DECOMMISSIONING STRATEGIES AND PLANS

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The two most common decommissioning strategies are immediate dismantling and deferred dismantling.

A combination of these options, known as phased decommissioning, which consists of periods of active dismantling interspersed with safe enclosure phases, is also common.

In the case of "front end" NFC facilities uranium is the most significant nuclide present. Uranium is a long lived isotope and there is no radiological justification for a deferred decommissioning strategy. In the case of uranium mining and milling facilities the adverse effect on the environment (e.g. possible contamination of groundwater) is a major driver for immediate decommissioning. There is a possibility that the engineering safety barriers implemented at the liquid waste/tailings and other storage areas could fail and that the proper monitoring carried out during the operation of the facility is not continued as accurately after shut-down of the facility.
Phase 1 decommissioning covers the facility Termination of Operation and the minimum decommissioning activities such as the removal of inventory to obtain a state of passive safety. This phase is associated with a facility-specific care and maintenance programme which is developed to be commensurate with acceptable risk.

Phase 1: Preparation for decommissioning.
This phase includes:
• The development of a decommissioning strategy.
• Initial decommissioning planning.
• Radiological and chemical characterisation of the facility.
• Preliminary decontamination and initial cleanup that could include the fixing of contamination until the next phase is implemented. Normally after the first phase of preparation and initial cleanup the facility is placed under surveillance or safekeeping as a passively safe facility.
DEFINITIONS

**Phase 2** decommissioning covers the dismantling and removal of the components, systems and equipment including decontamination as appropriate with the aim of restricted re-utilisation of facilities or reducing care and maintenance requirements.

**Phase 2: Implementation of Decommissioning**
The preparatory work for Phase 2 requires more in-depth evaluation. An adequate number of radiation and contamination surveys should be conducted to identify all the remaining radionuclides present in inner and outer surfaces throughout the facility, maximum and average dose rates and surface contamination levels. All the inventory that was not removed during Phase 1 decommissioning should be listed. Contamination inside pipes and equipment should also be characterised and quantified as far as possible.

The selection of the correct dismantling and decontamination techniques is critical.
Phase 3 decommissioning covers the activities required for the clearance of facilities. Activities may range from final decontamination of facilities to clearance levels, or complete demolition of buildings and removal of all contaminated materials. Phase 3 (in particular for nuclear facilities) is the ultimate endpoint of decommissioning after which a facility is released or removed from further regulatory control.
DEFINITIONS

Care and maintenance: Actions such as surveillance, inspection, testing and maintenance to ensure that facilities are maintained in a safe state between decommissioning phases.

Clearance: Removal of radioactive materials and/or chemicals or radioactive/chemical objects within authorised practices from any further control by the relevant regulatory authority.

Decommissioning plan: A Decommissioning plan must be submitted to the Regulator as a basis for authorisation of specific actions or phases of decommissioning.

Decommissioning: Actions, including Termination of Operation, dismantling and decontamination taken at the end of the useful life of a nuclear or chemical facility (building and process equipment) in retiring it from service with adequate regard for the health and safety of workers and members of the public and protection of the environment. The ultimate goal of decommissioning is clearance for reuse of buildings or total removal of buildings and site restoration (green fields). The time period to achieve this goal is dependent on the circumstances of each case.
DEFINITIONS

Decommissioning option: One of various decommissioning strategies, such as immediate dismantling and safe enclosure or deferred dismantling, which may be considered when decommissioning is being planned. A variety of factors, such as further use of the facility, the availability of technologies and waste management facilities, will influence which decommissioning option is ultimately chosen.

Decommissioning strategy: Decommissioning strategy must be submitted as part of the prior safety assessment and must be updated throughout the operation of the authorised action as a basis for detailed decommissioning planning.

Decontamination: The removal or reduction of radioactive or chemical contamination by a physical, chemical or metallurgical process.

Dismantling: The disassembly and/or removal of any structure, system or component during decommissioning. Dismantling may be performed immediately after the Termination of Operation of a facility or may be deferred.

Termination of Operation: The activities involved during the period from the time when normal operation ceases until the facility permanently stops processing.

CONTINUE.....
DEFINITIONS

Nuclear Fuel Cycle Facilities:

The following facilities are regarded as NFC Facilities:

• Uranium mining and milling facilities.
• Uranium conversion facilities.
• Uranium enrichment facilities.
• Fuel fabrication facilities.
• Fuel reprocessing facilities.
SELECTION OF A DECOMMISSIONING STRATEGY

There are a large number of nuclear and radiological facilities including legacy sites worldwide that have been decommissioned successfully, are either currently in an active decommissioning phase or will require decommissioning in the near future.

The IAEA has developed safety standards and recorded technical information for use by regulators, operators, owners and decommissioning specialists for more than 30 years.

Decommissioning activities must be performed with an integrated approach to achieve a progressive and systematic reduction in radiological hazards and ensuring the safety of workers and the public and the protection of the environment, throughout as well as after the project.
NUCLEAR FUEL CYCLE FACILITIES

The specific decommissioning problems encountered by the NFC facilities as compared to reactors are due to their extreme diversity, which are reflected in the wide range of functions carried out in the areas required to be dismantled.

There are different types of equipment requiring decommissioning ranging from hot cells, glove boxes, shielding and other containment systems, to large storage vessels and non-process mechanical equipment such as overhead cranes.

The types of contamination encountered (alpha, beta and gamma) and chemical contamination are also diverse. It must be ensured that the correct radiological and chemical characterisations are done from the planning phase throughout the project to ensure that the chances of discovering unforeseen high levels of contamination are limited.
CONSEQUENCES OF SHUT-DOWN

Termination of NFC operations results in a significant impact on the local economy because most of these facilities supplied various job opportunities. The NFC facilities occupied large areas with large components and complex equipment and facility arrangements that required labour skills ranging from highly skilled to non-skilled labour.

After the termination of operations these areas or facilities require some form of control until fully decommissioned. In the case of uranium mining and milling the shutdown is due to a sudden downward fluctuation in selling price or depletion of ore that resulted in a forced shut down. These unplanned shut downs usually go hand-in-hand with a lack of resources and retrenchment of personnel.
CONSEQUENCES OF SHUT-DOWN

Phase 1 should immediately proceed as part of the shut-down activities, while the technical resources, specialist and supporting facilities that were available during operation are still on the site.

Necsa had to contract in 3 old guys (Richard 75 years old) to assist in the decommissioning project due lack of other specialists on site/country.
A survey of radiological and non-radiological hazards should be made as an important input to the compilation of a decommissioning plan and a safety assessment for decommissioning that will be used for the implementation of safety aspects during the execution of the decommissioning activities.

The proper recording of information while the staff are still on the site is an essential part of the survey. The survey should be conducted to identify the inventory and location of radioactive materials as well as other hazardous materials. Hazardous Chemical Substances (HCS) such as asbestos, mercury and polychlorinated biphenyls (PCBs) require special consideration to prevent harm to human health and to the environment. Failure to identify these HCS could have a major impact on the decommissioning project cost.
DECOMMISSIONING PLANNING

The decommissioning plan must at least contain the following:

PURPOSE: What is the reason for compiling a decommissioning plan. There could be more than one reason but the main purpose is to obtain approval for a project.

The purpose of the plan is to request authorisation and approval from the National Nuclear Regulator and other regulatory and financial bodies (internal or external from the organisation). The plan should thus explain to all interested parties how you intend to decommissioning the facility in a safe and effective manner, how long it will take you to complete the project, how much will it cost you do execute the project and what are the benefits of performing the project.
DECOMMISSIONING PLANNING

SCOPE AND OBJECTIVE: The scope and objective of each decommissioning project could be different and are influenced by the end-state required for the facility. Will you remove the facility after the completion of the decommissioning project from regulatory control.

The Scope of the decommissioning plan must at least include the various approvals and resources required prior to commencing with the project.

The objective must state the final state of the facility.
DECOMMISSIONING PLANNING

RESPONSIBILITIES: As part of the planning for decommissioning it is important to clarify each role player and their responsibilities.

The responsible personnel should be appointed in their capacity and their various authorisation and accountability should be well defined.
DECOMMISSIONING PLANNING

FACILITY HISTORY: This information is very critical and as much of the history should be recorded and evaluated to determine what the risks are (element of surprise). The incident or nuclear occurrence history should be analysed to assist in determining the total scope of the project.

Do the radiological characterisation results compare with the history records of the facility.

Maybe a Cliché but still valid : ALWAYS EXPECT THE UNEXPECTED
DECOMMISSIONING PLANNING

OTHER ELEMENTS OF PLANNING ARE:

• Sequence of Work
• Waste Management
• Radiological Hazards
• Environmental Control
• General Working conditions (working on heights, confine spaces, temperatures etc.)
• Chemical Hazards
• Record Control
• Public Participation
• Etc.
There are various “state of the art” decommissioning technologies that can be used for characterisation, decontamination, dismantling, waste processing, remote handling, etc.

Such technologies are readily available in developed countries but are often costly and hard to apply in the absence of adequate resources and fully developed infrastructures. This leaves developing countries with challenges often leading to serious delays in performing decommissioning activities. Some decommissioning projects have been deferred since the mid 1970s. The lack of resources and available technologies, however, is not the only reason for this. The lack of waste management and waste disposal in many instances is contributing to selecting the deferred decommissioning option.

There should also be a balance between developing project specific technologies and purchasing technologies in the open market based on cost, stakeholder satisfaction and safety.
The operational lives for the NFC facilities and the associated decommissioning times required, are different for various facility. The time required for decommissioning, however, is influenced by the end state specified for the decommissioning project. A decision that the facility is to be reused for radiological purposes and the aim is not unrestricted release will have a significant influence on the time required for decommissioning.

- Uranium mining and milling facilities: 25 years of operation and approximately 1 year required for decommission.
- Uranium conversion facilities: 30 years of operation and approximately 3 - 5 years required for decommission.
- Uranium enrichment facilities: 30 years of operation and approximately 10 years required for full decommissioning.
- Fuel fabrication facilities: 25 years of operation and approximately 2 years required for decommissioning.
- Fuel reprocessing facilities: 25 years of operation and more than 15 years for decommissioning.
Thank You!!!