	Simple	Complex	Simple	Simple, Complex	Simple, Complex	Flat, Unobstructed	Flat, Unobstructed	Flat, Unobstructed
Release Mode	Continuous	Continuous	Continuous	Continuous, Instantaneous	Continuous, Instantaneous, Time Variant	Instantaneous, Short-duration, Continuous	Continuous, Instantaneous, Time Variant	Continuous, Instantaneous, Time Variant	Continuous, Instantaneous, Time Limited
Averaging Time	1 Hour to Annual	1 Hour to Annual	1 Hour to Annual	Minutes to a Few Hours	1 Hour to Annual	Unknown	1 Hour or less	1 Hour or less	1 Hour or less
Land Use	Rural or Urban	Urban	Rural or Urban	Rural or Urban	Rural or Urban	Unknown	Rural or Urban	Rural or Urban	Rural or Urban
Contaminant Type	Gas or Particulate	Gas or Particulate	Gas or Particulate	Gas or Particulate	Gas or Particulate	Gas or Particulate	Gas or Aerosol	Gas or Aerosol	Gas or Aerosol
Applicable Range	≤50 km	≤50 km	≤50 km	To 10s of Kilometers	To 100s of Kilometers	Unknown	Computed by Model	Computed by Model	Computed by Model
Generic or Real Meteorological Data?	Real	Real	Real	Real, with Gridded Wind Field	Real, Time and Space Variable	Real	Real, Limited	Real, Limited	Real, Limited
Model Chemical Reactions?	No (Except Exponential Decay)	No (Except Exponential Decay)	No	No	Yes, Common Chemical Reactions	No	No	No (Except for Hydrogen Fluoride)	No
Dry Deposition Calculations?	Yes	No	No	Yes	Yes	No	No	No	No

MODEL CHARACTERISTIC	REFINED MODELS								
	ISC3[1]	**RAM[2]**	**CTDMPLUS[3]**	**INPUFF[4]**	**CALPUFF[5]**	**OBODM[6]**	**DEGADIS[7]**	**HGSYSTEM[7]**	**SLAB[9]**
Wet Deposition Calculations?	Yes	No	No	No	Yes	Yes	No	No	No
Model Negatively Buoyant Gases?	No	No	No	No	No		Yes	Yes	Yes
Single or Multiple Sources per Simulation?	Multiple	Multiple	Multiple	Multiple	Multiple		Single	Single	Single

[1] Industrial Source Complex 3 model
[2] Gaussian-Plume Multiple Source Air Quality Algorithm
[3] Complex Terrain Dispersion Model Plus Algorithms for Unstable Situations
[4] Integrated Puff Model
[5] CALPUFF Dispersion Model
[6] Open Burn Open Detonation Model (This model should become available in 1997.)
[7] Dense Gas Dispersion Model
[8] Dispersion Models for Ideal Gases and Hydrogen Fluoride
[9] SLAB Dispersion Model

It should be noted that a dispersion model is currently being developed under DOD/DOE Strategic Environmental Research and Development Program (SERDP) specifically to address release and dispersion characteristics from OB/OD sources. The model is a gaussian puff model, and will probably be called the Open Burn and Open Detonation Model (OBODM). There is a current OBODM model which the US Army Dugway Proving Ground (DPG) has developed. Utah currently requires the use of thie OBODM-DPG model. This model is also being used as the basis for the OBODM-SERDP model.

This OBODM-SERDP model, when ready for operational use, will address dispersion characteristics of near instantaneous and short-term releases from OB/OD sources which are not treated well in other dispersion models. The model will include: "1) a continuous treatment of dispersion as the release condition varies from instantaneous to continuous, 2) cloud and plume rise obtained from appropriate entrainment models, 3) cloud and plume penetration of elevated inversions, 4) relative (puff) and total dispersion based on modern scaling concepts for the planetary boundary layer (PBL), and 5) a capability for the use of onsite profiles of wind, temperature, and turbulence from a mobile meteorological platform."(Weil, et al. 1996). When this model becomes available, it is expected that it will be the preferred model for evaluating OB/OD operations. 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.

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-SERDP
The Open Burn and Open Detonation Model (OBODM-SERDP) is a gaussian dispersion model for evaluating downwind concentrations or deposition values from open burn and open detonation sources. A gaussian puff approach is used for open detonation sources, and open burn sources are evaluated using puff, integrated-puff, and plume dispersion techniques. OBODM-SERDP has been designed to simulate contaminant release and dispersion characteristics that occur with OB and OD sources. OBODM-SERDP features dispersion expressions that address cloud and plume rise from high energy releases, plume penetration of inversion layers, and the turbulence structure of the planetary boundary layer. The model provides continuous treatment of dispersion as a release changes from instantaneous to continuous. OBODM-SERDP has the capability to use standard meteorological data from National Weather Service, or sophisticated meteorological profiles from an on-site mobile meteorological platform. It is expected that the mobile meteorological platform will be used primarily for research applications. When released, OBODM-SERDP will be able to calculate contaminant concentrations and deposition values, and will be able to address simple and complex terrain issues.

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, multicompound 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 subitem 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. Under certain conditions, several point sources in close proximity may be merged in a screening analysis. The specific conditions and directions for merging stacks are presented in *Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised* (EPA 1992). 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 from another source that emits 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 also must 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) can 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 4.3 and the model descriptions of models provided in this guidance 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 probably will 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 meteorologica, 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 4.3, those that use detailed meteorological data include ISC3, RAM, CTDMPLUS, INPUFF, CALPUFF, and 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 *On-Site Meteorological Program Guidance for Regulatory Modeling Applications* (EPA 1987). 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 CTDMPLUS (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 recently was revised to handle complex terrain better and is an acceptable model for applications to complex terrain. When using a model that cannot address complex terrain an applicant also may 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 differ 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 4.3 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 health or the environment. 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 4.3 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 NO_2 can be estimated by postmodeling calculations. Usually, a conservative assumption is made that all the NO_x converts to NO_2 in the atmosphere. If a permit applicant has included a transformation calculation from NO_x to NO_2 in the modeling analysis, the permit writer should refer to *Guideline 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 §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 to an understanding of 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 4.2.1.2 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. Examples of areas of inadequacy include:

- The permit application must model multiple intermittent sources; currently, no screening models are available to model that situation.

- Chemical transformations are important in plume dispersion dynamics at the unit; currently, no screening models are available to model that problem.

The permit writer should evaluate carefully any screening models that are not in Table 4.1 or in appendix A or B of *Guideline 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 results of modeling. 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 4.3, ISC3 is the most commonly used and accepted for regulatory applications. Other models in Table 4.3 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 is currently under development specifically to model OB/OD emissions. The OBODM algorithms are reportedly able to address the unique disperion characteristics associated with such operations. It is expected that OBODM will be the preferred model for addressing OB/OD emissions when it becomes available.

Figure 4-1 presents a subpart X model selection decision tree for selection of models for subpart X units. The decision tree has two parts, screening analyses and refined analyses. Decisions about which model should be used are based on each model's capabilities and the site-specific criteria that must be met. Only models presented in Tables 4.2 and 4.3 are included in Figure 4-1. It is important to note that this decision tree is a guide only. Neither should it be construed that the models listed in this document are the only models capable of performing modeling tasks for subpart X units. Often, professional judgment is required on a case-by-case basis to make a final decision about the most appropriate model for a given task. Figure 4-1, however, does provide the permit writer with a decision-making tool to assist in determining which model is the best one for a specific use.

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.

4.3.2.2 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 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) is as a guide to 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 below.

TABLE 4.4
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 4.5
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				

4.4 AIR REFERENCES

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5.0 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 fisk assessment may be focused towards solving the appropriate questions and confucted in the most expedient ad 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.

5.1 OVERVIEW OF ASSESSMENT OF ECOLOGICAL AND HUMAN HEALTH RISK

As set forth in §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 an OB/OD 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 an OB/OD unit is consistent with that provided by other EPA guidance for incineration and combustion units (EPA 1985, 1989, 1990, 1993, 1994), while incorporating information specific to operations of OB/OD units, the waste streams they generate, and the hazards they pose.

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 OB/OD 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. Figure 5-1 presents a flowchart for the tiered risk assessment evaluation.

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 concentration. Calculation of risks or hazard indices (HI) 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 hazard indices in the screening evaluation is specified under each of the subsections of the risk assessment components. If risks and hazard indices affecting humans calculated in the screening level evaluation are below $\mathbf{10^{-5}}$ and **0.25**, respectively, no further evaluation is necessary (EPA 1994). If estimated risks and hazard indices 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 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 hazard indices 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.

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.

5.2 EVALUATION OF MEDIA FOR INCLUSION INTO A RISK ASSESSMENT

Figure 5-2 presents media potentially affected by OB/OD operations. The figure provides the CSM for an OB/OD unit risk assessment; the CSM is described in detail in the next section. From the OB/OD 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 OB/OD 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 OB/OD unit, that data may provide for establishing accurate release parameters and, therefore, risks associated with the planned OB/OD activity. Even if site data are available, modeling may be necessary to estimate runoff to surface-water bodies or leaching to groundwater. Figures 5-3 A, B, and C illustrate various transport mechanisms that may affect off-site media.

The evaluation of on-site areas in close proximity to the OB/OD 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 6, air modeling also predicts deposition rates, and therefore soil concentrations, at areas downwind of the OB/OD 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 OB/OD 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, 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 OB/OD 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 OB/OD 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.

5.3 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 OB/OD 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 an OB/OD 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 OB/OD 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 OB/OD 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 OB/OD 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):

- Preliminary site investigation
- Problem formulation
- Exposure assessment
- Toxicity assessment
- 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 OB/OD 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. The discussion of components of the risk assessment is based on the CSM presented in Figure 5-2.

5.3.1 Data Evaluation

Data to support quantitative assessment of risk at OB/OD 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 OB/OD 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 an OB/OD unit would not meet DQOs 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 OB/OD unit; modeled concentrations, such a those from an air dispersion model; or bioaccumulation equations, for uptake of chemicals into animals and plants from soil, groundwater, and surface water. Most risk evaluations involve some combination of measured and modeled data.

Screening Level Evaluation

Identification of COCs at an OB/OD 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. Table 5.1 presents some of the chemicals commonly found in energetic materials and combustion products that may be released during OB/OD. 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).

TABLE 5.1
Common Components and Reaction By-Products of Energetic Materials

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

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

The exposure point concentration must be estimated for each medium investigated. For air and soil in and around the OB/OD 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 terrestrial receptors), that too should be modeled, again using maximum concentrations as the exposure concentration for the end receptor. EPA guidance (1990, 1993, and 1994) 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 check lists 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 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.

5.3.2 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.

Figure 5-2 presents receptors that may be exposed to chemicals released during OB/OD, including on-site workers performing OB/OD operations on-site, and residents in the vicinity of the site using the area. Both direct and indirect exposure pathways are considered for workers on site, since direct contact with residues from OB/OD operations in soil and air may occur, and indirect exposure through deposition and storm water runoff also is possible. Only indirect exposure pathways are considered for residential and recreational receptors in the vicinity of the site. Indirect contact, with chemicals generated from OB/OD, by such residents may occur through ingestion of produce, meat, dairy products, or fish that have been exposed to chemicals from the OB/OD unit through deposition to soil or surface water and through plant 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 OB/OD 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 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 to screen sites if the pathways are representative of on- and off-site exposures in the vicinity of the OB/OD unit. However, additional site-specific information is used in the detailed risk assessment to identify exposure pathways that are most likely complete.

Figure 5-2 presents a comprehensive diagram of all potentially complete exposure pathways. 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 OB/OD 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 bases 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 x CR x EF x ED)/(BW x 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 OB/OD 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 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, upper-bound exposure parameters, are made in evaluating exposures for each receptor, and 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 OB/OD 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), 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).

5.3.3 Toxicity Assessment

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

Qualitative and quantitative toxicity values and specific information should be gathered for all COCs. Detailed toxicity profiles also should be generated. Sources of toxicity values include Integrated Risk Information System (IRIS) (EPA 1996) and Health Affects Assessment Summary Tables (HEAST) (EPA 1995). IRIS is a computerized EPA database that contains verified toxicity values and up-to-date toxicological and regulatory information about commonly used chemicals; it is updated monthly. HEAST is a source of unverified provisional toxicity information to be used when toxicity information is not available from IRIS; it is updated annually. If information on toxicity of chemicals is not provided by an applicant, permit writers should issue an NOD requiring the applicant to look at information in IRIS and HEAST.

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

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

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

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

- Current RfDs and RfCs and the toxicological basis for those values

- Overall database and critical study on which the toxicity value is based
- Target organ(s) and uncertainty factors
- Possible biochemical mechanism(s) of toxicity

Permit applicants should be required to obtain information about COCs that do not have toxicity values derived by EPA for exposure routes relevant to site exposures. For example, EPA has derived only a limited number of RfCs for the inhalation route of exposure, and few RfDs or CSFs have been derived for the dermal route of exposure. EPA guidance suggests, however, that in the case of dermal exposure, toxicity values may be derived from oral toxicity values. It is necessary to adjust the oral RfD and CSF to take into account differences between gastrointestinal and dermal absorption. To derive a dermal toxicity value for an absorbed dose from an oral toxicity value based on an administered dose, the oral toxicity value must be adjusted by the fractional oral absorption value. RfDs are multiplied by and CSFs are divided by the fractional oral absorption values, respectively. The following oral absorption values should be used in the absence of chemical-specific values: 80 percent for volatile organic compounds; 50 percent for semivolatile organic compounds; and 20 percent for inorganic chemicals (EPA 1994b).

Screening Level and Detailed Human Health Risk Evaluations

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

Screening Level and Detailed Ecological Risk Evaluations

Like human health risk assessments, there are no differences between the two tiers in the level of effort required for toxicity assessment. The objective of the toxicity assessment is “to establish the quantitative relationship between ecological effects and the concentration, dose, or exposure of a contaminant of concern” (Maughan 1993). Both screening level and the detailed risk evaluations should include tables that present the chemicals being evaluated at the unit, applicable toxicity values, and the sources of the toxicity values. Methodologies for assessing the toxicity of contaminants involve comparisons of estimated intakes with published data on the toxic effects of chemicals or conduct of original toxicity testing for individual OB/OD units. Qualitative and quantitative ecotoxicity values and chemical-specific information should be gathered for all COCs. Detailed toxicity profiles also should be prepared. In the absence of ecotoxicity information, conversions for species-to-species extrapolation may be applied to published data (EPA 1994).

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

- NOAEL = Acute or subchronic LOAEL/10

- NOAEL = Chronic LOAEL/5
- NOAEL = (LD_{50}/5)/10
- NOAEL = NOAEL $_{\text{different family-same order}}$/2 (for nonprotected species)
- NOAEL = NOAEL $_{\text{different order-same class}}$/2 (for nonprotected species)
- NOAEL = NOAEL$_{\text{related nonprotected species}}$/2 (for protected species)

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

5.3.4 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:

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

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:

Hazard Quotient	=	CDI/RfD
where:		
CDI	=	Estimated exposure level (or intake)
RfD	=	Reference dose

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:

Hazard Index	=	$CDI_1/RfD_1 + CDI_2/RfD_2 + ... + CDI_i/RfD_i$
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:

$$HQ = EEC_1/TRV_1 + EEC_2/TRV_2 + \ldots + EEC_i/TRV_i$$

$$\text{or} \quad CDI_1/NOAEL_1 + CDI_2/NOAEL_2 + \ldots + CDI_i/NOAEL_i$$

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.

5.3.5 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 (100 percent of the diet and home range lies within the exposure area)

- The ecological effects analysis applies Toxicity Reference Values (TRV) has not been established 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, conservativism, 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, and Region 10 currently is developing guidance on the issue. 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.

5.4 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) is one of the newer risk assessment models. It is discussed here as an example of 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 OB/OD 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.

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EXECUTIVE SUMMARY

This document was developed by the Subpart X Permit Writers Workgroup to provide permit writers with the background necessary to effectively review a subpart X permit application. The document provides information about the regulatory requirements that must be met in completing such an application; the types of units that are subject to subpart X; specific information requirements for the permit and how a permit writer might review an application for compliance with those requirements; discussions of monitoring and modeling for such permits; and, finally, an interpretation of risk assessments.

Appendix A

This section includes Module III from the draft model Subpart X permit and covers "Treatment of Energetic Wastes." Also incluced is the draft checklist for Subpart X permits.

MODULE III - TREATMENT OF ENERGETIC WASTES

III.A. MODULE HIGHLIGHTS

[The Permit Writer should include a general discussion of the activities covered by this module. The discussion should contain the following information: description of the units, general types and amount of wastes treated, traffic restrictions, any special or unique features associated with the units, and a reference to any special permit conditions.]

III.B. PERMITTED AND PROHIBITED WASTE IDENTIFICATION

III.B.1. The Permittee may ___________ **[open burn or open detonate]** the following wastes subject to the terms of this permit and as described below:

Type of unit Waste	Description of unit	Description of Hazardous	Hazardous Waste No.	Allowed Quantity
[Open burning by 3'pan on a 15'by 15' concrete pad.]	Unit consists of a steel 10'	Scrap powder	D003	100 lbs./event; 20,000 lbs./yr.

III.B.2. The Permittee is prohibited from treating hazardous waste that is not identified in Permit Condition III.B.1. **[Note: The Permit Writer may wish to include a specific list of wastes or materials that are prohibited. Open burning of all non-explosive wastes is prohibited. Other prohibited wastes could include: infectious wastes, lethal or incapacitating chemical and biological munitions and their residues, or contaminated packaging wastes containing radioactive materials.]**

III.C. <u>DESIGN, CONSTRUCTION, AND OPERATING REQUIREMENTS</u>

[This Section includes requirements for open burning in containment devices, open burning on a pad, open detonation on the ground, and open detonation in a pond. The Permit Writer should include only applicable sections when drafting the Permit. In addition, design and construction requirements would apply only to proposed units.]

III.C.1 <u>Open Burning in a Containment Device</u>

[Note: this section would cover processing in trays, pans, cages, or other enclosures. Trays and pans are typically elevated and used in conjunction with a cement pad or some other type of liner to protect the surrounding ground surface.]

III.C.1.1 The Permittee shall design and construct an open burning device in accordance with the design plans and specifications contained in Permit Attachment <u>III-2</u>. **[Note: The application should contain detailed discussion of the physical characteristics, materials of construction, dimensions of the unit, engineering drawings of the unit, description of the liner material below the device, minimum safe distances, etc.]**

III.C.1.2 The Permittee shall operate and maintain the open burning device in accordance with the operating procedures contained in Permit Attachment <u>III-1</u>. **[Note: The application should include detailed standard operating procedures (SOP) that specify how the wastes are to be treated. The SOP should discuss loading/unloading procedures, how waste is to be.placed in the unit, the amount to be burned per event, how the waste will be ignited, duration between burns, number of burns per day, ash/residue management, misfire procedures, and any other relevant information on procedures that could affect the quantity, quality, duration, or frequency of releases to the environment.]**

III.C.1.3 The Permittee shall **[design, construct,]** operate and maintain leak detection equipment in accordance with the **[design plans, specifications and]** operating practices contained in Permit Attachment(s) <u>III-[2] 3</u>. **[Note: This condition applies only to facilities with leak detection equipment. The permit application should specify the items/equipment used, their function, types of materials, dimensions and applicable engineering properties, and any other relevant information on procedures that could affect the quantity, quality, duration, or frequency of releases to the environment.]**

III.C.1.4 The Permittee shall **[design, construct,]** operate and maintain a precipitation cover in accordance with the **[design plans, specifications and]** operating practices contained in Permit Attachment(s) <u>III-[2] 3</u>. **[Note: If the facility uses a precipitation cover, the application/SOP should address use of the cover during nonoperational periods, its dimensions, materials of construction, or other information that could affect infiltration during non-operational periods or the quantity, quality, duration, or frequency of releases to the environment.]**

III.C.1.5 The Permittee shall manage accumulated precipitation in accordance with Permit Attachment III-3. **[Note: The application should discuss if/how precipitation will be collected, how it will be sampled and analyzed, how it will be managed/treated, or other information that could affect infiltration during nonoperational periods or the quantity, quality, duration, or frequency of releases to the environment.]**

III.C.1.6 The Permittee shall **[design, construct]** operate and maintain the open burning unit in order to minimize air emissions or exposure of people (onsite or offsite) to toxic or hazardous emissions in accordance with Permit Attachment(s) III-1[2] 5 **[and/or the following permit conditions:] [Note: The SOP should contain any meteorological restrictions on burning (e.g., wind speed, humidity). Any restrictions imposed by the Permit Writer which are not addressed in the SOP should be specified in this condition.]**

III.C.1.7 The Permittee shall **[design, construct]** operate and maintain the open burning unit in order to minimize noise in accordance with Permit Attachment(s) III-[2] 6 **[and/or the following permit conditions:] [Note: Noise issues usually pertain only to open detonation, but may also apply to open burning of large unit wastes such as rocket motors. If noise is a potential problem at the facility, design and operating procedures to minimize noise (such as wind direction, allowable operating times, sound buffers, etc.) should be addressed in the application. Such provisions should be consistent with any applicable State regulations.]**

III.C.1.8 Ash/residues from the open burning unit shall be managed in accordance with Permit Attachment III-4 **[and/or the following permit conditions:] [Note: The application should address how ash/residues from the unit will be managed, including how/when they will be collected from the unit and the surrounding area, how they will be sampled and analyzed, how/where they will be stored, methods to control wind dispersal, and any other relevant information on procedures that could affect the quantity, quality, duration, or frequency of releases to the environment.]**

III.C.2 Open Burning On A Pad

[This section applies to open burning conducted on a pad on the ground surface. The pads are typically bermed, are constructed of clay, cement, metal, etc., and may or may not have some type of liner surrounding the unit.]

III.C.2.1 The Permittee shall design and construct an open burning pad in accordance with the design plans and specifications contained in Permit Attachment III-2. **[Note: The application should contain detailed discussion of the physical characteristics, materials of construction, dimensions of the pad, engineering drawings of the pad, minimum safe distances, etc.]**

III.C.2.2 The Permittee shall operate and maintain the open burning pad in accordance with the operating procedures contained in Permit Attachment III-1. **[Note: The application should include detailed standard operating procedures (SOP) that specify how the wastes are to be treated. The SOP should discuss loading/unloading procedures, how waste is to be.placed in the unit, the amount to be burned per event, how the waste will be ignited, duration between burns, number of burns per day, ash/residue management, misfire procedures, and any other relevant information on procedures that could affect the quantity, quality, duration, or frequency of releases to the environment.]**

III.C.2.3 The Permittee shall **[design, construct,]** operate and maintain a precipitation cover in accordance with the **[design plans, specifications and]** operating practices contained in Permit Attachment(s) III-1[2]. **[Note: If the facility uses a precipitation cover, the application/SOP should address use of the cover during nonoperational periods, its dimensions, materials of construction, or other information that could affect infiltration during nonoperational periods or the quantity, quality, duration, or frequency of releases to the environment.]**

III.C.2.4 The Permittee shall manage accumulated precipitation in accordance with Permit Attachment III-3. **[Note: The application should discuss if/how precipitation will be collected, how it will be sampled and analyzed, how it will be managed/treated, or other information that could affect infiltration during nonoperational periods or the quantity, quality, duration, or frequency of releases to the environment.]**

III.C.2.5 The Permittee shall **[design, construct]** operate and maintain the open burning pad in order to minimize air emissions or exposure of people (onsite or offsite) to toxic or hazardous emissions in accordance with Permit Attachment III-1[2] 5 **[and/or the following permit conditions:] [Note: The SOP should contain any meteorological restrictions on burning (e.g., wind speed, humidity). Any restrictions imposed by the Permit Writer which are not addressed in the SOP should be specified in this condition.]**

III.C.2.6 The Permittee shall **[design, construct]** operate and maintain the open burning pad in order to minimize noise in accordance with Permit Attachment III-[2] 6 **[and/or the following permit conditions:] [Note: Noise issues usually pertain only to open detonation, but may also apply to open burning of large unit wastes such as rocket motors. If noise is a potential problem at the facility, design and operating procedures to minimize noise (such as wind direction, allowable operating times, sound buffers, etc.) should be addressed in the application. Such provisions should be consistent with any applicable State regulations.]**

III.C.2.7 Ash/residues from the open burning pad shall be managed in accordance with Permit Attachment III-4 **[and/or the following permit conditions:] [Note: The application should address how ash/residues from the pad will be managed, including how/when they will be collected from the pad and the surrounding area, how they will be sampled and analyzed, how/where they will be stored, methods to control wind dispersal, and any other relevant information on procedures that could affect the quantity, quality, duration, or frequency of releases to the environment.]**

III.C.3 Open Detonation On/In The Ground

[This section covers open detonation in or on the ground surface. The open detonation area may be one large area or may consist of several smaller areas. The detonation areas may or may not be bermed.]

III.C.3.1 The Permittee shall design and construct an open detonation area(s) in accordance with the design plans and specifications contained in Permit Attachment III-2. **[Note: The application should contain detailed discussion of the topography, types of soils, berms (if any), engineering drawings delineating the detonation area(s), minimum safe distances, etc.]**

III.C.3.2 The Permittee shall operate and maintain the open detonation area(s) in accordance with the operating procedures contained in Permit Attachment III-1. **[Note: The application should include detailed standard operating procedures (SOP) that specify how the wastes are to be treated. The SOP should discuss loading/unloading procedures, how waste is to be placed in or on the ground, the amount to be detonated per event and per day, how the waste will be initiated, duration between events, number of events per day, misfire procedures, and any other relevant information on procedures that could affect the quantity, quality, duration, or frequency of releases to the environment.]**

III.C.3.3 The Permittee shall **[design, construct]** operate and maintain the open detonation area in order to minimize air emissions or exposure of people (onsite or offsite) to toxic or hazardous emissions in accordance with Permit Attachment(s) III-1[2] 5 **[and/or the following permit conditions:] [Note: The SOP should contain any meteorological or other restrictions on detonation (e.g., wind speed, humidity) designed to minimize air pollution releases during firing and wind dispersal of residual ash. Any restrictions imposed by the Permit Writer which are not addressed in the SOP should be specified in this condition.]**

III.C.3.4 The Permittee shall **[design, construct]** operate and maintain the open detonation area in order to minimize noise in accordance with Permit Attachment(s) III-[2] 6 **[and/or the following permit conditions:] [Note: If noise is a potential problem at the facility, design and operating procedures to minimize noise (such as wind direction, allowable operating times, sound buffers, covering the waste with soil, limits on the amount of waste per detonation event, etc.) should be addressed in the application. Such provisions should be consistent with any applicable State regulations.]**

III.C.3.5 Ash/residues from the open detonation area shall be managed in accordance with Permit Attachment III-4 **[and/or the following permit conditions:] [Note: The application should address how ash/residues from the detonation area will be managed, including how they will be collected, how often the area will be "policed," how they will be sampled and analyzed, how/where they will be stored, methods to control wind dispersal, and any other relevant information on procedures that could affect the quantity, quality, duration, or**

frequency of releases to the environment.]

III.C.3.6 The Permittee shall **[design, construct]** operate and maintain a runon control system in accordance with the design plans, specifications, and operating practices contained in Permit Attachment(s) III-2. **[Note: The application should describe how runon will be prevented or minimized.]**

III.C.3.7 The Permittee shall **[design, construct]** operate and maintain a runoff control system in accordance with the design plans, specifications, and operating practices contained in Permit Attachment(s) III-2 and 3. **[Note: If the facility does not have measures to prevent runon, the application should describe how runoff from the area will be minimized and managed, how/if it will be sampled and analyzed, how it will be collected, and any other relevant information on procedures that could affect the quantity, quality, duration, or frequency of releases to the environment.]**

III.C.4 Open Detonation In A Pond

[This section applies to detonation of waste underwater. Underwater detonation is typically used because of noise considerations. The deadening effect of the water greatly diminishes air blast and noise associated with the detonation. Thus, underwater detonation can sometimes be used in locations where open detonation in or on the ground cannot.]

III.C.4.1 The Permittee shall design and construct an open detonation pond in accordance with the design plans and specifications contained in Permit Attachment III-1. **[Note: The application should contain detailed engineering drawings showing the size of the pond, water depth, any liners, freeboard, equipment for loading and detonating the waste, minimum safe distances, etc.]**

III.C.4.2 The Permittee shall operate and maintain the open detonation pond in accordance with the operating procedures contained in Permit Attachment III-1 . **[Note: The application should include detailed standard operating procedures (SOP) that specify how the wastes are to be treated. The SOP should discuss loading/unloading procedures, how waste is to be placed in the pond, the amount to be detonated per event and per day, how the waste will be initiated, duration between events, number of events per day, misfire procedures, and any other relevant information on procedures that could affect the quantity, quality, duration, or frequency of releases to the environment.]**

III.C.4.3 The Permittee shall **[design, construct]** operate and maintain the open detonation pond in order to minimize air emissions or exposure of people (onsite or offsite) to toxic or hazardous emissions in accordance with Permit Attachment(s) III-1[2] 5 [and/or the following permit conditions:] **[Note: The SOP should contain any meteorological or other restrictions on detonation (e.g., wind speed, humidity) designed to minimize air pollution releases during firing and wind dispersal of residual ash (if any). Any restrictions imposed by the Permit Writer which are not addressed in the SOP should be specified in this condition.]**

III.C.4.4 The Permittee shall **[design, construct]** operate and maintain the open detonation pond in order to minimize noise in accordance with Permit Attachment(s) III-[2] 6 [and/or the following permit conditions:] **[Note: If noise is a potential problem at the facility, design and operating procedures to minimize noise (such as wind direction, allowable operating times, sound buffers, limits on the amount of waste per detonation event, etc.) should be addressed in the application. Such provisions should be consistent with any applicable State regulations.]**

III.C.4.5 Ash/residues from the open detonation pond shall be managed in accordance with Permit Attachment III-4 [and/or the following permit conditions:] **[Note: The application should address how ash/residues (if any) from the detonation pond will be managed including: how/will the pond be dredged, how often the pond will be dredged, if/how residues will be collected from the surrounding area, how often the surrounding area will be "policed," how residues will be sampled and analyzed, how/where they will be stored, methods to control wind dispersal, and any other relevant information on procedures that could affect the quantity, quality, duration, or frequency of releases to the environment.]**

III.C.4.6 The Permittee shall **[design, construct,]** operate and maintain a runoff control system in accordance with the design plans, specifications, and operating practices contained in Permit Attachment(s) III-2 and 3. **[Note: The application should address procedures to prevent overflow of the pond.]**

III.D. HANDLING AND STORAGE REQUIREMENTS

[This section discusses handling and storage requirements for energetic wastes. These requirements will generally be dominated by safety concerns.]

III.D.1 The Permittee shall handle/manage energetic waste in accordance with Permit Attachment II-5 **[Note: The application should contain a detailed description of how wastes are handled at the point of generation; how they are handled in containers, tanks, surface impoundments, waste piles; and how they are prepared for transport and transported, etc. This condition should also address loading and unloading hazards at open burning/open detonation facilities. These may include the possibility of spillage or accidental ignition or detonation during loading and unloading of the hazardous wastes. These procedures, because of the nature of the wastes, will be dominated by personnel safety concerns. The Permit Writer should also specify to which waste these requirements apply.]**

III.D.2 The Permittee shall store energetic wastes in accordance with Permit Attachment III-3. **[Note: This section should include only special storage/accumulation requirements unique to energetic wastes; general requirements for a permitted storage area would be contained in a separate section. The Permit Writer should also specify to which waste these requirements apply.]**

III.E. INSPECTION SCHEDULES AND PROCEDURES

[Module II contains General Inspection Requirements for the facility. This section should include only inspection requirements specific to the open burning/open detonation units.]

III.E.1 The Permittee shall inspect the open burning or open detonation unit in accordance with the Inspection Schedule, Permit Attachment II-3, and shall complete the following as part of those inspections. **[Note: The Permit Writer should specify inspection conditions for each unit. These conditions will depend on the peculiarities of the units and will therefore be highly site specific. They should include, however, inspection of the physical integrity of the unit, frequency of inspections, etc.]**

III.F. PREVENTION OF UNINTENDTED IGNITION OR REACTION OF WASTES

The Permittee shall follow the procedures, contained in Permit Attachment II-5, designed to prevent unintended ignition or reaction of wastes. **[Note: Procedures for igniting or detonating waste in the unit should incorporate safety precautions (such as prohibiting smoking and remote ignition of the waste on the burn pad). Typically, these precautions are included in existing documents, such as SOP's, utilized by site operators.]**

III.G. MONITORING REQUIREMENTS

[This section discusses monitoring requirements associated with operation of the facility. These requirements will be highly site specific and will depend on the results of assessments conducted by the facility to demonstrate compliance with the Environmental Performance Standards of Subpart X (40 CFR 264.601). Currently, there are no standard, EPA-approved sampling and analytical methods for many of the wastes treated by these facilities. EPA is, however, presently developing a guidance document for sampling and analysis at OB/OD facilities.]

III.G.1 Ground-Water Monitoring

The Permittee shall conduct ground-water monitoring in accordance with Permit Attachment III-7. **[Note: If the facility should, at the discretion of the Permit Writer, undertake a detection monitoring program, requirements for such a program are shown in section IV of this model permit. If ground-water monitoring is required, the application should specify the types and schedules of monitoring required and the**

instrumentation required and include a Sampling and Analysis Plan.]

III.G.2 Air Monitoring

The Permittee shall conduct air monitoring in accordance with Permit Attachment III-8. **[Note: If air monitoring is required, the application should specify the types and schedules of monitoring required and the instrumentation required and should include a Sampling and Analysis Plan.]**

III.G.3 Surface Water Monitoring

The Permittee shall conduct surface water monitoring in accordance with Permit Attachment III-9. **[Note: If surface water monitoring is required, the application should specify tthe types and schedules of monitoring required and the instrumentation required and should include a Sampling and Analysis Plan.]**

III.G.4 Soil Monitoring

The Permittee shall conduct soil monitoring in accordance with Permit Attachment III-10. **[Note: If soil monitoring is required, the application should specify the types and schedules of monitoring required and the instrumentation required and should include a Sampling and Analysis Plan.]**

III.H. FACILITY MODIFICATION/EXPANSION

III.H.1 Permit Modification

EPA reserves the right to modify this Permit in accordance with 40 CFR 270.41.

III.H.2 Permit Modification At The Request Of The Permittee

Modifications or expansions of the facility shall be accomplished in accordance with 40 CFR 270.42.

III.I. CLOSURE [AND POST-CLOSURE]

[General closure/post-closure requirements are addressed in Module II. This section should discuss closure/post-closure requirements specific to the OB/OD operations. Post-closure care is required only at facilities that do not anticipate clean closure.]

III.I.1 At final closure of the **[open burning and/or open detonation]** unit(s) the Permittee shall follow the procedures in the Closure Plan, Permit Attachment II-9. **[Note: The Closure Plan should be adequate to ensure, after it has been completed, that EPA receives adequate documentation that post-closure care is not required.]**

III.I.2a If after closure the Permittee finds that not all contaminated soils and debris can be removed or decontaminated in accordance with the Closure Plan, then the Permittee shall close the **[open burning and/or open detonation]** unit(s) and perform post-closure care in accordance with requirements contained in Section VIII of this Permit. **[Note: This condition would apply only to units for which clean closure was anticipated but could not be accomplished. Post-closure care requirements are contained in Module VIII.]**

III.I.2b The Permittee shall perform post-closure care in accordance with the Post-closure Plan, Permit Attachment II-11. **[Note: This condition would apply to units for which clean closure is not proposed.]**

III.J RECORDKEEPING

III.J.1 The Permittee shall develop and maintain all records required to comply with 40 CFR 264.73, 40 CFR 264.602, and Permit Attachment III-11. **[Note: The facility should maintain sufficient records to demonstrate compliance with the conditions of the Permit, including any restrictions placed on operation of the OB/OD units (e.g., meteorological, daily or event limits, etc.).]**

III.K. COMPLIANCE SCHEDULE

[Note: The Permit Writer should include this section if the Permittee is required to complete specific steps within a specific time period, beyond those covered by other conditions of the Permit, as a condition for retaining this operating permit. Compliance schedules are generally used in cases where requirements that are supposed to be met by the Permittee before the permit is issued are deferred for good cause until after permit issuance. Appropriate compliance schedules included in the Part B Permit Application should be attached to, or incorporated in, the Permit. If the application does not include a compliance schedule, the Permit Writer should prepare one and attach it to the Permit. Each compliance schedule should have at least two columns-one identifying the activity and one identifying the milestone or completion dates. The following is an example of a condition that may apply for an open burning/open detonation unit.]

The Permittee shall provide the following information to the Regional Administrator:

Item	Date Due to the Regional Administrator
[Example:	
1. Sampling and analysis of soils surrounding open burning unit.]	**December 31, 1990**

PERMIT ATTACHMENTS REFERENCED IN MODULE III

This list is provided to assist the Permit Writer in checking that all Permit Attachments referenced in this module are attached to the Permit. The purpose of the numbering scheme used here is to facilitate cross-walking with the model permit conditions. The Permit Writer may select other numbering schemes, as appropriate, when preparing actual permits.

Permit Attachment No. (from the Part B Permit Application)	Plan or Document
II-3	Facility Inspection Schedule
II-5	Procedures for Handling Ignitable, Reactive, or Incompatible Waste
II-9	Facility Closure Plan
II-11	Facility Post-Closure Plan
III-1	Standard Operating Procedures
III-2	Design Plans and Specifications
III-3	Operation and Maintenance Procedures
III-4	Ash Management Procedures
III-5	Procedures for Limiting Air Emissions

III-6	Procedures for Limiting Noise Emissions
III-7	Sampling and Analysis Plan for Ground-Water Monitoring
III-8	Sampling and Analysis Plan for Air Monitoring
III-9	Sampling and Analysis Plan for Surface Water Monitoring
III-10	Sampling and Analysis Plan for Soil Monitoring
III-11	Recordkeeping Procedures

Checklist for Technical Review of RCRA Part B Permit Application for Subpart X Units

I. PART A GENERAL INFORMATION REQUIREMENTS

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
SECTION I						
A. PART A GENERAL INFORMATION						
Description of activities conducted which require facility to obtain a permit under RCRA and brief description of nature of the business	40CFR270.13(a) and (m)					
Name, mailing address, and location of facility for which the application is submitted including a topographic map	40CFR270.13(b) and (l)					
Up to four Standard Industrial Classification (SIC) Codes which best reflect the products or services provided by the facility	40CFR270.13(c)					
Operator/owner's name, address, telephone number, and ownership status	40CFR270.13(d) and (e)	Ownership status must include status as federal, state, private, public, or other entity.				
Facility is new, existing, or located on Indian lands	40CFR270.13(f) and (g)	Also, description must include information on whether this is a first or revised application with date of last signed permit.				
Description of processes to be used for treating, storing, and disposing of hazardous waste	40CFR270.13(i)	Description must include the design capacity for these items.				
Specification of the hazardous wastes listed or designated under 40CFR261	40CFR270.13(j)	Specifications must include an estimate on the quantity of wastes to be treated, stored, or disposed.				
Listing of all permits or construction approvals received or applied for	40CFR270.13(k)	Permits include the following programs: Hazardous Waste Management under RCRA; UIC under Solid Waste Disposal Act (SWDA); Prevention of Significant Deterioration (PSD), Nonattainment Program, and National Emissions Standards for Hazardious Pollutants (NESHAPS) under the Clean Air Act (CAA); ocean dumping permits under the Marine Protection Research and Sanctuaries Act; dredge and fill permits under Section 404 of the Clean Water Act (CWA); or other relevant environmental permits including state permits.				

Checklist for Technical Review of RCRA Part B Permit Application for Subpart X Units

II. PART B GENERAL INFORMATION REQUIREMENTS

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
SECTION II						
A. FACILITY DESCRIPTION						
A1. General Description	40CFR270.14(b)(1)					
Applicability of Part B to this facility	40CFR264.1					
Manages waste generated on-site and off-site						
Location						
Owner or operator's name						
Types of waste management activities conducted						
Type of treatment unit						
Engineering drawings						
Specification of all wastes that have been managed at the treatment unit						
Wind rose		The frequency of occurrence of various wind directions should be compared to sensitive (local and regional) receptor points downwind.				
General dimensions and structural description						
A2. Topographic Map	40CFR270.14(b)(19)	A distance of 1,000 feet around the unit at a scale of 1 inch to not more than 200 feet (multiple maps may be submitted at this scale) should be shown and should be similar to Part A topographic map.				
Scale and date		Other scales may be used if justified.				
The 100-year flood plain area						
Surface waters						
Surrounding land use						
Map orientation						
Legal boundaries						
Access control						
Injection and withdrawal wells (on-site and off-site)						
Buildings and other structures		See 40CFR270.14(b)(19)(x) for an example list.				
Drainage and flood control barriers						
Location of the treatment unit(s) and decontamination areas						
· Distance to property boundaries						
· Distance to buildings on- and off-site						

Checklist for Technical Review of RCRA Part B Permit Application for Subpart X Units

II. PART B GENERAL INFORMATION REQUIREMENTS

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
• Distance to public roadways						
• Distance to passenger railroads						
• Distance to closest receptor	40CFR270.23(e)	Receptors include human and environmental receptors within the facility boundary.				
Additional information on the topographic map	40CFR270.14(c)(3)					
• Uppermost aquifer and hydraulically connected aquifers beneath facility property	40CFR270.14(c)(2)					
• Ground water flow direction	40CFR270.14(c)(2)					
• Waste management areas	40CFR270.14(c)(3)					
• Property boundaries	40CFR270.14(c)(3)					
• Point of compliance location	40CFR270.14(c)(3)	Point of compliance is defined in 40CFR264.95; however, for open burning/open detonation (OB/OD) units, this will be determined on a case-by-case basis and may be at the unit boundary.				
• Location of ground water monitoring wells	40CFR270.14(c)(3)					
• Extent of any ground water contaminant plume	40CFR270.14(c)(4)(i)					
• Location of unsaturated zone monitoring	40CFR270.23(e)	If unit incorporates the soil as part of the zone of engineering control, the monitoring of this zone should be shown.				
A3. **Description of Treatment Unit(s)**	40CFR270.23(a)(2)	Includes detailed plans and engineering reports.				
• Location						
• Design						
• Operation						
• Maintenance						
• Monitoring						
• Inspection						
• Closure						
A4. **Facility Location Information**	40CFR270.14(b)(11) and 264.18					
A4a. **Seismic Requirements**	40CFR270.14(b)(11)(i), (ii) and 264.18(a)	Seismic requirements applicable only to new facilities.				
Political jurisdiction in which facility is proposed to be located	40CFR270.14(b)(11)(i)					
Indication of whether facility is listed in Appendix VI of 40CFR264 (new facilities)	40CFR270.14(b)(11)(i)					
New facility must be located at least 200 feet from a fault which has had displacement in Holocene time.	40CFR264.18(a) and 270.14(b)(11)(ii)	If facility location is listed in Appendix VI of 40CFR264, this information is required.				

Checklist for Technical Review of RCRA Part B Permit Application for Subpart X Units

II. PART B GENERAL INFORMATION REQUIREMENTS

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
A4b. Flood Plain Requirements	40CFR270.14(b)(11)(iii), (iv) and 264.18(b)					
Copy of Federal Insurance Association (FIA) or other flood map	40CFR270.14(b)(11)(iii)	The source to determine whether the facility is located in a 100-year flood plain should be indicated.				
Engineering analysis to indicate the various hydrodynamic and hydrostatic forces expected to result from the 100-year flood plain	40CFR270.14(b)(11)(iv) and 264.18(b)	Flood plain requirements applicable if facility is located in a 100-year flood plain.				
Demonstration that facility is designed, constructed, operated, and maintained to prevent washout, or detailed description of procedures to be followed to remove hazardous waste to safety before facility is flooded		Flood plain requirements applicable if facility is located in a 100-year flood plain.				
Demonstration that no adverse effects will result from failure to remove waste by providing:		Flood plain requirements applicable if facility is located in a 100-year flood plain.				
· Volume and physical and chemical characteristics of the waste in the facility		Flood plain requirements applicable if facility is located in a 100-year flood plain.				
· Concentration of hazardous constituents that would potentially affect surface waters as a result of washout		Flood plain requirements applicable if facility is located in a 100-year flood plain.				
· Impact of such concentration on current or potential uses of, and water quality standards established for, the affected surface waters		Flood plain requirements applicable if facility is located in a 100-year flood plain.				
· Impact of hazardous constituents on the sediments of affected surface waters, or the soils of the 100-year flood plain, that could result from washout		Flood plain requirements applicable if facility is located in a 100-year flood plain.				
Plans and schedule for future compliance	40CFR270.14(b)(11)(v)	Flood plain requirements applicable if facility is located in a 100-year flood plain and not in compliance with 40CFR264.816.				
A5. Traffic Patterns	40CFR270.14(b)(10)					
Estimate of number and types of vehicles around the facility						
Information about waste transfer or pick-up stations						
Quantity of waste moved per movement per vehicle						
Traffic control signs and persons						
Road surface composition and load-bearing capacity						
B. WASTE CHARACTERISTICS						
B1. Physical and Chemical Characteristics of Wastes and Residues	40CFR270.14(b)(2) and 264.13(a)	Data generated by testing the waste, published data on the hazardous waste, or data gathered from similar processes may be used.				
Volume and composition of wastes	40CFR270.14(b)(2) and 264.13(a)					
Wastes in containers	40CFR270.15					

Checklist for Technical Review of RCRA Part B Permit Application for Subpart X Units

II. PART B GENERAL INFORMATION REQUIREMENTS

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
Wastes in tanks	40CFR270.16					
Wastes in surface impoundments	40CFR270.17					
Wastes in waste piles	40CFR270.18					
Wastes in incinerators	40CFR270.19					
Wastes in land treatment facilities	40CFR270.20					
Wastes in landfills	40CFR270.21					
Wastes in miscellaneous units	40CFR270.23					
Wastes at facilities with process vents	40CFR270.24					
B2. Copy of the Waste Analysis Plan	40CFR270.14(b)(3) and 264.13(b) and (c)					
Parameters for which each hazardous waste will be analyzed	40CFR264.13(b)(1)					
Rationale for parameters	40CFR264.13(b)(1)	The plan must discuss how analysis for these parameters will provide physical and chemical characteristics representative of the waste.				
Methods used to test the parameters	40CFR264.13(b)(2)					
Methods used to obtain representative samples of the waste being analyzed	40CFR264.13(b)(3) and 261 Appendix I	If a sampling method described in 40CFR261 Appendix I is not used, the facility must provide a detailed description of the proposed method and demonstrate its equivalency.				
Frequency of revisions or repetition of analysis	40CFR264.13(b)(4)					
Facilities managing wastes generated off-site	40CFR264.13(c)					
· Copy of the waste analyses supplied by the waste generators	40CFR264.13(b)(5)					
· Procedures used to inspect and analyze (if necessary) each shipment						
· Procedures used to inspect each movement of hazardous waste received at the facility						
· Methods of obtaining samples of the waste		If a sampling method described in 40CFR261 Appendix 1 is not used, the facility must provide a detailed description of the proposed method and demonstrate its equivalency.				
· For highly unstable wastes, a certification that the waste can be safely treated		Applicant must provide supporting data which demonstrate waste has potential to detonate or is bulk propellant.				
Additional waste analysis for demonstrating compliance with requirement of ignitable, reactive, or incompatible waste management (safe handling) methods	40CFR264.13(b)(6) and 264.17					
C. PROCEDURES TO PREVENT HAZARDS						
C1. Security Procedures and Equipment	40CFR270.14(b)(4) and 264.14					
Demonstration that unknown or unauthorized contact with waste is not	40CFR264.14(a)(1)	This item required if requesting a waiver to the security procedures.				

Checklist for Technical Review of RCRA Part B Permit Application for Subpart X Units

II. PART B GENERAL INFORMATION REQUIREMENTS

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
harmful						
Demonstration that disturbance of waste or equipment will not cause violation of 40CFR264	40CFR264.14(a)(2)	This item required if requesting a waiver to the security procedures.				
Description of a 24-hour surveillance system	40CFR264.14(b)(1)	Monitor/camera, guards, or personnel must continuously monitor or control access to active portions of the facility.				
Description of the artificial or natural barrier	40CFR264.14(b)(2)(i)	This item required if 24-hour surveillance system is not feasible.				
Method to control entry and number of personnel in the treatment area	40CFR264.14(b)(2)(ii)	This item equired if 24-hour surveillance system is not feasible.				
Sign posted at each entrance with legend "Danger - Unauthorized Personnel Keep Out"	40CFR264.14(c)					
C2. Inspection Schedule						
Copy of inspection schedule	40CFR270.14(b)(5) and 264.15	Inspection is required for monitoring equipment, safety emergency equipment, communication and alarm systems, decontamination equipment, security devices, and operating and structural equipment.				
Types of problems to be checked	40CFR264.15(b)(3)	Must provide checklist for each type of problem.				
Frequency of inspections of equipment and process	40CFR264.15(b)(4)					
Inspection record keeping	40CFR264.15(d)	An example log or summary must be provided.				
Schedule of remedial action	40CFR264.15(c)					
Daily inspection for leaks, spills, and fugitive emissions, and all emergency shutdown controls and system alarms	40CFR265.377(a)(3)	This must be provided as applicable for miscellaneous units (Subpart X units), thermal treatment units, and associated equipment.				
C3. Preparedness and Prevention	40CFR270.14(b)(6) and 264 (Subpart C)	The facility must submit justification of any waiver to the requirements of this section.				
Description and location of internal communications and alarm system to instruct facility personnel	40CFR264.32(a)					
Device (telephone, radio) to summon emergency assistance from outside the facility	40CFR264.32(b)					
Access to communication or alarm control	40CFR264.34					
Description of fire control, spill, and decontamination equipment	40CFR264.32(c)					
Documentation of water volume and pressure required to operate equipment listed above	40CFR264.32(d)					
Testing and maintenance schedule and procedures for the above mentioned equipment	40CFR264.33					
Documentation of adequate aisle space	40CFR264.35	Aisle space is required for unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment in case of emergency.				
Documentation of arrangements with:	40CFR264.37					

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II. PART B GENERAL INFORMATION REQUIREMENTS

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
· Police						
· Fire Department						
· Emergency Response Teams						
· Local Hospitals						
C4. General Hazard Prevention	40CFR270.14(b)(8)					
Identification of possible loading and unloading hazards and documentation of steps taken to minimize or eliminate the possibility of these hazards	40CFR270.149(b)(8)(i)					
Description of mechanisms to prevent runoff and flooding	40CFR270.14(b)(8)(ii)					
Description of mechanisms to prevent contamination of water supplies	40CFR270.14(b)(8)(iii)					
Identification of equipment failure and power outage hazards and description of procedures to mitigate effects of equipment failure and power outages	40CFR270.14(b)(8)(iv)					
Personnel protection procedures	40CFR270.14(b)(8)(v)					
Procedures to minimize releases to the atmosphere	40CFR270.14(b)(8)(vi)					
C5. Prevention of Accidental Ignition or Reaction of Wastes	40CFR264.7(a) and 270.14(b)(9)					
Description of procedures to prevent accidental ignition or reaction of wastes	40CFR264.17(a) and (b)	Waste must be protected from sources of ignition or reaction. Precautions must be taken to prevent reactions which generate toxic emissions, heat, or pressure, and cause explosions.				
Documentation of adequacy of procedures	40CFR264.17(c)	Published literature, a trial test, waste analyses, or similar processes may be used.				
D. CONTINGENCY PLAN						
D1. Copy of Contingency Plan	40CFR270.14(b)(7)					
Actions to take in case of emergency	40CFR264.52(a) and 264.56	The actions to be taken in response to any unplanned release of hazardous waste to air, soil, or surface water must be described.				
Arrangements with local authorities	40CFR264.52(c)	Police and fire departments, hospitals, and emergency response teams must be notified.				
Names, addresses, and phone numbers of emergency coordinators	40CFR264.52(d) and 264.55	There must at least be one primary emergency coordinator available at all times.				
Location and description of emergency equipment at the facility	40CFR264.52(e)	It should include decontamination equipment and the capabilities of each item.				
Evacuation plan for facility personnel	40CFR264.52(f)	Evacuation plans must include evacuation signals and primary and alternate evacuation routes.				
Location and distribution of contingency plan	40CFR270.14(b)(7) and 264.53	A copy of the contingency plan must be maintained at the facility and submitted to local authorities.				
D2. Emergency Procedures	40CFR264.56(a)					
Immediate procedures for emergency coordinator to alert all facility personnel in case of emergency and notify state and local agencies if help is needed	40CFR264.56(a)					
Plans for the emergency coordinator to identify the character, source,	40CFR264.56(b)	Observation, records or manifest, or chemical analysis may be used by emergency coordinator.				

II. PART B GENERAL INFORMATION REQUIREMENTS

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
amount, and areal extent of any explosion, fire, or release						
Means for assessment of possible hazards to human health or the environment from an explosion, fire, or release	40CFR264.56(c)	Direct and indirect effects must be considered.				
Procedures to be followed by emergency coordinator in case of a threat to human health or the environment outside the facility	40CFR264.56(d)	Local authorities and either EPA's on-scene coordinator or the National Response Center must be notified.				
Procedures to be followed by emergency coordinator to prevent fires, explosion or release from occurring, recurring, or spreading to other hazardous wastes at the facility	40CFR264.56(e)					
Storage, treatment, and disposal of released material	40CFR264.56(g)					
Monitor for leaks, pressure buildup, gas generation or ruptures of released material	40CFR264.56(f)	This item applies if facility stops operations.				
Procedures for preventing handling of incompatible wastes until cleanup is complete	40CFR264.56(h)(1)					
Decontamination procedures	40CFR264.56(h)(2)	Decontamination is required for emergency equipment.				
Notification of EPA and state and local authorities before resuming operations	40CFR264.56(i)	EPA (or state) must be notified within 15 days of occurrence.				
Procedures for record keeping and reporting to EPA	40CFR264.56(j)					
E. PERSONNEL TRAINING						
Outline of both the introductory and continuing training programs	40CFR270.14(b)(12)	All facility personnel must be trained to perform their duties safely.				
A description of how training will be designed to meet actual job tasks	40CFR270.16(a),(b), and (c)	The training must be conducted by a qualified person; there must also be an annual review of the training.				
Training for emergency response	40CFR264.16(a)(3)	Personnel must be made familiar with emergency procedures, emergency equipment, and emergency systems.				
Maintenance of training records/copy of personnel training documents	40CFR264.16(d)(e) and 270.14(b)(12)	The owner or operator must maintain records of job titles, names of employees, job descriptions, and the types and amount of training given to each employee.				
· Training content, frequency, and techniques		Training must also be applicable to site conditions.				
· Training director is properly trained						
F. CLOSURE AND POST-CLOSURE PLAN						
F1. Closure Plan Documentation	40CFR270.14(b)(13)					
Description of partial or final closure procedures	40CFR264.112(b)(1) and (2)	Final closure must minimize the need for further maintenance and must control post-closure release to ground water, surface water, soil, and the atmosphere.				
Description of maximum unclosed portion during the active life of the facility	40CFR264.112(b)(2)					
Estimate of maximum waste inventory in storage and treatment during	40CFR264.112(b)(3)					

Checklist for Technical Review of RCRA Part B Permit Application for Subpart X Units

II. PART B GENERAL INFORMATION REQUIREMENTS

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
facility life						
Description of procedures for removal or decontamination of hazardous waste residues, equipment, structures, and soils	40CFR264.112(b)(4) and 264.114					
• Location of disposal facility (equipment, structures, and soils when removed)						
• Methods for sampling and testing surrounding soils						
• Criteria for determining decontamination levels						
Description of additional activities performed during closure:	40CFR264.112(b)(5)					
• Ground water monitoring						
• Leachate collection						
• Run-on and run-off control						
Description of closure schedule including:	40CFR264.112(b)(6) and 264.113					
• Total time to close each unit		The hazardous waste must be treated, removed, or disposed of within 90 days after receiving the final volume of waste; all closure activities must be completed within 180 days after receiving the final volume of waste.				
• Timetable of closure activities						
Estimate of year of closure	40CFR264.112(b)(7)	Estimate of year of closure is required for those facilities that use trust funds to establish financial assurance and are expected to close before expiration of the permit.				
Extension of closure time	40CFR264.113(a) and (b)	Justification is required if extension is expected to exceed 90 days for treatment, removal, and disposal of wastes and 180 days for completion of closure activities.				
F2. Copy of Post-Closure Plan	40CFR264.117, 264.118, and 264.603	Post-closure plan is expected when the OB/OD unit incorporates the soil as part of the zone of engineering control, unless clean closure is to be attained.				
Post-closure care mechanisms	40CFR264.603	This includes procedures to prevent any releases that have adversely affected human health or the environment due to migration of wastes in the ground water, surface water, wetlands, soils or air.				
Description of maintenance, monitoring, inspection, and frequencies for:	40CFR264.118(b)(1) and (2)					
• Waste-fabricated structures						
• Facility monitoring equipment						
Identification and location of person responsible for storage and for updating facility copy of post-closure plan during post-closure period	40CFR264.118(b)(3)					
Procedure for updating all other copies of post-closure plan	40CFR264.118(b)(2)	A procedure is required to cover changes in operating plans, facility design, expected years to closure, or other events.				
F3. Copy of Most Recent Closure and Post-Closure (if applicable) Cost Estimates	40CFR264.142, 264.144, and 270.14(b) (15) and (16)	Cost estimates must be detailed and assume the hiring of a third party to conduct closure and post-closure care.				

Checklist for Technical Review of RCRA Part B Permit Application for Subpart X Units

II. PART B GENERAL INFORMATION REQUIREMENTS

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
F4. Copy of Documents Used as Financial Assurance Mechanisms	40CFR264.143, 264.145, and 264.146	For new facilities, the documentation may be substituted up to 60 days before initial receipt of hazardous waste.				
Financial assurance document for closure						
Adequacy of document						
Copy of document						
F5. Documentation of Notice of Deed	40CFR270.14(b)(14) and 264.119	This notice applies to a closed unit.				
F6. Copy of Insurance Policy	40CFR264.147					
Coverage for sudden accidental occurrences	40CFR264.147(a)	Liability coverage of $1 million per occurrence and $2 million for annual aggregate is required.				
Coverage for nonsudden accidental occurrences	40CFR264.147(b)	Liability coverage of $3 million per occurrence and $6 million for annual aggregate is required.				
G. PROTECTION OF GROUND WATER						
Unit is a regulated unit	40CFR270.14(c), 270.23(b), and 264.90(a)(2)	Protection of ground water must be addressed only for regulated units.				
Existing ground water monitoring data	40CFR270.14(c)(1) and 270.23					
Identification of upper-most aquifer and aquifers hydraulically interconnected beneath the facility property	40CFR270.14(c)(2) and 270.23					
Ground water flow, direction, rate, and source of information	40CFR270.14(c)(2) and 270.23					
Description of any plume of contamination that has entered the ground water from a regulated unit	40CFR270.14(c)(4) and 270.23					
• Indication of the extent of the plumes on the topographic map	40CFR270.14(c)(4)(i), 264.600, and 270.23					
• Concentration of pollutants in the plume	40CFR270.14(c)(4)(ii)	The description must identify constituents of 40CFR264 Appendix IX, waste open burned or detonated, and potential compounds formed in OB/OD.				
Proposed ground water monitoring program	40CFR270.14(c)(5), 264.97, 264.600, and 270.23					
• Description of well design and location	40CFR264.97, 264.600, and 270.23	The description should include discussion or inspection of well to withstand OB/OD or other activities.				
• Sample collection	40CFR264.97(d)(1), 264.600, and 270.23					
• Sample preservation and shipment	40CFR264.97(d)(2), 264.600, and 270.23					
• Sampling and analysis procedures	40CFR264.97(d)(3), 264.600, and 270.23					
• Determination of the ground water surface elevation each time	40CFR270.23(e)					

II. PART B GENERAL INFORMATION REQUIREMENTS

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
ground water is sampled						
• Vadose zone monitoring	40CFR270.23(e) and 270.32(b)(2)					
• Field measurements	40CFR270.23(e)					
- Water level						
- pH						
• Well evacuation	40CFR270.23(e)					
• Sample preparation	40CFR270.23(e)					
• Analytical procedures	40CFR270.23(e)					
• QA/QC procedures	40CFR270.23(e)					
• Data evaluation and reporting	40CFR270.23(e)					
• Chain-of-custody control	40CFR264.97(d)(4), 264.600, and 270.23					
Detection monitoring program information:	40CFR270.14(c)(6), 264.98, 264.600, and 270.23	This applies when hazardous constituents have not been detected in the ground water at the time of permit application.				
• Indicator parameters	40CFR270.14(c)(6)(i), 264.98(a)(i), 264.600, and 270.23	This can include waste constituents.				
• Hazardous constituents	40CFR270.14(c)(6)(i), 264.600, and 270.23					
• A proposed ground water monitoring system	40CFR270.14(c)(6)(ii), 264.600, and 270.23					
• Background values for each proposed monitoring parameter or constituent	40CFR270.14(c)(6)(iii), 264.600, and 270.23					
• Description of proposed sampling, analysis, and statistical comparison procedures	40CFR270.14(c)(4)(iv), 264.600, and 270.23					
Record keeping of ground water analytical data	40CFR264.98(c) and (g)					
Compliance monitoring program	40CFR270.14(c)(7) and 264.94	This applies when hazardous constituents have been detected in the ground water at the point of compliance.				
• Description of wastes previously handled at the facility	40CFR270.14(c)(7)(i)					
• Characterization of ground water	40CFR270.14(c)(7)(ii)	Any hazardous constituents should be included.				
• Use of Ground Water Information Tracking System (GRITS) or other system	40CFR270.32(b)(2) and 270.23(e)					

Checklist for Technical Review of RCRA Part B Permit Application for Subpart X Units

II. PART B GENERAL INFORMATION REQUIREMENTS

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
• List of hazardous constituents for which compliance monitoring will take place	40CFR270.14(c)(7)(iii)					
• Proposed concentration limits for each hazardous constituent	40CFR270.14(c)(7)(iv)					
• Detailed plans and an engineering report describing the proposed ground water monitoring system	40CFR270.14(c)(7)(v)					
• Description of proposed sampling, analysis, and statistical comparison procedures	40CFR270.14(c)(7)(vi)					
• Ground water flow rate and direction reported annually	40CFR264.99(e)					
• Reporting when concentration limits exceeded	40CFR264.99(h) and (i)					
Corrective action program or data showing that the existing levels are not harmful	40CFR270.14(c)(8)	When level of contaminants exceeds background level or the limits established under 40CFR264.94 Table 1, the facility may present data demonstrating that the levels are not harmful in place of a corrective action program.				
• Characterization of the contaminated ground water	40CFR270.14(c)(8)(i)					
• Concentration limit for each hazardous constituent	40CFR270.14(c)(8)(ii)					
Detailed plans and engineering report describing the corrective action to be implemented	40CFR270.14(c)(8)(iii)	A schedule for submitting this information may be presented.				
Description of use of the ground water monitoring program to demonstrate the adequacy of the corrective action	40CFR270.14(c)(8)(iv), 270.14(d), and 264.101	A schedule for submitting this information may be presented.				
H. PROTECTION OF SURFACE WATER						
Prevention of migration of wastes to surface water	40CFR264.601(b)	Location of surface waters must be depicted on a topographic map.				
I. OTHER APPLICABLE REGULATIONS						
Unit is classified as a "miscellaneous unit"	40CFR264.600	To address miscellaneous units, see Section III.				
Unit is classified as a process vent	40CFR264.1030	To address process vents, see Section IV.				
Unit is subject to equipment leaks	40CFR264.1050	To address equipment leaks, see Section V.				

Checklist for Technical Review of RCRA Part B Permit Application for Subpart X Units

III. SPECIFIC INFORMATION REQUIREMENTS FOR MISCELLANEOUS UNITS (SUBPART X)

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
SECTION III						
A. PROCESS INFORMATION						
Applicability as a "miscellaneous unit"	40CFR264.600 and 270.23 56FR720002(2/21/91) and 52FR469252(12/10/87)	The Subpart X regulations cover "miscellaneous" units. Among these units are OB/OD units for propellants, explosives, and pytrotechniques (PEP), geologic repositories and thermal treatment units such as microwave destruction.				
A1. Open Burning (OB) in Containment Devices Where Unit Incorporates Soil as Part of the Unit	40CFR270.23 and 270.32					
Appropriateness of treatment methods	40CFR270.32(b)	The applicant must demonstrate that the treatment technology is protective of public health and various environmental media, in addition to being safe for the waste handler.				
Containment device description	40CFR270.23(a)	Dimensions, construction materials, and controls must be described.				
· Physical characteristics, construction materials, and dimensions of the unit	40CFR270.23(a)(1)					
· Engineering drawings of the fabricated device	40CFR270.23(a)(2)	Drawings must be provided to determine design specifications and dimensions.				
· Lining material within device	40CFR270.23(a)(1) and (2)	Construction materials and applicable physical properties must be described.				
· Lining material below device	40CFR270.23(a)(1) and (2)	Dimensions, type of material, applicable physical properties, and depth below the fabricated device must be described.				
Leak detection provisions	40CFR270.23(a)(1) and (2)	Items and equipment used, functions, types of materials, dimensions, and physical properties must be described.				
Precipitation cover	40CFR270.23(a)(1) and (2)	For nonoperational periods, dimensions, construction materials, physical properties, and method of covering device must be described.				
Control of releases of ashes and residues during OB (integrity of containment devices)	40CFR270.23(a)(1) and (2)	Control must be by preventing releases or collecting the ashes and residues.				
Methods to control deterioration of fabricated devices	40CFR270.23(a)(1) and (2)	When organic compounds are present in the waste, the device must be located above ground with secondary containment below the device.				
Prevention of accumulation of precipitation	40CFR270.23(a)(1) and (2)	Precipitation can cause releases of ashes or waste or prevent complete thermal treatment of wastes. The type of cover must be indicated.				
Handling of precipitation accumulated in fabricated devices	40CFR270.23(a)(1) and (2)	Treatment and disposal must be described.				
Controls to prevent wind dispersion of ash and other residue	40CFR270.23(a)(1) and (2)	Controls during and between burns must be described.				
Inspection, monitoring, and maintenance plan	40CFR270.23(a)(2)	A schedule should be included.				
Ash and residue management	40CFR270.23(a)(2)	Treatment and disposal must be described.				
Copy of standard operating procedures (SOPs)	40CFR270.23(a)(2)					
A2. OB on the Ground Surface Where Unit Incorporates the Soil as Part of the Unit	40CFR270.23 and 270.32	Acceptance of this method must be evaluated on case-by-case basis.				

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III. SPECIFIC INFORMATION REQUIREMENTS FOR MISCELLANEOUS UNITS (SUBPART X)

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
Appropriateness of treatment technology	40CFR270.32(b)	The applicant must demonstrate that the treatment technology is protective of public health and various environmental media, in addition to being safe for the waste handler.				
Description of OB unit	40CFR270.23(a)	A brief overview must be provided.				
• Physical characteristics, construction materials, and dimensions of the unit	40CFR270.23(a)(1)					
• Engineering drawings of the OB unit	40CFR270.23(a)(2)	To determine design specifications and dimensions, the drawings must indicate how the boundaries of the OB unit are marked.				
• Pad description (if any)	40CFR270.23(a)(2)	Material, dimensions, compatibility with wastes, slope (if any), and permeability must be provided.				
• Lining material (if any)	40CFR270.23(a)(2)	The grade just below the pad should be able to withstand OB.				
Precipitation cover for nonoperational periods	40CFR270.23(a)(2)	Dimensions, construction materials, applicable physical properties, and method of covering the device must be described.				
Measures to minimize subsurface contamination	40CFR270.23(a)(2)	Use of underground liner may be limited because accidental detonations may damage the liner.				
Prevention of accumulation of precipitation	40CFR270.23(a)(2)	Precipitation can cause releases of ashes or waste or prevent complete thermal treatment of the wastes. The type of cover must be indicated.				
Inspection, monitoring, and maintenance plan	40CFR270.23(a)(2)	A schedule should be included.				
Copy of SOPs	40CFR270.23(a)(2)					
A3. Open Detonation (OD)	40CFR270.23 and 270.32					
Appropriateness of treatment technology	40CFR270.32(b)	The applicant must demonstrate that the treatment technology is protective of public health and various environmental media, in addition to being safe for the waste handler.				
Description of OD Unit	40CFR270.23(a)					
• Physical characteristics, materials of construction, and dimensions of the unit	40CFR270.23(a)(1)					
• Engineering plan and drawings of the OD unit	40CFR270.23(a)(2)	To determine design specifications and dimensions, the drawings must indicate how the edges of the OD unit are marked.				
Inspection, monitoring, and maintenance plan	40CFR270.23(a)(2)	The schedule should be included.				
Ash and residue management	40CFR270.23(a)(2)	Although little or no ash is generated in OD units, provisions should be made to demonstrate that soils and surface water have not been contaminated (such as soil and surface water sampling from designated areas and depths at required frequencies).				
Run-on and run-off management	40CFR270.23(a)(2)	Devices and equipment (berms, ditches, collection systems), dimensions, and other applicable physical properties are not of major concern for OD units because little or no ash is generated.				
Copy of SOP	40CFR270.23(a)(2)					
A4. Geologic Repositories - placement of containerized hazardous waste or bulk nonliquid hazardous waste in geologic repositories such as	52FR46952(12/10/87)	Description of unit must be included.				

III. SPECIFIC INFORMATION REQUIREMENTS FOR MISCELLANEOUS UNITS (SUBPART X)

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
underground salt formations, mines, or caves						
A5. Deactivated Missile Silos	52FR46952(12/10/87)	This does not include underground injection wells or other units currently covered in 40CFR264.				
A6. Certain Thermal Treatment Units other than incinerators such as:	56FR720002(2/21/91) and 57FR546952(12/10/87)					
· Molten salt pyrolysis	52FR46952(12/10/87)	Description of unit must be included.				
· Calcination	52FR46952(12/10/87)	Description of unit must be included.				
· Wet-air oxidation	52FR46952(12/10/87)	Description of unit must be included.				
· Microwave destruction	52FR46952(12/10/87)	Description of unit must be included.				
· Carbon regeneration	56FR720001(2/21/91)	Description of unit must be included.				
· Sludge dryers	56FR720102(2/21/91)	Sludge dryer refers to any enclosed thermal treatment device used to dehydrate sludge and that has a maximum thermal input of 1,500 British Thermal Units per pound (Btu/lb) sludge treated on a wet-weight basis. A description of unit should be included.				
Future additions as needed.						
A7. Certain Chemical, Physical, and Biological Treatment Units.	52FR46952(12/10/87)	This does not cover treatment in tanks, surface impoundments, and land treatment units. Description of unit should be included.				
B. ENVIRONMENTAL PERFORMANCE STANDARDS						
B1. Quantity and Physical and Chemical Characteristics of the Waste and Products of Combustion.	40CFR264.601(a)(1), (b)(1), and 270.23	Provide chemical properties pertinent to the compounds in wastes and potential compounds formed during OB/OD and their behavior in soil, ground water, or surface water.				
EPA waste code	40CFR270.23(e)					
Amount burned at the unit	40CFR264.601(a)(1) and 270.23	This amount indicates the maximum amount of wastes that could migrate to the ground water.				
Waste composition data	40CFR264.601(a)(1) and 270.23	These data should be briefly presented in this section again.				
Solubility in water	40CFR264.601(a)(1) and 270.23	Solubility should be provided for each compound.				
Mobility in soil	40CFR264.601(a)(1) and 270.23	Mobility in soil should be provided for each compound.				
Physical state and molecular properties	40CFR264.601(a)(1) and 270.23	Physical state and molecular properties should be provided for each compound.				
Mobility in ground water	40CFR264.601(a)(1) and 270.23	Mobility in ground water should be provided for each compound.				
Sorption properties of waste material relative to environmental media	40CFR264.601(a)(1) and 270.23					
Biodegradability, bioconcentration, and biotransformation relative to	40CFR264.601(a)(1) and 270.23					

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
environmental media						
Photodegradation rates of waste	40CFR264.601(a)(1) and 270.23					
B2. Hydrogeological Characteristics of the Site	40CFR270.23(b), 264.601(a)(2), and (b)(3)					
Depth to water beneath the unit	40CFR264.601(a)(2) and 270.23(b)	This information should be obtained from boring logs associated with the process of identifying the uppermost aquifer. The source of this information should be referenced.				
Estimate of net recharge rate	40CFR264.601(a)(2) and 270.23(b)	Net recharge = (precipitation + runon) - (evapotranspiration + runoff)				
Description of uppermost aquifer	40CFR264.601(a)(2) and 270.23(b)					
Description of soil types and depth range of each soil	40CFR264.601(a)(2) and 270.23(b)	Between the ground surface and the water table.				
Topography of the unit area	40CFR264.601(a)(2) and 270.23(b)	A brief description and maps showing natural surface drainage basins and storm water collection systems for the area affected by the operation should be provided.				
B3. Protection of Ground Water and Subsurface Environment	40CFR264.601(a) and 270.23(b)(c)	Applicant must conduct an assessment of the potential for a release to ground water or subsurface environment.				
Potential for migration through soil, liners, and containing structures	40CFR264.601(a)(1)					
Ground water quality and all possible sources of contamination	40CFR264.601(a)(3)	To determine whether a particular contaminant is introduced by the OB/OD unit and evaluate the cumulative effect on ground water				
Ground water flow and rate	40CFR264.601(a)(4) and (b)(5)	To determine direction and rate of plume migration in case of ground water contamination				
Proximity to and withdrawal rates of current and potential ground water users	40CFR264.601(a)(5)	The 1,000-foot radius of the unit is useful in determining need for and level of cleanup in case of ground water contamination.				
Potential for damaging unsaturated zone	40CFR264.601(b)(8)					
Land use patterns in the area	40CFR264.601(a)(6) and (b)(9)					
Potential for deposition or migration of waste constituents into subsurface physical structures, and into root zone of food chain crops and other vegetation	40CFR264.601(a)(7)					
Effects of explosion on geologic units and ground water flow under the unit	40CFR270.23(e), 264.601(a)(1), and (b)(2)					
Potential impacts on human health	40CFR264.601(a)(8) and (b)(10)	When the uppermost aquifer is used as a drinking water supply, a risk evaluation should be developed. Potency factors by hazardous constituent should be used to determine risks.				
Potential for damage to flora, fauna, and physical structures due to exposure	40CFR264.601(a)(9) and (b)(11)					

III. SPECIFIC INFORMATION REQUIREMENTS FOR MISCELLANEOUS UNITS (SUBPART X)

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
B4. Protection of Surface Water, Wetlands, and Soil Surface	40CFR264.601(b), 270.23 (b), and (c)					
Effectiveness and reliability of containing, confining, and collecting systems and structures in preventing migration	40CFR264.601(b)(2)					
Precipitation patterns in the area	40CFR264.601(b)(4)					
Proximity of the units to surface waters	40CFR264.601(b)(6)					
Water and surface soil quality standards, quality data, and uses	40CFR264.601(b)(7)(8)	If operation does not affect surface waters, this item does not apply. Otherwise, actual uses of surface waters (including seasonal uses) should be discussed.				
C. AIR QUALITY ASSESSMENTS						
C1. Volume and Physical and Chemical Characteristics of the Waste in the Unit	40CFR270.23(b) and 264.601(c)(1)	Emissions from evaporation or reaction processes should be evaluated for potential dispersal of gases, aerosols, and particulates. The emissions may be determined by direct measurement or by using emission factors. Emission factors for all suspected hazardous air pollutants and compounds formed in OB/OD should be determined.				
C2. Effectiveness and Reliability of Systems and Structures to Reduce or Prevent Emissions	40CFR264.601(c)(2) and 270.23(d)	Emissions during preburn phase should be zero.				
C3. Operating Conditions of the Unit (Case by Case)	40CFR264.601(c)(3)	The following operating conditions should be addressed: allowable quantities of waste per unit, operating time frames, ambient air monitoring requirements, acceptable meteorological conditions, meteorological requirements, and meteorological monitoring.				
C4. Atmospheric, Meteorological, and Topographic Characteristics of the Unit and Surrounding Areas	40CFR264.601(c)(4)	The mechanisms for using meteorological data to understand and manage air emissions should be specified.				
Frequency of inversions	40CFR264.601(c)(4)					
Lake and pond evaporation	40CFR264.601(c)(4)					
Annual and 24-hour rainfall data	40CFR264.601(c)(4)					
Seasonal temperatures	40CFR264.601(c)(4)					
Relative humidity	40CFR264.601(c)(4)	Relative humidity should be considered in terms of possible formation of harmful chemicals from the combustion products.				
Wind rose	40CFR264.601(c)(4)	Restriction should be applied when the direction is not appropriate for release emissions.				
C5. Existing Air Quality (Toxic Pollutants) and Other Sources of Contamination	40CFR264.601(c)(5)	Applicant must determine general ambient air quality conditions prior to releases. If not available, such data should be generated. Applicant must use EPA-approved air monitoring methods to provide data.				
C6. Potential Impacts to Human Health and the Environment	40CFR264.601(c)(6)	These impacts should be evaluated for the entire treatment process through modeling or emissions monitoring of hazardous constituents.				
C6a. Screening Assessment	40CFR264.601(c) and 264.602					
Types and quantities of wastes	40CFR264.601(c)(1)					
Number of fabricated devices, burn areas, or detonation pits involved in a	40CFR264.601(c)(3)					

III. SPECIFIC INFORMATION REQUIREMENTS FOR MISCELLANEOUS UNITS (SUBPART X)

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
burn or detonation event and the number of events per day						
Total amounts of each pollutant emitted per event and the total combined amounts of pollutants emitted per year	40CFR264.601(c)(1)	The models and calculations used to determine the emission factors should be clearly identified. Emission factors for all suspected hazardous air pollutants should be determined. Units of measure should be presented in mass of pollutant emitted per mass of material burned.				
Duration of release (from a few seconds to a few hours)	40CFR264.601(c)(3)					
Description of emissions (plume) to the atmosphere	40CFR264.601(c)(1)					
• Release height	40CFR264.601(c)(1)	For burns and detonations conducted on the ground surface, the release height will be 0 meters.				
• Temperature	40CFR264.601(c)(1)	Typical values are around 6,700 degrees Fahrenheit (°F) for open burning. No detonation temperatures are given.				
Downwind concentrations of each known or suspected hazardous waste constituent emitted, including carcinogenic compounds	40CFR264.601(c)(1)	Air monitoring or an EPA-approved dispersion model can be used. The selection of the model will be a function of the geometry of the treatment unit, duration of the release, and local topography. Specific models used by the applicant must be evaluated and approved by EPA.				
Compare concentrations with existing toxic air pollution standards	40CFR264.601(c)(1)	EPA Superfund guidance should be used for assessing the air pathway utilizing IRIS data.				
Risk analysis	40CFR264.601(c)(6)	EPA's Risk Assessment Guidance should be used for Superfund and RCRA Facility Investigation (RFI) documents.				
• Urban or rural area	40CFR264.601(c)(6)					
• Population density	40CFR264.601(c)(6)	The location of the facility in a densely or sparsely populated area should be described.				
• Land use in nearby areas	40CFR264.601(c)(6)	Land use should be identified as residential, industrial, agricultural, or others.				
• Sensitive receptors within a 69-kilometer (km) radius	40CFR264.601(c)(6)	This includes schools or hospitals.				
• Estimate of number of exposed individuals	40CFR264.601(c)(6)	Estimate should include individuals living and working on the premises.				
• Calculation of lifetime cancer risk	40CFR264.601(c)(6)	This is a function of downwind concentrations, unit risk value, and exposure duration. EPA's guidance documents (Superfund and RFI) should be used for the risk assessment. This result will determine whether a more detailed risk assessment is required.				
C6b. Detailed Assessment	40CFR264.601(c)(6)					
The following general parameters should be considered:	40CFR264.601(c)(6)					
• EPA approved dispersion model should be used	40CFR264.601(c)(6)	Sufficient meteorological data (3 to 5 years) should be used to verify that worst-case meteorological conditions are addressed.				
• Detailed network of receptor points	40CFR264.601(c)(6)	This is necessary to permit the estimation and identification of receptor points that are exposed to maximum concentrations.				
• Detailed estimate of exposed population	40CFR264.601(c)(6)	Permit writers must consult with the regional EPA toxicologist for risk assessment issues.				
• Noninhalation pathways (ingestion and dermal contact) must be addressed	40CFR264.601(c)(6)	Appropriate pathway exposure models for direct and indirect exposure should be used. The regional EPA toxicologist should be consulted.				
• Estimate of individual excess lifetime cancer risk	40CFR264.601(c)(6)	This value is the sum of the excess cancer risk due to the inhalation of airborne carcinogens and the				

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
		excess risk due to exposure from other paths (ingestion and dermal absorption).				
C7. Potential Damage to Domestic Animals, Wildlife, Crops, Vegetation, and Physical Structures	40CFR264.601(c)(7)					
D. POTENTIAL PATHWAYS OF EXPOSURE AND POTENTIAL EXPOSURE MAGNITUDE						
Potential for the public to be exposed to hazardous wastes	40CFR270.23(c)					
Amount of time the waste will remain in the unit before it is detonated or burned	40CFR270.23(c)					
Expected time to complete burning	40CFR270.23(c)					
Protection or shelter for personnel during burning or detonation	40CFR270.23(c)	Description of personal protection equipment (PPE) should be included.				
Meteorological conditions under which burning or detonation will be permitted or restricted	40CFR270.23(c)					
Length of time after operation of the unit before reentry of personnel to the burning ground or detonation site is allowed	40CFR270.23(c)					
D1. Potential Human and Environmental Receptors	40CFR270.23(c)	Based on current and future land use, including both short-term and long-term exposure receptors, receptors of indirect exposure, such as consumers of fish and agricultural products from the site area, must be considered.				
Locations of receptors relative to the site	40CFR270.23(c)					
Sensitive populations	40CFR270.23(c)	Include subpopulations such as children, elderly people, and endangered species, that are at increased risk.				
D2. Potential Exposure Pathways	40CFR270.23(c)	Use Risk Assessment Guidance for Superfund and RFI.				
Release sources, characteristics, quantities, and duration	40CFR270.23(c)	Releases can occur from the waste itself, from contaminated soil and water, or from the compounds formed in OB/OD.				
Release mechanisms	40CFR270.23(c)	Volatilization, fugitive dust, particulate emissions, surface runoff, leaching, and tracking are common mechanisms.				
Receiving media	40CFR270.23(c)	Media include air, surface water, ground water, soil, sediment, and biota.				
Fate and transport in receiving media	40CFR270.23(c)	Fate and transport include physical transport (convection), physical transformation (volatilization, precipitation), chemical transformation (photolysis, oxidation), biological transformation (biodegradation) and accumulation.				
Exposure points	40CFR270.23(c)	Any point, both on-site and off-site, where any of the potential human and environmental receptors can contact the receiving media is considered an exposure point.				
Probable exposure routes	40CFR270.23(c)					
Wetting of the burning area	40CFR270.23(c)	If wetting area is required by operating procedures, descriptions of methods used in process and methods to minimize release of hazardous wastes or constituents should be included.				
D3. Potential Magnitude and Nature of Exposure	40CFR270.23(c)					
Exposure concentrations	40CFR270.23(c)	Arithmetic average of concentration that is contacted over the exposure period at exposure points in air,				

Checklist for Technical Review of RCRA Part B Permit Application for Subpart X Units

III. SPECIFIC INFORMATION REQUIREMENTS FOR MISCELLANEOUS UNITS (SUBPART X)

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
		surface water, ground water, soil, sediment, and biota is sufficient.				
Total risk	40CFR264.601 and 270.23(c)					
E. EFFECTIVENESS OF THE TREATMENT						
Report demonstrating the effectiveness with supporting lab or field data	40CFR270.23(d)					
F. ADDITIONAL INFORMATION						
F1. Noise Considerations	40CFR264.601 and 270.23(e)	Protection of human health and the environment primarily related to OD units is the primary concern.				
Distance of the OB/OD unit, or area, from off-plant inhabited buildings	40CFR265.382					
Wind direction	40CFR264.601 and 270.23(e)	Noise will be carried in the direction of the wind.				
Airblast	40CFR264.601 and 270.23(e)	See 30CFR816.67(b)(69).				
· Airblast maximum levels	40CFR264.601 and 270.23(e)	The use of explosives and control of adverse effects are covered by 30CFR816.67(b)(1). It presents a table of the maximum acceptable levels of decibels (dB). Also see 30CFR816.67(b)(69).				
· Monitoring of airblast effects at several receptors	40CFR264.601 and 270.23(e)	See 30CFR816.67(b)(69).				
· Type, sensitivity, and capability of blast-monitoring equipment	40CFR264.601 and 270.23(e)					
· Procedure	40CFR264.601 and 270.23(e)					
· Map showing monitoring receptors	40CFR264.601 and 270.23(e)					
· Range of sizes of explosive charges in the monitoring data	40CFR264.601 and 270.23(e)					
· Atmospheric conditions during the monitoring	40CFR264.601 and 270.23(e)					
Ground vibration	40CFR264.601, 270.23(e), and 30CFR816.67(d)(69)	Three methods of compliance are presented in 30CFR816.67(d)(69) with maximum acceptable levels of ground vibration: (1) maximum peak-particle-velocity limits; (2) scaled-distance equation; and (3) blasting level chart.				
· Specific maximum ground vibration	40CFR264.601 and 270.23(e)					
· Method of determination of ground vibration	40CFR264.601 and 270.23(e)					
Manner of placing the waste in the unit	40CFR264.601 and 270.23(e)					
· Use of supplemental fuels, type, amount, and manner of placing them in the waste	40CFR264.601 and 270.23(e)					
Minimum protective distances	40CFR265.382 and 270.23(e)	Minimum distances to the property of others are: <u>Quantity of Explosive</u> <u>Distance</u> 1. 0 to 100 lb - 670 ft				

III. SPECIFIC INFORMATION REQUIREMENTS FOR MISCELLANEOUS UNITS (SUBPART X)

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
		2. 101 to 1,000 lb - 1,250 ft 3. 1,001 to 10,000 lb - 1,730 ft 4. 10,000 to 30,000 lb - 2,260 ft or other distances as demonstrated to protect human health and the environment.				

Note: Miscellaneous general guidance documents such as:

- Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual - Part A
- RCRA Guidance Manual for Permitting Commercial Explosive Industry Open Burning/Open Detonator Units, 1989

may also be used for guidance purposes only.

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IV. SPECIFIC INFORMATION REQUIREMENTS FOR PROCESS VENTS (SUBPART AA)

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
SECTION IV						
A. GENERAL DEFINITION OF PROCESS VENTS						
Description of process vent	40CFR264.1030 and 264.1031	A process vent is any open-ended pipe or stack that is vented to the atmosphere either directly, through a vacuum-producing system, or through a tank.				
B. OPERATIONS ASSOCIATED WITH PROCESS VENTS						
Applicability - operations that manage hazardous waste with organic concentrations of at least 10 parts per million by weight (ppmw)	40CFR264.1030(b) and 264.1031	Concentrations should be determined by a time-weighted average annually or when waste or process changes.				
B1. Distillation - a batch or continuous operation which separates one or more feed stream(s) into two or more exit streams, each exit stream having component concentrations different from those in the feed stream(s)	40CFR264.1030(b) and 264.1031	A description of process should be included.				
B2. Fractionation - a distillation operation or method used to separate a mixture of several volatile components of different boiling points in successive stages	40CFR264.1030(b) and 264.1031	A description of process should be included.				
B3. Thin-film Evaporation - a distillation operation that employs a heating surface consisting of a large diameter tube that may be either straight or tapered, horizontal or vertical	40CFR264.1030(b) and 264.1031	A description of process should be included.				
B4. Solvent Extraction - an operation or method of separation in which a solid or solution contacts a liquid solvent (the two being mutually insoluble) to preferentially dissolve and transfer one or more components into the solvent	40CFR264.1030(b) and 264.1031	A description of process should be included.				
B5. Air Stripping - a desorption operation employed to transfer one or more volatile components from a liquid mixture into a gas (air) either with or without the application of heat to the liquid	40CFR264.1030(b) and 264.1031	A description of process should be included.				
B6. Steam Stripping - a distillation operation in which vaporization of the volatile constituents of a liquid mixture takes place by the introduction of stream directly into the charge	40CFR264.1030(b) and 264.1031	A description of process should be included.				
C. METHODS FOR REDUCING EMISSIONS FROM PROCESS VENTS						
C1. Reduce Total Organic Emission Below 1.4 Kilogram Per Hour (3 pound per hour) and 2.8 Million Grams Per Year (3.1 tons per year), or	40CFR264.1032(a)(1), (c), and 270.24(b)	Engineering calculations or performance test may be used.				
C2. Reduce Total organic Emissions of 95% by Weight with the Use of a Control Device, or	40CFR264.1032(a)(2), (b), and 270.24(b)					

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IV. SPECIFIC INFORMATION REQUIREMENTS FOR PROCESS VENTS (SUBPART AA)

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
C3. Reduce Emissions for Various Control Devices with Closed-vent Systems Under the Following Operational Conditions:	40CFR264.1032(a) and (b), 264.1033 (b-j), and 270.24(b)	Closed-vent systems are optional devices but must comply with regulations if they are used.				
· Control device involving vapor recovery (condenser or absorber) shall recover at least 95 percent by weight of the organic vapors	264.1032(a)(1) and (b)	A less than 95 percent recovery is permissible if the control devices meet emission limits set in 40CFR264.1032(a)(1).				
· Closed combustion device (a vapor incinerator, boiler, or process heater) shall recover at least 95 percent by weight of organic emissions	40CFR264.1033(c)	The device must achieve 20 ppmw or ½ second residence time at 760 degrees Celsius (°C).				
· A flare shall operate under the following four conditions: (1) no visible emissions, (2) a flame present at all times, (3) an acceptable net heating value, and (4) appropriate exit velocity	40CFR264.1033(d)					
· Carbon adsorption system shall recover at least 95 percent by weight of the organic vapors	40CFR264.1032(a)(2), (b), and 270.24(b)					
D. MONITORING AND INSPECTION OF CONTROL DEVICES						
Inspection readings are conducted at least daily. Vent stream flow information is provided at least hourly.	40CFR264.1033(f)(l) and (3)					
D1. Continuous Monitoring for the Following Control Devices:	40CFR264.1033(f)(2)					
· Thermal vapor incinerator (one temperature sensor)	40CFR264.1033(f)(2)(i)	Sensor must have accuracy of ± 1 percent °C or ± 0.5 °C, whichever is greater.				
· Catalytic vapor incinerator (two temperature sensors)	40CFR264.1033(f)(2)(ii)	Sensors must have accuracy of ± 1 percent °C or ± 0.5 °C, whichever is greater.				
· Flare (heat sensing device)	40CFR264.1033(f)(2)(iii)					
· Boiler or process heater with heater input capacity equal or greater than 44 megawatts (recorder which indicates good combustion practices)	40CFR264.1033(f)(2)(v)					
· Condenser (device to measure organic vapors or temperature sensor)	40CFR264.1033(f)(2)(vi)	Sensor has accuracy of ± 1 percent °C or ± 0.5 °C, whichever is greater.				
· Carbon adsorption system (device to measure organic vapors or a recorder that verifies predetermined regeneration cycle)	40CFR264.1033(f)(2)(vii)					
D2. Alternate Monitoring of Control Device	40CFR264.1033(i) and 270.23(c)	Information should be provided describing measurement of applicable monitoring parameters.				
D3. Inspection of the Following Control Devices:	40CFR264.1033(g) and (h)					
· Regenerable carbon adsorption system	40CFR264.1033(g)	Carbon replacement schedule must be acceptable.				

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IV. SPECIFIC INFORMATION REQUIREMENTS FOR PROCESS VENTS (SUBPART AA)

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
· Nonregenerable carbon adsorption system	40CFR264.1033(h)	Carbon must be replaced when breakthrough is observed or on an acceptable schedule.				
D4. Use of Reference Method 21 for Compliance Testing	40CFR264.60 and 1034					
E. BASIC OPERATIONAL PROPERTIES OF CLOSED-VENT SYSTEMS						
No detectable emissions	40CFR264.1033(k)(1)	Emissions must be less than 500 parts per million (ppm) above background.				
Monitoring to verify no detectable emissions	40CFR264.1033(k)(2)	The monitoring shall be done: (1) the date the system is subject to the regulation, (2) annually, and (3) other times requested by the regional administrator of the EPA.				
F. RECORD KEEPING REQUIREMENTS FOR CONTROL DEVICES AND CLOSED-VENT SYSTEMS						
Owner complies with record keeping requirements	40CFR264.1035 and 270.24(d)	Closed-vent systems are optional devices but must comply with regulations if they are used.				
Semiannual report is submitted according to subpart AA requirements	40CFR264.1036	Closed-vent systems are optional devices but must comply with regulations if they are used.				
Implementation schedule is provided	40CFR264.1033(a)(2) and 270.24(a)	A schedule must be provided when facilities cannot install a closed-vent system and control device to comply with 40CFR264 on the date the facility is subject to the requirements.				
Performance test plan is provided	40CFR264.1035(b)(3) and 270.24(c)	A performance test plan must be provided where an owner/operator applies for permission to use a control device other than a thermal vapor incinerator, catalytic vapor incinerator, flare, boiler, process heather, condenser, or carbon adsorption system, and chooses to use test data to determine the organic removal efficiency achieved by the control device.				

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V. SPECIFIC INFORMATION REQUIREMENTS FOR EQUIPMENT LEAKS (SUBPART BB)

Item	Authority	Comments on Requirements	Location of Information in the Application	Addressed (Y/N)	Technically Adequate (Y/N)	See Attached Comment Number
SECTION V						
A. EQUIPMENT LEAKS						
Definition of equipment leaks	40CFR264.1050	Equipment leaks are associated with operations that manage hazardous waste with organic concentrations of at least 10 ppmw. Equipment in a vacuum is excluded from Subpart BB requirements. Each piece of equipment shall be marked.				
B. STANDARDS FOR PUMPS IN LIGHT LIQUID SERVICE						
Monthly monitoring for leaks	40CFR264.1052(a)(1) and 270.25(d)					
Visual inspection for pump seal leakage on a weekly basis	40CFR264.1052(a)(2) and 270.25(d)					
Leak detection	40CFR264.1052(b), 264.1063, and 270.25(d)	Leak detected if: (1) A leak detection instrument reads 10,000 ppm or greater or (2) there are indications of liquids dripping from the pump seal.				
Leak repair as soon as practicable	40CFR264.1052(c), 1059, and 270.25(d)	Repairs are to be made within 15 calendar days after detection. Repair extensions are allowed under conditions specified in 40CFR264.1059.				
Specific exceptions to these standards	40CFR264.1052(d), (e), (f), and 270.25(d)	Exceptions to these standards are dual mechanical seal systems or no detectable emissions.				
C. STANDARDS FOR COMPRESSORS						
Barrier fluid pressure greater than the compressor stuffing box pressure	40CFR264.1053(b)(1) and 270.25(d)					
Barrier fluid system connected by a closed-vent system to a control device as described in Subpart AA	40CFR264.1053(b)(2) and 270.25(d)					
No detectable atmospheric emissions of hazardous contaminants from the barrier system	40CFR264.1053(b)(3) and 270.25(d)					

Sensors checked daily or an audible alarm checked monthly	40CFR264.1053(d),(e) and 270.25(d)					
Leak detection	40CFR264.1053(f) and 270.25(d)	A leak is detected if sensor indicates a failure of: (1) the seal system or (2) the barrier fluid system.				
Leak repair as soon as practicable	40CFR264.1053(g)(1), 264.1059, and 270.25(d)	Repairs are to be made within 15 calendar days after detection. Repair extensions are allowed under conditions specified in 40CFR264.1059.				
Specific exceptions to these standards	40CFR264.1053(h),(i), and 270.25(d)	Exceptions to these standards are certain closed vent systems or no detectable emissions.				
D. STANDARDS FOR PRESSURE RELIEF DEVICES IN GAS/VAPOR SERVICE						
Except during pressure releases, no pressure relief device shall release detectable emissions.	40CFR264.1054(a) and 270.25(d)	Emissions shall be less than 500 ppm above background levels.				
Within 5 calendar days after a pressure release, no detectable emissions shall emanate from pressure release device.	40CFR264.1054(b) and 270.25(d)	Emissions shall be less than 500 ppm above background levels.				
Specific exceptions to these standards	40CFR264.1054(c) and 270.25(d)	Exceptions to these standards are certain closed vent systems.				
E. STANDARDS FOR SAMPLING CONNECTING SYSTEMS						
Sampling connecting system equipped with a closed-purge system or closed-vent system	40CFR264.1033, 264.1055(a),(b), 264.1060, and 270.25(d)	Each closed-purge system or closed-vent system shall either: (1) release no detectable air emissions into the hazardous waste management process line, (2) release no detectable air emissions to the recycled hazardous waste stream, or (3) meet operational conditions of control devices as found in 40CFR264.1033 and 40CFR264.1060.				
Specific exception to these standards	40CFR264.10(c) and 270.25(d)	Exceptions to these standards are in situ sampling systems.				
F. STANDARDS FOR OPEN-ENDED VALVES OR LINES						
Open-ended valve or line	40CFR264.1056(a),(c) and 270.25(d)	Each open-ended valve or line shall be equipped with a cap, blind flange, plug, or a second valve that seals the open end at all times except during operations. A double block and bleed system will follow the same operating procedures except when operations require venting the line between block valves.				
Second valve	40CFR264.1056(b) and 270.25(d)	A second valve shall be operated such that the primary valve must be closed before the second valve is opened.				
G. STANDARDS FOR VALVES IN GAS/VAPOR SERVICE OR IN LIGHT LIQUID SERVICE						
Monitoring schedule based on detection of leaks and predetermined	40CFR264.1057(a-e),	A reading of 10,000 ppm denotes a detected leak.				

schedule	and 270.25(d)					
Specific exceptions to the monitoring schedule	40CFR264.1057(f-h), 264.1061, 264.1062, and 270.25(d)	Exceptions to the schedule include unsafe-to-monitor valves, no detectable emissions, and difficult-to-monitor valves.				
H. STANDARDS FOR PUMPS AND VALVES IN HEAVY LIQUID SERVICE, PRESSURE RELIEF DEVICE IN LIGHT LIQUID OR HEAVY LIQUID SERVICE, AND FLANGES AND OTHER CONNECTORS						
Monitoring	40CFR264.1058(a), 264.1063(b), and 270.25(d)	Monitoring is required within 5 days after a leak is found by sight, sound, smell, or other detection method.				
Leak detection	40CFR264.1058(b) and 270.25(d)	A leak is detected if a leak detection instrument reads 10,000 ppm or greater.				
Leak repair as soon as practicable	40CFR264.1058(c), 264.1059, and 270.25(d)	Repairs are to be made within 15 calendar days after detection. The first attempt at repair shall be made no later than 5 calendar days after each leak is detected. Repair extensions are allowed under conditions specified in 40CFR264.1059.				
I. TESTING						
Use of reference method 21 for compliance testing	40CFR264.60 and 264.1034					
J. RECORD KEEPING AND REPORTING REQUIREMENTS						
Owner complies with record keeping requirements	40CFR264.1064					
Semiannual report	40CFR264.1065	The semiannual report must be submitted according to requirements.				
Implementation schedule	40CFR270.25(b)	An implementation schedule must be provided if the facility cannot install a closed-vent system and control device to comply with the provisions of 40CFR264 Subpart BB on the effective date that the facility becomes subject to the provisions of 40CFR264 and 265.				
Performance test plan	40CFR270.25(c)	A test plan must be provided if the owner/operator applies for permission to use a control device for other than a thermal vapor incinerator, flare, boiler, process heater, condenser, or carbon adsorption system and chooses to use test data to determine the organic removal efficiency achieved by the control device.				