5.2.1.1 Emissions Quantification

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

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

Emission Source Monitoring

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

Emission Characterization for Mechanical Units

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

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.

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

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

Upwind/Downwind Monitoring

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

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

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

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

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

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

Transect Monitoring

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

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

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

BangBox Tests

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

View of the Bang Box Facility

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

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

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

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

Emissions = 0.5 lb/(lb NEW) x (1,000 lb new)
= 500 lb

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

Evaluation of Emission Monitoring Programs

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

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

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

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

Limitations of the Bang Box Emission Factors

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

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

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

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

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

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

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.