International Atomic Energy Agency

Decommissioning of Nuclear Facilities

Decommissioning Planning

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Lesson Objectives

- Understand the overall planning process as it applies to decommissioning including economic inputs and preliminary studies
- Understand the Work Breakdown Structure (WBS) system and how it is used in decommissioning planning
- Understand the importance of and the understanding for early planning, formal project execution and control measures

Planning Process

- General Planning
  - Overall – some general thoughts of what the licensee needs to consider
- Initial Planning
  - This planning is conceptual in nature and is planning done in lesser detail
- On-going planning
  - This is 'update planning' of the details as new information and experience is available
- Final Planning
  - This is the finalization at the detail level for finalizing the actual plans for decommissioning

General Planning

- Successful decommissioning depends on careful and organized planning
- The extent, content and degree of detail of planning depends on the complexity and hazard potential of the installation
- The planning requirements have to be consistent with regulatory requirements
- One goal of the planning process is the development of a decommissioning plan

General Planning (ctd)

- 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 the initial to the final decommissioning plan
- 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 a final decommissioning plan
- Operating facilities without an initial decommissioning plan should have one prepared 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

Final Planning

- Upon notice of final shutdown of the facility, the operating organization should initiate detailed studies and finalize planning for decommissioning
- The operating organization should then submit an application for decommissioning including a final decommissioning plan for review and approval by the regulator
- The decommissioning plan may be amended or refined as the decommissioning proceeds

Some Common Issues Encountered

- Different fabrication techniques
- Different materials of construction
- Different radiological conditions and/or other hazards
- Inaccurate drawings
- Accessibility

Details of the Decommissioning Planning Process

- Project Scope
- Selecting the Decommissioning Strategy
- Economic Inputs to the Decision Process
- Project Initiation – Pre-Decommissioning
- Preliminary Studies – Post-Shutdown Pre-Planning
- Detailed Design Studies – Post-Shutdown Design Planning
- Project Execution
- Project Controls
- Project Closeout

Project Scope

- When beginning the initial decommissioning planning efforts the answers to a number of issues frame the scope for the project. These answers need to be established at the earliest opportunity to minimize the overall project cost and schedule
  - What facilities and area bounds the project?
  - What is the expected end-state for the affected facilities and area?
  - What are the final release criteria to be met for facilities and area?

Selecting the Decommissioning Option

- Once the overall project scope is determined, the decommissioning approach is selected. Three main approaches are considered
  - Prompt decontamination and dismantlement
  - Safe storage for a defined period prior to decontamination and dismantlement
  - Entombment of the facility
- 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 potential decommissioning option considered
- Decommissioning funding approaches, whether a fully funded external fund or annual budget allocation
- The effects of project delays (both for timing to begin the project and delays while the project is in progress)
- Projections on growth rates for decommissioning funds (if any)
- Projections on interest rates (determination of future cost of money)
- Evaluation of the variability in these parameters

Project Initiation

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

Preliminary Studies – Post-Shutdown Pre-Planning

- 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

Detailed Design Studies – Post-Shutdown Design Planning

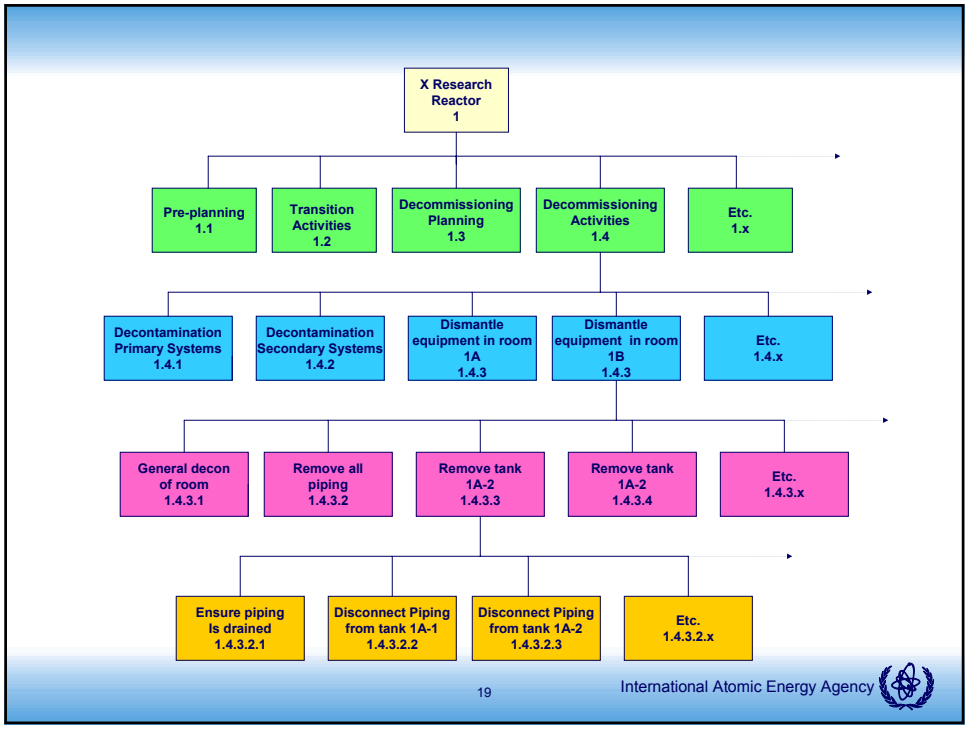
- During this phase of the project, the decommissioning organization begins to work more closely to prepare the facility for decommissioning. Other key actions include:
  - Awarding major contracts and subcontracts
  - Contractor mobilization
  - Preparation of detailed procedures
  - Facility changes to ready the site for decommissioning activities

Development of Work Breakdown Structure (WBS)

- The WBS is used to categorize cost elements and work activities into logical groupings that have a direct or indirect relationship to each other
- The work groupings are usually related to the accounting system, or chart of accounts used for budgeting and tracking major elements of the decommissioning costs
- The WBS elements are generally arranged in a hierarchal format that reflects the organization chart. The topmost member or level of the WBS would be the overall project. Subsequent levels are used to track increasing levels of detail in the project.

Work Breakdown Structure (cont'd)

- From a cost perspective, WBS element levels rarely exceed the sixth level; as such, detail is usually unnecessary for cost reporting purposes. In most cases the costs are "rolled up" to Level 3 or Level 2 summary costs for management information
- The project management or accounting software used on major projects usually identifies categories of costs in terms of a chart of accounts
- Most project management and accounting software packages are capable of relating the chart of account information directly into the WBS format for project reporting purposes



Example WBS Based Schedule

WBS #	Task Name	Labor Hours (x 1000)	Budget (includes labor) (x 1000€)	T = - 3 Mon	T = 0	T = 3 Mon	T = 6 Mon	T= 9 Mon	T = 12 Mon	T = 15 Mon	T = 18 Mon	T = 24 Mon
1	Decommission Research Reactor		2000									
1.1	Pre-shutdown planning		30									
1.2	Final Shutdown		===		Milestone							
1.3	Preliminary Studies		30									
1.4	Project Execution		1905									
1.4.1	Decommissioning Activities		1740									
1.4.1.1	Decon/Remove Auxilary Systems		870									
1.4.1.2	Decon/Remove Reactor Systems		870									
1.4.2	Final Status Surveys		150									
1.4.3	Confirmatory Surveys		15									
1.4.4	License Termination		===									Milestone
1.5	Closeout Actions		35									
1.5.1	Non-radiological remediation		25									
1.5.2	Demobilization		5									
1.5.3	Closeout Documentation		5									

Project Execution

- Decommissioning activities
  - Spent fuel transfer and storage
  - Draining and deactivation
  - Decontamination
  - Removal
  - Waste management, packaging, transport, and disposal
  - Surveillance and maintenance (S&M)
- Final surveys and license termination
- Confirmatory / verification surveys

Project Controls

- Quality Assurance
- Project Baselines
  - Baseline Cost Estimate
  - Baseline Schedule
  - Program Evaluation and Review Technique (PERT)
  - Baseline Exposure Estimate
  - Other Control Parameters

Project Closeout

- When radiological and hazardous material have been satisfactorily removed or remediated, the site license may be terminated by the regulatory body
- Site management may still need to perform differing tasks to reach the agreed upon final end state
- If any long term monitoring or institutional controls are needed, they are developed and implemented
- Once physical work is done to reach the end point, appropriate project reporting and documentation is completed

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 should be an ongoing process
- The entire decommissioning process must be well planned and have the roles of all the various parties clearly defined
- Numerous IAEA reference documents are available

Failing to plan is planning to fail!

References

- IAEA Safety Guide WS-G-2.1
- IAEA Safety Guide WS-G-2.2
- IAEA Safety Guide WS-G-2.4
- IAEA Safety Report #26
- IAEA Safety Report #45
- IAEA TRS #351
- IAEA TRS #382
- IAEA TRS #399
- IAEA TRS #414
- IAEA TECDOC-1133
- IAEA TECDOC-1394
- IAEA TECDOC-1476
- IAEA TECDOC-1478