Application of the Graded Approach

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Graded Approach to Safety Assessment
Plan of the presentation

- Definition of the graded approach
- Aims of using a graded approach
- Items to be considered in a graded approach
- Complexity of safety assessment vs complexity of the decommissioning project
- Experience feedback from the DeSa test cases
Graded Approach to Safety Assessment

Definition of the graded approach

- The need for a graded approach in safety assessments for decommissioning can be implemented according to:
  - The complexity of decommissioning activities:
    - multi-site facilities (facilities under decommissioning and in operation)
    - complex facilities (reprocessing plants for example)
    - facilities not designed to be easily dismantled (NPPs)
  - The implementation of a phased approach (step by step) to perform the dismantling operations (work packages), even for small facilities
  - The nature of the dismantling operations and the associated hazards are often different for each phase
Graded Approach to Safety Assessment

Definition of the graded approach

- The graded approach in safety assessments for dismantling:
  - must be implemented without compromising the safety of the public, employees or facilities and adversely impacting the environment
  - should be commensurate with complexity and hazard potential of the facility and work to be performed
  - depends on type of facility / decommissioning phase
  - should reflect the evolution of the (radiological) hazard potential with progress of decommissioning
Graded Approach to Safety Assessment
Definition of the graded approach

- Most Member States apply a graded approach in performing safety assessments
  - without following specific procedures
  - based on expert judgement

- IAEA DeSa Programme had a working group dedicated to the Graded Approach: GAWG
  - has defined the graded approach with respect to safety assessments
  - has analysed grading in DeSa Test Cases (NPP, RR, Laboratory)
Graded Approach to Decommissioning
Definition of the Graded Approach

- Safety Guide on Safety assessment for decommissioning (WS-G.5.2.)
- “A graded approach is a process by which the level of analysis, the documentation and the actions necessary to comply with the safety requirements and criteria are commensurate” with:
  - the magnitude of any hazard involved
  - the particular characteristics of a facility
  - the step within the decommissioning process
  - the balance between radiological and non-radiological hazards
Aims of Using a Graded Approach

- A graded approach helps:
  - to identify the key areas of the assessment, those where the highest contribution to doses and risk are to be expected
  - to direct effort to these specific areas
  - to minimize the overall costs of the assessment

- No graded approach means the risk:
  - of wasting effort at irrelevant areas
  - of not paying enough attention to dose relevant analyses
  - of overlooking critical exposure pathways and scenarios
Graded Approach to Decommissioning
Items to be considered (1)

- The particular characteristics of a facility,
  - the size and type of the facility (including its complexity)
  - the initial physical and radiological state of the facility:
    - shutdown after normal operation, after an incident or accident
    - shutdown following a long period of poor maintenance
    - uncertainty about the state of the facility (ageing may have compromised building structures or engineered safety measures)
Graded Approach to Decommissioning
Items to be considered (2)

- The purpose and the scope of the safety assessment
  - the overall final decommissioning plan or a phase of the decommissioning plan
  - a part of a facility, a single facility at a multi-facility site or an entire site

- The uncertainty issues associated to the input data for the safety assessment
  - the quality of the characterization of the facility
  - the reliability and availability of relevant supporting information
    - e.g. drawings, records of modifications
Graded Approach to Decommissioning
Items to be considered (3)

- Radiological hazards: source term
  - activity inventory of the facility
    - surface contamination, bulk contamination, activation
  - radiological characteristics
    - presence of short / long lived radionuclides, presence of alpha emitters
  - chemical and physical state of radioactive material
    - solid, liquid, gaseous; sealed sources; heat generating material, combustible material
Graded Approach to Decommissioning

Items to be considered (4)

- Radiological hazards: events and sequences
  - likelihood of hazards and their potential unmitigated consequences, with account taken of site characteristics
  - seismic events, flooding, influences from or dependence on any neighbouring facilities
  - presence and type of potential initiating events for incident/accident sequences
  - human error, fire, flood, dropped loads, collapse or failure of buildings or structures, chemicals, temperatures

- Administrative issues:
  - requirements / criteria against which results will be assessed
  - end state of decommissioning (unrestricted / restricted use)
The DeSa Project
Safety Assessment Process

Safety Assessment Framework

Description of Facility and Activities

Hazard Identification and Screening

Hazard Analysis

Engineering Analysis

Evaluation of Results and Identification of Safety Measures

Compliance with Criteria?

yes

no

Independent Review
Complexity of Safety Assessments to be Commensurate with Decommiss. Task

- High: NPPs after accidents, NPPs, complex fuel cycle facilities
- Medium: Simple fuel cycle facilities, large laboratories, research reactors
- Low: Small research reactors, simple laboratories

Decreasing level of complexity with decommissioning phases / time.
How to assess the level of complexity of a decommissioning project?

- The “level of complexity” (low, medium, high) is determined by the project team and documented according to the graded approach implemented.
- Guidelines (main items, criteria and priority) can be defined to help the team members in determining the overall level of complexity for a given project.
- Examples of “identified risk elements” and criteria (it is a non-exhaustive list based on French feedback on decommissioning projects):

1. **Project schedule** – defines how much time the project team has to complete the schedule:
   - Everyone has as much time as they want.
   - The schedule is somewhat compressed
   - The schedule is very compressed or very critical

2. **Interfaces** – defines how many organizations are involved in project planning and/or execution:
   - one to three
   - four to seven
   - greater than eight
How to assess the level of complexity of a decommissioning project?

3 - Experience/Capability – defines the level of experience and capability of project team members:
  - project has mainly experienced personnel
  - a blend of experienced and inexperienced personnel
  - the project is loaded with inexperienced personnel

4 - Technology – defines what degree of technical complexity will be faced by the project team in executing the project:
  - utilize off-the-shelf technology
  - buy something off the shelf and modify it; an engineered solution
  - perform research and development (R&D) activities

5 – Facility characterisation – defines the level of environmental characterization that has been completed:
  - fully characterized
  - partially characterized and results indeterminate
  - unknown characterization
How to assess the level of complexity of a decommissioning project?

6 – **Safety functions** – defines the safety issues the project team will encounter while completing the project:
- standard safety functions (confinement, radiation protection)
- increased diligence due to location or type of work, (inaccessible areas)
- very restrictive safety considerations (criticality).

7 – **Waste management** – defines the routes for the radioactive and conventional waste produced during the decommissioning works:
- Routes are available (clearance levels, storage and disposal),
- Main Routes are available and some particular waste have to be managed,
- Routes must be implemented.
How to assess the level of complexity of a decommissioning project?

8 - **Funding availability** – defines the availability of internal and external resources to plan and execute the project.
   - Funding readily available
   - Funding are somewhat restricted
   - The project will be fund constrained impacting schedule and cost

9 - **Public involvement** – Indicates how much the public is involved in your project
   - None – just get it done
   - Somewhat involved – issue news releases as required
   - Very involved – representative(s) part of project scope, schedule, cost, and quality decisions
How to assess the level of complexity of a decommissioning project?

- The level of complexity of the decommissioning project is the result of:
  - the level of risk per “identified risk element” (high risk, medium risk, low risk)
  - the priorities defined by the project team and applied within the “identified risk elements” (high priority, medium priority, low priority)

- Special attention should be given to:
  - overall level of risk of the decommissioning project (risk · priority)
  - the “identified risk element” for which high risk and high priority have been assessed
Application of Graded Approach DeSa Test Cases

- NPP, Research reactor and Laboratory Test Cases
  - Many areas where grading apparent
- Examples:
  - Descriptions of the surroundings of the three sites
    - graded according to potential off-site consequences
  - Description of the work packages/work steps
    - graded according to complexity of the work sequences
  - Radiological characterisation of the facilities
    - graded according to the available information on the radioactive inventory
Examples (cont.):
- Stocktaking of contaminated areas / masses performed:
  - in all three Test Cases to such a level that the decommissioning work could be adequately planned
  - required effort differed between the Test Cases
- All dose calculations are graded according to the hazard potential:
  - dose assessment to workers: differences in number of scenarios to be analysed
  - dose assessments to public: differences in models for analysing dispersion of radionuclides in environment