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## **Nuclear energy — Performance and testing requirements for criticality detection and alarm systems**

*Énergie nucléaire — Prescriptions relatives aux caractéristiques techniques et aux méthodes  
d'essai des systèmes de détection et d'alarme de criticité*

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 7753 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

# Nuclear energy — Performance and testing requirements for criticality detection and alarm systems

## 0 Introduction

In some operations with fissionable materials the risk of nuclear criticality, while very small, cannot be eliminated. It is important in such an event to provide both a means of alerting personnel to the threat of high radiation intensity and a procedure for their evacuation.

This International Standard, which deals with the design and maintenance of criticality detection and alarm systems, is supplemented by three annexes. Annex A outlines the specification of a minimum accident of concern, annex B provides examples of application of this International Standard to process areas and annex C provides guidance for development of emergency plans.

## 1 Scope and field of application

This International Standard specifies performance and testing requirements for criticality detection and alarm systems; it is applicable to all operations with plutonium, uranium 233, uranium enriched in the 235 isotope, and other fissionable materials in which inadvertent criticality may occur and cause the exposure of personnel to unacceptable amounts of radiation. This International Standard does not require separate additional instrumentation when the operating instrumentation of facilities, such as nuclear reactors or critical experiments, meets the requirements of this International Standard.

This International Standard does not include details of administrative steps, which are considered to be managerial prerogatives, or specific design and description of instrumentation. Details of nuclear accident dosimetry, personnel exposure evaluations and detectors for post-accident diagnosis are not within the scope of this International Standard.

A standard which provides guidance on detailed characteristics of instrumentation to be used in criticality alarm systems is currently being drawn up by the IEC.

This International Standard is principally concerned with gamma-radiation rate-sensing systems. Specific detection criteria can be met with integrating systems or with systems detecting neutron or gamma radiation, and analogous considerations apply.

## 2 Definitions

For the purposes of this International Standard, the following definitions apply.

**2.1 criticality accident:** The release of energy as a result of accidentally producing a self-sustaining or divergent neutron chain reaction.

**2.2 minimum accident of concern:** The smallest accident a criticality alarm system is required to detect.

## 3 General principles

### 3.1 General

Alarm systems shall be provided wherever it is deemed that they will result in a reduction in total risk. Consideration shall be given to hazards that may result from false alarms.

### 3.2 Limitations and general requirements

**3.2.1** The need for criticality alarm systems shall be evaluated for all activities in which the inventory of fissionable materials in individual unrelated areas exceeds 700 g of  $^{235}\text{U}$ , 520 g of  $^{233}\text{U}$ , 450 g of the fissile isotopes of plutonium or 450 g of any combination of these isotopes (see [1]). Attention shall be given to all processes in which neutron moderators or reflectors more effective than water are present.

In the above context, individual areas may be considered unrelated where the boundaries are such that there can be no interchange of material between areas, the minimum separation distance between material in adjacent areas is 10 cm and the surface density of fissile material, averaged over each individual area, is less than 50 g/m<sup>2</sup>.

**3.2.2** A criticality alarm system is not required under the terms of this International Standard in areas where the maximum foreseeable accidental dose in free air will not exceed 0,12 Gy. For the purpose of this evaluation, a maximum yield may be assumed not to exceed  $2 \times 10^{19}$  fissions for events outside reactor cores.

### 3.3 Detection

In areas in which criticality alarm coverage is required, a means shall be provided to detect excessive radiation dose or dose rate and to signal personnel evacuation.