1.0 INTRODUCTION

1.1 Background

The Control Technology Center (CTC) at the U.S. Environmental Protection Agency (EPA) is responsible for supporting State and local air pollution control agencies in the implementation of their programs. As part of this support, the CTC provides assessments of the control technologies available for reducing emissions from a particular type of source. The CTC typically provides expertise and information not otherwise available to the State or local agency.

The CTC has received requests from State and local regulatory agencies, as well as from EPA regional offices, regarding how to assess the different options for cleaning up contaminated soil. The requests have addressed a number of specific remediation techniques, such as the clean-up of soils using rotary drum dryers. Information is needed for estimating the potential air emissions from various types of processes and for determining what control options may be appropriate. While some guidance is currently available, it is dispersed among multiple documents.

The purpose of this project was to develop a procedure and guidance document for use by State and local regulatory agencies for evaluating the air emission potential and applicable control technologies for the treatment of contaminated soil. Radian Corporation assisted the CTC in this effort. The original document was prepared in 1992 under EPA Contract Number 68-DO-0125, Work Assignment 25 and Contract Number 68-D1-0117, Work Assignment 31. The document was revised in 1995 under EPA Contract Number 68-D2-0160, Work Assignment 62. Existing guidance for how to assess both potential air emissions and available control technologies was identified. Examples of different clean-up operations were identified for soils contaminated with gasoline, diesel fuel, or fuel oil. In addition, information on the kind of control technologies that are available and their expected range of capital and operating costs was obtained.

1.2 Objectives

The specific objectives of this program were to:

- Identify options for the disposal/treatment of soils contaminated with gasoline, oil, or diesel fuel;
- Review the available literature pertaining to the emissions of volatile organic compounds (VOCs) for each clean-up option and emissions of dioxins/furans from the thermal treatment options;
- Summarize suggested approaches for estimating the VOC emissions from the various clean-up options;
- Identify applicable control technologies and compile ranges of capital and operating costs for each technology; and
- Summarize the information in a guidance document.

The clean-up options addressed in this document are:

- Excavation and removal;

- Thermal desorption (includes asphalt plants);
- Soil vapor extraction (SVE);
- In-Situ biodegradation;
- Ex-Situ biodegradation;
- On-site incineration; and
- Soil washing/solvent extraction.

1.3 Approach

The general approach was to perform a literature search and telephone survey of researchers and regulators. Several hundred publications were reviewed and evaluated. Contacts were made with researchers active in the field to identify any new or emerging information. Contacts also were made with regulatory staff in California, Florida, Louisiana, Maryland, Michigan, and Texas to obtain any air emissions measurement data submitted as part of permit applications. These states were thought the most likely to have such data, but no data were found in this search.

For each of the identified remedial options, the literature was reviewed to develop a process flow diagram and identify emission points, as well as to analyze available air emissions data. For most of the technologies examined, VOC emission estimates or measured data were found. Where VOC data were limited, data for other types of organic compounds were compiled. EEMS were identified or developed based on available data as well as assumed "typical" operating conditions for the remediation of relatively large sites.

Cost data were obtained from a variety of sources, but data from prior to 1986 were generally avoided due to the changes in remediation technology, standard operating practices, and regulations in recent years. All cost data prior to 1991 were converted to 1991 dollars using a 5% annual escalation factor. All cost data published after 1991 are reported with no correction.

1.4 Frequency of Use of Various Remediation Options

The remediation options addressed in this document are all potentially suitable for use as part of the remediation process for soils contaminated with fuels. The various options, however, are not necessarily all equally cost-effective nor is their use equally widespread. EPA's Office of Underground Storage Tanks (OUST) has surveyed state agencies responsible for the cleanup of leaking underground storage tank (UST) sites to ascertain the frequency of use of various remediation options. The information is primarily derived from the remediation of UST sites contaminated with gasoline and dates from 1991. This information is summarized in Figures 1-1 and 1-2.

Figure 1-1 shows the relative frequency of use of the major classes of remediation options. Land filling (excavation and removal) is used somewhat more than half the time, with in-situ methods, thermal treatment, or land treatment also frequently used. Figure 1-2 provides more detail as to the type of in-situ, land treatment, and thermal treatment

Figure 1-1. Relative Frequency of Use of Remediation Technologies at UST Sites.

Source: EPA-OUST (Due to rounding, figure may not total to 100%)

Figure 1-2. Relative Frequency of Use at UST Sites by Specific Technology.

Source: EPA-OUST (Due to rounding, figures may not total to 100%)

methods employed. For sites employing in-situ remediation, the exact technology used is undefined the majority of the time. It is assumed that soil vapor extraction is probably used in most of these cases. For applications of thermal treatment, thermal desorption is almost always employed and incineration is only very rarely used.

The frequency with which various treatment methods have been proposed for use at Superfund sites is shown in Figure 1-3. Superfund sites may be contaminated with a number of pollutants instead of or in addition to petroleum fuels, such as heavy metals, polychlorinated biphenyls (PCBs), asbestos, and pesticides. Therefore, it is not surprising that the frequency with which various remedies are proposed for Superfund sites differs from that for UST sites.

1.5 Limitations of the Document

The review of the available information showed that the amount of data is more limited than originally expected. There is not adequate data on VOC air emissions from remediation to assess the importance of fuel type, spill volume, the age of the spill, and the soil type as they relate to the combination of remediation and control technologies that are applied. Therefore, there is insufficient data to develop empirical step-by-step estimation procedures and to assess the uncertainty associated with such estimates.

In this document, the limited existing information was compiled to provide users with a summary of air emissions data. Information is included for VOC air emissions from the treatment of both soils contaminated with petroleum fuels and the treatment of hazardous waste to fill as many data gaps as possible.

Generalized guidance for the remediation of soils contaminated with fuels has inherent limitations. Many of the cleanup processes are “developing technologies” and therefore have short operating histories. For these technologies, data on air emissions, treatment effectiveness, and costs are very limited. Furthermore, each site was its own unique obstacles to cleanup that may force modifications to the cleanup hardware or operating conditions.

The development of typical air emission rates and emission factors applicable to the maximum number of site conditions and site locations required assumptions regarding the rate and scope of the clean-up effort, the type of fuel being treated, the number and nature of emission release points, and so on. Assumptions were based on what is "typical" and "reasonable" for the remediation of relatively large sites. Obviously, the diverse nature of sites with fuel contamination will result in the information presented here being more applicable to some sites than others. A limited data set must be used to generalize about a wide-spectrum of process conditions.

The VOC air emissions data compiled in this document can be used for planning purposes and for comparison to permit applications, but the user must take into account the inherent limitations of the data and the limitations in extrapolating the data to fit the specific remediation scenario under consideration.

Figure 1-3. Alternative Treatment Technologies Specified in Superfund Remedial Action RODs from FY 1982 Through FY 1992.

Source: The Hazardous Waste Consultant: May/June 1994.
(Reprinted by permission of the publisher from "Use of Innovative Treatment Technologies Is Increasing at Superfund Sites", The Hazardous Waste Consultant, May/June 1994, p. 1.15, Copyright 1994 Elsevier Science Inc.)