

Travaux actuels et futurs de l'OCDE/AEN dans le domaine du démantèlement

The Programme of Work of the NEA in the Field of Decommissioning

■ **Claudio PESCATORE**, Deputy Division Head for Radioactive Waste and Decommissioning, OECD/NEA, and **Patrick O'SULLIVAN**, Administrator in charge of Decommissioning, OECD/NEA

Résumé

Les pays membres se trouvent tous les jours davantage devant la nécessité de prendre des dispositions pour régler tous les aspects de la gestion de l'héritage laissé par les anciennes installations nucléaires et, en particulier, de mettre en place les politiques et structures réglementaires indispensables à la sûreté et la mise en œuvre efficace des projets de démantèlement. L'efficacité dicte aussi de prévoir des financements garantissant, le moment voulu, la disponibilité de fonds suffisants, et cela même s'il devait survenir, pendant la phase de réalisation, des problèmes qui n'auraient pas été prévus à la planification. Le dispositif mis en place pour la gestion des déchets peut comporter des voies adaptées aux différents types de déchets, dont les déchets de très faible activité, et prévoir la libération et le recyclage des matériaux.

Avec les déclarations récentes de plusieurs pays en faveur du lancement de nouveaux programmes nucléaires, le démantèlement revient au centre du débat car il faut convaincre le public que cette opération est réalisable. Si, dans certains cas, on construit de nouvelles installations sur d'anciens sites nucléaires, cela ne dispensera pas d'y associer la société civile. La riche expérience du démantèlement que l'on possède aujourd'hui devrait pouvoir être exploitée pour abaisser les coûts des centrales et autres installations sur toute leur durée de vie.

Le défi consiste alors à créer un cadre qui puisse intégrer des activités nucléaires industrielles en plein essor sur des marchés mondialisés concurrentiels tout en préservant et en garantissant la sûreté des opérations de démantèlement pour le public et les travailleurs. Dans ces conditions, ce sont tous ces aspects - dispositions institutionnelles, démarche participative, coûts et financement, gestion des déchets, politique en matière de rejets de même que la disponibilité des technologies et des compétences - qu'il convient d'examiner.

Abstract

OECD member countries are increasingly faced with the need to make provisions for dealing with all aspects of the management of legacy nuclear installations, especially in terms of having in place adequate policies and regulatory frameworks for ensuring both safety and the efficient implementation of the decommissioning projects. Efficiency also requires that funding schemes are capable of providing adequate funds when required, even in the event that issues arise during implementation that were not anticipated during the planning phase. Waste management arrangements may encompass separate disposal routes for different categories of waste, including Very Low Level Waste, and may also include provisions for clearance and recycling.

Recent moves in several countries towards establishing new nuclear programmes are bringing decommissioning activities into fresh focus, for reasons of public confidence (i.e. demonstrating that decommissioning can be done). In some instances existing nuclear sites will be used for the construction of new installations, but stakeholder issues are important for these sites as well. Maturing decommissioning experience should also provide lessons that would help in the reduction of lifetime costs for nuclear plants and other facilities.

The challenge lying ahead is to establish a framework that will account for growing nuclear industrial activities in competitive, globalised markets, while maintaining and assuring the safety of decommissioning for the public and for workers. Within this context, institutional arrangements, stakeholder issues, costs and funding, waste management and release policies, as well as availability of technologies and skills, need to be kept under review. All these issues form part of the work programme of the NEA in the field of decommissioning.

1. Introduction

The NEA (www.nea.fr) is the Nuclear Energy Agency of the Organization of Economic Cooperation and Development (OECD). As such it has the broad mandate to help member governments in their efforts to remain informed of developments in other countries and to develop and implement policies and strategies that respect the tenets of sustainable development and are compatible across national divides. The NEA is concerned with all aspects of the production of nuclear energy for peaceful uses.

The NEA's work is carried out for the most part by the member countries themselves through the representatives they provide to the committees or working parties that form the backbone of the NEA working structure.

Decommissioning is a cross-cutting area in the NEA work programmes; it relates to radioactive waste and materials management, to safety and regulation both during and after operation of a plant, as well as to the economics and further development of nuclear. Most of the work undertaken under the aegis of the NEA in this field is concerned with waste and materials management and therefore it is co-ordinated by the Radioactive Waste Management Committee (RWMC).

This paper presents the current NEA programme of work in the field of decommissioning and reports on the lessons that have been learnt.

2. The Working Party on Decommissioning and Dismantling (WPDD)

The Working Party on Decommissioning and Dismantling (WPDD) of the RWMC is the focus for the analysis of decommissioning policy, strategy and regulation within the NEA, including the attending issues relating to the management of materials, the release of buildings and sites from regulatory control and associated costs and funding. It tracks decommissioning developments worldwide and develops reports and position papers on emerging issues. Its overarching aim is to contribute to the development of best practice through circulation of its reports and through dialogue between policy makers, practitioners, regulators, researchers and international organisations.

Beyond policy and strategy considerations the WPDD's programme of work also addresses practical considerations for implementation such as techniques for characterisation of materials, techniques and equipment for decontamination, cutting and dismantling - with and without remote operation.

The WPDD brings together senior experts in decommissioning from 18 OECD countries and from international organisations such as the European Commission and the IAEA. Its members include policy specialists, regulators, implementers, researchers and waste management

specialists. The group meets once each year, at a host location that rotates among the member countries. Each meeting normally includes a topical session on an issue of special interest and a session focusing on the framework for decommissioning in the host country. Associated with this, the host country normally arranges a visit to a local decommissioning facility.

An important role of the WPDD is to facilitate the exchange of experience amongst its members and promote the further understanding of specific aspects. This is achieved through workshops and working sessions on issues of topical interest, through projects undertaken by task teams made up of experts from the participating organisations, and through collaboration with other groups working in the field of decommissioning. The latter include the NEA's Cooperative Programme on Decommissioning (CPD) (see below), as well as decommissioning groups within the IAEA and the European Commission. WPDD also works closely with the NEA's Forum on Stakeholder Confidence (FSC), to help develop the links between decommissioning, decision-making and public confidence and acceptance, and with the RWMC Regulators' Forum on regulatory issues that are of strategic interest. The range of issues covered by the group can be judged by observing the breadth of its recent publications, namely⁽¹⁾:

- *Regulating the Decommissioning of Nuclear Facilities* (2008) [NEA No. 6401]
- *The Release of Materials and Buildings* (2008) [in print]
- *Stakeholder Issues and Involvement in Decommissioning Nuclear Facilities* (2007) [NEA No. 6320]
- *Decommissioning Funding: Ethics, Implementation, Uncertainties* (2006) [NEA No. 5996]
- *Selecting Strategies for the Decommissioning of Nuclear Facilities* (2006) [NEA No. 6038]
- *The Release of Sites of Nuclear Installations* (2006) [NEA No. 6187]
- *Achieving the Goals of the Decommissioning Safety Case* (2005) [NEA No. 5417]
- *Decommissioning: It can and has been done* (2005) [Brochure]
- *The Decommissioning and Dismantling of Nuclear Facilities: Status, Approaches, Challenges* (2002) [ISBN 92-64-18488-0]

At the beginning of 2008 the WPDD established the Decommissioning Cost Estimation Group (DCEG), a specialist sub-group to foster the exchange of information and experience on the specific topic of estimating costs for decommissioning (see below).

3. Main Lessons Learnt

3.1 Selecting a Strategy for Decommissioning

The term "decommissioning" is used to describe all the management and technical actions associated with ceasing operation of a nuclear installation and its subsequent dismantling to facilitate its removal from regulatory

⁽¹⁾ All reports that are mentioned in this paper can be downloaded or ordered through the NEA web site – www.nea.fr/. The reports can usually also be located efficiently by using the internet 'google' facility.

control (delicensing). These actions involve decontamination of structures and components, demolition of components and buildings, remediation of contaminated ground and disposal of the resulting waste.

The strategy that is currently applied most commonly for nuclear power plant decommissioning is immediate dismantling, commencing shortly after shut-down and following a necessary transition period to prepare for implementation of the decommissioning strategy, and generally ending with the release of the site from regulatory control. As an alternative strategy, dismantling may be deferred for as long as several decades during which a facility or site is kept in a safe condition. In that case, a surveillance and maintenance programme is implemented to ensure that the required level of safety is maintained.

The factors that affect the choice of decommissioning strategies are dependent on country- and facility-specific conditions. Apart from site reuse considerations, the availability of a waste management path, the desire to retain knowledge of the plant's history and the availability of plant equipment needed for the plant's dismantling are the main factors considered in selecting a decommissioning strategy. These technical factors, however, are complemented by socio-economic considerations regarding future regional development and local employment in the often remote site area. Inadequate funding potentially creates a major constraint, which may make immediate dismantling impracticable in certain cases.

3.2 Regulating the Decommissioning of Nuclear Facilities

The removal of fuel from a shutdown nuclear facility eliminates the major source of radiological hazard, i.e. that related to a nuclear criticality. This, together with the cessation of operations at high temperatures and pressures, means that the risk to public health and to the environment is very significantly reduced. The process of decommissioning does however involve processes – such as the cutting and dismantling of structures, plant and equipment – which involve both conventional and radiological hazards, e.g. the use of explosive cutting techniques. Some radiological hazards remain because of the possibility of coming into contact with radioactively contaminated or activated material.

Regulatory arrangements appear to be adapting to this continuously changing environment and to the changing risk situation in a nuclear facility that is being decommissioned. One such development involves greater use of internal authorisation systems for minor plant modifications, with a first level of oversight by an independent safety committee established by the plant operator. In this situation regulatory resources are focussed on a smaller number of issues that have a major importance for safety.

3.3 The Release and Reuse of Materials, Buildings and Sites

The radiological concept of clearance can be defined as the release of radioactive materials or buildings from any further regulatory control applied for radiation protection purposes by the competent body. It is generally based on the assumption that any resulting radiological exposure of

the public will be trivial, and is applicable only to materials for which sufficient decontamination has been carried out prior to their release.

Clearance is a mature concept allowing the swift and safe determination of compliance with the release criteria of nearly all materials (metals, building rubble, cables, plastics etc.) and building surfaces. There are, however, differences in the ways in which clearance is dealt with in the regulatory framework in various countries and the ways in which clearance is implemented in various decommissioning projects.

Releasing disused materials from regulatory control – which materials may then be used for other purposes outside the nuclear industry – provides one option for their long term management. Other possibilities include the recycling of these materials, especially metals, within the nuclear industry, and/or their direct emplacement in dedicated disposal facilities.

Once a nuclear installation has been completely dismantled, the final step involves the decontamination of the site for either re-use as an industrial site, including for nuclear purposes, or for re-use for non-nuclear purposes. The step of removal of the nuclear site license is taken only after extensive surveys show that any residual levels of radioactivity are at extremely low levels.

3.4 Stakeholder Involvement

As in other phases of the nuclear facility life cycle, it is necessary to develop trust among stakeholders in decommissioning and dismantling projects. This may be accomplished through involving local and regional actors in decision-making, but also in monitoring activities, so as to have a better grip on the continuous changes taking place at the site. Transparency is needed in decision-making and in the respective roles played by regulators, implementers and local authorities. At all times, proactive information, and efforts to “translate” technical information into language meaningful to the chosen audience, will contribute to building mutual understanding and trust. Partnership arrangements, by which institutions enter into structured project-management relationships with local communities, have been found beneficial.

Decommissioning in both nuclear and non-nuclear areas may be viewed as an opportunity to improve the sustainability of the host community. The creation of added cultural or economic value can contribute to increasing quality of life over the years. More recent designs integrating reflection on the end use of the facility and site, or technical provisions for quick transitions to other types of facilities, provide better assurance to the host community that there will be flexibility in future planning capacity.

4. The NEA Cooperative Project for the Exchange of Scientific and Technical Information on Nuclear Installation Decommissioning Projects (CPD)

The CPD is an NEA-sponsored “Joint Undertaking” comprising projects from 12 NEA member countries, which began in 1985. The projects on which information

is exchanged comprise 26 reactors as well as 16 fuel cycle facilities, covering a very large spectrum of plants at all stages of decommissioning.

Its aim is to foster the exchange of scientific and technical information on the decommissioning of nuclear installations. This is achieved through collaborative projects, annual meetings of the management board for the programme and biannual meetings of the project managers of the participating projects. The CPD is currently engaged in collaborative projects on remote handling techniques used during decommissioning and on techniques used in the decontamination and dismantling of concrete structures. Reports from these projects are planned for publication during 2009. Recent outputs from the collaborative projects include:

- *Radioactivity Measurements at Regulatory Release Levels* (2006) [NEA No. 6186]; and
- *The NEA Cooperative Programme on Decommissioning: A Decade of Progress* (2006) [NEA No. 6185]; and
- *A Proposed Standardised List of Items for Costing Purposes* (1999) [Interim Technical Document] – co-sponsored by the European Commission and the International Atomic Energy Agency.

5. Looking Forward

The above issues will continue to be addressed in the ongoing work of the WPDD and of the CPD. In addition, the following emerging issues are of specific current interest.

5.1 Decommissioning and Lifetime Plant Management

Although the decommissioning of a nuclear facility occurs many decades after its construction, important provisions for decommissioning need to be incorporated at the plant design stage. Regulators increasingly require that a decommissioning plan be provided at the time of the request of a construction license and that this plan be updated regularly during plant operation. This requirement, coupled with the today's demands for transparent and timely accumulation of decommissioning funds, makes decommissioning an integral part of lifetime plant management.

It is evident that the designers of third generation nuclear power plants are implementing many improvements that will be beneficial to decommissioning, even though several of these are driven by objectives other than decommissioning, such as for reasons of more efficient maintenance, greater safety and/or lower cost. Key design considerations include incorporation of modular concepts, innovations in equipment, materials and system layout, and measures to reduce potential levels of contamination, e.g. by use of fewer components, piping and control cable as well as through use of equipment with longer design life and thereby less need for its replacement. The WPDD is taking a lead role in this area. A topical session involving vendors, utilities, regulators, and international agencies has been organised in Slovakia in November 2009. In a parallel initiative organised under the auspices of the NEA's Information System on Occupational Exposure (ISOE), the collection of data on

workforce exposures to radiation during decommissioning is being improved. (See www.isoe-network.net).

5.2 Decommissioning Cost Estimation

The lack of standardized approaches to developing and reporting cost estimates can mean that it is difficult to understand fully the basis for differences between estimates. In 2007 the WPDD established a specialist group to work on this issue – the Decommissioning Cost Estimation Group (DCEG). This group is currently working on reports on the cost drivers and reporting requirements for decommissioning and, in 2009, will begin a project aimed at updating the 1999 tri-agency report *A Proposed Standardised List of Items for Costing Purposes* (see above).

Estimates of decommissioning costs have been performed and published by many organizations for many different purposes and applications, including the report from a study undertaken by the NEA's Nuclear Development Committee (NDC), *Decommissioning Nuclear Power Plants: Policies, Strategies and Costs* (2003) [ISBN 92-64-10431-3]. The published data often vary, e.g. because of the type of plant to be dismantled (NPP, research plant, research laboratory, fuel cycle plant), differences in basic assumptions such as the choice of the decommissioning strategy (immediate vs. deferred), availability of waste management pathways, assumed end states of installations, detailed definition of cost items, technical uncertainties, unforeseen events, evolution of regulation and requirements.

Different approaches are applied to dealing with uncertainties and to the associated issue of risk management. The most common approach followed by the countries participating in the DCEG is to include contingency amounts to cover uncertainties in assumptions used to develop the cost estimate, e.g. uncertainties in unit labour costs for undertaking specific tasks. The impact of issues that could change the entire project scope, e.g. changes in regulations for the management of waste, are generally addressed by means of a separate risk assessment, in order to ensure that adequate funding arrangements are being implemented.

5.3 Technological Developments

NEA's recently published *Nuclear Energy Outlook* (2008) concludes that currently available technology – for the characterisation of materials and measurement of radioactivity, decontamination, cutting and dismantling of plant as well as remote handling – allows efficient dismantling and clean-up of all types of nuclear installations. Nonetheless, given that decommissioning activities will be ongoing for periods of several decades, it may clearly be expected that further substantial improvements in technology will occur during this period. Such potential developments, for example in using robotic and laser technologies and new technologies for decontamination and cutting, may allow important reductions in the radiation doses received by workers in the decommissioning industry, reductions in the amount of secondary waste that is generated, and improvements in the duration and cost of decommissioning projects.

The *Nuclear Energy Outlook* calls on governments and relevant international organisations to play an important role in ensuring that appropriate research and development activities are undertaken over the next decade, in order to ensure that the above benefits are obtained. These issues, together with the associated policy considerations, will continue to be at the centre of the ongoing work of the WPDD and of the CPD.

6. Conclusions

Worldwide, of the 563 commercial nuclear power plants that are or have been in operation by October 2008, 119 plants have been permanently shut down and are at some stage of decommissioning. Approximately two-thirds of these are located in the European Union - mostly in the United Kingdom, Germany and France. About 10% of all shut-down plants have been fully decommissioned, including eight reactors of more than 100 MWe. In addition to the nuclear power reactors, various types of fuel cycle and research facilities have been permanently shut down, including facilities used for the extraction and enrichment of uranium and for fuel fabrication and reprocessing, a large number of facilities have been or are being discontinued - adding up to a decommissioning business that is now worth more than 5 billion Euros a year worldwide.

Decommissioning will remain a significant industrial activity for several decades – for many reasons, including

the number of power plants currently in operation or shut-down that will need to be decommissioned, the large number of legacy facilities still in existence and the long timeframe for each decommissioning project. Although the likely closure dates of many power plants are being extended into the future, there is also an increasing likelihood that new plants will be built worldwide during the coming decade, many of which, in the NEA countries, will be located on the sites of existing nuclear facilities, thus providing a further impetus for the dismantling of disused installations on those sites.

The scale of decommissioning liabilities, in terms of their cost and the socioeconomic impacts on the host communities, is such that governments are paying ever-increasing attention to how these liabilities are managed. This increasing interest goes hand-in-hand with a desire to promote initiatives that increase shared understanding and best practice. The NEA countries produce roughly 80% of the world's nuclear electricity and this will remain broadly the case for the next few decades at least. It is thus clear that the Agency will continue to provide its services in the field of decommissioning for many years to come.

Note: The web address of the WPDD is <http://www.nea.fr/html/rwm/wpdd.html>

