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Decommissioning of Nuclear Facilities

Safety Related Documentation

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1

Objectives

- **Describe typical key safety related documents prepared to support a decommissioning project**
- **Describe the development of these documents**
- **Review the approval process for these documents**
- **Review the role of the regulatory body**
- **Review the types of and contents of the Decommissioning Plan**
- **Review examples of some typical supporting documents**

2

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Stages in a Facility Lifetime

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

3

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National Requirements

- **Legal Framework and Guides**
 - Statutes, laws and decrees
 - Legislation and regulations
 - Nuclear safety requirements
 - Radiation protection
 - Industrial safety and fire protection
 - Environmental requirements
 - Local building codes
 - International Guidelines

4

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Key Decommissioning Safety Documents

- Site Policies, Programs and Procedures
- Decommissioning Plan
- Safety Report
- Environmental Report
 - Environmental Impact Assessment
- Final Radiological Survey Plan
- Final Radiological Survey Report
- Public Relations Plan
- Final Decommissioning Report

5

Key Decommissioning Safety Documents

- **Others may be added to this list depending upon specific requirements**
 - Emergency Plan
 - Project Management Plan
 - and others
- **Contents of some other key plans in the decommissioning process are described elsewhere in Module 26 lessons**
 - Health & Safety Plan
 - Historic Site Assessment
 - Characterization Plan
 - Characterization Report
 - Waste Management Plan
 - and others

6

Document Preparation and Approval

- **Requirements defined by Regulatory Body**
 - Safety requirements defined
 - Decommissioning Plan usually required
- **Decommissioning Plan**
 - Commensurate with type and status of facility
 - Key document in Decommissioning process
- **Stages of Decommissioning Plan**
 - Initial- Prepared during facility design
 - Updated- during operations, based on changes
 - Final- Before termination of operations, except for Deferred Dismantlement strategy, then 3- 5 years out

7

Role of the Regulatory Body

- Ensures that the licensee understands the need to establish the site clean-up guidelines as an early step in the decommissioning process
- Ensures licensee performs the decommissioning to either generic site clean-up guidelines or other negotiated, risk based clean-up guidelines
- Reviews licensee's final radiological survey plan and final report- provides basis for authorizing license termination for site
- Confirms that the site is acceptable for release
 - This may be accomplished by the regulator or an independent contractor for the regulator. It is important that the independent verification process is performed with compatible instruments and QA/QC program.

8

Role of the Regulatory Body- Submittals

- **Decommissioning Plan and revisions**
 - Approval from Regulatory Body
 - Special emphasis on Cost Estimate and funding mechanisms
- **Final Radiological Survey Report**
 - Basis to request license termination
- **Final Decommissioning Report**
 - Information only
 - Allows license termination

9

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Site Policies, Programs and Procedures

- Policies are developed by the institution based on laws and standards
- Programs describe how policies are to be implemented by the site
 - May require supporting Technical Basis Documents
- Procedures are standardized so that operations are conducted in a consistent manner
- Work instructions provide the worker with specific tasks. The worker uses published procedures to accomplish the tasks.
- Policies, programs, procedures, and work instructions used during decommissioning by revision are maintained as controlled documents

10

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Initial Decommissioning Plan

- **Basic information on the complexity of the facility decommissioning**
- **Establishes a funding mechanism and collection process**
- **Lists assumptions for decommissioning**
- **Describes the procedures and requirements for collection of data during**
 - **Construction**
 - **Operation**
 - **Maintenance**

11

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Final Decommissioning Plan

- **A comprehensive plan that provides the basis for showing the regulatory body that decommissioning activities can be performed safely**
- **Operator shall develop and maintain the decommissioning plan**
- **Regulatory body shall approve the plan and any modifications**
- **Certain aspects of the decommissioning plan – for example waste management or health and safety aspects - may be detailed further in a separate plan or report on that certain aspect for the project**

12

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Decommissioning Plan- Contents

- Introduction
- Facility Description
- Objectives of the Project
- Decommissioning Strategy
- Project Management
- Decommissioning Activities
- Surveillance and Maintenance
- Waste Management
- Cost Estimate and Funding Mechanisms
- Safety Assessment
- Environmental Assessment
- Health and Safety
- Quality Assurance
- Emergency Planning
- Physical Security and Safeguards
- Final Radiation Survey

13

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Decommissioning Plan – Facility Description

- Introduction
- Facility Description
 - Physical description of the site and facility
 - Include maps, drawings, and pictures
 - Description of major systems and equipment
 - Radioactive and hazardous material inventory
 - Operational history
 - Abnormal events that occurred during operation
 - Previous decommissioning activities

14

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Decommissioning Plan - Decommissioning Strategy

- Objectives of Project
- Decommissioning alternatives considered
- Safety principles and criteria for each
- Details of alternatives studied
- Selection and justification of preferred strategy

15

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Decommissioning Plan - Decommissioning Strategy

- Specific information for each strategy considered
 - Regulatory
 - Safety- radiological and non-radiological
 - Schedule
 - Cost
 - Waste types and volumes
 - Dose estimates- worker and public
 - Technology
 - Social factors

16

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Decommissioning Plan - Project Management

- **Legal and regulatory requirements**
- **Organization and responsibilities**
- **Safety culture**
- **Training and qualifications**
- **Resources and staffing levels, Contractor support**
- **Schedules**

17

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Decommissioning Plan - Decommissioning Activities

- **Description of each phase**
- **Describe major tasks associated with each phase**
- **Description of contaminated structures, systems and equipment**
- **Description of associated contamination**
- **Use a Work Breakdown Structure or equivalent Project Management process**

18

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Decommissioning Plan - Surveillance and Maintenance

- Identify equipment and systems required to support decommissioning
- Schedule each system for dismantlement
- Identify replacement systems
- Schedule periodic maintenance- each system
- Identify equipment recalls and changes in manufacturer requirements for maintenance
- **NOTE: Much greater effort if Deferred Dismantling option is the preferred decommissioning strategy**

19

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Decommissioning Plan - Waste Management

- Identification of individual waste streams
- Characterization of waste streams
- **Procedures**
 - Waste handling
 - Packaging
- **Calculations**
 - Correlation factors
 - Waste volume estimates by type
 - Transportation
- **Waste disposition**

20

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Decommissioning Plan - Cost Estimate and Funding Mechanism

- **Cost Estimate**
 - Base on Decommissioning Project Work Breakdown Structure activities and schedule
 - Includes labor, expense and capital
 - Develop appropriate contingency
 - Identify all assumptions
- **Funding Mechanism**
 - Detail funding collection process throughout life
 - Identify contingency funding
 - Develop cost estimates for contingency restart

21

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Decommissioning Plan- Safety Assessment

- Identify relevant safety criteria
- Develop operating limits and conditions
- Perform hazards analysis
 - Normal and abnormal events
 - Assess potential consequences
 - Identify preventive and mitigating measures
- Develop risk assessment
- Compare analysis results with safety criteria
- Draw conclusion
- Consider impact of other activities on the safety of the decommissioning project

22

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Decommissioning Plan- Environmental Assessment

- Evaluates the impact of decommissioning activities on the environment
- Two main aspects
 - Discharges are within authorized limits
 - Residual contaminants meet site release criteria
- Consider all pathways and activities
 - Surface water, ground water, gaseous, airborne particulate, direct radiation
 - Decontamination, dismantlement, remediation, transportation

23

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Decommissioning Plan- Health and Safety

- Radiation Protection
 - Optimization analyses
 - Dose Estimates/ Dose Assessments- Major Tasks
 - Contamination control
 - Training
- Nuclear Criticality Safety
- Industrial Health and Safety
- Work Controls
- Clearance and Release Criteria
- Audits and Inspections

24

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Decommissioning Plan - Quality Assurance

- Description of the QA program
- Personnel training and qualification
- Document Control activities and requirements
- Control of measuring and test equipment
- QC activities and requirements
- Audits and surveillance
 - Corrective action program
- QA records
- Lessons Learned

25

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Decommissioning Plan- Emergency Planning

- Emergency Services
 - Fire protection
 - Emergency medical
 - Utility companies
- Emergency Monitoring
 - Special teams
 - Emergency equipment and instruments
- Emergency Communications
 - Emergency Operations Center location and capabilities
 - Communications with public officials
- Drills and Exercises

26

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Decommissioning Plan- Physical Security and Safeguards

- Organization
- Site access control
 - Identification program
 - Access control reduction plan
- Coordination with local security agencies
- Communications coordination
- Security for special nuclear material
- Consideration for changes due to decommissioning project activities
- Note: This may be a classified (ie access controlled) document

27

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Safety Report

For each decommissioning license:

- Description of the work to be performed
 - for example, dismantling of systems or removal of Biological Shield or decontamination of rooms, buildings and release procedures
- Initial conditions
 - Description of systems or rooms/buildings and contamination status
 - Specification of materials and masses to be dismantled or decontaminated
 - Radiological conditions and radioactivity inventories of systems or rooms/buildings

28

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Safety Report (ctd)

- **Execution of work**
- **Principles:**
 - minimization of doses and contamination spreads
- **Description of equipment and devices to be used**
 - cranes, lifts, platforms, etc.
 - mobile air ventilation systems
 - decontamination station
 - packaging station
- **Description of main working steps**
 - chronological dismantling plan, dismantling sequences
 - specify whether standard or special equipment is needed
 - describe the special equipment and it's installation
 - specification of work packages
 - removal of remaining parts, e.g. supports, frames, etc.

29

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Safety Report (ctd)

- **Description of redundancy measures**
 - electricity supply
 - air ventilation system
 - radioactive water collection system
- **Description of decontamination and release procedures**
 - classification of material (steel, concrete, etc.)
 - decontamination process (chemical, mechanical, wet, etc.)
 - measurements (direct, smear tests, samples)
 - packaging station
 - mark or label and characterize the material

30

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Safety Report (ctd)

- **Description of waste treatment**
 - collection areas for radioactive and non radioactive material
 - treatment of radioactive waste (conditioning on site or shipment to an external facility)
 - treatment of special waste: PBC, Asbestos, etc.
- **Description of Safety measures**
 - Fire protection
 - Industrial work safety

31

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Safety Report (ctd)

- **Description of Safety measures (ctd)**
 - **Radiation protection**
 - supervision of personnel
 - radiological control of working areas
 - control of emissions (air, water)
 - estimation of collective doses based on work load and staff
- **Environmental Impact**
 - radiological preventions to avoid unlicensed releases
 - preventions to reduce other implications like dust, noise, traffic, etc.

32

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Safety Report (ctd)

- **Analysis of operational failures**
 - air ventilation system
 - crane or lifting devices
 - dismantling equipment especially remote controlled
- **Description of personnel qualification and training procedures**
- **Quality assurance, controls and its documentation**
 - revision of work packages to optimize processes and thereby reduce doses
 - elaboration of documents
 - documentation and archives

33

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Environmental Impact Assessment Report

- **Evaluates possible impacts to the environment from the proposed actions to be undertaken in performing some work**
- **Examples of typical contents:**
 - **Geographical description of site and neighborhood**
 - **Short description of the plant**
 - **Short description of the project**
 - **Description of residues and wastes**
 - **Environmental Impact**
 - radiological impact of the project to the public and to the environment
 - emissions via air and water
 - impact to protective goods: humans, animals, plants, soils, groundwater, atmosphere, climate, endangered species, landscape, cultural assets and other goods
 - **Unexpected radiological releases**
 - **Other implications:**
 - dust production, noise pollution, traffic, etc
 - **Summary and evaluation**

34

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Environmental Impact Assessment Report

- A tiered approach can be used for details of the process – that is - the more complex and larger the project, generally speaking, the longer time it takes to complete the compilation of the data and preparation for the report and therefore, the longer time it takes to be completed
- This process can become a very involved process and occur over a several year period
- Often involves extensive stakeholder and regulator involvement

35

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Final Radiation Survey

- Summary of the Final Radiological Survey Plan and Final Survey Radiological Report
- Includes
 - Map/ drawing of areas included in survey
 - Reference areas and their justification
 - Types of instruments used and justification
 - Summary of Procedures for sample collection, processing, QC, laboratory analysis, and data validation
 - Summary of statistical models

36

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Historical Site Assessment

- Referenced in the Characterization Plan
- Design and as built drawings
- Construction materials
- Facility modifications
- Facility operating records
- Production schedules
- Routine surveys
- Interviews with operators and support personnel
- Event log- accidents and unplanned events
- Review of security files for classified projects
- Photographs
- QA document review

37

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Characterization

- Based on Historical Site Assessment (HSA)
- Confirms HSA conclusions
- Serves as a guide for the Final or Release Survey
- Characterization used as basis for Job Safety Analysis for each decommissioning task
- Develop Waste Disposal Strategies
- Define Cost Estimates and Schedules
- Regulatory agency may request copy of the Characterization Plan and Report

38

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Characterization Plan

- **General**
- **Document and Historical Review**
- **Identification of potential contamination sources and locations**
- **Characterization and reference surveys**
 - **Schedule and resources required**
 - **Instrumentation and procedures to be used**
 - **Conduct of survey – guidance**
 - **Background level determination**
 - **Sample analysis requirements**
- **Health and Safety provisions**
- **Data interpretation**
- **Comparison to guideline values**
- **Contents of the Characterization Survey Report**

39

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Characterization- Uses of Data

- **Provide input into Decommissioning Plan**
 - **Cost estimate**
- **Assess Health and Safety impacts to workers and public**
- **Used in the development of Health and Safety Programmes**
- **Radiological site guidelines (end-point criteria)**
- **Identification of suitable reference areas**
- **Input for planning the Final Radiological Survey**

40

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Characterization Report

- Shows condition of facility at end of operations
- Contents
 - General
 - Document and historical review
 - Identification of contaminant sources and locations
 - Survey Procedures- Techniques and Instruments
 - Comparison to guideline values
 - Conclusion and summary
 - Appendices – detailed information
- Used to plan decommissioning activities



Final Radiological Survey

- The purpose of the final radiological survey is to demonstrate compliance with the regulatory body guidelines for site license termination. The underlying assumption is that the remediated area is contaminated above release guides. The analysis of the results of the Final Radiological Survey will prove it is not
- Primary objectives:
 - Describe final radiological conditions of the facility on site following remediation
 - Demonstrate potential dose or risk from any residual contamination or elevated activity is below applicable regulatory threshold
 - Provide the data to demonstrate compliance with all radiological parameters



Final Radiological Survey Plan

- **General**
- **Document and historical review**
- **Identification of potential contamination sources and location**
- **Surveys**
- **Health and safety provisions**
- **Data interpretation and results**
- **Comparison to site guideline values**
- **Report**

43

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Final Radiological Survey Report

- **General- Installation name, location, history, etc.**
- **Decommissioning activities**
- **Identification of contaminant sources/ locations**
- **Methods/ Techniques, Measurement Uncertainty**
- **Comparison to guideline values**
- **Conclusion and Summary**
- **Appendices**
 - **Detailed survey data**
 - **Sample data**
 - **Survey procedures**

44

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Public Relations Plan

- Not a safety document but important for external organization interfaces
- Provide plan for interfacing with local public
- Identify who will be main contact
- Describe general decommissioning activities
- Describe how information will be passed on to public
 - Newsletters
 - Meetings
 - Visits

45

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Final Decommissioning Report- Contents

- Description of the facility
- Decommissioning objectives
- Release (end point) criteria (radiological)
- Description of decommissioning activities
- Description of any remaining buildings and facilities
- Final radiological status; description of facility restrictions
- Inventory of waste generated/ disposition, material released
- Summary of occupational and public doses from activities
- Summary of any abnormal events occurring during decommissioning
- Lessons learned
- References
- Appendices

46

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Documents and Records- Retain After Decommissioning Complete

- **Decommissioning Plan and amendments**
- **Characterization Survey Report**
- **Final Decommissioning Report**
- **QA records including QC activities**
- **Document Control- work plans and procedures**
- **Engineering drawings, photographs and videos produced through completion of decommissioning**
- **Manufacturing and as-built drawings for any work done to support or as part of decommissioning**
- **Personnel dose records**
- **Radiation instrumentation and survey records**
- **Details of abnormal events and actions taken**

47

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Summary

- **The safety related documents that support the decommissioning process are extensive and provide a large amount of detailed information**
- **These documents require a significant effort to prepare and maintain throughout the decommissioning project**
- **These documents serve as the major or main source of information upon which the Regulatory Body bases its decisions for the licensed facility**
- **Information must be accurate and complete**

48

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References

- IAEA WS-R-2
- IAEA DSS-332
- IAEA DSS-333
- IAEA Waste Safety Guide WS-G-2.1
- IAEA Waste Safety Guide WS-G-2.2
- IAEA Waste Safety Guide WS-G-2.4
- IAEA Safety Report #45
- IAEA Fundamental Safety Principles, DS298 – approved to be published, 2006

