International Atomic Energy Agency

Safety Assessment Framework

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Safety Assessment Considerations (I)

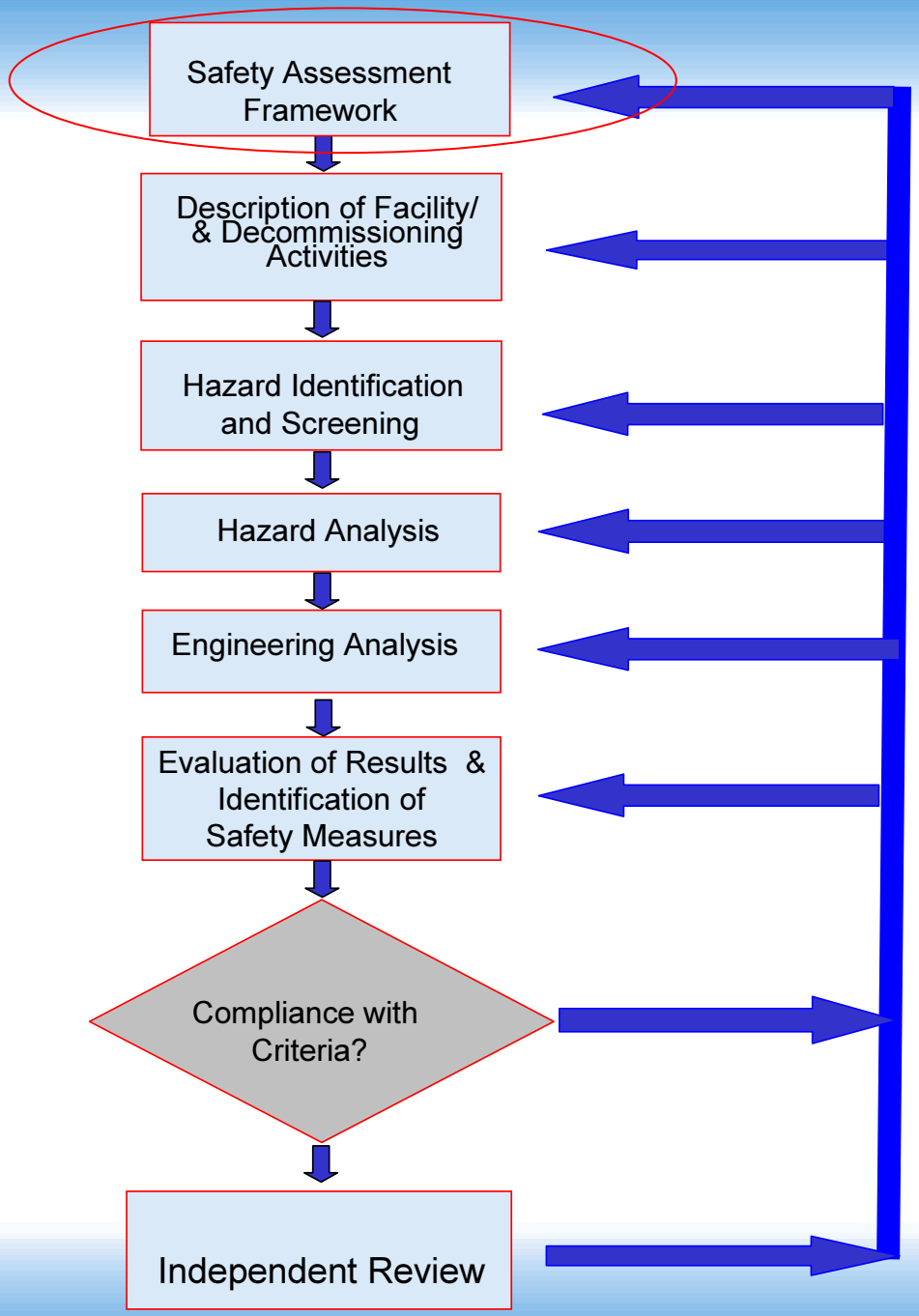
Based on WS-G-5.2 the Safety Assessment should:

- **Be consistent with its basis documentation** the decommissioning plan and other relevant national and site-specific strategies, e.g. for radwaste management; the release of material and sites from regulatory control
- **Provide systematic hazard evaluation of** the nature, magnitude and likelihood of consequences to workers, public & environment under normal + accident conditions
- **Quantify hazard potential** and its systematic and progressive reduction through implementation of the decommissioning activities

Safety Assessment Considerations (II)

- **Identify the limits, controls and conditions** that will need to be applied **during** the decommissioning activities to ensure that the requisite safety standards are met and maintained throughout the project
- **Provide for optimisation of institutional controls** after decommissioning, e.g. they should not impose undue burden on future generations
- Provide input to on- and off-site **emergency planning and other safety management arrangements**

Safety Assessment Methodology



Safety Assessment Framework Elements

- The Safety Assessment Framework consists of:
  - Context of Safety Assessment
  - Scope
  - Objectives
  - Timeframes
  - End-points of decommissioning phases
  - End-state of decommissioning
  - Requirements and criteria
  - Assessment Outputs
  - Safety assessment approach
  - Existing safety assessments
  - Safety Management Measures

Context & Scope

- **Context of the Safety assessment** – the safety assessment usually forms part of a larger project-decommissioning plan
  - assessment carried out in the context of that plan
  - needs to be linked and be consistent with the scope of the project decommissioning plan as a whole
- **Scope of the safety assessment**
  - needs to cover all the safety-related activities set out in the decommissioning plan
  - it may be appropriate to subdivide the overall decommissioning activity into phases with separate safety assessments for each phase

Context
Examples from DeSa Test Cases

- NPP Test Case
  - developed in support of the **final decommissioning plan** necessary to obtain authorization for decommissioning
- Research Reactor Test Case
  - forms part of the **documentation package** presented by the operator for approval by the Regulatory Body prior to initiating decommissioning of the research reactor
  - explanation and justification of what is **included/ excluded from the safety assessment** based on interdependencies with other facilities at the site, waste management, clearance (subject to separate / prior analysis)

Scope
Examples from DeSa Test Cases

NPP Test Case

- Safety assessment limited to two systems
- General explanation of activities covered (cutting, removal in waste containers)
- Explanation of what's not in (e.g. waste treatment) & why

Research Reactor Test Case

- All decommissioning activities starting after de-fuelling and removal of operational waste, terminating with release for unrestricted release
- Only decommissioning activities inside the reactor hall
- Clarification of the approach to radioactive waste and material to be cleared

Objectives

- To support the selection of the decommissioning strategy, the development of a decommissioning plan and associated specific decommissioning activities

- To demonstrate that all safety requirements and criteria are fulfilled:
  - e.g. exposures to members of the public and workers do not exceed the relevant constraints or limits, are as low as reasonably achievable and that protective measures are optimised

Objectives
Examples from DeSa Test Cases

NPP Test Case

- Demonstrate safety of workers and the public
- Show compliance with regulatory requirements and criteria
- Confirm existing or new safety measures / controls
- To be independently reviewed
- =>Show, that the selected systems serve well to demonstrate that the DeSa methodology is fit for purpose

Research Reactor Test Case

- Demonstrate, that decommissioning activities can be carried out without undue exposure
- Main focus on radiological hazards, but non radiological hazards are taken into account
- Demonstrate to regulatory body, that criteria are fulfilled

Timeframe Considerations

Timeframes, especially for the "phased approach should:

- Provide adequate time for planning and execution of decommissioning activities
- Take into account any separation of phases
- Have clearly defined start and end points for each phase
- Include periods of monitoring and institutional control

Timeframes may influence the safety!

Timeframes
Examples from DeSa Test Cases

NPP Test Case

- Whole NPP to be taken out of regulatory control after 7 years from start of decommissioning
- Unrestricted use of the buildings after 5 years from start of decommissioning
- Dismantling of 2 systems in total of 18 months

Research Reactor Test Case

- Total duration of 18 months
- 4 “work packages” arranged in sequential order

End-states and End points

- Intended **end-state** of the overall decommissioning process and **end points** of individual phases are important to planning decommissioning safety assessments
  - end-point of one phase = initial state for following phase
  - detailed physical, chemical and radiological condiitons will need to be described for end-points of each phase
- As a rule of thumb – **end points** should be stable from a safety point of view
- Typically, the justification of the **end-state** is subject to the decommissioning plan and its review

End-states and end points
Examples from DeSa Test Cases

NPP Test Case End-state:

(End point = removal of 2 systems)

- removal of the reactor nuclear and auxiliary systems
- Buildings below release values, relevant for release from regulatory control
- On-site buffer storage for radioactive waste until a final depository is available

Research Reactor Test Case End-State (=end point):

- Complete dismantling of the research reactor and the auxiliary systems from reactor hall
- Decontamination of the reactor hall and release for unrestricted used from regulatory control
- As far as necessary, partial removal of the wooden floor

Using Requirements and Criteria

- Summarize and refer to safety requirements and criteria to be met
- Represent the „measuring scale“ for the comparison of the safety assessment results and thus for the acceptability of the decommissioning activities
- Link requirements and criteria to the safety assessment outputs to facilitate later comparison
- Safety requirements and criteria may contain:
  - Dose limits for workers and the public under normal operation or under accident conditions
  - Waste acceptance criteria
  - Transport criteria

Requirements and Criteria
Examples from DeSa Test Cases

NPP Test Case

- Workforce dose criteria (e.g dose limits)
- Public dose criteria
- Accident criteria (e.g. defence-in-depth criteria resulting in requirements on safety measures)
- Clearance criteria (surface, activity concentration, site)
- Waste classification (management) criteria
- Conventional safety/risk management criteria

Research Reactor Test Case

- Dose limits and constraints for normal operation on effective dose (workers, public) and hand dose (workers only)
- Dose limits for accident situations
- Clearance levels for the reactor hall
- Transport criteria

Assessment Outputs

Outputs of a safety assessment must correspond to its purpose and the associated regulatory requirements and criteria, e.g.

- expressed in effective dose or risk, or percentages of relevant limits or control values
- used to determine which of the outputs should be subject to optimisation (ALARA)

Therefore, the operational limits, conditions and controls applied during the decommissioning process need to be specified & agreed in advance with management and regulatory authorities

Assessment Output
Examples from DeSa Test Cases

NPP Test Case provides

- Estimate of the effective dose to workers and members of the public from normal decommissioning operation and from fault conditions from work on the 2 systems
- Operational limits and conditions
- Recommendations for improvements to achieve ALARA
- Safety measures

Research Reactor Test Case

- Estimates of effective dose and hand dose to workers and to members of the public for normal decommissioning activities and from hypothetical incidents and accidents
- Identifies non radiological hazards

Safety Assessment Approach

Approaches:

- deterministic – the normal practice
- probabilistic – to complement deterministic results
  - e.g. for fault sequences with conditional likelihood

Methods:

- broad spectrum of methods available
- dose calculation to workers via est. dose-rates, times
- dose calculation to environment / man via complex environmental pathways

Selection needs to take into account dynamic change of the state of the facility

Safety Assessment Approach
Examples from DeSa Test Cases

NPP Test Case

- DeSa Safety Assessment Methodology
- HAZOP methodology for hazard identification

Research Reactor Test Case

- DeSa Safety Assessment Methodology
- “Check list” and “What-if technique?” approaches for hazard and scenario identification

Using Existing Safety Assessments

Parts of existing safety assessment for the operational phase of the facility may be used as basis for the decommissioning safety assessment

Important to recognize that decommissioning is fundamentally different from operation of the facility

- source terms may have changed (e.g. By decay)
- engineered barriers may become ineffective
- systems are opened
- new equipment is introduced – e.g. flammables
- radioactivity is mobilised by D&D activities

Simplifying assumptions may also be possible

Safety Management Measures

Safety management systems are used to assure compliance with regulatory requirements & criteria and the terms and conditions of the license

Safety management systems include components as:

- task-level procedures,
- change control procedures,
- work control procedures,
- personal protective equipment,
- training and testing programmes,
- radiation protection programmes,
- occupational safety programmes,
- emergency preparedness programmes

Safety Management Measures
Examples from DeSa Test Cases

NPP Test Case - Management system includes

- Organizational structure with clear responsibilities and authorities
- Change control procedures
- Maintenance and testing procedures
- …

Research Reactor Test Case - management system to

- Ensure that work is carried out in accordance with the regulatory framework of the country, the operator's policies and procedures
- Ensure that staff and contractors involved are appropriately qualified and experienced

Summary/Conclusions

- Assessment framework is the part within the safety assessment methodology to define all conditions relevant to assessing the safety of the proposed decommissioning activities
- Application of the Graded Approach is facilitated by use of a (consistent) framework
- Examples from DeSa NPP and RR work illustrate typical content of the assessment framework