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Nuclear energy — Fuel technology — Trunnion systems for packages used to transport radioactive material

Énergie nucléaire — Technologie du combustible — Systèmes de tourillons pour colis de transport de matières radioactives

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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 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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

This second edition cancels and replaces the first edition (ISO 10276:2010), which has been technically revised. The main changes compared to the previous edition are as follows:

— The scope is extended to trunnion attachment components (trunnion systems are defined as being the trunnions and their attachment components);

— The normative references have been updated (IAEA TS-R-1 replaced by IAEA SSR-6) and enlarged to the IAEA SSG-26 (Appendix IV-1 - Package stowage and retention during transport);

— Quality Assurance is replaced by Management Systems;

— The load cases are to be defined by use of the minimum acceleration factors given in table IV-1 of the Appendix IV of IAEA SSG-26;

— The calculation methods (analytical and finite element analysis) and the minimum associated criteria are more precisely detailed;

— The bibliography has been updated and enlarged to the most recent recommendations, guidance and standards as acceptable by most of the Competent Authorities;

— The structure of the document has been slightly modified to enhance its legibility and understanding.

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

This document has been produced to enable package owners, designers, users and regulatory organizations to have at their disposal a comprehensive document covering all aspects of trunnion systems. Experience has been drawn from the extensive knowledge of owners, designers, users and competent authorities. This document contains the minimum requirements and makes recommendations covering various aspects of trunnion systems.

Intermediate devices (sometimes referred to as transport frames, supports or cradles) can be used between the packaging trunnions and the transport conveyance to support and secure the package during transport; however, the energy-absorbing effects that may be provided by these intermediate devices are not taken into consideration in this document.

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Nuclear energy — Fuel technology — Trunnion systems for packages used to transport radioactive material

1 Scope

This document covers trunnion systems used for tie-down, tilting and/or lifting of a package of radioactive material during transport operations.

Aspects included are the design, manufacture, maintenance, inspection and management system. Regulations which can apply during handling operation in nuclear facilities are not addressed in document.

This document does not supersede any of the requirements of international or national regulations, concerning trunnions used for lifting and tie-down.

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.

IAEA SSR-6, *International Atomic Energy Agency (IAEA) Safety Standard No. SSR-6, Regulations for the Safe Transport of Radioactive Material*

IAEA SSG-26, *International Atomic Energy Agency (IAEA) No. SSG-26, Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material*

3 Terms, abbreviated terms, symbols and definitions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IAEA SSR-6 and the following 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/

3.1.1
bending stress
variable component of *normal stress* (3.1.10), which might not be linear across the thickness

3.1.2
bolts
fasteners including bolts, screws and studs

3.1.3
designer
organization responsible for the design of the package

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3.1.4
independent expert organization
organization administratively and managerially separate from the designers, manufacturers or owners of the subject package, constituted of specialized experts, or an insurance organization used to verify, oversee, witness or check

3.1.5
linearized stress
sum of the *membrane stress* (3.1.9) and of the linear component of the *bending stress* (3.1.1)

3.1.6
load case
specific configuration of transport or lifting associated to a total mass (transport or lifting), specified value and direction of acceleration, a given number of acting trunnions, and a given point/area of application of the load on the trunnion

3.1.7
maintenance schedule
document drawn up by the designer that gives, in appropriate detail, the applicable frequency/periodicity of maintenance items and details of methods to be employed; applied by the owner/operator

3.1.8
maximum service load
greater of *total mass (lifting)* (3.1.19) and *total mass (transport)* (3.1.20), subjected to gravity (1 g)

3.1.9
membrane stress
component of *normal stress* (3.1.10) that is uniformly distributed and equal to the average stress across the thickness of the section under consideration

3.1.10
normal stress
component of stress normal to the plane of reference

3.1.11
owner
operator
organization responsible for maintaining the condition of the packaging for transport

Note 1 to entry: The condition of packaging shall be in accordance with IAEA SSR-6.

3.1.12
peak stress
maximum stress that occurs in a component by reason of geometry, local discontinuities or local thermal stress, including the effects, if any, of stress concentration

3.1.13
periodic inspection
inspection of the trunnion system during the in-service life of the packaging at predetermined periodicities defined in the *maintenance schedules* (3.1.7)

3.1.14
primary trunnion system
trunnion system provided as a primary means for lifting and/or tilting, tie-down and supporting of the package

3.1.15
quality plan
document, or several documents, that together specify quality standards, practices, resources, specifications, and the sequence of activities relevant for manufacture

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3.1.16
removable trunnion
trunnion, on a package secured by non-permanent methods, e.g. bolting

3.1.17
secondary trunnion system
trunnion system provided as an additional or alternative means for lifting and/or tilting, tie-down and supporting of the package

3.1.18
tie-down
securing of the package to the conveyance

3.1.19
total mass (lifting)
maximum mass of a package as supported by the trunnion systems during lifting, fitted with all necessary ancillaries and equipment, and including the radioactive material and water as appropriate

3.1.20
total mass (transport)
maximum mass of a package fitted with all ancillaries (shock absorbers, neutron shields, covers, transport frame as appropriate, etc.), as presented for transport and as supported by the trunnion systems

3.1.21
transport cycle
complete round-trip journey of a package between two complete loadings

3.1.22
trunnion
projection, typically cylindrical in shape, attached on a packaging by various means and used for lifting, tilting and/or *tie-down* (3.1.18) of the package; parts permanently attached to the trunnion are considered as being part of the trunnion

Note 1 to entry: A trunnion is an example of an attachment point as defined in IAEA SSG-26, Appendix IV.

3.1.23
trunnion attachment method
method of attaching the trunnion (e.g. welding, bolting, threaded attachment, interference fitting and bolting, or any combination of these methods) to the packaging body

3.1.24
trunnion attachment components
attachment components, e.g. welding to the packaging body, bolts, removable shear discs, female threads or housing in the packaging body, removable baseplates, etc., used to secure the trunnion to the packaging body

3.1.25
trunnion system
assembly of *trunnion* (3.1.22) and *trunnion attachment components* (3.1.24)

3.1.26
welded trunnion
trunnion directly secured to the packaging by welding

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3.2 Symbols

K_{Ic} plane strain fracture toughness

$R_e(T)$ guaranteed yield strength or guaranteed 0,2 % proof strength at the operating temperature, T

$R_m(T)$ guaranteed minimum tensile strength at the operating temperature, T

T operating temperature

3.3 Abbreviations

FEA Finite Element Analysis

MT Magnetic particle test

NDE Non-destructive examination

PT Liquid penetrant test

SCC Stress corrosion cracking

UT Ultrasonic test

VT Visual inspection test

4 Regulatory requirements

4.1 General

In this document, the word “shall” denotes a requirement; the word “should” denotes a recommendation; and the word “may” denotes permission, i.e. neither a requirement nor a recommendation. Imperative statements also denote requirements. To conform to this document, all operations shall be performed in accordance with its requirements, but not necessarily with its recommendations.

The word “can” denotes possibility rather than permission.

4.2 Relevant regulations

The main applicable document is IAEA SSR-6. Other relevant national or international transport regulations should also be considered to ensure that any differences with the IAEA Transport Regulations are taken into account.

This document does not relieve the relevant parties of the responsibility for compliance with any requirement of the regulations applicable within the nuclear power plants (e.g. KTA 3905[3] or ANSI N 14.6[4]).

5 Design

5.1 General

5.1.1 Trunnion systems as part of a package design shall be designed in accordance with IAEA SSR-6 with consideration of IAEA SSG-26, and in particular its Appendix IV.

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