



International Atomic Energy Agency

Hazard Identification and Screening and Analysis

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**Workshop on Safety Assessment for Decommissioning
of Nuclear Power Plants and Research Reactors**

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Safety Assessment Framework

Description of Facility/ & Decommissioning Activities

Hazard Identification and Screening

Hazard Analysis

Engineering Analysis

Evaluation of Results & Identification of Safety Measures

Compliance with Criteria?

Independent Review

Safety Assessment Methodology

Hazard Identification and Screening Basics

- Fundamental aspects of the Hazard Identification
 - Identification of the locations of radioactive material
 - Consideration of future accumulation of radioactive material
 - Identification of initiating events, in particular
 - External events (natural events, human made)
 - Internal events
 - Human induced events
 - Identification and later analysis of their evolution to be based on appropriate techniques and sources of information
 - Identified hazards need to be quantified and screened (see later)
 - Even if not focus of the methodology: consideration of non radiological hazard

Hazard Identification and Screening Basics

- Fundamental aspects of the Screening
 - Quantification of hazards taking benefit only from intrinsic (passive) features of the facility but not from further protective or mitigating safety measures
 - Reduction of the list of hazards by screening out those hazards out of the scope of the safety assessment or with consequences not leading to consequences in excess of relevant criteria
 - Hereby, consideration of all relevant exposure pathways (for normal decommissioning operation and accidents), e.g.
 - External exposure due to contamination, activation in structures or other radioactive material
 - Internal exposure due to inhalation or ingestion from airborne release during cutting or decontamination



Hazard Identification and Screening Basics

- Hazard Identification and Screening should
 - Lead to a list of relevant hazards
 - Lead to a list of relevant exposure pathways
 - And in total to a list of relevant scenarios
- During identification of the relevant scenarios
 - Consideration of on-site management of material intended either for clearance or for processing, storage and disposal as radioactive waste
 - Likelihood of particular scenarios in conjunction with their consequences should be analysed as basis for screening out
 - Scenarios should describe how hazards identified could be „realized“ either as anticipated operational occurrences in normal operation or as accidents



Details on Hazard Identification

From Decommissioning Safety and WS-G-5.2

- Current and future hazards/events need to be determined
 - Radiological hazards resulting in e.g.
 - Criticality
 - External exposure
 - Internal exposure
 - Liquid and gaseous radioactive effluents
 - Erroneous free-release of materials
 - Non radioactive hazards consisting of e.g.
 - Combustible and flammable materials
 - Toxic and otherwise hazardous materials
 - Electrical hazards
 - Physical hazards
 - Natural hazards
- resulting in radiological consequences

Details on Hazard Identification

- Particular emphasis should be placed on hazards that could be created or exacerbated e.g. by
 - Decommissioning activities undertaken
 - During transition from one decommissioning phase to another
 - Use of common systems between several facilities
 - Loss of barriers
 - Potential for interactions between many works taking place in parallel
 - Deterioration of structures, systems and components
 - Chemicals left
 - Premature removal of safety features
 - Human errors



Details on Hazard Identification

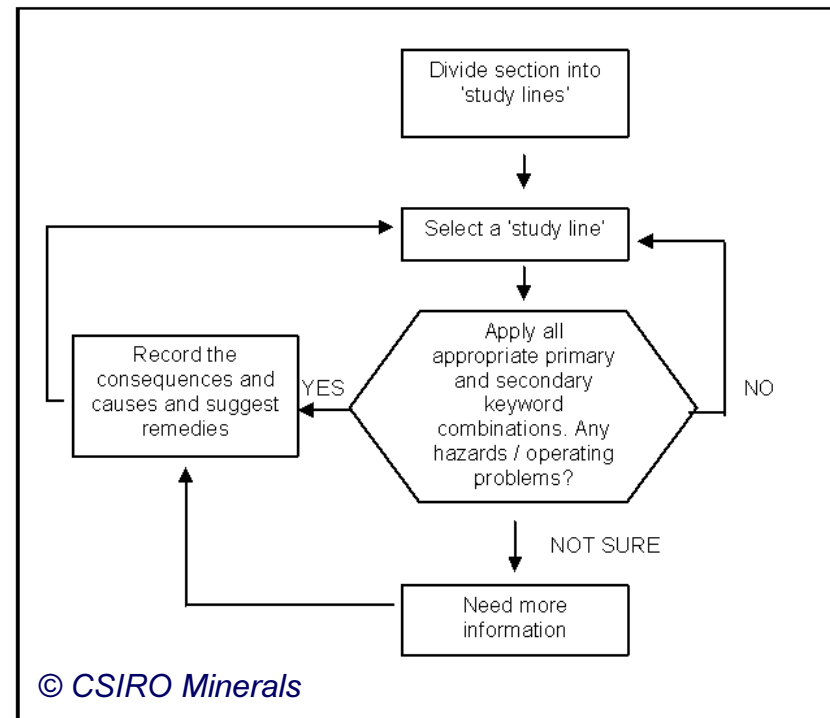
- Approaches to identify hazards
 - Evaluation of existing safety assessment for the facility
 - Evaluation based on past operational experiences (e.g. from incidents)
 - Use of checklists
 - Standardized list of hazards to checked step by step
 - Easy to apply by experienced and less experienced assessors
 - Can be applied by one assessor, but should be discussed in a team
 - For less complex facilities: regarded to be appropriate
 - For more complex facilities: starting point for a more complex approach
 - “What-if?” technique
 - Brainstorming approach
 - Best to be applied within a group familiar with the facility and equipment
 - May be used with a checklist (called “SWIFT” structure “what-if?” technique)



Details on Hazard Identification

- Approaches to identify hazards
 - Hazard and Operability study (HAZAP)
 - Approach to identify potential hazards and operating issues with the design and construction of equipment and plants (concept originating from process industries)

- Identification base on a set of keywords and sub-keywords to determine deviations and their consequences
- Requires a multi-disciplinary team
- Complex, but powerful approach



Hazard Identification

Examples from Decommissioning Safety Test Cases

- NPP Test Case
 - Used approaches
 - Review of operational history
 - Human error / ergonomic walk down
 - Use of Check list – Decommissioning Safety Vol. 1 – now WS-G-5.2
 - HAZOP
 - Result: completed checklist, separate list of possible initiating events
- Research Reactor Test Case
 - Used approaches:
 - Use of Checklist – Decommissioning Safety Vol. 1 – now WS-G-5.2
 - What-if? Technique:
 - External factors
 - Operator error and other human factors
 - Equipment / instrumentation failure
 - Utility failures
 - Integrity failures
 - Result: completed checklist and additional explanations on the list



Details on Screening

- Screening includes a preliminary hazard analysis
- Identify those hazards and scenarios which require an in-detail analysis (see “Hazard Analysis”)
- Depending on the national regulatory system and the hazards and potential consequences of a facility, either the preliminary hazard analysis or the later hazard analysis might be regarded to be sufficient for demonstration of the safety



Screening

Examples from Decommissioning Safety Test Cases

- NPP Test Case
 - Focusing only on accident scenarios as all normal operation scenarios will be subject to the “Hazard Analysis”
 - From a list of 7 accident scenarios 1 becomes subject of the “Hazard Analysis” while the remaining 6 are sufficiently assessed in the preliminary analysis and the relevant safety can be achieved by means of standard good practice workplace systems and procedures, subject to the operators management system

Screening

Examples from DeSa Test Cases

- Research Reactor Test Case
 - Preliminary analysis performed, distinguishing
 - Workers / public under normal conditions
 - Workers / public under accident conditions
 - Selection of conservative / worst case situations
 - For the public: use of simple tools for estimate of the radiological consequences for a release / discharge
 - Analysis of the safety significance of the waste management
 - Reduction of the scenario to become subject to the “Hazard Analysis”
 - Normal situation for workers: only removal of a dedicated component
 - Normal situation for the public: consequences very low, but for illustration reasons to become subject to the “Hazard Analysis”
 - Accident situation for workers: preliminary analysis regarded to be sufficient detailed such that not “Hazard Analysis” is needed
 - Accident situation for the public: more detailed analysis
 - Waste management: no further analysis required



DR3 Hazard Analysis

Using Decommissioning Safety and WS-G-5.2

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 - Natural hazards
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Summary/Conclusions

- Hazard Identification and Screening results in a comprehensive list of relevant hazards and scenarios.
- Screening is based on a first preliminary assessment of radiological consequences of hazards and related scenarios.
- A set of different techniques / tools is proposed for hazard identification to allow a graded approach.
- Examples from Decommissioning Safety test cases provide some helpful illustration on the application of the idea of Hazard Identification and Screening.
- Safety Guide WS-G-5.2, Safety Assessment for Decommissioning of Facilities using Radioactive Materials.

