General Benefits Associated With the Wider Cooperation in Decommissioning - 9367

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ABSTRACT

This paper describes decommissioning as a critical phase in the life cycle of nuclear facilities with effective and efficient decommissioning that is progressively becoming a regulatory requirement and general expectation. Countries could benefit from cooperation with other countries with mature decommissioning programs. This cooperation could especially be beneficial to developing countries that wish to enter into or expand their nuclear programs. The paper only covers the general decommissioning areas and benefits that could be considered in initiatives to establish wider cooperation in decommissioning.

INTRODUCTION

The awareness of the importance of decommissioning has progressively grown to the point today where decommissioning is recognised as a critical phase in the life cycle of nuclear facilities. The authorization of nuclear facilities is subject to the demonstration of adequate capability to decommission a nuclear facility throughout the life cycle of the facility. Designers of nuclear facilities have to be able to demonstrate that the design caters for aspects that could have an impact on the eventual decommissioning of the facility. The design of the nuclear facility should be in a manner that facilitates decommissioning in a technically advanced, safe and cost effective way with the minimum effects on the environment. Design for decommissioning should be applied at a higher level as best practice to enable a smooth transfer from operation to the decommissioning phase, meeting all regulatory requirements.

Decommissioning has developed into a critical phase in the life cycle of a nuclear facility due to:

- The increasing demand and number of nuclear facilities, from the previous generation, that have reached the end of their useful life.
- The anticipated nuclear renaissance and reality of “new build” with the renewed emphasis on sustainability and life cycle management. (How can it be allowed to construct new facilities if good environmental practice is not evident on the existing facilities)
- The overall public and stakeholder involvement and demand on the operators of nuclear facilities to demonstrate control throughout the life cycle of nuclear facilities.

As with any industrial installation, a nuclear facility has a limited operating life. At the end of the operating live of a nuclear facility, planned decommissioning has to be performed in accordance with the selected decommissioning strategy. The extent of decommissioning depends on the prevailing condition of the facility as well as the agreed decommissioning strategy and end-point. Approximately 100 Nuclear Power Reactors,
250 Research Reactors and many more fuel-cycle and smaller facilities are in or will be in a decommissioned phase soon [1].

Many nuclear facilities have been decommissioned successfully over the past few decades. Decommissioning has become a mature industry in some countries. It should be recognised that a vast amount of decommissioning related experience and lessons learned are available on a global scale. Unfortunately decommissioning was in many instances performed in isolation. Although it is realized that

decommissioning management is influenced by national factors such as regulatory frameworks and waste management infrastructure, international cooperation will be beneficial in many areas.

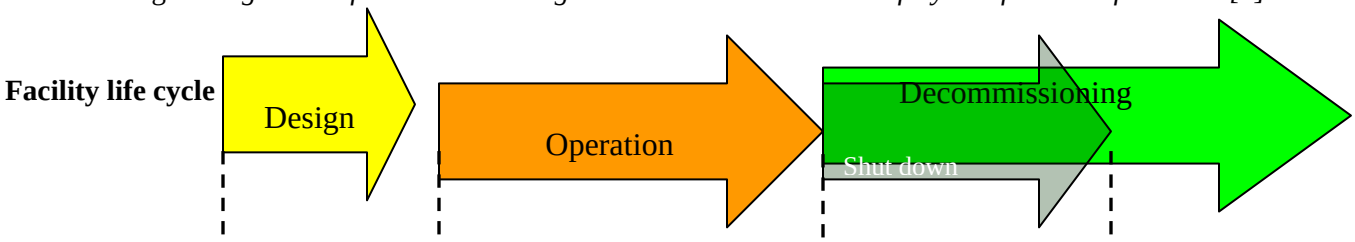
Global decommissioning knowledge and experience has not been optimized to date and it is believed that a lot of time, money and scarce resources are wasted on the "re-development of the wheel". The level of benefit is influenced by the following factors:

- The scale and spectrum of national nuclear developments.
- The maturity of the industry and the regulator of the specific country.
- The availability of decommissioning related resources and infrastructure.

DEFINING DECOMMISSIONING

Decommissioning is no longer an "end of life activity" as perceived in the past. When referring to decommissioning today, it is important to consider the scope of decommissioning activities as integrated with the life cycle of a nuclear facility.

Fig1: *Integration of decommissioning related activities with the lifecycle of nuclear facilities. [2]*



Decommis-sioning activity	Decommis-sioning considered during design/-construction and initial Decommis-sioning planning	On going decommissioning planning	Final decommissioning planning	Decommissioning projects
Desired state	Promotion of decommissioni ng good practice attributes and establishment of decommissioni ng planning framework	Decommissioning plan that is updated and commensurate with the operational stage of the facility and in accordance with the overall site decommissioning plan. Cost of decommissioning assessed and funds made available for decommissioning projects	Shut down and final decommissioning plan	Authorized decommissioning projects or implemented surveillance and maintenance plans. Passively safe end state or released or reused facilities

Decommissioning is integrated throughout the life cycle of nuclear facility starting with design and ending with the actual decommissioning resulting in a facility in a passively safe end state or in a redeveloped and reused facility.

Decommissioning management could include management/regulatory arrangements on a facility as well as on a national level. This wider definition of decommissioning management applies when considering the general benefits associated with cooperation in decommissioning.

AREAS OF COOPERATION

The following are areas of international cooperation in decommissioning that could be beneficial to the wider nuclear industry:

Decommissioning Policies and Regulation

Decommissioning policies and regulation is required on a national level to ensure consistent and good practice related to all aspects of decommissioning (including decommissioning planning) on a facility level.

The decommissioning policies and regulations however, should be aligned with international standards and practices. National decommissioning policies and regulations should provide standards to nuclear facilities that will ensure that they demonstrate technical and financial capabilities to decommission the facilities that they require authorization for.

A sound legal framework that addresses decommissioning activities, resources and structures to put in place timeously, is a prerequisite for effective and efficient decommissioning. Developing countries as well as countries with small nuclear industries should gain by considering the development of national policies and regulations related to decommissioning. The IAEA has launched the Joint Convention on the Safety of Spend Fuel Management and on the Safety of Radioactive Waste Management in 1997. The Joint Convention covers the obligation to establish and maintain regulatory frameworks to govern inter alia the safety of facilities until after their closure.

A critical aspect of decommissioning is a sound basis for ensuring sufficient financial resources for eventual decommissioning of a facility. The requirements and mechanisms for ensuring the availability of funds for decommissioning is an example of what should be addressed in national decommissioning policies and regulations.

Decommissioning Management throughout the Life Cycle of Nuclear Facilities:

A number of arrangements and systems are required to ensure the management of decommissioning throughout the life cycle of nuclear facilities. Examples of such arrangements and systems are the following:

- Guidelines/standards for considering decommissioning during the design of a nuclear facility (Design for Decommissioning);
- Decommissioning planning requirements/guidelines covering the full life cycle of a nuclear facility (progressive development of decommissioning plans);

- Decommissioning organization, responsibilities and management system. (special arrangements are required in the case of multi-facility sites) [2].

Countries with mature decommissioning organizations and programs should be in a position to provide valuable experience and guidance related to decommissioning management throughout the lifecycle of nuclear facilities.

Decommissioning Strategies, Plans and Strategy Selection

Decommissioning strategies should ideally be selected as early as possible in the life cycle of a nuclear facility to render a basis for planning. Decommissioning strategies depend on a range of facility related and wider factors. It is generally accepted that if the factors that are relevant to a specific facility are considered, the optimum strategy could be derived. The outcome of such a process depends on the process, the relative contribution allocated to factors as well as the stakeholders involved in the process. The authenticity of the outcome depends on the structure and general acceptance of the multi-attribute evaluation process.

Significant experience regarding the methodology and performance of multi-attribute analysis exists. Because decommissioning strategies are influenced by national and local factors cooperation should be focused on experience related to the processes to strategy selection/justification. The IAEA launched an initiative to capture the experience, regarding decommissioning strategy development, of the members of the Technical Group on Decommissioning (TEGDE) [3].

The significance of decommissioning plans should not be underestimated and the continuous updating (management) of these decommissioning plans should be controlled. Decommissioning plans should be reviewed to include the development of new technologies and waste management practices. Decommissioning plans requires careful planning that will include the consideration of the following:

- Background information of similar decommissioning projects.
- Age of the facility by the time it will be decommissioned.
- Integrity of equipment to be decommissioned.
- Deterioration of safety equipment through aging of the facilities and the aging management applied.
- Choices of technical scenarios and available technologies.
- Decommissioning waste and availability of approved disposal routes.
- Management of waste streams and material categories.
- Management of uncertainties, organizational and project risks.
- Possible redevelopment and re-use options to be investigated.

Decommissioning Waste Management Technologies

Decommissioning is associated with unique waste streams and material categories generated during decommissioning activities. The waste management processes employed during the operational phase of the facility are not necessarily sufficient for the waste and material generated during decommissioning. Radioactive waste streams and material categories are distinguishable by factors such as operational use e.g. process or non-process and measured or predicted radiological characteristics. Techniques and technologies for characterization, material categorization and waste processing have been developed and refined over time in countries with mature decommissioning programs. Sharing of such techniques and technologies will benefit countries entering into the nuclear industry.

Decommissioning Cost and Financial Provision

Decommissioning liability and the assessment or prediction of the liability and financial provision, are further critical aspect of decommissioning. Extensive experience exists in the prediction or determination of the decommissioning liability and mechanisms to secure funding. Tried and tested models and guidelines for cost estimation are used in countries with mature decommissioning programs that again can benefit countries entering into the nuclear industry.

The IAEA launched an initiative to capture the experience, regarding financial aspects of decommissioning, of the members of the Technical Group on Decommissioning (TEGDE) [4].

Decommissioning Specific Safety Assessment Methodologies

Nuclear authorization or licensing requires an activity specific safety assessment to demonstrate compliance with regulatory criteria which include demonstration of ALARA. Decommissioning activities usually involves lower radioactivity inventories while decommissioning actions could have a higher exposure potential. Safety assessment methodologies for decommissioning are simplified in comparison with operational safety assessment methodologies. Such safety assessments are designed around specific decommissioning activities. Experience related to safety assessments, performed in accordance with methodologies designed for decommissioning, is available and reflected in IAEA guidelines as developed by the International Project on Evaluation and Demonstration of Safety for Decommissioning of Nuclear Facilities (DeSa). The experience includes the validation and refinement of safety assessment methodologies.

Clearance of Material and Release of Sites

Other key aspects of decommissioning are the ability to maximize the quantity of clearable material generated by decommissioning activities and the ability to release a site after decommissioning.

In view of the sensitive and technical nature of these activities, clear criteria and guidance, that are acceptable on an international scale, is essential. Necsa benefited by the application on the IAEA guideline [5] related to the derivation of clearance criteria. A high percentage of the total quantity of material generated during the decommissioning of nuclear fuel cycle facilities has been cleared by the application derived and approved clearance criteria.

Redevelopment and Reuse of Nuclear Facilities

The nuclear renaissance has in recent times placed a renewed emphasis on redevelopment and reuse of decommissioned nuclear facilities and sites. The demand for such facilities and sites as well as the inherent benefits of reuse in comparison with demolition and return to Greenfield, is considerable.

Vast experience exists globally regarding redevelopment and reuse of nuclear facilities and sites. The experience includes reuse option specific considerations and constraints. The experience of Necsa regarding the redevelopment and reuse of a multi-facility site is reflected in [6].

Promotion of redevelopment and reuse as decommissioning end point versus demolition and release is generally supported. Potential reuse scenarios and also challenges associated with reuse options should be considered in the selection of decommissioning strategies and end points.

International cooperation should include the topic of redevelopment and reuse. The objective should be to cover promotion of reuse and development and knowledge sharing regarding the impact and considerations associated with
these options. The IAEA is active in the promotion and development of the technical field related to redevelopment and reuse.

CURRENT IAEA COORPORATION INITIATIVE

In recent years the IAEA took the initiative to bring international experts together to develop high level requirements as well as practical guidance documents. A wide range of decommissioning topics and processes are covered. A more recent initiative of the IAEA was to establish an
International Decommissioning Network (IDN), in order to create a network of organizations with an interest in and experience of decommissioning. As indicated in the Terms of Reference of the IDN, the IDN aims to provide:

- Support to participants or member/States with the emphasis on those with less developed decommissioning industries;
- Specialist advice and technical guidance;
- A Forum for the exchange of information to pursue the promulgation of good practices and the longer term retention of knowledge in support of decommissioning planning;
- Training and demonstration activities, mainly demonstration projects with regional or thematic focus providing hands-on, user orientated experience.

CONCLUSIONS

Decommissioning is an important phase in the life cycle of nuclear facilities. Regulatory requirements and good practice demands are as applicable to decommissioning as to any other phase in the life cycle of nuclear facilities. Besides compliance, a high standard of decommissioning management is required in support of stakeholder perception and the sustainability of the nuclear industry.

The standard of decommissioning could increase and be made more consistent on a global scale if successful cooperation between countries with matured decommissioning programs and developing countries could be established. This seems be in alignment with the terms of reference and objectives of the IDN. South Africa and Necsa specifically could benefit from being part of the IDN. The ability to be in direct contact with other specialists in the
field and to experience what is regarded as international good practice, are viewed as some of the main benefits of IDN program.

A number of areas within decommissioning exist and have been explored in terms of general benefits that if could have. Areas of cooperation could include
but are not limited to the following:

- Decommissioning policies and regulation;
- Guidance on decommissioning management throughout the life cycle of nuclear facilities;
- Standardization of decommissioning strategies and strategy selection,

- Decommissioning and stakeholder interface requirements;
- Decommissioning and waste management technologies;
- Decommissioning cost and financial provision;
- Decommissioning specific safety assessment methodologies;
- Approaches related to the clearance of material and release of sites;
- Approach and considerations related to reuse and redevelopment of facilities/ sites.

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