APPENDIX B

QUANTIFYING POTENTIAL RELEASES FROM SELECTED REMEDIATION TECHNOLOGIES

Remediation activities at hazardous waste sites have the potential to cause emissions and impacts in addition to those being addressed. Potential emission sources during remediation include point sources of treatment residuals such as incinerator stacks; fugitive emissions from treatment equipment leakage; and areal sources of volatile organics and fugitive dusts from the disturbed surface of a contaminated land area. Uncontrolled releases can result in exposures to contaminants in soils, surface water, ground water, and ambient air surrounding the treatment equipment. The following sections provide descriptions of several common remediation activities to serve as examples of the considerations involved in quantifying technology-specific releases. This appendix also contains a list of references that can be useful in quantifying potential air releases for a variety of remediation technologies.

B.1 SOILS HANDLING TECHNOLOGIES

Soils handling is a major component of nearly all ex-situ technologies for treating contaminated soils. Soil handling activities include: excavation; transportation (e.g., to storage or treatment areas); dumping (e.g., onto trucks or piles); storage; and grading the treated or replaced soil. Any or all of these activities may result in fugitive dust emissions, the main type of release from soils handling. These emissions can carry organic and/or inorganic contaminants, which may be bound to soil particles, for great distances away from the site. Soil handling activities also can increase volatile organic emissions by exposing contaminated soil to the atmosphere, and through agitation of the soil.

Some of the important parameters that may affect the fugitive dust emissions potential at a contaminated site are listed in the box below. These parameters depend on site and remedial activity characteristics. Details can be obtained from onsite observation or from vendors and/or operators. Some or all of these parameters may already have been considered in the RI/FS. Fugitive dust emission factors (mass per unit operation) or rates (mass per unit time, derived from emission factors) for volatile organic, particulate and/or metal contaminants during each soil handling remedial activity can be estimated using equations and procedures outlined in the documents listed in Section B.4. These emission factors or rates can be used as inputs to fate and transport models, which are used to generate exposure point concentrations. Additional information on exposure assessment can be obtained from Chapter 2 of this guidance and Chapter 6 of RAGS/HHEM Part A.

KEY PARAMETERS AFFECTING RELEASES FROM SOILS HANDLING

- Area of working surface
- Agitation factor
- Drop height (when transferring soil)
- Storage pile geometry
- Soil moisture content
- Soil silt content
- Meteorological conditions
- Chemical characteristics

B.2 THERMAL DESTRUCTION TECHNOLOGIES

Thermal destruction uses high temperature and controlled conditions to oxidize and/or degrade a substance into simple combustion products such as CO_2, H_2O vapor, SO_2, NO_x, HCl gases, and ash. Thermal destruction methods can be used to destroy organic contaminants in liquid, gaseous, and solid waste streams. Incinerators are by far the best known and most studied thermal destruction devices. In many cases, thermal destruction techniques that do not have sufficient

emission data can be assumed to have emission characteristics similar to incinerators.

Emission sources from incinerators include process emissions and fugitive emissions. Incinerator process emissions include stack gas, bottom ash and air pollution control device residuals. Fugitive emissions include uncontrolled or undetected equipment leakage. Process emission estimation methods for organic compounds, metals, particulates, and acid gases (HCl, SO_2, and HF) can be obtained from EPA (1985a) (see Section B.4.1). Fugitive emission sources and equations for estimating emissions are detailed in EPA (1989) (see Section B.4.1) and Holton and Travis (1984) (see Section B.4.3). Fugitive emissions from soils handling prior to incineration can be estimated using the guidance given in Section B.1 on soils handling.

Emissions from thermal destruction technologies generally can be estimated using any one of the approaches listed below. (These methods do not directly account for removal of contaminants by air pollution control devices that may be used to treat emissions from thermal destruction devices.)

- **Default approach:** Thermal destruction devices at most contaminated sites may be required to meet the requirements under federal regulations such as RCRA or the Toxic Substances Control Act (TSCA), since these requirements are generally considered ARARs. RCRA requires at least 99.99% destruction and removal of regulated organic constituents from wastes. TSCA requires 99.9999% destruction and removal for wastes containing PCBs and dioxins. Thus, organic emissions from thermal destruction of hazardous waste can be estimated by assuming that the above requirements of RCRA and TSCA will be exactly met, for pollutants covered by those regulations. Similar requirements can be used to estimate HCl emissions, but this approach may not provide estimates for particulate or air emissions.

- **Trial run approach:** Federal regulations such as RCRA and TSCA require trial burns to demonstrate removal efficiencies. Whenever trial burn data for the waste in question exist they can be used to estimate the emissions that might occur during actual remedy implementation. Data obtained from trial burns at different sites or different operable units from the same site can be used for estimating emissions.

- **Theoretical or empirical approach:** Theoretical or applicable empirical equations — often called models — can be used to estimate emissions. These models correlate incinerator operating parameters and pollutant emission rates.

Some of the important parameters that may affect the emissions associated with thermal destruction technologies are listed in the box below. Many of these parameters are device dependent and can be obtained from onsite observation or from vendors and/or operators.

KEY PARAMETERS AFFECTING RELEASES FROM THERMAL DESTRUCTION

- Waste feed rate
- Burn temperature
- Residence time
- Excess air rate
- Facility size/type
- Atomization
- Control device efficiency
- Chemical characteristics

B.3 SOLIDIFICATION/ STABILIZATION TREATMENT TECHNOLOGIES

Solidification/stabilization technologies are used to immobilize the toxic and hazardous constituents in the waste by changing those constituents into immobile forms, binding them in an immobile, insoluble matrix, and/or binding them in a matrix that minimizes the material surface exposed to solvents. Except for emerging technologies that involve in-situ treatment, the implementation of stabilization or solidification generally involves several of the soils handling activities discussed in Section B.1. The box below lists some of the key parameters affecting releases associated with solidification/ stabilization. These parameters depend on the specific

solidification/stabilization process. These can be obtained from onsite observation or from vendors and/or operators.

KEY PARAMETERS AFFECTING RELEASES FROM SOLIDIFICATION/STABILIZATION TREATMENT TECHNOLOGIES

- Binder type
- Batch size
- Waste/binding agent ratio
- Mixing time/efficiency
- Curing time
- Meteorological conditions
- Chemical characteristics

B.4 REFERENCES FOR DETERMINING RELEASES RESULTING FROM REMEDIAL ACTIVITIES

Provided below are references containing discussions of remedial activities and methodologies for determining releases associated with these activities. The references presented under the heading of various remedial activities contain information regarding the majority of remedial activities that may occur at a site (including soils handling, thermal destruction, and stabilization/solidification). The remaining references contain information specific to the activity listed in the heading. See the references provided for the main text of RAGS/HHEM Part C, especially the RI/FS Guidance (EPA 1988c), for additional references.

B.4.1 VARIOUS REMEDIAL ACTIVITIES

Primary References

Environmental Protection Agency (EPA). 1985a. *Handbook: Remedial Action at Waste Disposal Sites* (Revised). Hazardous Waste Engineering Research Laboratory. EPA/625/6-85/006 (NTIS PB87-201034/XAB).

Provides information on remedial technologies, selection of appropriate remediation technologies for a given waste site, and planning remedial activities. Includes discussions of onsite and offsite disposal of wastes and soil, removal and containment of contaminated sediments, and in-situ treatments.

EPA. 1989. *Estimation of Air Emissions from Cleanup Activities at Superfund Sites.* Air/Superfund National Technical Guidance Study Series, Volume 3. Office of Air Quality Planning and Standards. EPA/450/1-89/003 (NTIS PB89-180061/XAB).

This document provides a step-by-step protocol for estimating air quality impacts resulting from site remediation. Presents emissions estimation techniques for thermal destruction devices, air stripping of ground water, in-situ venting, soils handling, and solidification/stabilization.

Additional References

EPA. 1990. *Emission Factors for Superfund Remediation Technologies.* Draft. Office of Air Quality Planning and Standards.

EPA. 1988. *Superfund Removal Procedures Revision Number Three.* Office of Emergency and Remedial Response. OSWER Directive 9360.03B.

EPA. 1986. *Superfund Remedial Design and Remedial Action Guidance.* Office of Emergency and Remedial Response. OSWER Directive 9355.0-4A.

B.4.2 SOILS HANDLING

Primary References

EPA. 1985b. *AP-42: Compilation of Air Pollution Emission Factors*, Fourth Edition. Office of Air and Radiation. NTIS PB86-124906.

This document contains emissions data obtained from source tests, material balance studies, engineering estimates, and other sources. Emission factors and equations are derived from sand and gravel processing (Section 8.19.1), crushed stone operations (Section 8.19.2), surface coal mining (Section 8.2.4), and fugitive dust sources (Section 11.2).

EPA. 1985c. *Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites.* EPA/600/A-85/002.

This document provides a methodology for rapid assessment of inhalation exposures to respirable particulate emissions from surface contaminated sites. The methodology consists of a site survey procedure and particulate emission factor equations for wind and mechanical entrainment processes.

EPA. 1990. *Development of Example Procedures for Evaluating the Air Impacts of Soil Excavation Associated with Superfund Remedial Actions.* Office of Air Quality Planning and Standards. EPA/450/4-90/014 (NTIS PB90-255662/XAB).

This document identifies and defines computational requirements for estimating air impacts from remediation of CERCLA sites. The estimation of air impacts from two example sites employing soil excavation are discussed. Modified Research Triangle Institute (RTI) land treatment equations are used for calculating emissions from excavations.

Additional References

Baxter, R.A. and D.M. Wilbur. 1983. *Fugitive Particulate Matter and Hydrocarbon Emission Factors from Mining, Handling, and Storing Diatomite.* AeroVironment, Inc. Pasadena, California.

EPA. 1977. *Technical Guidance for Control of Industrial Process Fugitive Particulate Emissions.* Office of Air Quality and Planning Standards. EPA/450/3-77/010 (NTIS PB-272 288/2).

EPA. 1985d. *Modeling Remedial Actions at Uncontrolled Hazardous Waste Sites.* Office of Emergency and Remedial Response. Office of Solid Waste and Emergency Response. EPA/540/2-85/001 (OSWER Directive 9355.0-8).

Orlemann, J.A. and G.A. Jutze. 1983. *Fugitive Particulate Dust Control Technology.* Noyes Publications. Park Ridge, New Jersey.

B.4.3 THERMAL DESTRUCTION

Primary References

Holton, G.A. and C.C. Travis. 1984. Methodology for Predicting Fugitive Emissions for Incinerator Facilities. *Environmental Progress* 3:2. Oak Ridge National Lab., Health & Safety Research Division. Oak Ridge, TN.

Error analysis and Monte Carlo modeling techniques are used to predict fugitive emissions caused by leaky pump fittings, sampling connections, flanges, storage tanks, and other non-stack equipment. Ten equations and three parameter value tables are provided for emission calculations.

Travis, C.C., E.L. Etnier, G.A. Holton, F.R. O'Donnel, and D.M. Hetrick. 1984. *Inhalation Pathway Risk Assessment of Hazardous Waste Incineration Facilities.* Oak Ridge National Lab. Oak Ridge, Tennessee. ORNL/TM-9096..

This report evaluates the relative importance of plant design and waste physicochemical variables on human inhalation exposure and health risk using two hypothetical incineration facility designs of three sizes each, burning three different generic wastes. Fugitive emissions are calculated using equations relating incinerator facility operation and configuration to fugitive emissions.

Trenholm, A. and D. Oberacker. 1985. "Summary of Testing Program at Hazardous Waste Incinerators." *Proceedings — Annual Solid Waste Research Symposium.* Environmental Protection Agency. Cincinnati, Ohio. Report No. CONF-8504112.

This article summarizes the results of tests conducted at eight full-scale hazardous incineration facilities.

Additional References

Cheremisinoff, P.N. 1986. "Special Report: Hazardous Materials and Sludge Incineration." *Journal of the Air Pollution Engineering* 18:12(32-38).

EPA. 1984. *Performance Evaluation of Full-scale Hazardous Waste Incinerators.* (Five volumes.) Industrial Environmental Research Laboratory. Cincinnati, OH. EPA-600/2-84-181 a-e (NTIS PB85-129500).

Lee, C.C., G.L. Huffman, and D.A. Oberacker. 1986. "Hazardous/Toxic Waste Incineration." *Journal of the Air Pollution Control Association* 36:8.

Oppelt, E.T. 1987. "Incineration of Hazardous Waste, A Critical Review." *Journal of the Air Pollution Control Association.* 37:5.

Staley, L.J., G.A. Holton, F.R. O'Donnel, and C.A. Little. 1983. "An Assessment of Emissions from a Hazardous Waste Incineration Facility, Incineration and Treatment of Hazardous Waste." *Proceedings of the Eighth Annual Research Symposium.* EPA-600/9-83/003.

Wallace, D.D., A.R. Trenholm, and D.D. Lane. 1985. "Assessment of Metal Emissions from Hazardous Waste Incinerators." *Proceedings — 78th APCA Annual Meeting.* Paper 85-77. Air Pollution Control Association. Pittsburgh, Pennsylvania.

B.4.4 STABILIZATION/SOLIDIFICATION

Primary References

Cullinane, M.J., L.W. Jones, and P.G. Malone. 1986. *Handbook for Stabilization/Solidification of Hazardous Waste.* Hazardous Waste Engineering Research Laboratory. EPA/540/2-86/001.

Hill, R.D. 1986. *Stabilization/Solidification of Hazardous Waste.* Hazardous Waste Engineering Research Lab. EPA/600/D-86/028.

This document discusses techniques such as sorption, lime-fly ash Pozzolan process, Pozzolan-Portland process, thermoplastic microencapsulation, and other techniques.

Additional References

Cullinane, M.J. and L.W. Jones. 1985. *Handbook for Stabilization/Solidification of Hazardous Waste.* Prepared for: Environmental Protection Agency, Hazardous Waste Engineering Research Laboratory. Office of Research and Development. EPA/540/2-86-001.