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Nuclear criticality safety — Solid waste excluding irradiated and non-irradiated nuclear fuel

Sûreté-criticité — Déchets solides à l'exclusion du combustible nucléaire irradié et non irradié

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Foreword

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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

Nuclear criticality safety considerations can play a significant role in the production, management, transport and disposal of waste containing fissile nuclides. Such waste can present particular challenges from a nuclear criticality safety perspective.

— The fissile content of waste can vary significantly. Most waste has a relatively low fissile content; however, there is the potential for waste to contain some items with significantly higher fissile inventory or for fissile nuclides to move and/or increase in local concentration. Typically, there are also large variations associated with the moderators, absorbers and scattering materials which make up the waste matrix.

— The uncertainties associated with the quantity, distribution, concentration and elemental fractions of fissile nuclides associated with a waste material can be large. Typically, there is also significant uncertainty associated with the moderators, absorbers and scattering materials that may comprise the waste matrix.

— Very large volumes of waste requiring criticality assessment can arise. Often the average fissile concentration can be low, but the total fissile mass can be significant.

— The physical and chemical form of waste can be very diverse, with a wide variety of potential effects on nuclear criticality safety (e.g. moderation, neutron poisons, neutron reflectors, etc.).

— The timescales that require nuclear criticality safety to be demonstrated for waste may be very long (and could be as large as hundreds of thousands of years or more when considering final disposal). Over such timescales, there is the potential for key parameters to change - for example, nuclide proportions as a result of radioactive decay, chemical changes in the waste matrix, re-distribution of fissile nuclides and moderators, separation of poisons. There is the potential for significant variability in the distribution of fissile nuclides within the waste volume at the time of disposal.

— There is often a requirement to transport waste within the public domain, which can be subject to differing limits and constraints when compared with where the waste was produced.

The purpose of this document is to support nuclear criticality safety throughout the waste life cycle while taking into account the potential to have a significant negative impact on other important areas such as:

— Radiological safety: For example dose control, risk of nuclear material ingestion/inhalation, the potential for contaminated wounds when handling waste, etc. If the nuclear criticality safety limits are set with little consideration of the other areas, resulting in large criticality safety margins, there is the potential for reworking waste to ensure compliance, incurring unnecessary radiological risk.

— Environmental considerations: For example additional handling, processing and storage leading to additional discharges, use of services such as electricity and water, generation of additional contaminated and non-contaminated packaging materials, generation of increased waste volumes.

— Conventional safety: For example additional risks of acute or chronic physical injuries.

— Cost: For example excessive or disproportionate costs which might be better spent reducing risk elsewhere. Final disposal space (e.g. deep geological disposal or shallow/ surface disposal) is an expensive, finite resource – with costs being directly linked to the volume of waste produced. Cost may also arise from, for example, the numbers of packages produced and the number of package movements required.

— Delay: For example potential for excessive delay due to development of overly complicated engineered solutions or safety arguments.

The criticality safety specific requirements and guidance within this document are to be applied with an awareness of this wider context to ensure that an appropriate balance between the criticality safety considerations and these other important factors is achieved.