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TEST METHODS FOR EVALUATING SOLID WASTE, PHYSICAL/CHEMICAL METHODS, SW-846, 3RD EDITION,

FINAL UPDATE I

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Test Methods for Evaluating Solid Waste, Physical/Chemical Methods

Third Edition

Promulgated Update Package

Instructions

Enclosed is the promulgated Update I package for "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", SW-846, Third Edition. The methods in this package are officially part of the SW-846 manual, and carry the status of EPA approved methods. Use this package to replace current pages (green pages and, where appropriate, white pages) in the manual.

Enclosure

Revision 1 methods (methods which have been revised in the promulgated Update I package) are designated by the letter "A" in the method number. In order to properly document the method revision used, the entire method number, including the letter designation, must be referenced.

ABSTRACT

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (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. 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. 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, ignitibility, reactivity, and corrosivity, and for determining physical properties of wastes. It also contains guidance on how to select appropriate methods.

The hazardous waste regulations under Subtitle C of the Resource Conservation and Recovery Act (RCRA) require that specific testing methods described in this manual be employed for certain applications. The following sections of 40 CFR require the use of SW-846 methods:

260.22(d)(1)(i) - Submission of data in support of petitions to exclude a waste produced at a particular facility (delisting petitions).

261.22(a) - Evaluation of wastes against the Corrosivity Characteristic (corrosivity).

261.24(a) - Evaluation of wastes against the Toxicity Characteristic (mobility of toxic species).

264.314(c) and 265.314(d) - Evaluation of wastes to determine if free liquid is a component of the waste (free liquid).

270.62(b)(2)(i)(C) - Analysis of wastes prior to conducting a trial burn in support of an application for a hazardous waste incineration permit (incinerator permit).

Disclaimer

Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Environmental Protection Agency.

SW-846 methods are designed to be used with equipment from any manufacturer that results in suitable method performance (as assessed by accuracy, precision, detection limits and matrix compatibility). In several SW-846 methods, equipment specifications and settings are given for the specific instrument used during method development, or subsequently approved for use in the method. These references are made to provide the best possible guidance to laboratories using this manual. Equipment not specified in the method may be used as long as the laboratory achieves equivalent or superior method performance. If alternate equipment is used, the laboratory must follow the manufacturer's instructions for their particular instrument.

For many RCRA-regulated constituents, action levels intended for the above purpose have been recommended in the proposed RCRA Subpart S regulations. These action levels were adopted from appropriate regulatory limits on contaminant concentrations in environmental media (e.g., maximum contaminant levels, MCLs) or were derived using conservative exposure assumptions and a health protective goal of no deleterious effects over a lifetime from exposure to systemic toxicants. For known and probable human carcinogens (Class A and B), the health protective goal for individual constituents is less than 10^{-6} excess lifetime cancer risk; and the goal is less than 10^{-5} excess lifetime cancer risk for possible human carcinogens (Class C).

Because radioactive materials are not regulated under RCRA, the proposed Subpart S does not address radioactive constituents, and action levels for radionuclides are not provided. There is no equivalent guidance regarding action levels for most radionuclides in the existing radiation protection regulations and standards. Thus, difficulties may arise for a number of facilities owned by the Department of Energy (including LANL), which need to deal with radioactive constituents within the context of ongoing RCRA investigations and integrate RCRA and CERCLA requirements (DOE 1990). To simplify the RFI process in addressing radiological issues, action levels similar to those recommended in proposed Subpart S needed to be developed for radioactive constituents.

Proposed Approach for Radioactive Constituents

Basis

In developing action levels for radioactive constituents it is necessary to consider all relevant and applicable standards for the protection of human health. In addition, other factors specific to radioactive constituents must also be considered, which warrants that the procedure for derivation of action levels for radioactive constituents differ somewhat from the Subpart S procedure for non-radioactive constituents. Considerations that influence the development of action levels for radioactive constituents are the following:

Dose vs. Risk Limit Most current radiation protection standards (e.g., EPA 1977, EPA 1991a,b) are based on dose limits rather than on risk limits as are the Subpart S values for non-radioactive constituents.

The generally accepted radiation dose limit for the individual in the general public who receives the maximum exposure is 100 mrem/yr over background (DOE 1990, ICRP 1991, NCRP 1988). The 100-mrem/yr limit applies to all radioactive contaminants and pathways, and lower limits apply to specific pathways,

radionuclides, and exposure sources. Radiation dose to the public is further limited to 25 mrem/yr from individual facilities or sources (e.g., EPA 1977, DOE 1988a).

Multiple vs. Single Exposure Pathway Many of the dose limits apply to cumulative exposure from multiple radioactive constituents through multiple pathways. Subpart S values are derived for a single contaminant via a single exposure pathway.

Relatively High Background Radiation Radiation dose to humans from background radiation (approximately 338 mrem/yr at Los Alamos, see Table 1) is much higher than limits established in radiation protection standards for the public. Most of the non-radioactive constituents listed in Subpart S have small or no background values in the environment.

ALARA Considerations There is a requirement to follow the ALARA (as low as reasonably achievable) principle (DOE 1990) to maintain all radiation exposures to levels as low as reasonably achievable. Because radiological cancer risk to humans has not been determined to have a threshold at low doses, the ALARA provision is an important factor in maintaining low radiation levels with reasonably achievable means. Acute toxic effects, for which thresholds do apply, are possible only at levels of exposure much greater than th oseencountered in environmental restoration activities.

In addition, limitations of conventional radiation detection instrumentation should also be considered. Action levels should be high enough to allow discrimination between areas of manmade contamination and uncontaminated areas. Limitations of current instruments for discriminating between background and above-background levels of ionizing radiation must be recognized.

Proposed Approach

From the above considerations, it seems reasonable to set the dose limit for a single radioactive constituent at some fraction of the 100-mrem/yr and 25-mrem/yr limits that may apply to exposure from multiple constituents. An annual dose of 10 mrem/yr from a single radioactive constituent via all pathways is proposed here as the basic limit for deriving action levels for radionuclides that do not have media concentration limits (e.g., MCLs) stipulated in regulations; in cases where concentration limits have been specified in regulations, these limits take

precedence as the action levels.

The proposed limit has the following characteristics:

- The proposed dose limit of 10 mrem/yr is a fraction of the current generally applicable radiation protection limits of 100 mrem/yr and 25 mrem/yr for members of the public.

- The proposed dose limit of 10 mrem/yr is specified in DOE Order 5400.5 (DOE 1990) as a reporting level for doses to the general public resulting from activities conducted under DOE programs.

- The proposed dose limit is compatible with the detection limits (about 1 μR/hr) for current instruments designed to detect direct gamma radiation in the field. A lower dose value may not be discernible from background radiation, which averages about 300 mrem/yr (including radon exposure) in the U.S.

- The proposed dose limit of 10 mrem/yr represents an incremental dose of only 3% of the natural background dose.

The proposed 10 mrem/yr limit, however, will not be implemented entirely as the Subpart S action levels for non-radiological constituents are implemented. Namely, characterization of radioactive constituents would require consideration of DOE's ALARA requirements in reaching an NFA decision, even if the contamination levels were below derived action levels. This additional condition would further ensure protection of human health and safety. Also, the doses of detected radioactive constituents would be summed to insure that total dose from multiple constituents does not exceed 10 mrem/yr. As noted above, radionuclides for which media-specific concentration limits are specified in regulations are considered independently.

Because of these requirements in addition to the Subpart S requirements, the levels derived from the proposed 10 mrem/yr dose limit would be termed "screening action levels," in that they serve as a preliminary screen for potential radioactive contamination in the environment. In situations where radioactive constituents at a site are determined to exceed the screening action levels, a more rigorous evaluation of dose and risk based on site-specific exposure conditions is required to determine the need for corrective action.

Rationale for the Proposed Approach

The derived screening action levels for the radioactive constituents represent a fraction of the existing radiation protection standards, which are largely based on dose limits (except for a few radionuclides, for which MCLs are deemed as the appropriate action levels per proposed Subpart S). They are therefore considered conservative in protecting human health.

Further, since additional evaluation measures are proposed according to the DOE ALARA guidance, precautions are assured before an NFA decision for a site can be made. Thus, the proposed dose limit is considered an appropriate basis for determining the screening action levels for radioactive constituents. The use of these screening action levels can result in significant reductions in resource expenditures for site investigations by screening out sites that present negligible radiological risk and focusing investigations on the significant risks.

Derivation of Screening Action Levels

Preliminary screening action levels have been derived for several radionuclides that may be encountered in contaminated soils at LANL (see Table 2). The following methodology and assumptions were used in deriving the screening action levels:

- The RESRAD computer code (Gilbert et al. 1989), version 4.6, was used in the computations. This code is referenced in DOE Order 5400.5 as the methodology required in the derivation of radionuclide soil guidelines (cleanup criteria) at DOE sites.

- A residential scenario was used in deriving conservative screening action levels. This scenario includes the following pathways: external exposure from gamma emitters in soil, inhalation of contaminated dust and radon gas, and ingestion of contaminated soil and plants grown on site. The residential scenario assumes consumption of uncontaminated water from a municipal supply due to the great depth of the main aquifer. Other scenarios, such as industrial or recreational uses, are likely to result in higher (less conservative) screening action levels.

- The input data used in the RESRAD calculations typify the range of values encountered in the mesa top environment at LANL. The contaminated soil is assumed to extend down to 3 m from the surface and cover an area of 500 m^2. When site-specific data (Dorries 1992-1993) were not available, recommended values in Gilbert et al. (1989) for the LANL soil types as well as default values based on national averages were used.

As their name implies, screening action levels are to be used for screening assessments only and are not meant to be used in baseline risk assessments or as cleanup criteria in a corrective measures study/implementation. If required based on the results of the screening assessment, more detailed site (SWMU) specific data and analyses may be required.

Table 1. Published U.S. Average Effective Dose Equivalent Rates and Estimates for the Los Alamos Area from Natural Background Radiation

Radiation Source	U.S. Average (mrem/yr)	Los Alamos (mrem/yr)
Cosmic Rays	27	58
Cosmogenic Radiation	1	1
External Terrestrial	28	39
Radionuclides in Body	40	40
Inhaled Radionuclides	200	200
Rounded Total	300	338

NOTES:

1. The U.S. average data is from Table 9.7, page 148, NCRP Report 94.
2. With the exception of the cosmogenic source, the Los Alamos data are from the report "Environmental Surveillance at Los Alamos during 1990." The cosmic and external terrestrial components were based on measurements; the balance of hte values in the report were taken from NCRP 94.

Table 2. Derived Soil Screening Action Levels

Nuclide	Screening Action Level (pCi/g dry soil)[a]
H-3[b]	1.5×10^{7}
C-14	4.7×10^{5}
Na-22	1.3
Mn-54	3.4
Co-57	4.0×10^{1}
Co-60	9.0×10^{-1}
Sr-90	8.9
Ru-106	1.5×10^{1}
I-129	4.1×10^{1}
Cs-134	1.9
Cs-137	4.0
Ra-226[c]	7.3×10^{-1}
Th-232[c]	8.8×10^{-1}
U-233	8.6×10^{1}
U-235	1.8×10^{1}
U-238	5.9×10^{1}
Pu-238	2.7×10^{1}
Pu-239	2.4×10^{1}
Am-241	2.2×10^{1}

[a] Based on 10 mrem/yr dose limit. Input data are representative of mesa top environment at LANL.

[b] When H-3 is measured in µCi/mL of soil moisture, the H-3 SAL in µCi/mL is a function of soil moisture: 15(1-M)/M, where M is the moisture fraction (g water/g total sample).

[c] Generic limits for Ra-226 and Th-232 are set in DOE 5400.5 (DOE 1990) at 5 pCi/g averaged over the first 15 cm of soil and 15 pCi/g averaged over each additional 15 cm interval. The more conservative derived screening action levels are to be used for screening purposes only.

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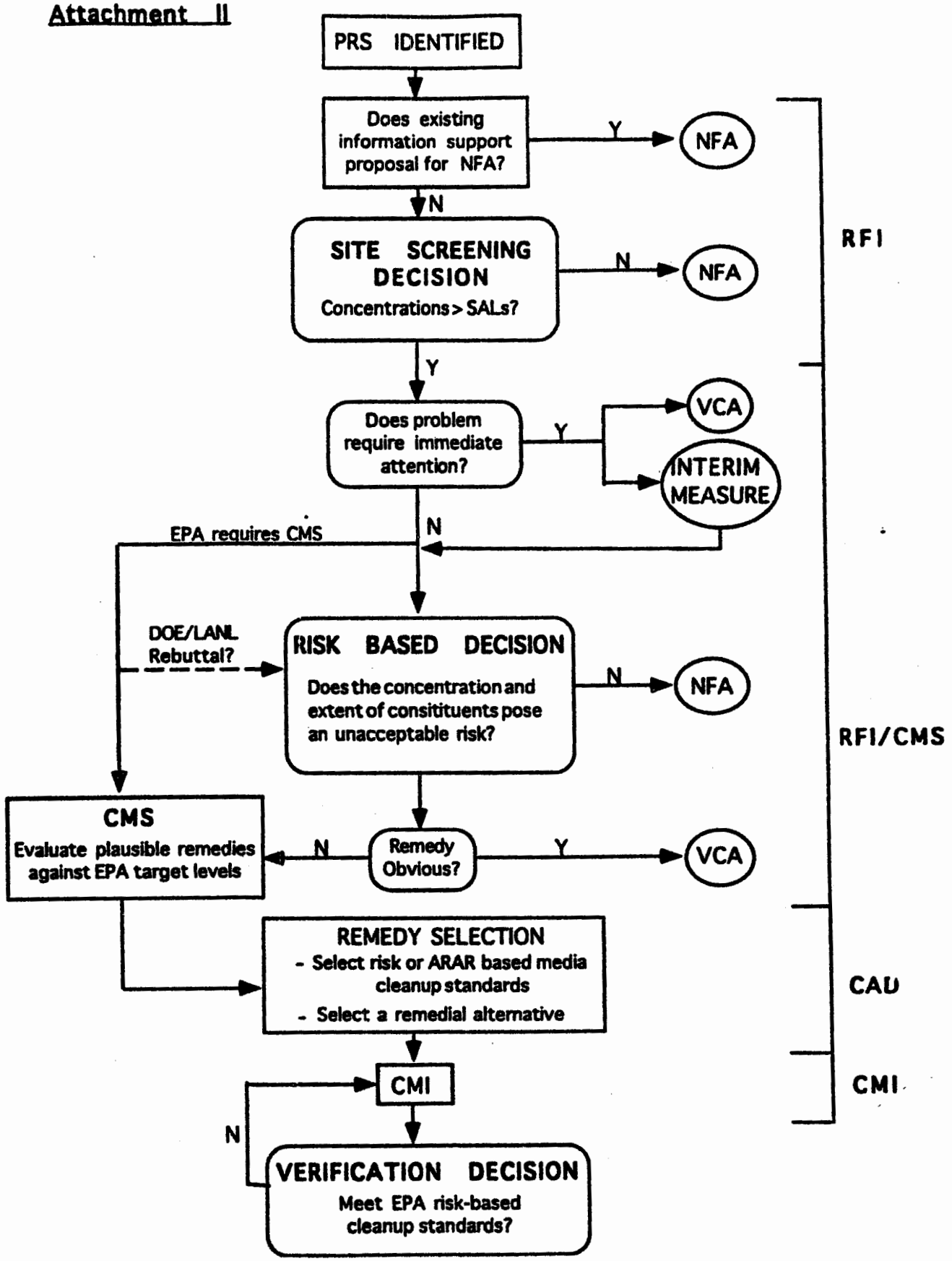
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