International Atomic Energy Agency

Application of the Graded Approach

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Workshop on Safety Assessment for
Decommissioning of Research Reactors

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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

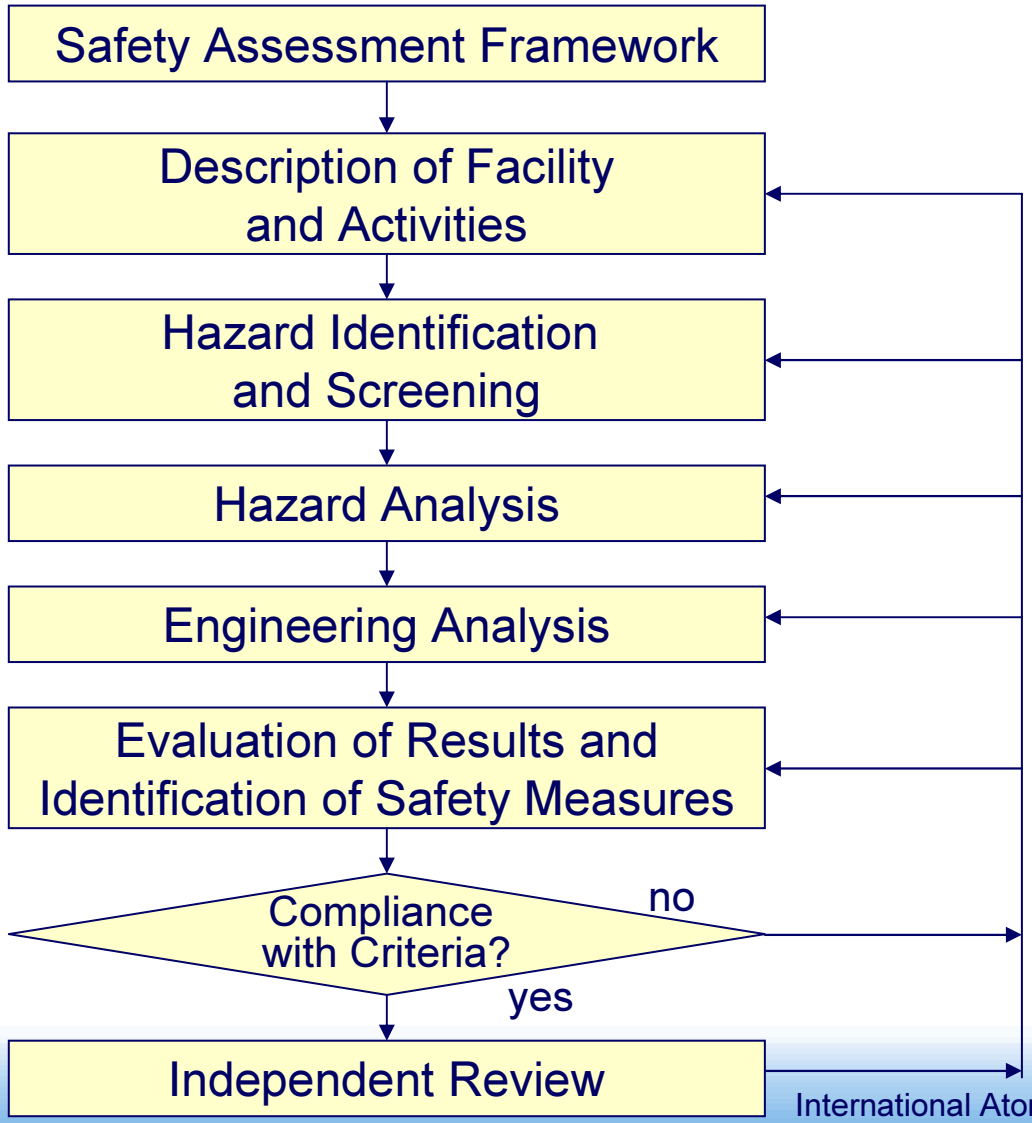
Graded Approach to Decommissioning
Items to be considered (3)

- 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

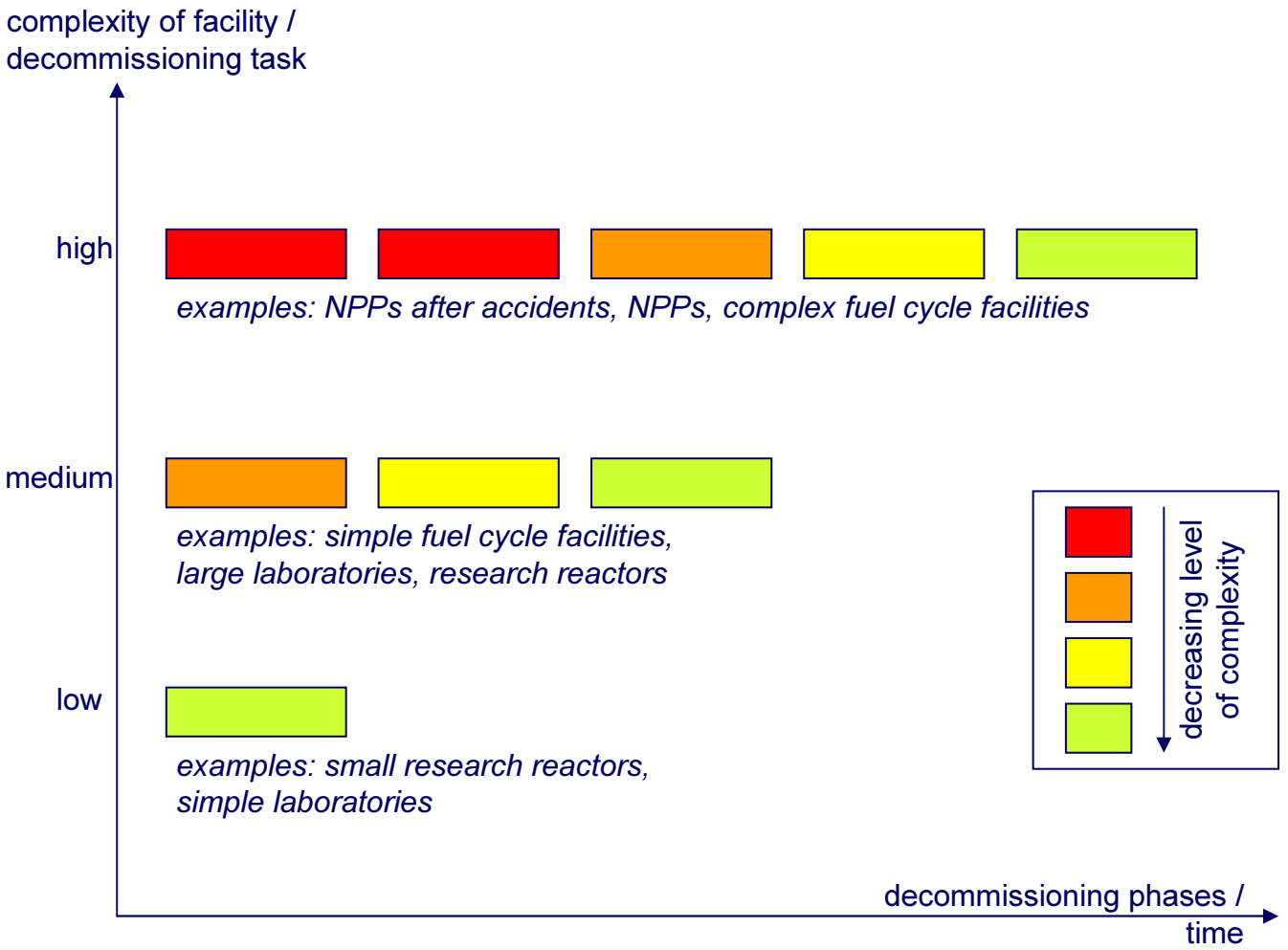
Graded Approach to Decommissioning
Items to be considered (4)

- 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



Complexity of Safety Assessments to be Commensurate with Decommiss. Task



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

Application of Graded Approach
DeSa Test Cases (cont.)

- 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