Lesson Objectives

• Understand the overall planning process as it applies to decommissioning including economic inputs and preliminary studies

• Understand the key points in the planning process

• Understand the cost estimation process including the use of a Work Breakdown Structure (WBS) and its interface with scheduling used in decommissioning planning

• Understand the importance of early planning for effective decommissioning

NOTE: This lesson has been modified to reflect both a summary of ‘conceptual’ material and practical considerations
Decommissioning of a facility is a PROJECT and should be operated using sound project planning principles and project management techniques.

- General Planning
  - General thoughts for the licensee to consider
- Initial Planning
  - Planning that is conceptual in nature
- Ongoing Planning
  - Incorporation of details from new information
- Final Planning
  - Detailed planning prior to conduct of field activities
**General Planning**

- Successful decommissioning depends on careful and organized planning.
- The planning requirements have to be consistent with regulatory requirements.
- A detailed project scope is mandatory for initiating even the most general planning.
- The extent, content and degree of detail of planning depends on the complexity and hazard potential of the installation.
- One goal of the planning process is the development of a decommissioning plan.
General Planning

- Three stages of planning are normally used:
  - Initial Planning
  - On-going Planning
  - Final Planning

- Again, the degree of detail will vary from facility to facility and will increase from initial to final decommissioning planning

- Pertinent facility records are critical in the development of the Decommissioning Plan
Initial Planning

• An initial Decommissioning Plan shall be prepared and submitted with each construction application for a new facility

• This plan would contain a lower level of detail than that which would be contained in the final Decommissioning Plan

• Operating facilities without an initial Decommissioning Plan should prepare one without undue delay
Ongoing Planning

• During on-going facility operations, the Decommissioning Plan shall be routinely reviewed, updated and made more comprehensive with respect to:
  • Technological advances
  • Incidents/abnormal operating events
  • Regulations and government policy
  • Cost estimates and financial provisions

• Additionally - to be incorporated into the Decommissioning Plan are:
  • Safety considerations, and
  • Any significant systems and structural changes
Details of the Decommissioning Planning Process

- Project Scope
- Selecting the Decommissioning Strategy
- Economic Inputs to the Decision Process
- Project Initiation
- Transition Phase
- Project Execution
- Project Controls
- Project Closeout
Project Scope

• Scope for the project is difficult to quantify
  • Better the definition of scope, more effective the planning process

• Project cost and schedule are affected by answers to the following
  • Facilities and area that bounds the project
  • Expected end-state for the affected facilities and area
  • Type and distribution of contaminants
  • Final release criteria to be met
Selecting the Decommissioning Strategy

• Once the overall project scope is determined, the decommissioning strategy is selected. Three main approaches are considered
  • Immediate dismantlement
  • Deferred dismantlement for some defined period
  • Entombment

• In general, each approach will be evaluated using a cost-benefit analysis methodology

• Both economic as well as non-economic inputs are typically used to support a site-specific decision for the optimal method of decommissioning
Economic Inputs to the Decision Process

- Cost estimates for each decommissioning strategy is considered
- Decommissioning funding approaches
  - Fully funded external fund
  - Annual budget allocation
- The effects of project delays
  - Timing to begin the project
  - Delays once the project is in progress
- Projections on growth rates for decommissioning funds
- Projections on interest rates
- Evaluation of the variability in these parameters
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
- Provides input to engineering design of the facility
- Update regularly as changes occur
Decommissioning Plan - Contents

• Introduction
• Facility Description
• 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 Radiological Survey
• Appendices if necessary
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
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
Decommissioning Plan –
Project Management

• Legal and regulatory requirements
• Organization and responsibilities
• Safety culture
• Training and qualifications
• Resources and staffing levels, Contractor support
• Schedules
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
Decommissioning Plan - Cost Estimate and Funding Mechanism

• Cost Estimate
  • Base on Decommissioning Project Work Breakdown Structure activities and schedule
  • Includes labour, 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
Project Initiation

- Project initiation begins when the decision is made to permanently shut down a facility and proceed to implementation of the decommissioning strategy.
Project Initiation

• Key tasks for project initiation include:
  • Planning the transition of the existing staff from operations to decommissioning
  • Setting up a management organization
  • Evaluating whether to use outside Contractor or to self-perform the project
  • Identifying resources and how to obtain them
  • Performing preliminary site characterizations to bound the scope of the work
  • Preparing baseline cost and schedule estimates to monitor and control expenditures
  • Evaluating fuel disposition options
Transition Phase Activities

• Following permanent shutdown of the facility, the activities necessary to prepare the facility for decommissioning are begun. These activities include:
  • Site characterization
  • Regulatory notifications and any required initial public interactions
  • Implementation of revised safety and authorization bases
  • Staff reorganization
  • Bid specification preparation – as appropriate
Development of the Work Breakdown Structure (WBS)

- Categorize cost elements and work activities into logical groupings
- Identify direct or indirect relationships
- Work groupings
  - Typically related to the accounting system used for budgeting
  - Track major elements against decommissioning costs
- WBS elements
  - Generally arranged in a hierarchical format
  - Top level of the WBS is the overall project
  - Subsequent levels used to track increasing levels of detail in the project
Work Breakdown Structure

- WBS element levels
  - Six levels may be adequate for a single decommissioning project
  - Decommissioning programs with multiple projects may use 8 or more WBS levels
  - Costs may be "rolled up" to Level 3 or Level 4 summary costs for management information

- Project management/ accounting software
  - Usually identifies categories of costs
  - Compares to the chart of accounts
  - Integrates WBS format for project reporting
Levels of Cost Estimating

• There are different levels of “Accuracy” used when performing a decommissioning cost estimate

• Typical levels of accuracy in cost estimates are:
  • **Order of magnitude** -30% to +50%
    • Based on similar project scope
  • **Budgetary** -15% to +30%
    • Use some drawings but not site specific
  • **Definitive** -5% to +15%
    • Site specific and very detailed; based on drawings and a detailed review of required activities and their costs
Contents of a Cost Estimate

- Description of the overall facility
  - Portions included in the cost estimate
- All assumptions
- Summary of information by major task
  - Cost
  - Man-hours and labor categories
  - Staffing levels
  - Waste volumes
  - Uncertainties
  - Contingencies
  - Backup details on development of cost to allow independent review
  - Funding mechanisms
Project Scheduling

• Project schedule
  • Developed during project planning
  • Based on a WBS approach
  • Integrates resources, cost and activity duration
  • Requires graphical output

• Critical activities
  • Plan and coordinate lead time for resources
  • Schedule budget to ensure activity success
  • Identify key elements (i.e. waste shipments)
  • Make a detailed list of tasks for each key element
  • Tie each line item in the schedule to resources and duration to complete the task
Project Scheduling

- Specific elements in a project schedule may include:
  - Preliminary site characterization
  - Safety assessment and licensing documentation
  - Preparation of the Decommissioning Plan
  - Obtaining required permits and approvals
  - Facility design/ engineering/ modifications to support decommissioning
  - Decontamination
  - Dismantlement and demolition
  - Waste management
  - Final radiological survey
  - License termination actions
Example of a WBS to Level 5

X Research Reactor 1

- Pre-planning 1.1
- Transition Activities 1.2
- Decommissioning Planning 1.3
- Decommissioning Activities 1.4
- Etc. 1.x

- Decontamination Primary Systems 1.4.1
- Decontamination Secondary Systems 1.4.2
- Dismantle equipment in Room 1A 1.4.3
- Dismantle equipment in Room 1B 1.4.3
- Etc. 1.4.x

- General decon of room 1.4.3.1
- Remove all piping 1.4.3.2
- Remove tank 1A-2 1.4.3.3
- Remove tank 1A-2 1.4.3.4
- Etc. 1.4.3.x

- Ensure piping is drained 1.4.3.2.1
- Disconnect Piping from tank 1A-1 1.4.3.2.2
- Disconnect Piping from tank 1A-2 1.4.3.2.3
- Etc. 1.4.3.2.x
### Example WBS Based Schedule

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Cost Estimating Considerations

- Provisions to protect the workers
- Provisions to protect the environment
- Regulatory framework within which the decommissioning must be performed
- Project management staff of both the licensee & the decommissioning contractor (if one is used)
- Radioactive waste disposal or storage sites
  - Low, intermediate and high-level wastes
  - Transportation

Black box / general cost estimates do not work !!!
Some Practical Considerations

• You will likely encounter
  • Different fabrication techniques and materials of construction than shown in records
  • Inaccurate and missing drawings
  • Different radiological conditions and/or other hazards
  • Accessibility issues (structural obstructions, radiological hazards, etc)

• Have a plan and work the plan
• Evaluate alternative approaches to undertake the work – self-perform or contract out
• Poor planning often leads to major schedule and funding issues for the management staff – scope, cost and schedule
Some Practical Considerations

- Consider select staff augmentation or use of independent experts to support the work even if contracting or self-performing.
- Don’t ‘under characterize’ the site or facility.
- Don’t overlook any regulatory hold or reviews in scheduling work.
- Don’t ‘rush to action’ – sometimes ‘to go fast you need to go slow’.
- Review project specific examples from two decommissioning project sites.
Summary

• Decommissioning is an orderly, phased final step in the life of a nuclear facility
• Focus on the shutdown/transition is a key step in the decommissioning process
• Planning for decommissioning is an ongoing process
• The Decommissioning Plan is the single document that captures information for the project
• Project schedule, controls and execution were discussed with respect to project planning
• Numerous IAEA reference documents are available

Failing to plan is planning to fail!
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