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Guidance for Sampling Waste Containing Technologically Enhanced Naturally Occurring Radioactive Material (TENORM)		

1. Purpose

The Ohio Department of Health (ODH) has developed this guidance document for sampling waste containing Technologically Enhanced Naturally Occurring Radioactive Material (TENORM). A representative sample needs to be collected and used to characterize whether the waste material meets Ohio's regulatory exemption criteria for Radium-226 (Ra-226) and Radium-228 (Ra-228), allowing the waste to be disposed of in a solid waste landfill.

2. TENORM Waste Material

It is important to accurately characterize the TENORM waste to:

- Ensure the health and safety of the public and individuals working around the waste material;
- Ensure the waste material is disposed of in accordance with the requirements of Chapter 3701:1-43 of the Ohio Administrative Code;
- Ensure compliance with transportation rules and regulations; and
- Ensure that applicable environmental concerns are addressed.
- Ensure TENORM loads accepted at solid waste landfills licensed under ORC Chapter 3734 must be accompanied by lab results referencing sampling and analytical methods recognized by ODH in order to ensure waste acceptance criteria is met.
- Ensure each conveyance appropriately analyzed and documented to ensure DOT shipping requirements are met including emergency responder adequate knowledge of radiological hazards.

Individuals handling TENORM waste shall:

- Assess their operational process for TENORM waste decisions.
- Develop and implement a sampling and analysis plan that specifies the sampling method and technique to be used to ensure the collection of a representative sample, analysis by a competent analytical laboratory using an ODH approved analytical method for Radium-226 and Ra-228.
- Ensure a representative or composite sample is obtained from each container used to collect waste defined as TENORM. Taking one sample for a production operation or geographic region is not acceptable.

For example, oil and gas industry exploration and production (E&P) waste predominantly will involve large volume storage tanks that contain liquids, semi-solid muds, sediments or moist solids. Because solids and heavy metals typically

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settle to the bottom of containers or tanks, sampling strategies should include systematic stratified or composite sampling using techniques such as time compositing, spatial compositing, or discrete depth sampling. Compositing samples collected solely in the upper region of a tank or roll-off (upper half) are not acceptable.

- Ensure a representative or composite sample is obtained from each conveyance used to transport waste defined as TENORM. Taking one sample for a production operation or geographic region to ensure DOT requirements for transportation is not acceptable.

3. Sampling Protocols

ODH strongly recommends that samples of waste containing TENORM be collected for analysis in accordance with any of the protocols and guidance presented in:

USEPA 530-D-02-002, August 2002, RCRA Waste Sampling Draft Technical Guidance Planning, Implementation, and Assessment

<http://www.epa.gov/osw/hazard/testmethods/sw846/pdfs/rwsdtg.pdf>

In this USEPA document, you'll find recommended procedures for sampling solid waste. The regulated and regulatory communities can use this guidance to develop sampling plans to determine if a solid waste contains concentrations of TENORM that meet the exemption criteria listed in paragraph (A) of rule 3701:1-43-07 of the Ohio Administrative Code.

This guidance document steps you through the three phases of the sampling and analysis process shown in Figure 1: planning, implementation, and assessment. Planning involves "asking the right questions." Using a systematic planning process such as the Data Quality Objectives (DQO) Process helps you do so. DQOs are the specifications you need to develop a plan for your project such as a Quality Assurance Project Plan (QAPP) or a waste analysis plan (WAP). Implementation involves using the field sampling procedures and analytical methods specified in the plan and taking measures to control error that might be introduced along the way. Assessment is the final stage in which you evaluate the results in terms of the original objectives and make decisions regarding management or treatment of the waste.

Standard Guide for Representative Sampling for Management of Waste and Media, ASTM Standard D6044-96(2003) Reapproved 2009;

<http://www.astm.org/DATABASE.CART/HISTORICAL/D6044-96R03.htm>

This American Society for Testing and Materials (ASTM) document is an approved method in accordance with the Ohio Administrative Code 3745-51-20 Characteristics of hazardous waste; general.

<http://codes.ohio.gov/oac/3745-51-20>

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4. Additional ODH Recommended References

- a. USEPA Environmental Response Team SOP#: 2009, 11/16/94, *Drum Sampling*;
<http://www.dem.ri.gov/pubs/sops/wmsr2009.pdf>

The purpose of this standard operating procedure (SOP) document is to provide technical guidance on implementing safe and cost-effective response actions at hazardous waste sites containing drums with unknown contents. Container contents are sampled and characterized for disposal, bulking, recycling, segregation, and classification purposes.

These are SOP's which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure.

- b. USEPA R9QA/002.1, *Sampling and Analysis Plan Guidance and Template; Private Analytical Services Used*; Version 2, April, 2000.
http://www.epa.gov/region9/qa/pdfs/sap_ot6_pvt_v2.pdf

This Sampling and Analysis Plan (SAP) guidance and template is intended to assist organizations in documenting the procedural and analytical requirements for projects involving the collection of water, soil, sediment, or biological samples taken to characterize areas of potential environmental contamination. It combines, in a short form, the basic elements of a QAPP and a Field Sampling Plan (FSP). Once prepared and approved it will meet the requirements for projects in which TENORM waste measurements are to be taken. Not all sections will apply to all organizations.

- c. USEPA publication, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, (SW-846), available on-line at
<http://www.epa.gov/osw/hazard/testmethods/sw846/online/>

SW-846 provides test procedures and guidance which are recommended for use in conducting the evaluations and measurements needed to comply with the Resource Conservation and Recovery Act (RCRA), Public Law 94-580, as amended. These methods are approved by the U.S. Environmental Protection Agency for obtaining data to satisfy the requirements of 40 CFR Parts 122 through 270 promulgated under RCRA, as amended. This manual presents the state-of-the-art in routine analytical testing adapted for the RCRA program. It contains procedures for field and laboratory quality control, sampling, determining hazardous constituents in wastes, determining the hazardous characteristics of wastes (toxicity, ignitability, reactivity, and corrosivity), and for determining physical properties of wastes. It also contains guidance on how to select appropriate methods.

- d. MARLAP 2004. *Multi-Agency Radiological Laboratory Analytical Protocols Manual*. Nuclear Regulatory Commission NUREG-1576, Environmental

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Protection Agency EPA 402-B-04-001A, National Technical Information Service NTIS PB2004-105421, July.
<http://www.epa.gov/radiation/marlap/links.html> (accessed November 10, 2008).

The Multi-Agency Radiological Laboratory Analytical Protocols (MARLAP) manual provides guidance for the planning, implementation, and assessment of projects that require the laboratory analysis of radionuclides. MARLAP's basic goal is to provide guidance for project planners, managers, and laboratory personnel to ensure that radio analytical laboratory data will meet a project's or program's data requirements. To attain this goal, the manual offers a framework for national consistency in the form of a performance-based approach for meeting data requirements that is scientifically rigorous and flexible enough to be applied to a diversity of projects and programs. The guidance in MARLAP is designed to help ensure the generation of radio analytical data of known quality, appropriate for its intended use. Examples of data collection activities that MARLAP supports include site characterization, site cleanup and compliance demonstration, decommissioning of nuclear facilities, emergency response, remedial and removal actions, effluent monitoring of licensed facilities, environmental site monitoring, background studies, and waste management activities.

MARLAP is organized into two parts.

- Part I, intended primarily for project planners and managers, provides the basic framework of the directed planning process as it applies to projects requiring radio analytical data for decision making. The nine chapters in Part I offer recommendations and guidance on project planning, key issues to be considered during the development of analytical protocol specifications, developing measurement quality objectives, project planning documents and their significance, obtaining laboratory services, selecting and applying analytical methods, evaluating methods and laboratories, verifying and validating radiochemical data, and assessing data quality.
 - Part II is intended primarily for laboratory personnel. Its eleven chapters provide detailed guidance on field sampling issues that affect laboratory measurements, sample receipt and tracking, sample preparation in the laboratory, sample dissolution, chemical separation techniques, instrumentation for measuring radionuclides, data acquisition, reduction, and reporting, waste management, laboratory quality control, measurement uncertainty, and detection and quantification capability. Seven appendices provide complementary information and additional details on specific topics.
- e. MARSSIM 2002. *Multi-Agency Radiation Survey and Site Investigation Manual* (Revision 1). Nuclear Regulatory Commission NUREG-1575 Rev. 1, Environmental Protection Agency EPA 402-R-97-016 Rev. 1, Department of

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Energy DOE EH-0624 Rev. 1, August.

<http://www.epa.gov/radiation/marssim/obtain.html> (accessed November 10, 2008).

- f. MARSAME 2009. *Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual*. Nuclear Regulatory Commission NUREG-1575, Supp. 1, Environmental Protection Agency EPA 402-R-09-001, Department of Energy DOE/HS-0004, Department of Defense.

MARSAME 2009 is a supplement to MARSSIM 2002 and provides technical information on approaches for planning, implementing, assessing, and documenting surveys to determine proper disposition of materials and equipment (M&E).

The technical information in MARSAME is based on the data life cycle, similar to MARSSIM. Survey planning is based on the DQO process and is discussed in MARSAME Chapters 2, 3, and 4. Implementation of the survey design is described in MARSAME Chapter 5, with discussions on selection of instruments and measurement techniques as well as handling and segregating the M&E. MARSAME also includes the concept of measurement quality objectives (MQOs) for selecting and evaluating instruments and measurement techniques from MARLAP 2004. Assessment of the survey results uses DQA and the application of statistical tests as described in MARSAME Chapter 6. In addition to the first six chapters, which present the MARSAME process, the MARSAME manual contains the statistical basis for the DQOs, MQOs, and survey designs (Chapter 7) and illustrative examples of the information and process presented in MARSAME (Chapter 8).

The scope of MARSSIM was limited to surfaces soils and building surfaces. The scope of MARSAME is M&E potentially affected by radioactivity, including metals, concrete, tools, equipment, piping, conduit, furniture and dispersible bulk materials such as trash, rubble, roofing materials, and sludge. The wide variety of M&E requires additional flexibility in the survey process, and this flexibility is incorporated into MARSAME.

- g. Ohio EPA, *Closure Plan Review Guidance for RCRA Facilities*, Ohio EPA, Division of Hazardous Waste Management, October 2009.
<http://epa.ohio.gov/portals/32/pdf/2008CPRG.pdf>

Chapter three of this Ohio EPA document provides some guidance on sampling and sample collection.