ADVANTAGES OF INVESTIGATING CHEMICAL AND RADIOLOGICAL CONSTITUENTS SIMULTANEOUSLY IN SOIL AND GROUNDWATER

H. Downey, E. Shephard, N. Walter
MACTEC, Inc.
P.O. Box 7050, Portland, ME 04112

ABSTRACT

At some sites both chemical and radiological investigation of soil and groundwater is required for overall site characterization. While the planning and execution of investigation activities is usually completed to fulfill regulatory (i.e., United States Environmental Protection Agency or United States Nuclear Regulatory Commission) requirements, coordination of chemical and radiological investigation programs may provide an opportunity for reducing the duration of investigation activities and reducing overall project costs.

There are several similarities in the chemical and radiological investigation processes that one can take advantage of in program design and execution to efficiently plan and execute chemical and radiological investigations simultaneously. At sites where both chemical and radiological constituents are being investigated in soil and groundwater, various steps can be taken during the investigation processes to combine chemical and radiological investigation and characterization activities.

With proper planning, investigating chemical and radiological constituents simultaneously in soil and groundwater can reduce the project schedule and provide cost savings for overall characterization of the site.

INTRODUCTION

Sites with both chemical and radiological contamination are commonly regulated by both the United States Environmental Protection Agency (EPA) and the United State Nuclear Regulatory Commission (NRC). At these sites, the EPA regulates investigation, characterization, and remediation of chemical contamination, while the NRC regulates investigation, characterization, and remediation of radiological contamination. While there may be some overlap of the programs in the overall risk assessment for a site, each regulatory agency typically acts independently within its own regulatory framework and requirements.

In many instances at sites with chemical and radiological contamination, the site investigation and characterization programs, similar to the independence of the regulatory agencies, share little overlap in the planning, investigation, and characterization aspects of program execution. When chemical and radiological contamination are or are suspected of both being present at a site, one can take advantage of similarities in program designs and execution to more efficiently plan and execute investigation and characterization activities.

In order to reap the rewards of these similarities, strategic planning and a well-coordinated investigation program effort are required by the project team to:

- Plan and coordinate investigations;
- Execute investigations concurrently; and
- Evaluate all data to get more thorough understanding of site condition.

With proper planning, execution and data evaluation, investigation of chemical and radiological constituents simultaneously in soil and groundwater can reduce the project schedule and provide cost savings for overall characterization of the site.

Investigation Planning

It is obvious that conducting an investigation once takes less time than doing it twice, and yet at some sites the investigation and characterization of chemical contamination in soil and groundwater is performed independently of the investigation of radiological materials in the very same media. Conducting one investigation instead of two can reduce mobilization costs (if similar equipment and personnel can be used), can reduce sampling costs (if samples for chemical analysis are collected from the same locations as samples for radiological analysis), and can reduce the overall project schedule since the investigations are conducted simultaneously.

When planning chemical and radiological investigations at a site, the two programs should be integrated into one as much as practical to maximize cost savings and reduce the duration of the investigation. Proper planning of an environmental investigation at a site with chemical and radiological contamination is the key step in integrating the investigation programs. Planning an investigation for chemical or radiological contamination in soil or groundwater relies on:

- Reviewing historical site records and photos;
- Identifying materials used at the site;
- Identifying waste handling practices at the site;
- Performing a review of the site setting and operations; and
- Researching the site physical features, geology, and hydrogeology.

Planning of soil and groundwater sampling activities to investigate potential chemical and radiological contamination should following the following steps:

1. Evaluate the data gathered from the activities listed above.
2. Identify areas where chemical contamination may potentially occur.
3. Identify areas where radiological contamination may potentially occur.
4. Identify areas where chemical and radiological contamination are both potentially present.
5. Design the investigation program to collect the data to characterize the areas.

By going through this routine, you identify areas where chemical and radiological contamination are both potentially located and can then design the investigation of these areas to take advantage of the similarities in the investigation techniques to gather the data.

Areas at a site where chemical and radiological contamination are collocated may provide additional opportunities for cost savings if a relationship between chemical and radiological contamination can be identified. While this savings may not be able to be taken advantage of in the initial investigation phase, planning of the initial investigation phase should keep this possibility in mind so that if a relationship is identified it can be used in later phases.

Investigation Execution

It is in the investigation execution phase that thorough investigation planning and integration of chemical and radiological investigation programs begins to pay off. When soil or groundwater sampling for chemical or radiological chemical characterization is being conducted there are several similar activities that take place during sample collection. The sampling point must be physically located, a means for collecting the sample must be employed, the sample location is initially screened (visually and/or with field screening instruments) for indicators of contamination, the sample material must be collected, and the sample location recorded.

For sites where chemical and radiological contamination are being characterized, proper planning and simultaneous execution of chemical and radiological sample collection activities can use these similarities in sample collection to reduce the project schedule and provide cost savings for overall characterization of the site.

Simultaneous execution of chemical and radiological sample collection activities can utilize the following techniques, when applicable, to maximize efficiency in sample collection:

- Use sampling personnel properly trained and qualified in both chemical and radiological sample collection and chain-of-custody procedures. Using the same sampling personnel to conduct both chemical and radiological sampling requires fewer personnel to be used on a sampling crew which provides a direct cost savings to the project.

- Complete field screening of the proposed sampling areas (visually and/or with field screening instruments) for indicators of chemical and/or radiological constituents to evaluate worker health and safety, select sampling locations, and possibly eliminate sample locations.

  Radiological field screening methods may include:
  - Gamma scanning with sodium iodide survey meter
  - In-situ gamma spectroscopy

  Chemical field screening methods may include:
  - Photoionization detector
  - Flame ionization detector for total volatile compounds

- Use same subsurface sample collection techniques (e.g. split-spoon soil sampling, low flow groundwater sampling) to collect the sample. Using similar types of equipment

reduces equipment costs, and when applicable, allows chemical and radiological samples to be collected from the same exploration location and depth.

- Collect sufficient sample volume to conduct chemical and radiological analyses from the same location (if applicable). Allows one exploration location to provide sample volume for both chemical and radiological analyses.

- Concurrently collect split samples for the various stakeholders (if applicable). Reduces sample collection costs and project schedule.

Combining sample collection efforts and collecting chemical and radiological during one investigation program can reduce the project schedule and provide cost savings for overall characterization of the site.

Data Evaluation

The final advantages of simultaneous investigation of chemical and radiological constituents present themselves during the evaluation of the investigation data collected. When an investigation is properly planned and executed, the data collected is evaluated in an attempt to understand how contamination was deposited at a site, how the contamination has been altered physically and chemically since it deposition, how contamination has migrated, and how the environment in the areas of contamination has been affected. By collecting chemical and radiological characterization simultaneously, and evaluating the data concurrently, a more thorough overall characterization of a site can be achieved.

Evaluation of both chemical and radiological site characterization data considers interaction of:

- The physical factors of the environment in which constituents are located;
- The chemical and physical properties of the constituents;
- How collocated constituents interact; and
- How site geological and hydrogeological properties affect the constituents.

By planning and executing chemical and radiological investigation simultaneously, data collected from all investigation locations can be used to help understand the overall characterization of a site.

For example, if a more thorough understanding of site geology and hydrogeology is needed for an area investigated for radiological constituents, then site geological and hydrogeological data collected from a nearby area investigated for chemical constituents may provide the additional information needed. Additionally, an evaluation of the chemical analytical data collected may also lead to a better understanding of the fate and transport of radiological constituents in the environment.

To facilitate data evaluation, all of the site data (e.g., geologic, hydrogeologic, chemical analytical, radiological analytical, etc.) can be entered into a database and evaluated using a Geographic Information System (GIS). A GIS allows manipulation and spatial views of the

stored data in order to evaluate that data and better understand the overall site characterization. A GIS can be used to look for concentration trends, easily investigate relationships between chemical and radiological analytical results, and identify areas where risk-based or regulatory based cleanup criteria are exceeded.

By simultaneously completing the investigation of chemical and radiological constituents in soil and groundwater, a larger pool of characterization data is available for evaluating either type of contamination. This larger pool of data allows for a more complete understanding of the overall characterization of the site. By being able to utilize data collected from an integrated chemical and radiological investigation program, less data can be collected for a specific investigation program which results in a reduction of the project schedule and provides cost savings for overall characterization of the site.

SUMMARY

In many instances at sites with chemical and radiological contamination the investigation and characterization programs share little overlap in the planning, investigation, and characterization aspects of program execution. When chemical and radiological contamination are or are suspected of both being present at a site, one can take advantage of similarities in program design and execution to more efficiently plan and execute investigation and characterization activities.

When planning chemical and radiological investigations at a site, the two programs should be integrated into one as much as practical to reduce the project schedule and maximize cost savings. Proper planning of an environmental investigation at a site with chemical and radiological contamination is the key step in integrating the investigation programs.

It is in the investigation execution phase that thorough investigation planning and integration of chemical and radiological investigation programs begins to pay off. When soil or groundwater sampling for chemical or radiological chemical characterization is being conducted there are several similar activities that take place during sample collection. Simultaneously execution of chemical and radiological sample collection activities can use these similarities in sample collection to reduce the project schedule and provide cost savings for overall characterization of the site.

The final advantages of simultaneous investigation of chemical and radiological constituents present themselves during the evaluation of the investigation data collected. By simultaneously completing the investigation of chemical and radiological constituents in soil and groundwater, a larger pool of characterization data is available for evaluating either type of contamination. By being able to utilize data collected from an integrated chemical and radiological investigation program, less data can be collected for a specific investigation program which results in a reduction of the project schedule and provides cost savings for overall characterization of the site.

A CASE STUDY IN THE NORTHEAST

At a site in the Northeast this method of simultaneously investigating chemical and radiological constituents in soil and groundwater is being applied to the extent possible to reduce the project schedule and provide cost savings for overall characterization of the site. The site is a former nuclear fuels manufacturing facility that manufactured fuels under both commercial and Atomic Energy Commission (AEC) contracts. Historical operations at the site have potentially contaminated areas at the site with residual chemical and radioactive constituents. The chemical constituents of concern include solvents, fuel related compounds, polynuclear aromatic hydrocarbons (PAHs), phthalates, and metals. The radiological constituents of concern include highly enriched uranium (HEU), low enriched uranium (LEU), natural uranium, depleted uranium (DU), and byproduct material.

In 1997 the site was entered into the Resource Conservation and Recovery Act (RCRA) Voluntary Corrective Action (VCA) Program to address chemical contamination. The RCRA VCA Program is being conducted under regulatory oversight from the United States Environmental Protection Agency (USEPA) and under the State Department of Environmental Protection (DEP) to meet State Property Transfer requirements.

In 2001 a Decontamination and Dismantlement (D&D) Program began at the site to address radiological contamination at areas where nuclear fuel manufacturing was conducted under commercial contracts. The Commercial D&D Program is being conducted under regulatory oversight from the United States Nuclear Regulatory Commission (NRC).

During the RCRA VCA program, 27 Areas of Concern (AOCs) were identified where soils and/or groundwater may have been impacted by chemical contamination. Of these 27 AOCs, 17 were identified with known or the potential for radiological contamination.

Because the chemical investigation started four years before the radiological investigation began, simultaneous execution of the chemical and radiological investigation programs was not initially possible. However, during the initial years of the chemical investigation some radiological data was collected. Radiological survey data was collected during chemical investigation sampling activities for safety purposes. In addition, samples were analyzed via on-site gamma spectroscopy for radiological materials to ensure that the appropriate sample shipment procedures were followed, and to ensure compliance with the site's NRC license. This data, while somewhat limited, was recorded into the database that was developed for the chemical investigation program. This radiological data along with the chemical data for the site was integrated into a GIS for evaluation.

At the 17 AOCs that were identified with known or the potential for radiological contamination, initial chemical investigation activities also included investigation for suspected radionuclides for evaluation under RCRA. At these AOCs investigation activities such as field screening using a photoionization detector (PID) and flame ionization detecter (FID) for volatile organic compounds (VOCs), and radiological surveys, the collection of geologic and hydrogeologic data, and both chemical and radiological analytical results naturally provided information focused on characterizing both chemical and radiological constituents. The collection of data that could be

used for both the chemical and radiological investigation programs provided direct cost savings in the overall characterization of the Site.

Once the radiological investigation began in 2001, there was already an abundance of radiological screening and analytical data, geological and hydrogeological information, and an understanding of fate and transport mechanisms at several areas at the site. This information was easily viewable using the GIS developed for the site and provided an excellent "initial view" of the radiological contamination at the site. In some cases, the radiological data collected during chemical investigation program was used to identify areas at the site as not impacted, or was used to focus additional radiological investigation activities to areas where contamination was identified. The data collected during the chemical investigation activities provided a more comprehensive scoping survey for the radiological contamination at the site, and allowed for a more focused radiological investigation to be conducted. Starting with a better understanding of the site radiological conditions, the project schedule was able to be accelerated and the cost of the radiological investigation program was reduced.

Laboratory analytical methods that have been utilized during the site contamination investigations include:

- Alpha spectroscopy (identification and activity of uranium isotopes)
- Gamma spectroscopy (identification and activity of byproduct isotopes)
- Volatile organic compounds (VOCs), SW-846 5035/8260B
- Semivolatile organic compounds (SVOCs), SW-846 3510B/3520B/8270C
- Polychlorinated biphenyls (PCBs), SW-846 35550B/8082
- Extractable total petroleum hydrocarbons (ETPH), CTDEP Methodology
- Metals, SW-846 3005A/3010A/3050A, 6010B/6020, 7470A/7471A (mercury)
- Toxicity characteristic leaching procedure (TCLP), SW-846 1311

With both the chemical and radiological investigation programs ongoing concurrently since 2001, investigation planning has become extremely important. A core project team has been maintained to plan and execute the investigations. Initially the core team was staffed with personnel experienced in either chemical or radiological fields. But by working together, members of the team have developed an understanding of both chemical and radiological investigation techniques and procedures. With both programs ongoing, investigations are planned with the understanding that any data collected may be of benefit to both programs, groundwater sampling events for chemical and radiological characterization are conducted simultaneously to reduce investigation costs, and relationships between chemical and radiological contamination are evaluated using the site GIS to guide future investigations.

This site in the Northeast is a prime example of how coordination and when possible simultaneous execution of the investigation of chemical and radiological constituents in soil and groundwater can reduce the project schedule and provide cost savings for overall characterization of a site.