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Nuclear criticality safety — Nuclear criticality safety training for operations

Sûreté-criticité — Formation à la sûreté-criticité dans le cadre de l'exploitation

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Foreword

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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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ISO 23133 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

Experience of criticality accidents and evidence of operations history worldwide has indicated that human errors on different levels (management, operations staff, and/or operations supervisors), through lack of understanding or ignorance of nuclear criticality safety, have contributed to accidents.

In order to maintain nuclear criticality safety for facilities handling and processing fissile material it is necessary to ensure the operations staff, operations supervisors, and management are suitably trained in nuclear criticality safety. This document was developed in response to demand for a definition of the minimum nuclear criticality safety training requirements for operations staff, operations supervisors, and management.

This training is distinct from that of the training necessary for nuclear criticality safety staff in that it is tailored to suit the needs of maintaining nuclear criticality safety for operations. This document sets out standards for achieving and maintaining an adequate level of understanding and knowledge in order to operate nuclear facilities safely with respect to nuclear criticality safety.

This document covers high-level training for maintaining nuclear criticality safety. This includes preparedness for and response to a potential criticality accident. ISO 11320 contains more specific training provisions on emergency preparedness and response. This document supports integrating such provisions, when relevant, within the training program for operations staff, operations supervisors, and management.

Nuclear criticality safety — Nuclear criticality safety training for operations

1 Scope

This document specifies minimum nuclear criticality safety training requirements for operations staff, operations supervisors, and management.

This document is applicable to areas, processes or facilities containing quantities of fissile material for which nuclear criticality safety assessment is required as defined in ISO 1709.

This document is not applicable to the transport of fissile materials outside the boundaries of nuclear establishments.

2 Normative references

There are no normative references in this document.

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 http://www.electropedia.org/

3.1
operations staff
workers who, in the act of carrying out activities as part of a facility or process, have duties for maintaining nuclear criticality safety

Note 1 to entry: These include staff and (sub)contractors performing activities in accordance with written procedures as part of production, processing and handling of fissile material. They may also include workers such as maintenance workers, and health physics monitors if they could have an effect on nuclear criticality safety either through action or inaction as part of their duties. They do not include support staff, whose actions would not be expected to affect fissile material processes.

3.2
operations supervisors
individuals who direct or supervise *operations staff* (3.1) in the production, processing or handling of fissile material, and who accept responsibility for the safety of operations under his/her control

3.3
management
individuals with overall responsibility for the nuclear criticality safety of operations for a site, process or facility

3.4
nuclear criticality safety staff
individuals competent in the assessment of nuclear criticality safety requirements

Note 1 to entry: The staff might not be competent in nuclear criticality safety for all fissile material operations carried out on a nuclear site but will be familiar with the fissile material operations for which they provide nuclear criticality safety support.

3.5
trainee
individual being trained in nuclear criticality safety

3.6
criticality trainer
individual competent in delivering nuclear criticality safety training

3.7
training coordinator
individual who provides assistance and advice to facilitate nuclear criticality safety training

3.8
nuclear criticality safety program
arrangements and procedures implemented in order to ensure nuclear criticality safety for a site, facility or process

3.9
operations nuclear criticality safety training program
program detailing the training requirements, method of delivery, and evaluation process for *operations staff* (3.1), *operations supervisors* (3.2) and *management* (3.3)

4 Operations training

4.1 General

Subclauses 4.2 to 4.6 define the high-level requirements for nuclear criticality safety training for operations. Detail of the roles in the training program and specific requirements for how some aspects of the high-level requirements are to be met are presented in the proceeding clauses.

4.2 Operations nuclear criticality safety training program

The nuclear criticality safety program shall include an operations nuclear criticality safety training program.

4.3 Objectives

An operations nuclear criticality safety training program shall address the following principal training objectives:

a) Understanding of the nature of a criticality accident so that the severity of the hazard and the need for maintaining safety are understood.

b) Understanding of the mechanisms and activities to control nuclear criticality safety.

c) Understanding that everyone involved in operations, directly or indirectly, can affect nuclear criticality safety.

d) Understanding of nuclear criticality safety relating to operations in the specific workplace.

e) Understanding of the role of emergency preparedness and response in mitigating the consequences of a criticality event.

Sufficient training shall be provided and confirmed to be effective, in keeping with Clauses 6, 7 and 8, before commencement of activities associated with processes that may present a criticality hazard and before operations supervisor duties are commenced. Where on-the-job training is provided, activities may commence before nuclear criticality safety training is complete provided that the trainee is subject to direct supervision by an individual trained in nuclear criticality safety. The continued effectiveness of training shall be evaluated or refresher training shall be required as detailed in Clause 9.

NOTE It is not an objective to train trainees so that they become criticality safety specialists.

4.4 Training of operations staff

Training in nuclear criticality safety shall be provided with due consideration of the nature of the work operations staff perform and the sensitivity of that work in maintaining nuclear criticality safety.

Operations staff working according to procedures that are required to maintain nuclear criticality safety will require a greater extent of training than those staff who do not perform those duties or those who perform tasks that are intrinsically less sensitive for maintaining nuclear criticality safety.

EXAMPLE Staff in a facility handling inventories of multiple critical masses, with nuclear criticality safety based on administrative control of batch sizes, will typically require a higher level of training than a facility handling small fractions of a critical mass.

The scope and the level (depth) of training shall be formulated to enable the operations staff to operate a process with sufficient understanding of the criticality hazards associated with that process, and the importance and reasons behind the controls identified to maintain nuclear criticality safety.

Understanding the reasons behind the controls may reduce the risk of operations staff deviating from procedures and/or responding inappropriately to unexpected process conditions. Analysis of past criticality accidents and near-miss data has revealed a number of instances where inadequate understanding of the reasons behind the criticality safety controls has been a contributory factor.

4.5 Training of operations supervisors

Certain roles are particularly important in maintaining nuclear criticality safety. A supervisory role to operations staff is one such role, as are those roles responsible for making decisions which could significantly affect nuclear criticality safety (e.g. operations manager or shift team leader). These key safety roles are termed collectively in this document as operations supervisors (as defined in 3.2).

It is necessary for operations supervisors to have a more comprehensive understanding of the nuclear criticality safety issues and their significance. This could include understanding of typical or common themes that have caused criticality accidents and the need to maintain systems to monitor, maintain and improve nuclear criticality safety in a facility. The specific content of the required training is discussed in Clause 6.

Operations supervisor training shall be in addition to the identified training for operations staff and should be biased to the particular nuclear criticality safety issues associated with the process for which they have responsibilities.

4.6 Training of management

Management shall have an awareness of the severity of the consequences of nuclear criticality accidents and, hence, of the importance of a suitable nuclear criticality safety program.

Management have overall responsibility for the nuclear criticality safety of operations for a site, process or facility and define the nuclear criticality safety program. Management do not require detailed nuclear criticality safety training because they do not carry out operations and, therefore, rely on operations supervisors and operations staff to maintain day-to-day criticality safety.

5 Role in the training program

5.1 General

Subclauses 5.2 to 5.7 define the roles of operations staff, operations supervisors, management, nuclear criticality safety staff, the training coordinator, and the trainer in the nuclear criticality safety training program.

5.2 Operations staff

Operations staff shall attain a level of understanding of nuclear criticality safety consistent with the nature of the work they carry out, as defined by the operations nuclear criticality safety training program.

5.3 Operations supervisors

NOTE These responsibilities are in addition to those defined in ISO 14943.

Operations supervisors shall consult with the nuclear criticality safety staff to identify operations staff requiring nuclear criticality safety training.

Operations supervisors shall confirm, via the criticality trainer(s), whether operations staff have attained sufficient understanding of nuclear criticality safety prior to allowing commencement of activities for processes that may present a criticality hazard.

Operations supervisors shall attain a level of understanding of nuclear criticality safety consistent with the nature of the work they carry out, as defined by the operations nuclear criticality safety training program.

5.4 Management

NOTE These responsibilities are in addition to those defined in ISO 14943.

Management shall ensure the establishment and maintenance of an operations nuclear criticality safety training program. This shall include the requirement for training for operations staff, operations supervisors, and management.

Management shall consult with the nuclear criticality safety staff to identify operations supervisors requiring additional nuclear criticality safety training, beyond that identified for operations staff (as identified in Clause 6).

Management shall confirm, via the criticality trainer(s), that operations supervisors have attained sufficient understanding of nuclear criticality safety prior to them assuming responsibility for processes that may present a criticality hazard.

Management shall attain a level of understanding of nuclear criticality safety consistent with the requirements of the operations nuclear criticality safety training program.

5.5 Nuclear criticality safety staff

Nuclear criticality safety staff should develop and maintain the nuclear criticality safety training materials for operations staff, operations supervisors, and management.

5.6 Training coordinator

The training coordinator should assist and advise in the development and delivery of the nuclear criticality safety training materials, in consultation with the nuclear criticality safety staff and criticality trainer(s).

5.7 Criticality trainer

The criticality trainer(s) shall deliver training to an adequate level of competency, as defined by the nuclear criticality safety staff and training coordinator.

The criticality trainer(s) shall decide whether operations staff, operations supervisors, and management have attained sufficient understanding of nuclear criticality safety.

6 Content of training

The content of the training for all operations staff and operations supervisors shall meet the objectives of Clause 4, and shall include, as a minimum, the following:

a) The nature of a nuclear criticality event, how it can be caused, and the hazards associated with a criticality accident.

b) The factors affecting nuclear criticality safety.

c) Past accidents relevant to the type of operations to be carried out and the root causes of these accidents.

d) Local incidents and deviations relevant to nuclear criticality safety, the reasons they arose and root causes.

e) Local or site-specific nuclear criticality safety limits, controls/instructions and equipment important to safety, to explain why they are needed and to illustrate the importance of following procedures.

Operations supervisors shall receive training on the following additional topics:

f) Potential faults identified for the process or processes that the operations supervisor is responsible for that could credibly lead to a criticality event and what protective measures are in place.

g) Typical or common themes that have contributed to criticality accidents for processes similar to the process or processes that the operations supervisor is responsible for.

h) The need to maintain systems to monitor, maintain, and improve nuclear criticality safety in the facility.

EXAMPLE Analysis of facility (and similar facilities or operations) near-miss data to provide direct learning from experience, which can reduce the risk of criticality.

The content of the training for management shall meet the objectives of Clause 4, and shall include, as a minimum, the hazards associated with a criticality accident and details of the facilities or operations under their control that have the potential to present a criticality hazard.

7 Delivery of training

Training should be structured and formulated to achieve a set of identified learning objectives. These learning objectives, the content, and delivery method of the training should be agreed with the nuclear criticality safety staff. Identified learning objectives enable a structured and focused training program, which has measurable aims. This helps with the evaluation process to ensure effective training.

The means of delivering the training should be tailored to the target audience. Tailoring can take the form of modifying training to suit the actual processes in a facility. This is likely to improve the effectiveness of the training.

EXAMPLE Tailoring can include describing the type of criticality event that could occur for the process, emphasising the particular factors affecting criticality that are relevant or controlled, or discussing particular past accidents or incidents that have direct relevance to operations.

The training shall be delivered by an individual or team competent in providing nuclear criticality safety training, where competency is judged by the nuclear criticality safety staff. The nuclear criticality safety staff should preferentially deliver training. It is expected that other individuals or teams judged to be competent will have received the nuclear criticality safety training themselves and have been observed delivering the training as a minimum.

NOTE 1 Not all nuclear criticality safety staff are judged to be competent to deliver training by default.

NOTE 2 Training that comprises shadowing experienced operations staff or operations supervisors will not, in most cases, be provided by nuclear criticality safety staff.

The most appropriate means of training is dependent on the nature of the subject matter and the audience. On-the-job training, classroom style or lectures can be the best means of conveying details of a technical nature but other means such as visual aids and workshops can be equally, or even more, effective. Computer-based learning may be an appropriate means of training but can lack the flexibility and trainer interaction of other delivery methods.

8 Evaluation of training and testing

The effectiveness of the training shall be evaluated. The evaluation shall confirm whether the requirements of the operations nuclear criticality safety program have been met. If learning objectives were identified (as expected in Clause 7) then the evaluation should ascertain whether those learning objectives have been achieved.

Evaluation should take the form of practical, oral or written/computer-based tests to monitor the effectiveness of the training and how well the information has been understood by the trainees. The extent of the testing shall be proportionate with the required knowledge and competency of nuclear criticality safety for the specific job role of each trainee.

EXAMPLE 1 A written test, with a minimum pass mark, might be a suitable evaluation of the effectiveness of the training for operations staff working in an area with well-defined processes and robust engineered protection measures. However, a formal interview with a nuclear criticality safety staff member might be more suitable for an operations supervisor with duties for an area that is reliant solely on administrative control for nuclear criticality safety.

The evaluation of the training should have a minimum standard identified whereby re-training and/or alternative actions to attain the standard should be triggered.

Operational safety performance information should be considered in the process for evaluating the effectiveness of training.

EXAMPLE 2 A good nuclear criticality safety performance record can be indicative of good nuclear criticality safety training. Poor performance would indicate areas for improvement.

9 Maintenance of training

Regular assessment of the continued effectiveness of training shall be made, or refresher training shall be required in regular intervals, for all operations staff, operations supervisors, and management. Re-assessment and refresher training shall verify whether the trainee continues to meet the required standard and shall be evaluated in-line with the requirements in Clause 8. Consideration should be given upon failure to attain sufficient standard as to the suitability of the trainee to continue in operations where nuclear criticality safety is significant.

NOTE 1 Refresher training is subject to the requirements of this document.

The frequency and content of re-assessment or refresher training should be proportionate to the requirements of the original training and should be defined and justified.

NOTE 2 Refresher training need not be as extensive as the original training.

