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The U.S. Department of Energy (DOE) Sampling and Analytical Chemistry Guide: Doe Methods for Evaluating Environmental and Waste Management Samples

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THE U.S. DEPARTMENT OF ENERGY (DOE) SAMPLING AND ANALYTICAL CHEMISTRY GUIDE: DOE METHODS FOR EVALUATING ENVIRONMENTAL AND WASTE MANAGEMENT SAMPLES

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DOE Methods for Evaluating Environmental and Waste Management Samples (DOE Methods) is a guidance/methods document to support sampling and analysis activities at DOE sites. *DOE Methods* is intended to supplement existing guidance documents (e.g., EPA's *Test Methods for Evaluating Solid Waste*, SW-846), which generally apply to low-level or nonradioactive samples. *DOE Methods* targets the complexities of DOE radioactive mixed waste and environmental samples. The document contains quality assurance (QA), quality control (QC), safety, sampling, organic analysis, inorganic analysis, and radioanalytical guidance as well as sampling and analytical methods. An addendum is distributed every six months (April and October) with updated guidance and additional methods.

DOE Methods provides a vehicle for technology transfer within the environmental restoration (ER) and waste management (WM) (collectively known as EM) community. As *DOE Methods* evolves, its usefulness and applicability are anticipated to grow to meet the demands of the DOE/EM mission. At the present time, *DOE Methods* contains methods and guidance information supplied by DOE sites. Because the EM activities in DOE are not unique to the United States, the international environmental community could benefit from the information gathered for the DOE program. This information could provide additional resources for their EM activities.

KEY WORDS: Sampling, analytical methods, wastes.

BACKGROUND

DOE Methods for Evaluating Environmental and Waste Management Samples (DOE Methods), which is prepared for DOE by the Pacific Northwest Laboratory (PNL), contains methods and guidance to support EM activities throughout DOE and its sphere of influence. The first issue of *DOE Methods* was completed in October 1992. One revision and two addendums to *DOE Methods* have been published. Revision 2 of *DOE Methods*, to be distributed in October, 1994, will contain guidance for effective project

planning, QA, QC, safety, and waste handling as well as methods for sampling and analyzing organic, inorganic, and/or radioactive analytes. Addendums are distributed biannually (April and October) to quickly meet DOE/EM sampling and analytical needs¹⁻⁴.

In support of *DOE Methods*, procedures were collected from all DOE sites and placed in the *Procedures Database*⁵, a repository of standard operating procedures that have been or are being used at various DOE sites for EM sampling and/or analysis. The database is managed by the Los Alamos National Laboratory (LANL). The procedures in the database are used to prepare consolidated methods for publication in *DOE Methods*.

DOCUMENT CONTENTS

Chapters

Guidance chapters in *DOE Methods* (listed below) contain general information on how to effectively select and use sampling and analysis methods. These chapters have been modified occasionally to address reviewer comments and to make the document more suitable for EM needs. Method chapters and guidance for their use are the major scope of this document. These are also listed below.

Guidance chapters

- Guidance for Effective Project Planning – provides general guidance for developing a project plan for sampling, handling and analyzing waste and environmental samples.
- Quality Assurance – reflects current quality principles and practices.
- Quality Control – provides an overview of the QC-program components that support sampling and analytical activities, and indicates the QC information that should be generated and maintained with the analytical data.
- Safety – provides general guidance for safe sampling and analysis of radioactive and/or hazardous waste samples at DOE facilities. It also presents basic radiation-protection practices and requirements.
- Waste Handling – outlines recommended disposal practices for radioactive and hazardous waste.
- Choosing the Correct Method – provides guidance in choosing the appropriate sampling and analytical chemistry method for collecting and analyzing environmental and waste management samples based upon data quality objectives, analyte, sample matrix, and level of radioactivity.

Method chapters

- Sampling Methods – focuses on methods for collecting hazardous radioactive and mixed-contaminant wastes and environmental samples. Emphasis is placed on sampling of air, liquid (e.g., liquid waste, surface, and groundwater), and solids (e.g., waste, soils, sediments), and samples associated with different waste-storage (e.g., tanks, repositories) and environmental-disposal scenarios (waste disposal sites, dispersed contamination drums).

- Organic Methods – addresses general considerations and QC concerns specific to organic analysis and provides field screening methods as well as unique sample preparation and instrumental analysis, and new technologies, such as immunoassay techniques for analyzing high-level radioactively contaminated samples in a hot cell or glovebox.
- Inorganic Methods – addresses general considerations and QC concerns specific to inorganic analysis and provides methods for field screening, sample preparation, immunoassay, and instrumental-analysis techniques.
- Radiochemistry Methods – addresses general considerations and QC concerns specific to radioactive analytes and provides methods for chemical separation and final measurements based on detection of alpha, beta, and/or gamma emissions.
- Miscellaneous Methods – at present, *DOE Methods* has no miscellaneous methods; however, methods for ignitability, corrosiveness, and reactivity are being solicited.

Methods

The April 1994 addendum of *DOE Methods* contains 42 methods⁴. The organic and inorganic analytical methods are either single-laboratory adaptations of standard methods or new methods that are developed independently of standard methods, but fulfill DOE/EM needs. Radiochemistry and sampling methods were generally consolidated from procedures in the *DOE Procedures Database*² when available, or were obtained from outside the database to fill a need. The consolidated methods generally reflect procedures that have been used at one or more DOE sites, but which were consolidated to provide a standard reference for these activities. Consolidated methods reference the standard operating procedures that were used to create the methods. The DOE labs submit updates and new procedures to keep the *DOE Methods* program current with new development. Three of the 42 methods in *DOE Methods* are sampling methods: two are for sampling drum headspace, and the third is a general method for sampling liquids and solids in low-level waste storage tanks. Thirteen organic methods are presented that offer methods for field screening, unique sample preparation and instrumental analysis, and new technologies, such as immunoassay techniques. Some of the methods are standard methods that were modified for analyzing high-level radioactively contaminated samples in a hot cell or glovebox. The eight inorganic methods also offer sample preparation and immunoassay methods in addition to new strip-based colorimetric tests for lead, nickel, and nitrate. The radiochemistry section contains 18 methods for analytes such as nickel-59, strontium-89 and 90, selenium-79, iodine-129, technetium-99, and niobium, as well as methods for gross alpha, beta, and gamma analysis.

Needs list

DOE Methods does not currently address all the EM sampling and analysis needs of DOE. To identify gaps, a “needs” document was produced⁶. The needs document is a “living ” document and will be revised as new needs are identified. To meet the identified needs, procedures from the database or from the field are being identified, selected, and/or consolidated. Unique methods and methods using new technology are solicited from the field. These methods are formatted as “draft” methods and are sent for peer review.

The performance-based approach

DOE Methods encourages using a performance-based philosophy in selecting and using methods, following a demonstration of their appropriateness to satisfy the data quality objective (DQO) needs of the project⁷. This approach allows the analyst to use new or modified consensus methods to analyze EM samples. This approach is necessary to address the “as low as reasonably achievable” (ALARA) concerns and the unusual and sometimes unique sampling and analysis problems associated with working in radioactive environments and/or with radioactive materials. The April 1994 addendum includes a draft appendix describing a process for demonstrating how an alternate method can be generated that is appropriate for EM activities. By publishing the process in draft form, we are encouraging acceptance from both regulators and the regulated community.

Method verification

Method verification is a continuous process. Draft methods are peer reviewed, and the editors of *DOE Methods* encourage users in the field to submit information about method performance. Quality control data provided by users are published with the applicable method in addendums to *DOE Methods*, and input from method users and the peer review comments are evaluated, enabling the “draft” status to be removed. This process will assist in verifying the usefulness of the methods and will act as a cooperative pool of information for all DOE labs.

Future directions

The growth and applicability of *DOE Methods* depends somewhat on input from the users. The type of method stressed, method corrections, corrections to guidance, etc., all depend on user input. As input is received, it will be evaluated for inclusion in the following addendum. Our vision is that this input will include QC data for both sampling and analytical methods. This data will help us to continue to understand method capabilities before they are selected. User input will also help us expand the methods to include information on interferences, matrix effects, and sampling and analysis times. Sampling and analysis times will help project managers select appropriate methods and plan more effectively. Further, we anticipate expanded efforts with the international community so that not only can international methods be represented in future issues of *DOE Methods*, but also international EM activities can share in the technology that is being used to help solve complex EM issues.

CONCLUSION

DOE Methods contains guidance as well as sampling and analytical methods to address DOE's sampling and analysis needs for EM programs. It fills needs currently not addressed by other sources (e.g., EPA or American Society for Testing and Material (ASTM)), thus aiding DOE in improving the cost effectiveness of strategies for monitoring, cleanup, and management of wastes and environmental contamination that are, in part, unique to the DOE complex. The *DOE Methods* Compendium program

works with the consensus of all DOE/EM lab staff and provides the vehicle for DOE and DOE contractors to submit procedures so they can be considered for inclusion in *DOE Methods*. *DOE Methods* is a standard reference document for guidance in conducting monitoring and contaminant characterization at DOE sites. Now that *DOE Methods* contains a large variety of methods, we anticipate accelerated use by various EM programs.

Readers of this article interested in 1) receiving future issues of *DOE Methods*, or 2) submitting methods for possible inclusion in *DOE Methods*, are encouraged to contact Georgia Ruebsamen, Pacific Northwest Laboratory, P.O. Box 999, MS P8-08, Richland, WA 99352, (509) 376-9786.

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