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## **Inspection and Review of Decommissioning Activities for Compliance**

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SSI, Sweden**

IAEA Regional Workshop: Legal and Regulatory Aspects  
of Decommissioning of Research Reactors  
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### **Objective**

- Approaches for control and inspection of authorised decommissioning activities with focus on most important safety related activities
- Specific safety aspects for inspection during dismantling, deferred dismantling and entombment

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## Inspection and review of Decommissioning

**IAEA Basic Safety Standards** for Protection against Ionizing Radiation and the Safety of Radiation Sources, Safety Series No. 115 (1996)

- The Regulatory Authority ... shall be responsible for the Enforcement of the Standards
- The principle parties shall permit duly authorized representatives of the Regulatory Authority... to inspect their protection and safety records and to carry out appropriate inspections of their authorized activities
- The IAEA BSS contains requirements for authorization and actions to be taken in cases of non-compliance, failures to take corrective actions or any breach of the requirements of the Standards

→ **General requirements for radiation protection and safety of radiation sources**

## Inspection and review of Decommissioning

A list of tasks for the Regulatory Body could read:

- Establish criteria for shut down facility
- Establish safety and environmental criteria for decommissioning, including clearance of material and acceptable conditions on end state
- Establish criteria for decommissioning planning
- Review initial decommissioning plan and review & approve final decommissioning plan prior to implementation
- Inspect and review decommissioning activities and, in case of non-compliance, enforce the requirements

## Inspection and review of Decommissioning

- Establish policy and requirements for collection and retention of relevant data, records and reports relevant to decommissioning
- Evaluate the end state of a decommissioned facility and decide on license termination, site release or the need for further activities/controls
- Ensure that interested parties (the public) can comment and influence decommissioning planning, acceptable strategies and end points

IAEA Safety Req. *Legal and Governmental Infrastructure...* GS-R-1

IAEA Safety Req. *Predisposal Management of Rad. Waste Including Decommissioning* WS-R-2

## Inspection and review of Decommissioning

|                                      | OPERATION  | DECOMMISSIONING   |
|--------------------------------------|--|---|
| <b>Hazard Profile</b>                | Stable, well-characterized, focus: radiological effects        | Changing, less well-characterized, changeable working environment, industrial safety issues |
| <b>Work Control and Planning</b>     | Routine operation and maintenance, short tasks                 | Task-/job-oriented, new tasks, work planning for workplace safety critical                  |
| <b>Hazard Analysis</b>               | Operation-oriented, generally stable, focus on off-site        | Dynamic, mainly task-oriented, changeable, focus on-site                                    |
| <b>Workforce Experience</b>          | Facility familiarity<br>Operation and work according to design | New mission, limited experience, contractors with little facility experience,               |
| <b>Staff</b>                         | Permanent  | Changeable (tasks and phases)   |
| <b>Permanent Structures</b>          | Constant with maintenance                                      | Interim facilities and degradation of structures  |
| <b>Public &amp; Involved parties</b> | Routine channels   | Dynamic & changing (contractors)  |

## Inspection and review of Decommissioning

**Some aspects will be the same or similar** (although in a changing working environment):

- Criteria for controlled/supervised areas, worker categories;
- Health surveillance, Dose limits, constraints and optimisation of protection (ALARA);
- Monitoring of the workplace, individual monitoring and exposure assessment;
- Authorization and certification of dosimetry, instrument control and protective equipment (exposure situations may vary and require more use of protective equipment);
- Information and education requirements

→ Existing regulations and inspection procedures may be sufficient (perhaps with modifications)!

## Inspection and review of Decommissioning

Depending on national legislation some actions may be **performed under operating license**:

- Placing the facility in safe and secure condition;
- De-fuelling (on-/off-site);
- Conditioning and management of operational waste;
- Removal of sealed sources and other materials and equipment not credited in the operational safety case of the facility
- **IMPORTANT** → Update (characterization) of radioactive inventory (source term as well as distribution).

**Procedures and safety of these actions should be controlled/authorized in pre-established way**

## Issues: Regulatory Guidance necessary

### A: Organisation and human factors

- An improved decommissioning plan – a road map for the operator management, new focus for the staff
- Plans for retaining adequate staff competency, maintaining safety focus, sustaining safety culture
- Contractors (new workers and managers) – mixture of experiences

### Regular meetings with site management

- Review procedures for facility change control and for maintaining records
- Look for possible adverse trends in overall safety culture

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## Staff is the most valuable asset!

No decommissioning will occur without them!



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## Issues: Regulatory Guidance necessary

### B: Shutdown and preparation for dismantlement

- Notification to Regulatory Body & Public announcement
- Operator may remove fuel, core components and radioactive materials to safe interim storage (under operating license)?
- Site survey for radioactive/hazardous material in buildings, in the ground and in groundwater
- Public contacts – safety, radioactive releases, transports, residual risks after license termination (Regulatory Body!)
- New procedures for dismantlement written (reviewed by RB)
- Release of component and materials assets - characterization and clearance criteria
- Can asbestos and chemicals be removed? ( Authorities?)

## Issues: Regulatory Guidance necessary

### B: Shutdown and preparation for dismantlement

Continued...

- Distinguish systems and components that may be de-powered and drained from those which are still needed (e.g. spent fuel cooling, ventilation, etc)
- Decontamination of systems, components and buildings in preparation for dismantlement
- Construction of new facilities (control room, off-site electrical power supply, new heat sink, new rail line etc...). New authorization required?

**The Regulatory Body may find this period very active and the needed resources for control and review, inspections, communications etc are usually significant!**

## Issues: Regulatory Guidance necessary

### C: Radiological and environmental control

- Acceptable time-period and strategic options of decommissioning
- Scope of radiation surveillances (also effluents)
- Interim storage facilities for radioactive waste
- Requirements for the scope and duration for maintaining operational and decommissioning records → especially if safe storage is foreseen!
- Criteria for termination of licences
- Careful planning of work tasks (radiological & industrial safety)

Established in regulations or agreed, case-by-case

## Issues: Regulatory Guidance necessary

### D: Safety and security challenges

- Immediate safety challenge: Maintain safety focus of staff after shutdown (retention plans, retraining plans, hiring workers & contractors, oversight plans)
- Update safety analysis report (facility specific risks)
- Modification of operating requirements (control room staffing, worker training, testing of systems and components, emergency planning, insurance, fire protection & steam erosion, QA and oversight)
- Security plans review
- Early removal of nuclear license of parts of the site/building

Regulatory review and discussions with operator before authorisation...

## Regulatory review of safety assessment

A **Safety assessment** for facility decommissioning is required by the operator (IAEA Safety Standards Series No. WS-R-2)

- As part of the decommissioning plan
- To support decommissioning strategy selection
- To demonstrate that decommissioning can be carried out safely and meets the requirements for protection of the workers, the public and the environment
- As input to the ultimate process of releasing the site/facility with remaining buildings and/or structures

→ **Prior to decommissioning license or any other authorisation of decommissioning!**

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## Regulatory review of safety assessment

**The regulatory review:** Assess scope, completeness, adequacy and uncertainties of the safety assessment. It should be used:

- To support regulatory assessment/authorization of decommissioning (construction, auxiliary facilities);
- To confirm and/or identify limits and conditions;
- As input to on-/off-site emergency preparedness activities
- As input to the ultimate process of releasing the site (with eventual remaining buildings and/or structures)

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## Regulatory review of safety assessment

The **safety assessment regulatory review** includes:

- Characterisation and records of material and wastes
- Identified work packages (interdependencies)
- Safety functions (vents, fire systems, electrical systems, administrative procedures)
- Engineered systems and structures
- Work performance (industrial & radiological safety)
- Waste and material categorisation criteria, sorting & clearance (dependence: transports, repositories etc)
- Capacity of processing and storage facilities
- Quantity and flow of material on the decommissioning site

## Regulatory review of safety assessment

The **safety assessment regulatory review**:

- Good engineering practice used?
- Decommissioning activities optimised with respect to dose and risk constraints (ALARA)?
- Effective and necessary controls (procedural and others) will be in place?

Screening or detailed technical review

Each phase but also for full decommissioning project (interdependencies!)

## Regulatory review of safety assessment

### The regulatory review:

- Structured, systematic fashion with clear traceable acceptance criteria
- Suitable qualified and experienced persons manage and undertake review
- Approach, findings and recommendations should be clearly documented

## Regulatory review of safety assessment

- Correct input assumptions? – relevant hazards, normal conditions & accidents (if risk/hazard high → independent review)
- The **safety management system** (limits and conditions based on safety assessments)
- Review most significant limits and conditions to safety (uncertainty, sensitivity analysis)
- Audits and reviews of training and qualification programmes
- Suitable maintenance and inspection program with procedures and controls that are auditable (review most important procedures)

## Regulatory review of safety assessment

### Hazard/risk



**LOW**

**HIGH**

Higher uncertainty allowed

Scooping evaluation

Less detail

Less conservatism

Less uncertainty allowed

Detailed (independent ?) evaluation

High detail

Conservative assumptions & results

**CHECK: Computer codes, numerical calculations and techniques!!**

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## Regulatory review of SA

### Deferred/partial dismantling

- Timeframes and due account of other national policies
- Degradation of remaining structures and buildings
- Retention of source-term (containment, shielding, leakage, evaporation...)
- Evaluation of kept systems (maintenance and surveillance adequate) (RB inspections!)
- **OBS!** Assess safety during safe enclosure as well as for future dismantling phase (interdependencies)

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## Regulatory review of SA

### Deferred/partial dismantling

- Future staffing and management procedures
- Record keeping extra important
- Security, intrusion, external events

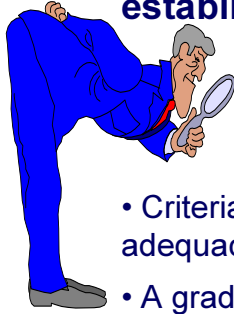
## Regulatory review of SA

### Entombment (Near surface disposal IAEA WS-G-1.1):

- Compliance with criteria for near surface disposal, e.g.
  - ✓ Collection of relevant data
  - ✓ Development of conceptual/ mathematical model
  - ✓ Analysis of features, events and processes (FEPs)
  - ✓ Scenario analysis, Identification of pathways
  - ✓ Model calculations, uncertainties
  - ✓ Comparison with the Regulatory requirements, etc..
- Records, institutional control, intrusion (safety issues)

## Inspection and review of Decommissioning

**Summary:** The Regulatory Body should establish or use:



- Procedures & requirements for authorization of decommissioning within the framework of the national legislation
- Criteria for evaluating the scope, completeness, adequacy and uncertainties of the safety assessment
- A graded approach for the review of safety assessments – screening by risk/projected dose (varying regulatory requirements, conservatism)

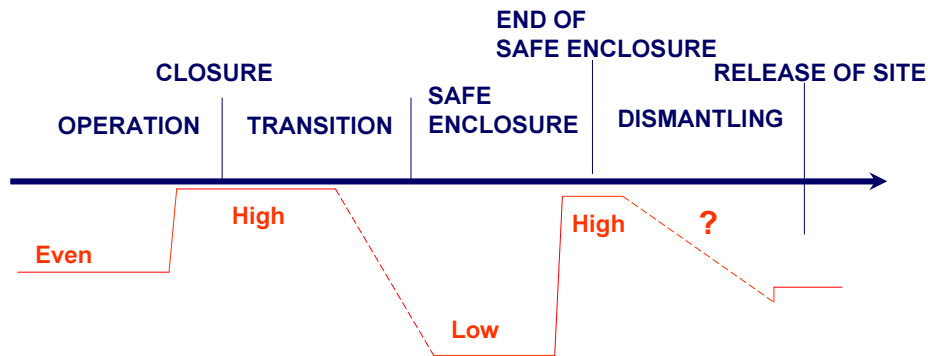
## Inspection and Enforcement

**The main purposes** of inspection and enforcement (IAEA GS-R-1 *Legal and Governmental Structure...*)

- Facilities, equipment and performance meet requirements;
- Relevant documents and instructions are valid and complied with;
- Personnel (including) contractors have necessary competence;
- Deficiencies and deviations are identified and are corrected/justified without undue delay;
- Lessons learned identified/propagated to other operators, suppliers and to the regulatory body as appropriate; and
- The operator is managing safety in a proper manner.

## Inspection and Enforcement

### “level” of inspection, review (simplified)



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## Inspection and Enforcement

### Inspections (general, IAEA GS-R-1)

- Establish a planned and systematic inspection programme (account of magnitude and nature of hazards)
- Announced or unannounced inspections – continuing activity. If consultants are used, the Regulatory Body should act on their reports
- Inspections on short notice if abnormal events
- Inspection reports, describing inspection activities and findings, should be prepared and fed back into the regulatory process.

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## Inspection and Enforcement

### Inspections (decommissioning)

- Broad range of safety, environmental and public policy issues → new challenges, plan ahead!
- Policy questions: If possible, develop criteria and requirements (site release, decommissioning planning, clearance, waste categorisation, etc...) early
- After cessation of operations: regular inspections to look for adverse trends in safety culture. Inspection plan changed to focus on
  - changing organisation, human factors
  - dismantlement issues

Augmenting Regulatory Body staff expertise in these areas?

## Inspection and Enforcement

### Inspections (decommissioning)

- Regular communication with operator throughout the full decommissioning period
- The Regulatory Body may request regular reports on the plans and status of decommissioning as work progresses
- During safe enclosure: Inspection activities can usually be downscaled to less frequent visits and checks of safety and security systems
- The Regulatory Body should ensure regular communication between operator and public

## Inspection and Enforcement

### Inspections (decommissioning)

- Period team inspections (replace site inspectors) of selected issues (as applicable):
  - ALARA programme implementation
  - Worker radiation protection (industrial safety!)
  - Site security, Safety culture
  - Operator's contractor oversight
  - Waste management
  - Measurements and record keeping
- When special decommissioning operations are performed (i.e. removal of vessel) – check procedures and observe the activity at the site

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## Inspection and Enforcement

### Enforcement (general)

- Is the Regulatory Body response, commensurate with the seriousness of the deviation, to non-compliance of conditions and requirements
- **Written** warning, penalties, suspension or revocation of authorization
- The operator should be requested to remediate the non-compliance, investigate the (root) causes and prevent any repetition
- The remediation should be performed within a specified time

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## Inspection and Enforcement

### Enforcement (general)

- Minor deviations, errors → written warning or directive to operator with request of change within specified time
  - Deterioration of safety, major deviation which causes imminent risk to workers, environment, public → halt activities, restore adequate level of safety
  - Continual, persistent or extremely serious non-compliance or serious release (malfunction or damage to facility) → halt activities, suspend or revoke authorisation
- Legal actions may be warranted

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## Inspection and Enforcement

### Enforcement (decommissioning)

- In many ways similar to the operational stage, but needs clear allocation of responsibilities (operator, contractors...)

#### Personal observation:

- If revenues from the operation of the facility are missing → Are high penalties effective?
- Important with hold-points and step-wise authorisation
- Communication and random checks of waste products, measurements and procedures have proven to be effective
- It is usually more effective to work with people than against them → willingness to report deviations etc might be destroyed if “too” much punishment

## Summary

- Early establishment of regulations and criteria for decommissioning as well as early planning of inspection activities facilitate the authority work.
- Review of the safety assessment is a key task for the Regulatory Body – especially in cases of phased decommissioning.
- Inspection and review activities should be proportionate to the hazards and the complexity of the shutdown facility.
- Inspection programme & procedures should be established. Safety culture, organisational issues and human factors are important during the transitional phase
- Involve the public!