Designation: C998 – 17

Standard Practice for Sampling Surface Soil for Radionuclides[1]

This standard is issued under the fixed designation C998; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers the sampling of surface soil for the purpose of obtaining a sample representative of a particular area for subsequent chemical analysis of selected radionuclides. This practice describes one acceptable approach to collect soil samples for radiochemical analysis.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C859 Terminology Relating to Nuclear Materials

D420 Guide to Site Characterization for Engineering Design and Construction Purposes (Withdrawn 2011)[3]

D1129 Terminology Relating to Water

2.2 *Other References:*

MARLAP, Chapter 10

IAEA-TECDOC-1415, Soil Sampling for Environmental Contaminants

3. Terminology

3.1 Except as otherwise defined herein, definitions of terms are as given in Terminology C859.

3.2 *Definitions:*

3.2.1 *sampling, n*—obtaining a representative portion of the material concerned (see Terminology D1129).

4. Summary of Practice

4.1 Guidance is provided for the collection of soil samples to a depth of 50 mm. Ten core samples are collected in a specified pattern and composited to obtain sufficient sample so as to be representative of the area.

5. Significance and Use

5.1 Soil provides a source material for the determination of selected radionuclides and serves as an integrator of the deposition of airborne materials. Soil sampling should not be used as the primary measurement system to demonstrate compliance with applicable radionuclides in air standards. This should be done by air sampling or by measuring emission rates. Soil sampling does serve as a secondary system, and in many cases, is the only available avenue if insufficient air sampling occurred at the time of an incident. For many insoluble radionuclides, the primary exposure pathway to the general population is by inhalation. The resuspension of transuranic elements has received considerable attention (**1, 2**)[4] and their measurement in soil is one means of establishing compliance with the U.S. Environmental Protection Agency (EPA) guidelines on exposure to transuranic elements. Soil sampling can provide useful information for other purposes, such as plant uptake studies, total inventory of various radionuclides in soil due to atmospheric nuclear tests, and the accumulation of radionuclides as a function of time. A soil sampling and analysis program as part of a preoperational environmental monitoring program serves to establish baseline concentrations. Consideration was given to these criteria in preparing this practice.

5.2 Soil collected using this practice and subsequent analysis can be used to monitor radionuclide deposition of emissions from nuclear facilities. The critical factors necessary to provide

[1] This practice is under the jurisdiction of ASTM Committee C26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.05 on Methods of Test.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] The boldface numbers in parentheses refer to the list of references at the end of this standard.

this information are sampling location, time of sampling, frequency of sampling, sample size, and maintenance of the integrity of the sample prior to analysis. Since the soil is considered to be a heterogeneous medium, multipoint sampling is necessary. The samples must represent the conditions existing in the area for which data are desired.

6. Apparatus

6.1 *Sampling Instrument*[5]—In order to standardize the sample collection, it is suggested that the coring tool be that instrument used by golf courses to place the hole in the putting green. This instrument is commercially available at reasonable cost, has approximately a 0.105-m diameter barrel, and can take samples down to 300 mm. An illustration of the sampling instrument and its use is provided in Fig. 1.

6.2 *Sample Container,* such as metal cans with lids, plastic bags, etc.

6.3 *Meter Stick.*

6.4 *Small Scoop.*

7. Sampling

7.1 *Introduction*—The sampling depth for this practice is the top 50 mm of soil. Experience has shown this depth is best for this purpose **(3)** and has been proven to provide samples for the analysis of deposited radionuclides following a recent airborne release. The difference in concentration from previously collected samples at the same locations would be a measure of the contamination. If the purpose of the sampling is to measure the total amount of a radionuclide deposited onto the soil, that is, from fallout of previous atmospheric nuclear tests, then sampling must be conducted to a 300 mm depth. It is recommended by the EPA **(2)** that soil sampling for plutonium be the top 10 mm of soil. Although this may be a desirable depth for resuspension studies in certain parts of the country that have powdery, dry, loose, sandy soils, in most areas, the vegetative cover and root mat make this an unworkable sampling depth. Because the data may be used in various ways, it is important to accurately record the sample location, the depth of the sample, and the sample weight. In order to obtain sufficient sample to be representative of the area, due to the inherent heterogeneity of soil, it is recommended that a total sampling area of greater than 0.05 m^2 be collected as described in Section 8.

7.2 *Site Selection:*

7.2.1 As an idealized guideline, each site should be selected on the basis that the soil appears, or was known to have been, undisturbed for a number of years. Open, level, grassy areas that are mowed at reasonable intervals, such as public parks, are suitable choices. The site should have moderate to good permeability and there should be little or no runoff during heavy rains. The site should not be near enough to buildings, trees, or other obstructions that it is sheltered or shielded. High earthworm activity (as a result of direct observation of the removed sample) or aeration of the root zone may result in uneven mixing of the surface soil and, therefore, this type of site should be avoided. Care should be taken not to select a site that is fertilized or watered with sources that may add radioactive materials to the soil, that is, some fertilizers have high uranium concentrations. It is important to be able to accurately describe the location at which the sample was collected (the use of GPS is suggested) if it becomes necessary to return and resample the location.

7.2.2 The number of sites sampled is determined by the purpose of the sampling and the information required from the particular analysis. If the sampling is part of a preoperational survey around a facility, one acceptable distribution is that proposed in HASL-300 **(4)** and depicted in Fig. 2. This distribution of 13 sampling sites extending up to 10 km in the downwind direction from the facility should be adequate to

[5] Model 28200 Scalloped Style of the Standard Manufacturing Company of Cedar Falls, IA, or its equivalent, has been found satisfactory for this purpose.

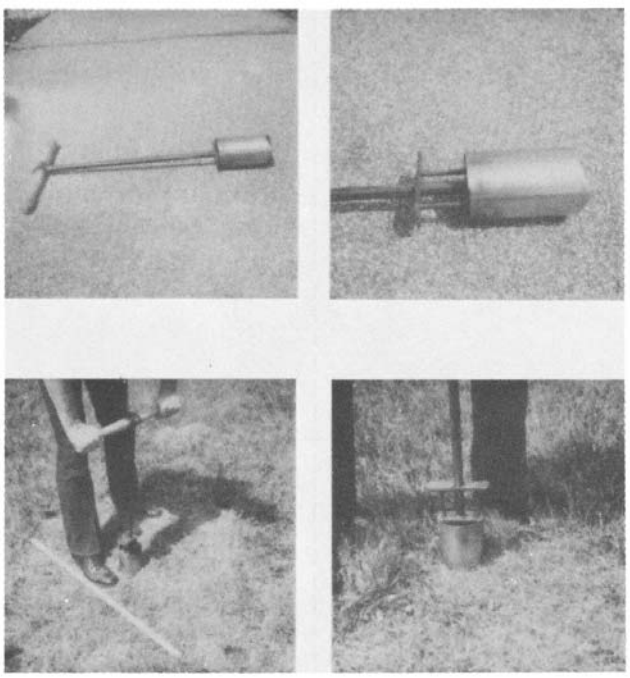

FIG. 1 Soil Sampling Instrument and Use

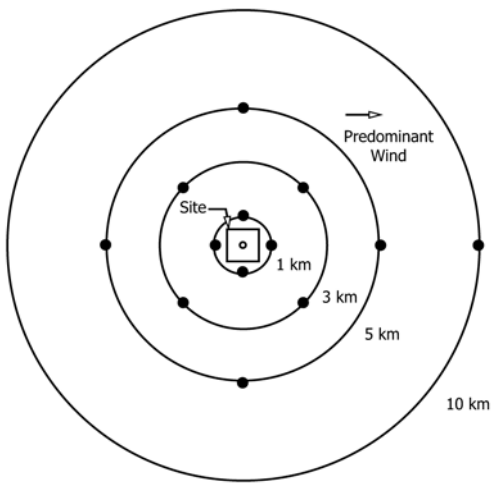

FIG. 2 Soil Sampling Pattern