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# **The Decommissioning Process**

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IAEA Regional Workshop: Legal and Regulatory Aspects  
of Decommissioning of Research Reactors  
Manila, Philippines, 26 -30 June 2006

## **Discuss and outline**

The overall decommissioning process and  
its various phases

The importance of the transition phase

The various decommissioning strategies  
with benefits and disadvantages

## Decommissioning

The **administrative** and **technical actions** taken to allow the **removal** of **some or all** of the **regulatory controls** from a nuclear facility

## Decommissioning Objective

Progressive and systematic reduction of radiological hazards...

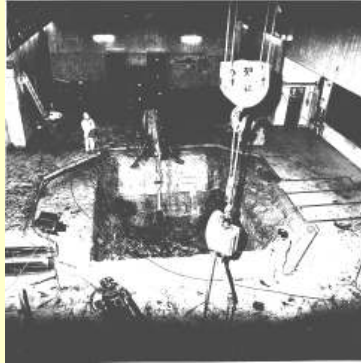
Protect human health and the environment from the radiological & non-radiological hazards resulting from the shutdown facility

## Why decommissioning ?

Conclusion of research programme

Economy

Technically outdated



Safety Considerations


Change in Governmental Policy

Others – Accident etc.

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## Decommissioning - principal steps

- Final shut down
- Removal of radioactive sources including liquids
- Decontamination, dismantling and clean-out
- Immediate or deferred dismantling of structures
- Waste management - treatment, storage and disposal of operational and decommissioning wastes
- Survey and release of site for unrestricted use

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## Decommissioning end state

### End state / End point

A facility is decommissioned when an approved **End state** has been reached.

Subject to national legal and regulatory requirements, this end state encompasses partial or full decontamination and/or dismantlement, with or without restrictions on further use.

## Decommissioning requires planning

- Successful decommissioning rely on careful and organized planning and decision making based upon factual data and information
  - ✓ A **Decommissioning Plan** (DP) should be prepared for each facility
  - ✓ The extent, content and degree of detail in the DP depends on the complexity and hazard potential of the installation
  - ✓ DP should be consistent with regulatory requirements

## Stages in a Facility Lifetime

IAEA Safety Series Report No.26 *Safe Enclosure of Nuclear Facilities During Deferred Dismantling*

<b>Facility Stage</b>	Design, Construction & Start-up Phase	Operating Phase Prepare Shutdown Plan	Shutdown	Safe Enclosure Preparation	Safe Enclosure Period	Final Phase
<b>Decommissioning Activity</b>	Initial Decommissioning Plan	Update Decommissioning Plan Finalize Safe Enclosure Plan & Prepare Site Preparation Plan & Surveillance & Maintenance Plan	Source Term Reduction, Defueling & Waste Conditioning	Site Preparation & Initial Dismantling	Update Final Decommissioning Plan Surveillance & Maintenance	Final Dismantling, Final Survey & License Termination

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## Phases of Decommissioning

### Operating Phase

- Update of initial decommissioning plan and finalize safe enclosure plan, site preparation plan and surveillance and maintenance plan

### Transition/Shutdown Phase

- Source term reduction, de-fuelling and waste conditioning
- A critical phase! → Change in operation, mindset, perhaps organisation etc...

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## Phases of Decommissioning (ctd)

### Safe Enclosure Period / Phase [OPTIONAL]

- Site preparation and initial dismantling
- Update final decommissioning plan
- Perform surveillance and maintenance activities

### Final Phase

- Final dismantling, final survey and license termination

## The Transition Phase – a Key Step

The **Transition Phase** from operation to the implementation of decommissioning strategy

- Facility in stable and safe conditions
- Removal of radioactive material (fuel, op. waste)
- Drainage, Cleaning, decontamination
- Update radioactive inventory, plant characterisation
- Planning, preparation of records etc...
  - **Organisational change – New focus!**
  - **Human Factors – confusing, stressful, leaves**
  - **No compromise with operational safety**
  - **Interfaces with general public & other interested parties**


## Decommissioning Strategies

Decommissioning starts with the implementation of the decommissioning strategy and ends with the release of the site – typically strategies are:

- **Immediate dismantling**
- **Deferred dismantling (Safe Enclosure)**
- **Entombment**

IAEA Safety Guide WS-G-2.1

## Decommissioning Strategies

- Cost/benefit evaluation should be used to determine the best strategy 
- Ideally planning for decommissioning should be started at the *facility design stage* and not after the facility has been *permanently shutdown*



70 MW, PHWR, Brennilis, France

## Decommissioning Strategies

### Examples of Influencing Components

- ✓ Compliance with laws, regulations and standards
- ✓ Characterization of the installation
- ✓ Safety assessment
- ✓ The physical status of the nuclear installation
- ✓ Adequate arrangements for waste management
- ✓ Financial resources
- ✓ Availability of experienced personnel
- ✓ Lessons learned
- ✓ The environmental and socio-economic impact
- ✓ Use of the installation and the area adjacent

## Specific Strategies

### Factors favoring Immediate Dismantlement

- Decommissioning funds available and costs are known
- Low-level waste disposal sites are available
- Least expensive option
- Experience of facility personnel and proven technologies are available
- Minimizes future regulatory uncertainty
- Minimizes near-term impact to the local economy
- Presents positive public perception
- Eliminates corporate liability sooner and makes site available for re-use
- Allows for earlier license termination



## Specific Strategies

### Factors favoring **Deferred Dismantlement**

- Funds not available for immediate dismantlement
- Smaller radioactive waste volumes
- Lower staff radiation exposures
- More time to resolve waste management issues
- Avoid industry “learning curve”
- Some areas may be able to be immediately reused
- Benefit from technology enhancements
- Multi-unit sites

## Specific Strategies

### Factors favoring **Entombment**

- Used only in rare instances
  - ✓ Geographic location – remote sites
  - ✓ Governmental controls – may be practical
  - ✓ Limited funding and resources available – quick and easy solution
- However
  - ✓ Waste disposal site created
  - ✓ Creates longer term liability / monitoring requirement
  - ✓ Presents burden to future generation

## References

- IAEA Safety Guide WS-G-2.1
- IAEA Safety Guide WS-G-2.2
  
- IAEA Technical Reports Series #351
- IAEA Technical Reports Series #375
- IAEA Technical Reports Series #399
  
- IAEA Safety Series Report #26 – *Safe Enclosure of Nuclear Facilities during Deferred Dismantling – 2002*
- IAEA Safety Series Report #36 – *Safety Considerations in the Transition from Operation to Decommissioning of Nuclear Facilities – 2004*

## Summary

- Decommissioning is **an orderly, phased, final step** in the life of a nuclear facility which considers the entire range of viable strategies/ options for decommissioning
- Focus on the **shutdown/transition** as a **key step** in preparing for the start of implementing the selected decommissioning strategy
- The objective is to **protect human health and the environment** from the radiological & non-radiological hazards resulting from the shutdown facility