



Environmental contamination

ISO standards for measuring radioactivity levels

by *Dominique Calmet, Convenor of ISO/TC 85, Nuclear energy, SC 2, Radiation protection, WG 17, Radioactivity measurements*

Environmental assessment studies are regularly commissioned to determine the activity levels of radioactive substances in the environment and to assess their radiological impact on the public. The robustness of the conclusions of such assessments relies, in part, on the reliability of radionuclide activity measurements.

Requests for expertise on environmental contamination (radioecology) and assessment of the impact on the population (radioprotection) are justified by the prior existence of, and addition to, radioactive substances in the environment, whether authorized or accidental. These requests originate from either official international bodies, or national and regional authorities, or from nuclear facility operators. They could also stem from others stakeholders such as public bodies and the media, eager to ensure the sustainability of their environment.

This growing awareness of the significance of environmental protection calls for references that enable socioeconomic players to assess the environmental implications of their activities following the lines of ISO 14001:2004. Measurement results are required to assess the impact of those practices during routine operation as well as in the event of nuclear accidents.

The results of these measurements are used to establish radiological assessment, long term chronological observations, or else to explain or quantify radionuclide transfer mechanisms between various environmen-



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tal components. They may also occasionally be set against the outcome of mathematical simulations, undertaken in order to validate theoretical impact evaluation or risk assessment.

The credibility of expertise in the nuclear and environmental domain must, in part, rest on the quality and reliability of radionuclide measurement results.

Monitoring near nuclear facilities

In 1999, a new work item proposal on radioactivity measurement was accepted by member countries of the technical committee on nuclear energy on the basis that standards were needed to help those in charge of the surveillance and monitoring of the environment surrounding a nuclear facility.

“ISO standards will help locate and identify source contamination, define the risks of it spreading and determine remedial options.”

Though ISO technical committee ISO/TC 85, *Nuclear energy*, subcommittee SC 2, *Radiation protection*, working group WG 17 is responsible for radioactivity measurement, it decided to create a subgroup devoted to radionuclide measurement in the environment.

The subgroup has focused on standards that are useful for persons in charge of the initial characterization of a site with respect to radioactivity and a routine surveillance, which includes systematic and periodic inspection of specific sites, such as the area around a nuclear power station.

The references of the initial radio-activity of a site are thereby established before operations begin, and are

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verified through periodic checks that the impact of the facility remains consistent with the evaluations of the provisional environmental studies.

Ensuring comprehensive studies of 'fallout zones'

The full set of standards, when published, will also provide advice to make sure that the study is comprehensive of the distribution of the radionuclides in the various environmental compartments, which may be transferred back to the human population through diet (mushrooms, blackberries, fish, etc.).

Standards will also help to carry out site inspection where pollution occurred following radioactive fallout, with a view to drawing up an inventory of its level of contamination. It may involve fallout from accidents in nuclear power stations that generate immediate or regional deposits, such as Chernobyl, or even those of past atmospheric nuclear tests. Following their specifications, these standards will allow to:

- locate and identify the sources of contamination,
- define the risks of it spreading,
- determine remedial options.

Radioactivity levels in solids, liquids and gases

The whole set of standards that will be drafted by the group concerns the measurement of the various gamma-emitting radionuclides, the beta emitters such as strontium, or alpha emitters such as uranium and plutonium isotopes.

These standards are intended to assist in the determination of activity levels of these natural and artificial radionuclides present in the various matrices that can be sampled in the environment: gas, aerosols, natural water, soil, sediments, and organs of plant and animal origin considered as bioindicators.

In addition to the natural environment, they may also concern farmland, urban or industrial sites that may have been contaminated.

Within the scope of ISO technical committee ISO/TC 85, *Nuclear energy*, subcommittee SC 2 covers radiation protection: standardization in the field of peaceful applications of nuclear energy and the protection of individuals against all sources of ionizing radiations.

The subcommittee's standards must answer public demand for the protection of human health and the environment, in order to help the operators comply with the rules and requirements in this area and to share good technical practices.

In addition to the usual radiation protection themes (reference radiations, dosimetres, materials and devices for protection against all types of radiations, air control and monitoring), SC 2 is devoted to energetic nuclear applications and developing standards for medical and biomedical applications including: radiation dose evaluation and protocols during medical diagnosis, biological dosimetry in post-incident or post-accident situations.

It also deals with radioactive sources, radiation measurement in the environment, illicit trafficking by detecting radioactive material, and radiation dose evaluation for aircraft crews.

An international advisory group, composed of participating members and other representatives from international organizations, helps the subcommittee's Chair to give orientations for new standardization fields. These orientations have, for example, been taken for complementing the guidance principles and standards of two important SC 2 liaisons, the International Commission on Radiological Radioprotection and the International Atomic Energy Agency.

The market of radiation protection comprises: equipment designed, built and operated according to the safe practices defined by radiation protection specialists, reactors, fuel cycle and medical equipment, and instruments for monitoring personnel, facilities and sites.

About the author



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in fundamental research in energy, defence and security, as well as health and information technology. He is a member of several working groups of the International Atomic Energy Agency. He is currently responsible for the BNEN/AFNOR (Bureau de normalisation d'équipements nucléaires / Association Française de Normalisation) committee on radioactivity measurement in the environment. Dr. Calmet is the convenor of ISO/TC 85/SC 2/WG 17, *Radioactivity measurements*, and ISO/TC 147, *Water quality*, WG 4, *Radioactivity*. He has written numerous articles on radioecology and radioactivity measurement.

Work is already in progress in the International Electrotechnical Commission (IEC) on radionuclide measurement equipment for gas and aerosols, with a view to drafting standards on radon volumic activity in the atmosphere and in ISO/TC 147, *Water quality*, on the measurement of radionuclide volumic activity in water.

Sampling soils

To cover the scope of radioactivity measurement in soil, the first standard (ISO 18589) is divided into six parts which can be used jointly or separately as required. The first part deals with definitions. It covers setting-up programmes and sampling techniques, bearing in mind existing ISO soil quality standards (ISO 10381).

Part two deals with the necessary methods of pre-processing and making a solution of soil samples in the laboratory, while parts three to six present the methods for measuring the radionuclides in the soil test samples. At this draft stage, they integrate the specification of the new standard on



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expanding partnerships from national players to those of other countries will, thanks to ISO's work, ensure that activity measurements (as given by a country to characterize environmental samples) are reliable and reproducible. Results will also be accepted and shared by all countries that might potentially be concerned by regional transboundary contamination. ■

determination of the detection limit and decision threshold for ionizing radiation measurements (ISO 11929-7 and GUM¹).

The laboratory in charge of radioactivity measurement has to apply the general requirements for acknowledging a testing laboratory as competent and reliable, in order to facilitate its accreditation and create confidence between laboratories. These laboratories have to follow the general requirements for the proficiency in testing and calibration laboratories specified in ISO/IEC 17025:2005.

Complementary to the latter, the laboratories must use the ISO test methods drafted by ISO/TC 85, *Nuclear energy, SC 2, Radiation protection*, including sampling methods, which meet the needs of the customer and which are appropriate for the tests undertaken. Though radionuclide measurement techniques are specific in nature because of the nuclear emission measurements, the sampling and storage techniques used for environmental samples can be part of general considerations used to measure other analytes.

Meanwhile, some radionuclides have specific requirements because of their short half-life or the volatility that require sampling and storage procedures to be adapted. For these radionuclides, parts of the standard cover the sampling procedure and information on storage and transport of samples.

Today, the state of development of nuclear measurement techniques used to quantify radionuclides has surpassed the state of maturity; the mechanisms are fully understood, the principles well-established and the equipment highly reliable. This state of development will progressively lead to the publication of standard-setting documents describing measurement protocols. In the context of ISO/TC 85/SC 2, this approach will evolve in conjunction with standards needed to assess the radiological impact on humans.

1) GUM – Guideline to the Expression of Uncertainty in Measurement, published jointly by seven international organizations.

Improving transparency through international collaboration

Particularly at the international level, standardization of the measurement of radioactivity signals the will of all the players to share know-how and improve transparency in this area. Soon, transparency will be supported by a full set of standards on measurement of radionuclides found in the environment.

For the nuclear industry and its way of interacting with the environment,

ISO standard for early assessment of radiation exposures and health risks

by Elizabeth Gasiorowski-Denis

A new International Standard will help protect workers from radiation exposure and contribute to the overall safety of the work environment.

Published by ISO (International Organization for Standardization), ISO 20553:2006, *Radiation protection – Monitoring of workers occupationally exposed to a risk of internal contamination with radioactive material*, is designed to protect workers against risks by monitoring potential intakes and/or quantifying actual intakes and exposures.

Occupational exposure to ionizing radiation can occur in a range of industries, mining and milling, medical institutions, educational and research establishments and nuclear fuel cycle facilities. Although exposure to ionizing radiation – whether accidental or chronic – carries risks, a monitoring programme plays a key role in greatly minimizing them.

The new standard offers guidance for deciding whether a monitoring programme is required and how it should be designed, established and maintained. Its intention is to optimize the efforts of such a monitoring programme, consistent with legal requirements, and with the aim of the overall radiation protection programme, which starts with an assessment to identify work situations where there is a risk of radionuclide intake by workers.

According to the 2000 Report of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), an estimated 11 million workers are monitored for exposure to ionizing radiation. They incur radiation doses attributable to their occupation, which range from a small fraction of the global average background exposure to natural radiation up to several times the value of natural radiation.

“Recommendations of international expert bodies and international experience with the practical application of these recommendations in radiation protection programmes have been considered in the development of the standard,” says Dr. María Limson Zamora, Convener of the ISO working group that developed the standard.

“Application of ISO 20553 will enhance the harmonization of monitoring practices and facilitate the exchange of information between regulatory bodies, supervisory institutions and employers which may include nuclear facilities, hospitals, research organizations, radio pharmaceutical companies, governmental or private laboratories.”

ISO 20553:2006 was developed by ISO technical committee ISO/TC 85, *Nuclear energy*, subcommittee SC 2, *Radiation protection*.