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Measurement of radioactivity in the environment — Bioindicators —

Part 1: General guidance to the sampling, conditioning and pre-treatment

Mesurage de la radioactivité dans l'environnement — Bioindicateurs —

Partie 1: Recommandations générales pour l'échantillonnage, le conditionnement et le prétraitement

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection*, Subcommittee SC 2, *Radiological protection*.

A list of all parts in the ISO 18510 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Everyone is exposed to natural radiation. The natural sources of radiation are cosmic rays and naturally occurring radioactive substances which exist in the earth's crust, soil, flora and fauna, including the human body. Human activities involving the use of radiation and radioactive substances lead to an additional radiation exposure from this natural exposure. Some of those activities, such as the mining and use of ores containing naturally-occurring radioactive materials (NORM) and the production of energy by burning fossil fuels such as coal that contains such substances, simply enhance the exposure from natural radiation sources. Nuclear power plants and other nuclear installations use radioactive materials and produce radioactive effluents and waste during operation and decommissioning. The use of radioactive materials in industry, agriculture, research and medicine is expanding around the globe.

All these human activities other than medical exposures give rise to radiation exposures that are only a small fraction of the global average level of natural exposure. The medical use of radiation and radioactive substances is the largest and a growing man-made source of radiation exposure throughout the world. It includes diagnostic radiology, radiotherapy, nuclear medicine and interventional radiology.

Radiation exposure also occurs as a result of occupational activities. It is incurred by workers in industry, medicine and research using radiation or radioactive substances, as well as frequent air travel passengers, for example those travelling for occupational purpose or crew. The average level of occupational exposures is generally similar to the global average level of natural radiation exposure[1].

As uses of radiation increase, so do the potential health risk and the public's concerns. Thus, all these exposures are regularly assessed in order to:

a) improve the understanding of global levels and temporal trends of public and worker exposure;

b) evaluate the components of exposure so as to provide a measure of their relative importance;

c) identify emerging issues that may warrant more attention and study. While doses to workers are mostly directly measured, doses to the public are usually assessed by indirect methods using the results of radioactivity measurements of waste, liquid and/or gaseous effluents and/or environmental samples.

Radioactivity from several naturally-occurring and anthropogenic sources is present throughout the environment. Thus, the atmosphere contains radionuclides of natural, human-made, or both origins.

— Natural radionuclides including ^{40}K, ^{3}H, ^{14}C and those originating from the thorium and uranium decay series, in particular ^{226}Ra, ^{228}Ra, ^{234}U, ^{238}U and ^{210}Pb which can be found in materials from natural sources or can be released from technological processes involving naturally occurring radioactive materials (e.g., the mining and processing of mineral sands or phosphate fertilizer production and use).

— Human-made radionuclides, such as transuranium elements (americium, plutonium, neptunium, and curium), ^{3}H, ^{14}C, ^{90}Sr, ^{129}I and gamma-ray emitting radionuclides can also be found in gaseous effluent, in environmental matrices (water, air, soil and biota), in food and in animal feed as a result of authorized releases into the environment, fallout from the explosion in the atmosphere of nuclear devices and fallout from accidents, such as those that occurred in Chernobyl and Fukushima.

To ensure that the data obtained from radioactivity monitoring programs support their intended use, it is essential that the stakeholders (e.g. nuclear site operators, regulatory and local authorities) agree on appropriate methods and procedures for obtaining representative samples and for sampling, handling, storing, preparing and measuring the test samples. Any assessment of the overall measurement uncertainty also needs to be carried out systematically. As reliable, comparable and 'fit for purpose' data are an essential requirement for any public health decision based on radioactivity measurements, international standards of tested and validated radionuclide test methods are an important tool for the production of such measurement results. The application of standards serves also to guarantee comparability of the test results over time and between different testing laboratories. Laboratories apply them to demonstrate their technical competences and to complete proficiency tests successfully during interlaboratory comparisons, two prerequisites for obtaining national accreditation.

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Today, over a hundred international standards, prepared by Technical Committees (TC) of the International Organization for Standardization (ISO), including those produced by ISO/TC 85, and the International Electrotechnical Commission (IEC), are available to testing laboratories for measuring radionuclides in different matrices.

The environment consists of a wide variety of biotopes. For this reason, the sampling process cannot be carried out on all environmental components; one therefore makes a selection of biological indicators that are relevant to the ecosystem being studied.

In the context of environmental radioactivity measurement, bioindicators can be used to demonstrate the presence of natural and artificial radionuclides that are difficult to detect in the surrounding environment (e.g. air or water).

Some bioindicators have the ability to exhibit higher radionuclide contents than those usually observed in the surrounding environment. Others have a lower capacity for accumulation, but their radionuclide content fluctuates in proportion to that which is present in the environment. These are referred to as "sentinel" organisms. The retention rate and incorporation time of these radionuclides vary from one bioindicator to another. These characteristics are taken into account in order to select the best available indicator for meeting the stated objectives.

This document describes the general principles pertaining to the sampling strategy, to the collection and conditioning of samples, to their transport to the laboratory and to the pre-treatment operations to be carried out prior to analysis. Other specific parts dealing with terrestrial, freshwater and marine bioindicators will be developed in other parts.

The test method is used in the context of a quality assurance management system (ISO/IEC 17025)[2].

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Measurement of radioactivity in the environment — Bioindicators —

Part 1: General guidance to the sampling, conditioning and pre-treatment

1 Scope

The purpose of this document is to set out the general principles pertaining to the sampling strategy, to the collection and conditioning of samples, to their transport to the laboratory and to the pre-treatment operations to be carried out prior to analysis.

It is intended for the use of organisations that implement a sampling programme as well as organisations responsible for collecting samples of bioindicators.

These principles are not directly applicable to accident or post-accident situations. These principles can apply to biological matrices in the environment.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11465, *Soil quality — Determination of dry matter and water content on a mass basis — Gravimetric method*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
activation product
AP
radioactive element resulting from the capture of a neutron by an element exposed to a neutron flux

3.2
anthropogenic
resulting from human activity

3.3
bioindicator
organism or group of organisms whose presence, abundance, or state provides information about certain environmental features (e.g., physicochemical, microclimatic, biological, or functional characteristics) or about the impact of certain *anthropogenic* (3.2) activities

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