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Policy and Strategy Options and Safety of Decommissioning

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Lesson Objectives

- Define specific decommissioning terms
- Understand the decommissioning process
- Review the various decommissioning strategies
- Discuss the overall process including the phases of decommissioning
Decommissioning Objective

Removal of the radiological and non-radiological hazards associated with the operation of a nuclear facility or system that will allow the facility to be released from regulatory control; and protect the worker, general public and the environment during the process.
## Terminology

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>Decommissioning</td>
<td>The <strong>administrative and technical actions</strong> taken to allow the removal of some or all of the regulatory controls from a nuclear facility</td>
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<tr>
<td>Decontamination</td>
<td>The <strong>complete or partial removal</strong> of radioactive substances or material from surfaces or from within a system or item</td>
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<tr>
<td>Dismantlement</td>
<td>The <strong>disassembly or demolition</strong> and removal of any structure, system or component during decommissioning</td>
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Why Decommission?

- Safety Issues
- Programme completed
- Obsolete technology
- Accident or unplanned event
- Uneconomical operation
- Governmental policy change
# Overall Decommissioning Process

<table>
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<th>Facility Stage</th>
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<th>Preparation Phase</th>
<th>Deferred Dismantling Period</th>
<th>Decontamination &amp; Dismantling Phase</th>
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<td>Design, Construction &amp; Start-up Phase</td>
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<td>Update Decommissioning Plan</td>
<td>Source Term Reduction &amp; Waste Conditioning</td>
<td>Update Final Decommissioning Plan</td>
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<td>Operating Phase</td>
<td>Finalize Safe Enclosure Plan &amp; Prepare Shutdown Plan</td>
<td>Site Preparation &amp; Initial Dismantling</td>
<td>Prepare Site Preparation Plan &amp; S&amp;M Plan</td>
<td>Surveillance &amp; Maintenance</td>
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Decommissioning Strategies

- Immediate dismantling
- Deferred dismantling
- Entombment
Immediate Dismantling

- All radioactivity above specified levels is removed
- Allows clearance or unrestricted use
- Normally begins very soon after shutdown (2 - 5 years)
- Allows use of current work force
- Work force remains relatively stable during period
- Does not allow for significant decay of radionuclides
- Waste and spent fuel management facilities must be available
- Funding must be available to complete the activities
- Preferred option if resources are available
Deferred Dismantling

- Facility is placed into long-term storage
- Dismantling is deferred from 10 to 60 years
- Systems are drained, waste removed & areas secured
- Allows decay of radionuclides
- Lose current work force knowledge
- Portions of the site may be used for other purposes
- Option if waste disposal or spent fuel management facilities are not available
- Allows for the collection of funds
- Work force reduced until dismantling begins
- Spent fuel may be an issue
- May be the preferred option if multiple facilities are on-site
- Sometimes called Safe Storage or Safe Enclosure
Entombment

- Radioactivity encased on-site
- Controlled area is reduced in size
- Remaining structure must be monitored and maintained
- Becomes a waste repository
- May be the preferred option for Member States with only a research reactor and no waste disposal facilities
Factors Affecting the Strategy Selection

- Governmental policy, laws and regulations
- Availability of waste management system
- Safety assessment of the hazards
- Availability of funding
- Physical status of the facility
- Availability of experienced staff
- Future use of facility or site
- Type of facility and residual activity
- Social and economic impact
Decommissioning Strategy Implementation
Facility Transition

- The time period between facility shutdown and implementation of the decommissioning strategy
- Part of operational phase
- Remove spent fuel, sources and operational radioactive waste
- Drain systems and process liquids
- Characterization survey completed
- Final decommissioning plan submitted to regulatory body for approval
Implementation of the Strategy

Immediate Dismantling

Decontamination & Dismantling Phase

Deferred Dismantling

Preparation Phase

Surveillance & Maintenance Phase

Preparation Phase

Decontamination & Dismantling Phase

Final Phase
Preparation Phase

- Activities that must be performed to place the facility into a position to implement the next phase
- Will depend on the selected strategy
- Normally begins when final decommissioning plan has been approved
- **If Immediate Dismantling is the selected strategy**
  - **Physical Actions** - Update systems, expand change rooms, new systems
  - **Administrative Actions** - Contract subcontractors, organize staff, prepare work procedures, buy equipment and supplies
- **If Deferred Dismantling is the selected strategy**
  - **Physical Actions** – Dismantle some minor systems, isolate areas, modify security systems
  - **Administrative Actions** – Reorganize staff, prepare detailed surveillance & maintenance plan
Implementation of the Strategy

Immediate Dismantling

Decontamination & Dismantling Phase

Deferred Dismantling

Preparation Phase

Surveillance & Maintenance Phase

Preparation Phase

Decontamination & Dismantling Phase

Final Phase
Decontamination & Dismantling Phase

- Main phase for removing the radiological hazards
- Perform decontamination and dismantling activities
- Waste management is a key issue
- Rigorous project management required
- Monitor activities for radiological and non-radiological hazards for personnel safety and environmental protection
Implementation of the Strategy

Immediate Dismantling

Decontamination & Dismantling Phase

Deferred Dismantling

Surveillance & Maintenance Phase

Preparation Phase

Decontamination & Dismantling Phase

Final Phase
Surveillance & Maintenance Phase

- Ensures a safe conditions are maintained at the facility awaiting dismantlement
- May last for a period of only a few months to many years
- Maintain only necessary systems to ensure safety and security
- Provide surveillance to spot deterioration
- Perform maintenance of essential systems
- Very reduced staff (normally <10)
Implementation of the Strategy

Immediate Dismantling

Decontamination & Dismantling Phase

Preparation Phase

Deferred Dismantling

Surveillance & Maintenance Phase

Decontamination & Dismantling Phase

Preparation Phase

Final Phase
Preparation Phase

- Activities that must be performed to place the facility into a position to implement dismantlement

- Begins when final decommissioning plan has been approved

- **Physical Actions** - Update systems, expand change rooms, new systems

- **Administrative Actions** - Contract subcontractors, organize staff, prepare work procedures, buy equipment and supplies

- Continue surveillance and maintenance until actual dismantlement commences
Implementation of the Strategy

Immediate Dismantling

Decontamination & Dismantling Phase

Preparation Phase

Deferred Dismantling

Surveillance & Maintenance Phase

Preparation Phase

Decontamination & Dismantling Phase

Final Phase
Decontamination & Dismantling Phase

- Main phase for removing the radiological hazards
- Perform decontamination and dismantling activities
- Radiological hazards tend to diminish while industrial safety hazards begin to dominate
- Waste management is a key issue
- Rigorous project management required
- Monitor activities for radiological and non-radiological hazards for personnel safety and environmental protection
Implementation of the Strategy

Immediate Dismantling

Decontamination & Dismantling Phase

Deferred Dismantling

Surveillance & Maintenance Phase

Preparation Phase

Decontamination & Dismantling Phase

Final Phase
Final Phase

- Perform final radiological survey
- Prepare final project report
- Request license termination from regulatory body
- Receive notification of termination of license

Removal from Regulatory Control !!
Project Completed !!
Key Points and Observations

- An experienced implementers observations of where others have struggled or failed in decommissioning -
  - **Infrastructure** – physical & regulatory
  - **Pre-planning and ‘optioneering’** – including a funding plan
  - **Waste management system**
  - **Project management skills**
  - **Safety focus** – industrial safety

- My three legged stool –
  - Waste Management
  - Project Management
  - Safety
Summary

- Decommissioning is an important stage in the life of any nuclear facility.
- Protection of human health and the environment is the primary objective of decommissioning and the regulators (and other stakeholders) expectations.
- Selection of the appropriate decommissioning strategy is complex and requires serious consideration.
- The decommissioning process consists of several orderly phases; decommissioning CAN be planned and implemented for all nuclear facilities.
References-1

- IAEA SF-1 Safety Fundamentals (2006)
- IAEA RS-G-1.7 Application of Concepts of Exclusion, Exemption and Clearance
References-2

- IAEA TECDOC-1124, On-Site Disposal of Nuclear Facilities as a Decommissioning Strategy (1999)
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