



BSI Standards Publication

Decommissioning of medical cyclotron

National foreword

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Foreword

This document was prepared by Technical Committee ISO/TC 85, Nuclear energy, nuclear technologies, and radiological protection, Subcommittee SC 5, Nuclear installations, processes and technologies.

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 documents 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 5, *Nuclear installations, processes and technologies*.

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.

Introduction

Many types of accelerators have been installed and operated in the last several decades primarily for nuclear research and radioisotope production worldwide.

A cyclotron is a type of particle accelerator invented by Ernest O. Lawrence in 1934 in which charged particles are accelerated outwards from the centre along a spiral path. Cyclotrons have been the best sources of high-energy beams for nuclear physics experiments for the last several decades. Additionally, cyclotrons can be used in particle therapy to treat various types of cancers. Ion beams from cyclotrons can be used to penetrate the body and eliminate tumours by radiation treatment, such as in proton therapy. Cyclotron beams can be used to bombard other atoms to produce various radioisotopes for diagnostic imaging in positron emission tomography (PET), single photon emission computed tomography (SPECT) and therapeutic applications in brachytherapy and alpha particle therapy. According to IAEA NW-T-2.9, it is estimated to be over 1500 cyclotron facilities worldwide as of 2025.

Some cyclotron facilities have been dismantled and decommissioned because they have reached the end of design life or because of ageing, accidents or other reasons like the changes in the purpose of use, location, etc. Even though any standardized technical or administrative procedures for decommissioning of medical cyclotron facilities have not been established yet, however, a safe decommissioning process is needed. Therefore, it is necessary to analyse the major considerations such as activation and radioactive waste management during the decommissioning of various kinds of cyclotron facilities.

Decommissioning actions typically involve different radiation protection strategies, such as radiological surveys and monitoring; decontamination; dismantling and removal of structures, systems and components and management of the radioactive waste generated during decommissioning. These actions are carried out to achieve a progressive and systematic reduction in radiological hazards during decommissioning and are conducted on a basis of planning and assessment to ensure the safety and protection of the workers, the public and the environment and to ensure that the facility meets the planned decommissioning end state.

It is necessary to clarify the dismantling procedures at each stage from installation to decommissioning of a medical cyclotron and to take measures to minimize decommissioning costs. This document aims to develop proper decommissioning procedures and methods for medical cyclotron facilities, that accelerate protons or deuterons for PET radiotracers (^{11}C , ^{13}N , ^{15}O , ^{18}F) by

- development of procedural guidelines for the decommissioning of a medical cyclotron facility,
- establishment of activation evaluation techniques for the end of operation of each cyclotron type, and
- consideration of the management of radioactive waste during the decommissioning of a medical cyclotron facility.

Decommissioning of medical cyclotron

1 Scope

This document provides information and guidelines on the decommissioning of a medical cyclotron facility, with a focus on activated or contaminated parts. Useful information and guidelines are given on decommissioning strategy and plan, safety assessment, and various decommissioning activities. This document also provides the guideline on the estimation of activation level using Monte Carlo simulation and the methodology for the measurement of activated radionuclides in the main structure, system components, and shielding walls, ceilings and floors during operation and decommissioning. Financial provisions and radioactive waste management aspects are also included.

This document can be used by organizations responsible for operation and decommissioning of a medical cyclotron facility. In addition, it is expected that organizations that design a medical cyclotron or manage radioactive waste generated by cyclotron can utilize or refer to this document in whole or in part.

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 4037 (all parts), *Radiological protection – X and gamma reference radiation for calibrating dosimeters and dose rate meters and for determining their response as a function of photon energy*

ISO 29661, *Reference radiation fields for radiation protection — Definitions and fundamental concepts*

ISO/IEC Guide 99, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in the ISO 4037 (all parts), ISO/IEC Guide 99, ISO 29661 and the following apply.

ISO and IEC maintain terminology 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 clearance

Removal of regulatory control by the regulatory body from radioactive material or radioactive objects within notified or authorized facilities and activities

[SOURCE: IAEA nuclear safety and glossary, 2022(interim)]

3.2 clearance level

value established by the competent authority, expressed in terms of activity, activity concentration or surface contamination (fixed and non-fixed) at or below which radioactive material or radioactive objects within authorized practice may be removed from any further regulatory control by the regulatory body

Note 1 to entry: Clearance levels are defined as generic and specific clearance levels.