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Hierarchy of Legal Framework / IAEA Safety Standards

- International conventions and agreements
- National Policy and Strategy on Radioactive Waste Management
- Safety Fundamentals / Primary Legislation (Law)
- Safety Requirements / Sub-ordinate Legislation (Reg.)
- Safety Guides / Guidance (Guides, Rules, Code of Practice etc.)
Overall Approach to Safety Assessment 1

• Avoid accidents / incidents
• Mitigate consequences should accidents happen
• Demonstrate compliance with safety requirements
• Derive limits, conditions, requirements (outcome)
• Start with screening assessments
• Identify and assess in detail critical / most relevant scenarios

Reminder:
• Safety assessment is an essential part of a decommissioning plan, i.e. an overall plan or the plan for an individual decommissioning step/stage
• Essential prerequisite for a license application
Overall Approach to Safety Assessment 2

• Safety assessment is necessary BEFORE an activity is carried out; it does not need a full set of real/factual data → work with best estimates → revise when new data become available
• Safety assessment includes nuclear and non-nuclear hazards
• Nuclear hazards have the potential of doing harm
• Non-nuclear hazards do harm (e.g. injuries, death)
• The presentation is focused on nuclear hazards

→ If necessary, request help and support from IAEA
Safety Assessment Objectives

WS-G-5.2 „Safety Assessment for Decommissioning“

• To support
  • The selection of a decommissioning strategy
  • The development of a decommissioning plan
    → Safety assessment is part of a decommissioning plan
  • Associated specific decommissioning activities
• Determine whether:
  • Exposures to the public and to workers are below limits and ALARA - as low as reasonably achievable
  • Risks due to accidents and / or normal operations are reduced accordingly
  • Radioactive waste generation is minimised
Safety Assessment for Decommissioning 1

Overall assessments for the whole facility / activity
Assessments for a decommissioning step / stage
At facilities with a phased (step-by-step) approach
  • Define the phases, the nature of the decommissioning activities and the associated hazards which may differ between phases / step / stage
  • A graded approach should be applied to each decommissioning phase
Give consideration to both: individual doses (occupational and public) and the collective dose
Safety Assessment for Decommissioning 2

WS-G-5.2 „Safety Assessment for Decommissioning“

• Use a systematic methodology
  • To demonstrate compliance with criteria
  • To build confidence with ‘stakeholders’ (regulatory body, public etc.)
• Review of assessment
  • Operator internal (independent)
  • Regulatory body; for approval according to the national legal framework
• Review and revise to keep it up-to-date, e.g.
  • When new data become available
  • If surprises have been found
  • If modifications of the plan are suggested
• In the absence of national requirements for the release of sites develop such requirements by safety assessment
• Demonstrate that exposures after site release will be below 0.3 mSv per year and ALARA
• Materials management should be addressed
  • Radioactive waste
  • Cleared material
  • Destination for waste and materials
  • Other hazardous material
Graded Approach

WS-G-5.2 „Safety Assessment for Decommissioning“

• Grading shall not compromise safety
• Commensurate with:
  • Complexity of type of facility
  • Decommissioning activities/associated hazards
  • Inventory
  • Physical state of the facility
  • Quality of data
  • Resources (human, financial) etc.
• All phases / steps of decommissioning
  • Need a safety assessment
  • Regulators review the safety assessment
• Safety functions and associated SSCs (Systems Structures and Components) should be identified for:
  • Planned decommissioning activities
  • Accident conditions
• Safety functions
  • Existing and temporary situations
  • Change of safety functions
  • Identification and justification
Safety Functions and SSCs 2

WS-G-5.2 „Safety Assessment for Decommissioning“

• Safety assessment should be used to evaluate
  • Suitability
  • Sufficiency
  • Reliability

of these safety functions (e.g. containment) for the duration of decommissioning, including deferrals

• Deferred dismantling strategy
  • Preference to passive systems, devices and approaches
  • Minimal reliance on active systems, human intervention or monitoring
Defence in Depth

WS-G-5.2 „Safety Assessment for Decommissioning“

• Sometimes called ‘Multi-barrier’ approach
• Safety assessment should:
  (a) **Identify** necessary
    • Preventative
    • Protective
    • Mitigating measures
  (b) **Justify** that these measures will be suitable and sufficient to ensure safety during decommissioning
Management System

WS-G-5.2 „Safety Assessment for Decommissioning“

• Management system for decommissioning safety assessment:
  • Performance of assessment
  • Interface with other related facilities and activities
  • Graded approach
  • Responsibilities
  • Qualification
  • Contractors
  • Training
  • Procedures (e.g. independent review)
  • Record and archiving
  • Involvement of Regulatory Body etc.
• Be reflected in the safety assessment e.g.:
  • Through consideration of increased initiating events due to human errors
  • Need for measures to prevent or mitigate the associated consequences
• Balance between human-based and engineered measures
• Rigour of training commensurate with complexity of decommissioning project
Decommissioning safety assessment needs a qualified and experienced multi-disciplinary expert team with expertise covering all relevant areas:

- Knowledge of the facility (operational history)
- Decommissioning technologies
- Waste management
- Radiation protection
- Industrial safety
- Hazard analysis
- Engineering analysis
- Specific areas: criticality, hydrogeology, modelling
Safety Assessment Outcome 1

WS-G-5.2 „Safety Assessment for Decommissioning“

• Document how regulatory requirements / criteria are met
• Evaluate the nature, magnitude and likelihood of hazards and their radiological consequences to workers, public and the environment under normal conditions and during accidents
• Quantify the systematic and progressive reduction in radiological hazards
• Identify the safety measures, limits, conditions, requirements ...
• Demonstrate safety after license termination
• Demonstrate that any institutional control will not impose undue burdens on future generations
Safety Assessment Outcome 2

WS-G-5.2 „Safety Assessment for Decommissioning“

- Provide input to on-site and off-site emergency planning and safety management arrangements
- Provide input to the training needs for decommissioning and qualification of staff
Safety Assessment Methodology

1. Safety Assessment Framework
2. Description of Facility and Activities
3. Hazard Identification and Screening
4. Hazard Analysis
5. Engineering Analysis
6. Evaluation of Results and Identification of Safety Measures
7. Compliance with Criteria?
   - yes
   - no
8. Independent Review
Assessment Framework

WS-G-5.2 „Safety Assessment for Decommissioning“

• Context and relation to decommissioning plan
  • Scope
  • Objectives
• Requirements and criteria
• Timeframes
• End state of decommissioning
• End states of decommissioning phases/steps …
• Assessment outputs
• Safety assessment approach
• Existing safety assessments and experience
• Involvement of interested parties
• Include normal operation and incidents / accidents
Description of Facility and Activities

WS-G-5.2 „Safety Assessment for Decommissioning“

• Facility and associated buildings: existing hazards
  • Site description and local infrastructure
  • Structures, systems and components
• Radioactive inventory, mechanical, physical, and chemical characteristics
• Existing and planned safety measures (as input)
• Common systems with other facilities
• Operational history
• Decommissioning plan (activities, sequence and techniques)
• Supporting facilities
• Before, during phases and after decommissioning
Hazard Identification and Screening 1

WS-G-5.2 „Safety Assessment for Decommissioning“

- Hazards
  - Radiological
  - Chemically toxic
  - Dangerous (e.g. asbestos)
  - Industrial / non-radiological hazards
  - Combined and additive effect
  - Initiating events, scenarios following such an event, (potential) consequences (radiological and non-radiological)
Hazard Identification and Screening 2

WS-G-5.2 „Safety Assessment for Decommissioning“

- Existing and potential hazards
- Induced:
  - External
  - Internal
  - Human
- Identification of hazards
  - To workers, public and environment
Hazard Identification and Screening 3

WS-G-5.2 „Safety Assessment for Decommissioning“

• Main steps:
  • Hazards and initiating event identification
  • Screening
  • Selection of critical / more relevant scenarios
    • Normal conditions (as planned)
    • Accidental conditions
  • Various techniques
    • Check lists
    • Expert judgement, etc.
  • Graded approach
  • Facility complexity, decommissioning phases...
Hazard Analysis 1

WS-G-5.2 „Safety Assessment for Decommissioning“

- Identify sources for radiological hazards
- Assess the magnitude of such hazards
- Check for scenarios that could lead to hazards
- Calculation of consequences (doses and risk)
- Verify and validate methods and models
Hazard Analysis 2

WS-G-5.2 „Safety Assessment for Decommissioning“

• Assumptions should be clearly justified
• Uncertainties should be assessed / determined
• Approach to the analysis should be selected
• Measures should be identified and put in place that would prevent or protect against accidents or mitigate their consequences
Engineering Analysis

WS-G-5.2 „Safety Assessment for Decommissioning“

• Physical, chemical, mechanical and radiological state of the facility after shutdown
• Extent of ageing of facility and safety systems
• Reliability of any existing engineered SSCs need to be in compliance with relevant current codes and standards
• Need for additional engineered SSCs to deliver safety functions
  • Necessary because existing SSCs are inadequate
  • Necessary as a result of proposed specific activities
Evaluation of Results and Identification of Safety Measures 1

Ws-G-5.2 „Safety Assessment for Decommissioning“

• Comparison of results with safety criteria (dose or risk etc.), including uncertainties
• Uncertainty analysis should take due account of all known uncertainties, e.g.
  • quality, reliability information, e.g. assumptions real data
  • precision in the planning of cleanup activities
  • later stages / steps in a phased approach
• Sensitivity analysis
• Adequacy of safety measures
  • Engineering
  • Procedural
Evaluation of Results and Identification of Safety Measures 2

WS-G-5.2 „Safety Assessment for Decommissioning“

• Level of confidence
• Safety margins
• Confidence building in assessment and results
  • Management system / procedures, etc.
  • Qualified and trained staff
  • Independent review carried out by operator
  • Involvement of ‘stakeholders’
  • Dialogue with regulators etc.
• Independent review of safety assessment with independent means by regulator
DeSa Project (2004-2007)

• DeSa: Evaluation and Demonstration of Safety for Decommissioning of Facilities Using Radioactive Material

• Objectives
  • Safety assessments for real facilities
  • Develop harmonized approach on safety assessment
  • Investigate practical applicability
  • Demonstrate and illustrate application of approaches
  • Investigate approaches for review
DeSa Project (2004-2007) 2

• **Scope**
  - Safety assessment for decommissioning of facilities using radioactive material
  - Not in the focus:
    - development of the Safety Assessment for decommissioning during life time of a facility and during progress of decommissioning work
    - Implementation of Safety Assessment results
    - These are some of the main issues for the new FaSa project

• **Outcome**
  - Important input to the finalization of WS-G-5.2
  - Safety Report with 4 volumes to illustrate safety assessment and review methodology
  - Network of experts in decommissioning

• **Website:**
FaSa Project (2008-2011) 1

• Use of safety assessment in planning and implementation of decommissioning of facilities using radioactive material (FaSa)
• Objectives of FaSa (based on DeSa experiences)
• Provide practical and useful recommendations on the evolution and use of safety assessment in planning and execution of decommissioning with the aim of ensuring safe termination of practices
• More detailed recommendations on
  • Use of safety assessment methodology and safety assessment results and their evolution
  • Use of safety assessments in identification and practical implementation of safety control measures and of their evolution
FaSa Project (2008-2011) 2

- Application of the graded approach
- Further recommendations on methodologies and approaches for independent reviews for the operator and regulatory reviews of safety assessments and the implementation of their results

**Scope of FaSa**

- Focus on immediate and deferred dismantling of a large range of facilities with different complexities and hazards, endpoints and end states
- Explore interfaces between safety assessments for decommissioning and for waste management

**Website:**
http://www-ns.iaea.org/tech-areas/waste-safety/fasa/default.asp?s=8&l=64
Summary

• Systematic analysis of the safety of a facility / activity
• Relevant input data (factual data or assumptions) are needed
• The better the data the better the safety assessment.
• Qualified, experienced, skilled experts are needed
• Important aspect of a license application as part of the decommissioning plan
• IAEA recommendations on safety assessment (see References)
• DeSa and FaSa Projects apply safety assessment and foster international co-operation
• IAEA provides continued assistance to Member States on the application of safety standards and the exchange of information
References 1

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• DeSa Project Reports (Password protected)