PREPARING FOR THE END OF THE LINE

RADIOACTIVE RESIDUES FROM NUCLEAR DECOMMISSIONING

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During the past 50 years, the nuclear industry has matured. Many of the associated facilities were initially designed with an effective operational life of 40 to 50 years and these facilities are coming of age.

There are over 800 facilities associated with the production of energy and fuel cycle that will require eventual decommissioning. These include nuclear power plants, reprocessing plants, interim storage facilities, enrichment plants and uranium mill plants.

There are another approximately 400 research reactors that will require some form of decommissioning. When the number of commercial companies and universities that use radioactive material are added, the number grows to several thousand facilities. This does not include many of the support complexes associated with former sites for nuclear weapons production.

WHAT IS DECOMMISSIONING?

Decommissioning is the actions that are taken to allow the removal of some or all of the regulatory controls that have been placed on a facility that has used radioactive material. These actions include both administrative and technical actions that must be accomplished to show that the facility that used radioactive material can be released for unrestricted use or otherwise reused. These actions may include dismantling a system or an entire building; or they may just consist of performing some decontamination activities and a radiological survey to show that acceptable conditions have been met.

Most people have the misconception that decommissioning begins near the end of a facility's life when the work of dismantling or decontamination is started. In fact, decommissioning is a process that begins during the initial design of the facility by including features in the design that will facilitate the eventual dismantling and decontamination efforts. This might include placing hatches in concrete floors and walls to allow the removal of large pieces of equipment, using modular biological shielding, or lining a process cell or other area that might get contaminated during the life of the facility. The decommissioning process continues during the entire life of the plant until conditions allow the removal of regulatory controls.

There are a number of reasons why a facility or system may be subject to final removal from regulatory control. This may include a change in government policy that does not allow or makes the use of radioactive material unfeasible to continue. There might be safety issues that cause an activity using radioactive material to be discontinued. The initial technology using the radioactive material might have become obsolete or uneconomical. It might be that a certain research programme has reached its goal and the equipment or material containing radioactive nuclides is no longer needed. Or there may have been other reasons for wanting to perform the final decommissioning activities, such as an accident or unplanned event.

No matter what the reason, the decommissioning process

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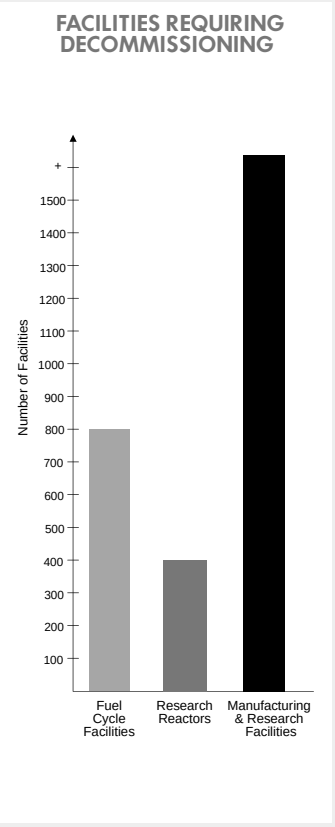
NUCLEAR DECOMMISSIONING



About 2800 nuclear facilities worldwide are estimated to require decommissioning over the coming decades for one reason or another.

The typical reasons for decommissioning a nuclear facility include:

- Change in governmental policy
- Technology becomes obsolete
- Uneconomical operation of the facility
- An unplanned event or accident
- Safety issues
- Completion of the programme

There are three main options for decommissioning:

- Immediate dismantling of the facility
- Safe storage of the facility
- Entombment of the facility

must be carefully planned and implemented in a safe and economical manner.

There are three main options available when planning the actions required for decommissioning. These options are immediate dismantling of the facility, safe storage or deferred dismantling and eventual entombment of the facility. Each of these options has benefits and disadvantages that should be considered when developing the appropriate strategy for activities leading to eventual decommissioning.

- The immediate dismantling option allows for the facility to be removed from regulatory control relatively soon after shutdown or termination of regulated activities. Usually, the final dismantling or decontamination activities begin within a few months or years, depending on the facility. The Fort St. Vrain nuclear power plant in the United States and the ZEEP Research Reactor in Canada are examples where this option has been successfully implemented. Both of these facilities no longer are under regulatory control.
- The safe storage option postpones the final removal of controls for a longer period, usually on the order of 40 to 60 years. The facility is placed into a safe storage configuration until the eventual dismantling and decontaminations activities occur. This is the case for the Berkeley nuclear power station in the United Kingdom. Currently the BN-350 breeder nuclear power plant in Kazakhstan is being placed into safe storage for 50 years.
- The entombment option entails placing the facility into a condition that will allow the remaining radioactive material to remain on-site without the requirement of ever removing it totally. This option usually involves reducing the size of the area where the radioactive material is located and then creating a monolith or other structure that will last for a period of time that will ensure the remaining radioactivity is no longer of concern. Most regulators do not prefer this approach as it amounts to allowing a low-level radioactive waste disposal facility being situated on the site. An example where this option has been implemented is the Hallam nuclear plant in the United States.

ORGANIZATION & MANAGEMENT

Normally, decommissioning operations begin at sites that already have an operating staff. There are two general approaches that can be followed to accomplish the decommissioning of a facility which have a substantial effect on the project organization. The first approach is for the licensee to perform the decommissioning with in-

house resources supplemented by specialist contractors as needed. The second approach is for the licensee to contract with an experienced outside organization to perform the decommissioning activities and then provide general oversight and support services.

There are advantages and disadvantages for each approach. If the licensee performs the decommissioning activity, there is maximum use of the existing staff that has a wealth of hands-on experience.

Some of the decommissioning activities are similar to maintenance activities for which procedures are already established. An example is that during operation of the plant, components are removed and replaced as a normal activity. The use of existing staff provides continuity of local employment. However, some of the more experienced staff may leave because they see their employment ending when decommissioning is completed and will go to other sites where new jobs or long-term career prospects are available.

A disadvantage of using former staff to perform the decommissioning activity is that such staff may have difficulties in accepting the cultural changes needed as the plant changes from an operational mode to decommissioning mode, e.g. from routine operations to unique tasks requiring more preparation. This causes them to be less efficient than an organization that performs decommissioning activities on a routine basis.

Even in an in-house approach, it is inevitable that at least some contractors will be used on site. This could range from one or two specialist contracts (e.g. plasma cutting) or at the other extreme using contracts for selected areas of the site. The extent of contractor usage will be dependent on the policy on staff retention, cost and availability of suitable contractors.

When an outside contractor is hired to perform the decommissioning activities, the licensee maintains a smaller staff due to its role as a supervising organization. The outside contractor takes control of major portions of the facility and ensures the activities are performed safely and in accordance with the regulatory requirements. These experienced contractors are normally more efficient than the in-house resources during the decontamination and dismantling activities. They have performed these activities on a routine basis and are more familiar with the available technologies that can be used to assist them in their efforts e.g. decontamination of concrete walls and floors. The contractor can also arrange for any sub-contractors that may be needed which will probably be fewer than if the licensee performs the decommissioning activities.

When using contractors the licensee still keeps control of the project. In order to maintain this control, the licensee will be required to be in constant contact with the contractor to ensure all safety and regulatory requirements are met and that the project goals are achieved. It is important that the licensee be familiar with various contracting mechanisms to minimize the risk of cost overruns. Resources and skills needed for the supervising work may be significant.

The licensing regime is based on the premise that the licensee is in day-to-day control of the facility, processes and activities and whose staff manages the operation of the facility. The licensee is an “intelligent customer” for services provided by contractors. This will still be necessary during periods of care and maintenance and waste storage. Therefore the licensee will need to be able to demonstrate that an adequate organization is and will be in place to discharge those responsibilities until the facility is finally removed from regulatory control and its period of responsibility has ended.

ISSUES RELATED TO SAFETY CONCERNS

There are a number of issues that are related to safety concerns that must be addressed during the development of the decommissioning plan and the planning process. These issues can have a dramatic effect on the selection of the eventual option that might be chosen.

In most cases, an unresolved conclusion of these issues leads to placing

the facility into a safe storage mode with a deferral of the final decontamination and dismantling activities.

■ The first issue is the lack of a disposal or storage site that would accept the waste generated during the decontamination or dismantling activities. It is not a good practice to produce radioactive waste if there is no national policy on waste management or a facility available to handle and dispose of this waste. It is highly recommended that a facility be available for all of the waste streams that will be generated during the decommissioning.

■ The second issue is the lack of funds to perform the activities that will lead to the removal of controls. There may be a number of reasons why the funds necessary for decommissioning may not be available when the facility is shutdown. It may be that the facility was closed prematurely before the total amount of funds was collected. The funds may also be lacking due to poor planning or the lack of a national requirement for prudent financial planning. The other cause may be that political conditions have changed, such as in the case of some of the former Soviet Union countries, and the funds are not available to complete the decommissioning process.

No matter what the reason, the lack of funding can cause substantial delays in the process and can have a significant impact on safety during the resolution of this problem.

■ The third issue is maintaining "corporate" knowledge during the operation of the facility and until the facility is finally released from regulatory control. This could be especially troublesome if a long safe storage period is selected which might cover a period that would exceed a person's normal working lifetime.

Without the working knowledge of the systems and of accidents or incidents that occurred during the life of the plant, the planning process is made more difficult and potential unknown or unexpected situations may occur during the eventual decontamination or dismantling activities.

PLANNING FOR RETIREMENT

Radioactive wastes are an inevitable legacy of nuclear operations and they must be managed safely. As facilities near the end of their operating lifetimes, tasks associated with their decommissioning assume greater importance.

Through IAEA programmes, States are sharing experience and information on safety and technological aspects of decommissioning operations required for a range of nuclear facilities. As more facilities are scheduled to go out of service in the coming years, these services and activities can provide valuable support to countries in preparing, planning, and implementing programmes for the safe management of radioactive wastes associated with decommissioning operations. ❐

Photo: In Germany, a reactor vessel head of a prototype reactor is cut during dismantling operations. Proper planning of decommissioning can lead to a large reduction of wastes. Worldwide, more than 800 nuclear power production and related facilities will require decommissioning eventually.