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Regulating the Decommissioning of Nuclear Facilities

Relevant Issues and Emerging Practices

NEA No. 6401

NUCLEAR ENERGY AGENCY
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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- to provide authoritative assessments and to forge common understandings on key issues as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.

Specific areas of competence of the NEA include safety and regulation of nuclear activities, radioactive waste management, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information. The NEA Data Bank provides nuclear data and computer program services for participating countries.

In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has a Co-operation Agreement, as well as with other international organisations in the nuclear field.

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FOREWORD

Set up by the NEA Radioactive Waste Management Committee (RWMC), the Working Party on Decommissioning and Dismantling (WPDD) brings together senior representatives of national organisations who have a broad overview of decommissioning and dismantling (D&D) issues through their work as policy makers, regulators, implementers and R&D experts. The European Commission is a member of the WPDD and the International Atomic Energy Agency (IAEA) participates as an observer. This broad participation is conducive to the co-ordination of activities in international programmes.

The WPDD held a one-day topical session on regulatory practices related to the decommissioning and dismantling of nuclear power plants (NPPs) on 24 October 2006 in Paris, France – the proceedings of which are available at www.nea.fr/documents/2007/rwm/rwm-wpdd2007-3.pdf. This topical session was jointly organised with the RWMC Regulators' Forum.

As a next step, the WPDD decided to prepare this status report with the aim of presenting an overview of the main developments and trends in the area of decommissioning regulation. These trends became apparent at the WPDD topical session and are illustrated in this report by case studies from a number of countries with substantial decommissioning programmes. The report also benefitted from the input of the NEA Regulators' Forum.

The report is intended to help, in particular, member countries that are planning soon to embark on decommissioning programmes – by highlighting the steps being taken by countries already involved in decommissioning work to enhance their regulatory practices. The report shows that the transition from operation to decommissioning of a nuclear facility involves changes in the risks presented by the facility. The efficiency of regulation may be improved by ensuring that the regulatory process is sensitive to this new risk environment.

Acknowledgement

The WPDD and the Regulators' Forum wish to express their gratitude to Dr. Allan Duncan for his important contribution to the drafting of this report.

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1. INTRODUCTION

During operation of a nuclear facility, and particularly in the case of a nuclear power plant, the primary hazards[1] are associated with the nuclear fission process. Safe operation requires careful control of reactor core operation and cooling, prevention of accidental criticality and avoidance of exposure of operators to the high levels of radiation associated with these activities. At all times, the substantial amounts of radioactive material in the plant must be safely and securely contained, not only to keep doses to operators as low as reasonably achievable, but also to comply with formal arrangements for release of radioactive substances into the environment, as well as arrangements for safeguarding against loss or diversion of nuclear material. With the exception of specific issues concerned with nuclear reactor core operations, equally rigorous considerations apply to nuclear power plants and to other nuclear plants such as spent fuel reprocessing plants. Because nuclear accidents have the potential to cause significant environmental damage, their prevention and mitigation are key objectives that are reflected in the stringent classification and qualification of structures, systems and components.

In addition to dealing with radiological matters, attention must be given to the non-radiological hazards to workers, the general public, and the environment. However, it is most likely that the levels of risk associated with the non-radiological hazards and with off-site matters will be relatively small and, in the balance of regulatory considerations about an established and well-run nuclear facility operating in steady state, it is the radiological hazards associated with the presence of large quantities of nuclear material that dominate.

After a nuclear facility is shut down for the final time, the next steps involve reducing the sources of hazard in a systematic and progressive way. This involves removal of as much of the nuclear material as possible. In the

1 In this report a *hazard* is a situation that has the potential to cause harm to human beings or the environment. The related concept of *risk* expresses the likelihood that specific harmful consequences occur and their magnitude.

case of a nuclear power plant, for example, it involves removal of irradiated fuel from the reactor and from spent fuel pools, the drainage of equipment containing radioactive materials and removal of any residual operational radioactive waste. The removal of fuel from a modern 1 000 MWe light water reactor results in probably the most significant example of such hazard reduction as the inventory of radioactive material present is reduced to about 0.1% of the operational level. In addition to reducing the major source of radiological hazard, other hazards such as those associated with operations at high temperatures and pressures are also reduced. Against this, however, some short-term hazards may be introduced because of the need to dismantle certain safety systems and confinement barriers in order to remove the inventory of radioactive materials.

At some stage following removal of the bulk of radioactive material, the main process of dismantling down to site clearance may begin. The timing of this depends on the strategy adopted for D&D and may influence the nature of the techniques used, which, in turn, may influence the nature of the hazards involved. In general, however, the process involves at least the following activities:

- Detailed radiological and physical characterisation of the state of the plant in order to plan work before the major tasks are started. (This is followed by in-process surveys as work progresses in order to modify work plans in the light of experience and new knowledge if necessary.)
- Installation of temporary systems for worker and environmental protection, such as moveable shielding, airlocks and mobile ventilation and filtration equipment, together with provision of protective personal equipment such as air suits, breathing equipment and masks.
- Decontamination of plant surfaces in order to facilitate access to working areas and dismantling activities and to reduce the volume of radioactive waste. This typically involves chemical, mechanical of electrical processes or some combination of them.
- Cutting and dismantling of structures, plant and equipment in order to facilitate decontamination and removal, using remote controlled techniques or conventional techniques operated from behind radiation shielding or from a safe distance. These may involve the use of mechanical/hydraulic, thermal, chemical (e.g. explosive cutting) or other techniques.

- Installation and operation of facilities for lifting and moving equipment necessary for D&D activities and any new plant required for treatment and packaging of waste arising from these activities. These facilities may or may not be similar to those used during the operational phase of the plant.
- Construction of temporary facilities for on-site storage of D&D-generated wastes until they are moved to their final destination.
- Treatment, packaging and transportation of large quantities of decommissioning waste, recycling of appropriate radioactive materials or their release from regulation by way of clearance arrangements, and site remediation if necessary.

It is clear, therefore, that the activities connected with the process of D&D are rather different from the day-to-day activities on an operating plant in steady state. Moreover, they vary and change progressively as the D&D process progresses. How then are regulatory requirements and practices adapted to the continuously changing situation in order to maintain a flexible and proportionate balance between regulatory requirements and the changing nature of the residual risk?

2. THE REGULATORY IMPLICATIONS OF D&D

2.1 A new working and risk context

The first step of removing the bulk of the radioactive inventory substantially reduces the radiological hazards associated with nuclear criticality. Those hazards associated with high temperature and high-pressure operations will already have been reduced upon shutdown of the plant. Furthermore, most of the regulatory issues associated with safeguards against illegal diversion of nuclear materials and with liability for a major nuclear accident will be gradually reduced, if not entirely eliminated, as radioactive material is removed.

However, the various new activities may increase the potential for accidental exposure to the residual radioactive materials, either by direct irradiation or release followed by ingestion or inhalation. This may happen, for example, when cutting into plant pipework or vessels without adequate precautions, perhaps because the relevant part of the plant has not been sufficiently well characterised before the start of work. So, although the main source of radiological hazard is substantially reduced and the associated risk is correspondingly lower, rigorous radiological control and worker protection is still necessary.

In the context of a lower overall level of hazard, and despite the difficulty in quantifying the related risk, experience of the last 20 years shows that a major change associated with transition from operation to D&D is the need for additional emphasis on non-radiological hazards. This is because many of the new activities are typically industrial processes, and the hazards associated with them are the conventional hazards of fire, explosion, toxic or hazardous materials, and the electrical and physical hazards associated with dismantling plant and with lifting and moving large structures or items of equipment. At the same time, the diversity and relative novelty of the activities involved, and the fact that they are non-routine and change as work progresses, constitute a major change in the pattern of work on the site. This introduces a range of issues concerned with human factors and behaviours, as well as with operational roles and responsibilities. Any difficulties associated with this change are likely also to be influenced by the introduction of new personnel, especially if these are employed by contractors on relatively short-term contracts.

2.2 A proportionate regulatory response

A proportionate regulatory response, to accommodate the new work and risk context during D&D, should result eventually in reduced emphasis on matters concerned with the handling and use of nuclear materials, such as criticality control, the potential for illegal diversion and emergency preparedness. At the same time, a shift in emphasis towards matters concerned with the various new activities associated with D&D may be expected, particularly in regard to protection of the work force, the public and the environment.

Against this background, and by comparison with site licence conditions for the operational phase, some modification or relaxation would be expected in conditions covering operational matters such as 24-hour control-room cover, inspection, maintenance and testing of plant and equipment, classification and qualification of equipment, and emergency plans. On the other hand, a broadening of scope, or strengthening, would be expected for conditions concerned with decontamination, dismantling, waste management and environmental protection. Given the new and continuously changing nature of D&D activities, such conditions need to address detailed work planning, safety systems and worker protection, procedures for modification of existing plant and construction of any new installations, work permits and record keeping, together with environmental assessment and management of both radioactive and conventional wastes. A key requirement is continuous updating of the control system to reflect changing plant configuration and to show dose rates in individual working areas as well as the levels of residual contamination on equipment. It would be appropriate also to have conditions requiring effective and auditable management systems for careful control and quality assurance of these aspects, and for dealing with contractors and any other temporary workers.

Other conditions might be expected to remain broadly as for the operating phase, such as those concerned with the handling and consignment of residual nuclear materials, leakage or escape of radioactive materials or waste, the need for operating rules and instructions, access to the site, instructions to visitors, warning notices, dealing with stakeholders and qualifications and training of staff. In this last regard, of course, the nature of qualifications and training will be different from the operational requirement and will reflect the needs of D&D activities.

Examples of site licence conditions that are typically amended or deleted during the transition from operation to D&D include the following:

- In the case of a reactor, conditions concerned with control of reactivity and coolant.
- Conditions covering the design, modification or installation of plant or equipment essential for the control of nuclear safety – as distinct from plant or equipment for the process of D&D.
- Technical Specifications for remaining systems relevant to nuclear safety.
- Conditions related to requirement for analysis of the risk associated with a nuclear accident or incident.
- Conditions concerned with preparedness for dealing with the consequences of a major nuclear incident, including off-site emergency plans.

Conditions that may need to be strengthened or introduced for the purposes of D&D are concerned, amongst other things, with protection of workers and the public against both radiological hazards and the conventional industrial hazards associated with the D&D process. They include the following:

- Conditions concerned with control and removal of radioactive contamination from plant and equipment.
- Conditions requiring minimisation of creation of waste, and covering its safe subsequent management.
- Conditions concerning conventional health and safety of the work force.
- Conditions covering environmental assessment and environmental protection from both radioactive and conventional industrial hazards and materials.
- Conditions relating to management systems, change control, quality assurance and contractor management.
- Conditions covering the design, modification or installation of plant or equipment essential for process of D&D, commensurate with the level of hazard involved in their application.

Other site licence conditions for the D&D phase that would be expected to remain substantially unchanged include the following:

- Conditions covering the new requirements for qualifications, training and supervision of staff. The detailed requirements will change in the transition to and throughout the process of D&D.
- Conditions concerning radiation protection of the work force.
- Conditions designed to safeguard nuclear material while on-site and in the process of consignment to or from the site, although the associated risk may be much reduced.
- Conditions that flow from requirements of legislation or regulation, such as environmental monitoring and, in the case of European Commission member countries, from requirements of the EURATOM Treaty such as timely submission of waste disposal plans under Article 37.
- Conditions concerned with formal oversight of site operations.
- Conditions related to involvement of stakeholders.

2.3 Achieving a regulatory balance

Underlying the changes proposed above is the need to have site licence conditions for D&D that reflect more closely the regulatory norms associated with conventional industrial activities rather than those for specifically nuclear activities. For many of the examples above this is a matter of balance or emphasis as opposed to being either one or the other. This point is best illustrated by way of the examples below, considered by the WPDD to be the most important in the first instance.

2.3.1 Health and safety of the workforce

In regard to operational health and safety, although the nuclear hazards associated with an operating plant reduce as radioactive material is removed; new activities associated with D&D may introduce new radiological hazards. This would suggest a need for modification of conditions covering radiological protection of workers, not to infer any change in the standard of protection but to reflect the varied and changing working environment of a plant undergoing D&D. Similarly, and without any suggestion that standards of protection are changed, the working conditions associated with various dismantling activities seem sufficiently different from routine nuclear site operational activities that particular regulatory attention needs to be given to conventional industrial health and safety implications. This needs to take account of the increased

potential for fire, explosion, electrocution, failure of partially dismantled structures, and accidents associated with lifting and moving heavy items, for example.

The essential point is that the stringent safety culture of the operating plant must be maintained and increased through the transition to D&D and during the process, having regard to a new and challenging working environment that is likely to involve a changing work force comprised of temporary, contracted staff and to a possible lack of attention to the changing of nature and location of hazards.

2.3.2 Modification of plant and equipment

Very stringent requirements for regulatory approval of the design or arrangements for modification or installation of plant, equipment or procedures are perfectly appropriate in application to systems that influence nuclear safety on an operating nuclear site. An example of such might be the equipment and arrangements for changing or handling nuclear fuel. When the bulk of the radioactive inventory is removed, however, and "new equipment" comprises the machinery and ancillary plant for decontaminating surfaces by an essentially conventional sandblasting process, for example, it seems reasonable to expect that the regulatory approval process would be modified. This should reflect the lower level of risk while still respecting, to the full, the environment in which the work is being undertaken. Allocation of appropriate safety responsibilities to the license holder may help to streamline the entire process, while assuring the highest safety levels.

2.3.3 Control of radioactive contamination

In the context of progressive reduction of hazards, it seems appropriate for conditions relating to site operations to focus more on matters concerned with control of contamination and minimisation of waste creation, in addition to any residual conditions concerned with nuclear accident analysis, for example. This would be entirely consistent with an objective of minimising impact on workers, the public and the environment. Again, as regards the issue of balance or emphasis, there is no suggestion that the matter of nuclear safety becomes negligible during D&D, particularly when there may be residual nuclear material or accumulation of waste.

2.3.4 Control of human and organisational issues

The varied and changing nature of the activities, and the way that staff are engaged and deployed during D&D, are somewhat different from the

operational phase where activities are generally routine and well practised by a stable work force. This gives rise to new and different management challenges more usually found in a conventional industrial project context, and these need to be reflected in modified licence conditions. Amongst other things, these conditions will reflect the need for greater emphasis on project management, the management of change, quality control, information retention, and contract management. Above all, however, the conditions will need to recognise the need for the management to be flexible and able to respond quickly to new situations as they develop. This is likely to mean vesting the local site management with a range of powers, probably within a formal and auditable management system that reflects the changing requirements rather than any change in regulatory standard or quality of management as such.

It is important to recognise, in this latter context, that even if site licence conditions are amended, the various new D&D activities may need closer day-to-day control or supervision. With the suggested formal management system it may be possible for regulators to concentrate on audit of the system while granting more of this control to others.

2.3.5 Knowledge retention

The recording and retention of information during the D&D process is already recognised above in the reference to licence conditions covering project management. Another major requirement, however, is availability of information about the operational history of the plant. It has been obvious for some time that the process of D&D is greatly assisted by access to first-hand knowledge of design, construction and operation of the plant, together with knowledge of any unrecorded plant modifications and any untoward events during operation. More recent experience only reinforces this. It applies particularly to early experimental and prototype plant and research facilities that have been subject to nuclear site licensing. These are more likely to have undergone several undocumented modifications, the memory of which now being lost. This observation is not particularly helpful for dealing with plant now shut down and undergoing D&D. It is intended rather to emphasise the need, in the licences of operating sites, for a condition that requires a system of capturing and retaining such information for future D&D purposes.

2.4 The wider regulatory framework

2.4.1 Interaction with other regulatory regimes

The issues above focus on evolution of nuclear site licensing in response to transition from operation to D&D. Site licensing is usually a matter for

national nuclear safety authorities but this transition also has implications for other regulatory regimes as nuclear hazards are progressively reduced and other matters arise or assume increased significance. These other regulatory matters, which are sometimes the responsibility of regulatory authorities other than the nuclear safety authority, include:

- Physical planning and socio-economic issues.
- Environmental impact assessment and, in the European Union, strategic environmental assessment.
- Conventional industrial safety.
- Radioactive and conventional waste management and disposal.
- Radioactive materials transport.

Other licences may be needed in the D&D process, depending upon national arrangements. These might include, for example, the need for local authority construction permits, if new structures are needed for D&D.

In addition to being regulatory matters that demand compliance in their own right, these matters have implications for the site licence and implementation of some of its conditions. For example, the regulatory regimes concerned with physical planning and environmental impact assessment, with their associated stakeholder and socio-economic inputs, have potential implications for the site end-state. Together with the regimes concerning radioactive waste management and disposal, they also have implications for the potential release of large quantities of material from regulatory control and for the availability and siting of waste disposal facilities. Also, radioactive materials transport regulations may influence the size and nature of items that can be transported from the site for either treatment or disposal. These matters have an obvious, direct effect on D&D project planning. They also have a direct effect on the estimation of overall D&D costs and, therefore, on the arrangements for securing adequate funds.

2.4.2 Interaction between regulatory authorities

An important question in the context of interaction of site licensing with other regulatory matters is how the requirements of all relevant regulatory regimes, at local, regional and national level, may be best satisfied without duplication of regulatory effort and without placing conflicting regulatory requirements on the site operator. Emerging experience suggests that handling of the interfaces between the relevant regulatory bodies is not entirely straightforward and that it needs early and careful attention if the regulatory

process for D&D is to be effective and transparent to all concerned, including implementers and the public. Some countries have already made arrangements to deal with this issue and there would be benefit in exchange of experience as D&D projects progress. The experience to date is mixed but some of it does indicate that success can be achieved by identification of a lead authority together with early, frequent and open communication between all authorities. This, however, is likely to depend on the precise characteristics of national systems and regulatory culture and it may be inappropriate to look for some general rule.

2.4.3 Harmonisation of standards and procedures versus *flexibility of approach*

The relatively new activity of nuclear plant D&D raises the question of whether to seek harmonisation of regulatory standards and procedures or to maintain a flexible regulatory approach. The emerging view seems to be that it is more important to harmonise on general principles and on understanding what needs to be achieved in the safe D&D of a nuclear plant, rather than on the details of standards and procedures. A more flexible approach allows authorities to take account of site-specific circumstances and to tailor requirements to the planned use of the site. Flexibility also allows implementers to be innovative in developing approaches and solutions to increase safety or efficiency, or reduce costs. Furthermore, the flexibility to set regulatory requirements on a case by case basis may facilitate accommodation of local issues that arise from the stakeholder consultation that is now required in European member states for example. Ultimately, good communication is more important than common criteria. Regulators need to be able to explain how they arrived at specific numerical criteria in a clear and transparent fashion, and how meeting the criteria will assure safety.

Nevertheless there may be situations, with several adjacent nuclear countries for example, when there may be some benefit in seeking to harmonise criteria such as clearance levels for release of material from regulatory control in order to facilitate transboundary movement. In Europe, however, experience of implementing the common clearance criteria has exposed some resistance to such harmonisation and, under the EC Basic Safety Standards each member country is free to adopt (or not) its own unique criteria for clearance, having regard to consultation with domestic stakeholders, and as far as they do not exceed the harmonised exemption criteria. Such criteria may not exceed the criteria for exemption established by this Directive decision. In the specific context of nuclear safety, the Western European Nuclear Regulators Association (WENRA) has established a Working Group on Waste and Decommissioning. It is charged with developing a set of nuclear safety standards for D&D, termed

safety reference levels, and is planning to produce a benchmark reference level in 2008. After evaluation, the WENRA member countries will develop a plan to implement the relevant safety reference levels by way of their national legislation.

2.4.4 Oversight of funding provisions

It is now a widely accepted principle that arrangements for securing the necessary funds for D&D need to be put in place at an early stage of plant operation, when revenue from operation of the plant is available. These arrangements necessitate reliable costing of D&D, and establishment of a mechanism that ensures availability of funds as and when required. The responsibility for this matter varies from country to country but, as regards cost estimation in NEA member countries, the implementers are usually responsible in the first instance and their results are usually validated or confirmed by some national authority which may be, or which may be advised by, the relevant nuclear safety authority. It is therefore an issue that is relevant to some nuclear regulatory authorities and, where that is so, site licences for currently operating plants generally include a condition covering the requirements.

International organisations such as NEA and IAEA have contributed substantially to developing models and norms for consistent costing of identifiable D&D activities. Costing should be carried out in the context of an overall plan that includes knowledge of site end-state and the fate of the wastes arising from D&D. In some member countries, the selection of end-states may involve socio-economic considerations that may not be firmly resolved during the operational phase of the plant. Similarly, the fate of wastes may depend on unresolved issues concerned with disposal and with matters concerning release from regulatory control of large amounts of material with very low levels of radioactivity. Clearly, estimates of the overall D&D cost should be reviewed periodically and cost recovery adjusted in light of developments in these areas. However, if these matters are not resolved well before the plant is shut down and the source of revenue ceases, there is a possibility that insufficient funds will have been recovered with no further opportunity to do so. This may have substantial implications for nuclear safety regulators and national governments, e.g. those regulators that have responsibilities for overseeing funding provisions may be unable to provide government with assurance that the necessary funds will be available for completion of D&D. This may even involve breach of a site licence condition that requires enforcement action. For government, the implication is that in the last resort it will have to find the necessary funds from national resources.

3. NATIONAL EXAMPLES OF RECENT EVOLUTION IN NUCLEAR SITE LICENSING FOR D&D: RELEVANT ISSUES AND EMERGING PRACTICES

Some NEA member countries, such as Canada, France, Germany, Italy and Sweden, have introduced the requirement for a new licence for nuclear sites undergoing D&D. In France, for example, this requires presentation of an overview of site evolution to the end-state. Other countries, such as the United Kingdom and the United States retain the operational site licence but modify the requirements appropriately to maintain effective regulatory control throughout the D&D phase. In all cases, however, the arrangements for transition involve submission of a formal document to the regulatory authority addressing issues arising from the new situation. In Canada, a new Nuclear Safety Control Act specifies the issues to be addressed in such a submission whereas in Italy, for example, the D&D licensing procedure is defined in law but there are no specific technical rules attached to it. The emerging impression is that all countries recognise the transition from operation to D&D by way of some formal requirement but that the precise arrangements are generally specific to the country. Some countries, including Canada and France, also have specific arrangements for delicensing after safe termination of nuclear site activities.

In the context of emerging practices, and regardless of the precise regulatory framework, it is considered that the most important issues for licensing of nuclear sites undergoing D&D (see Chapter 2) are those concerned with:

- Health and safety of the workforce.
- Approval for modification or installation of plant and equipment.
- Control of radioactive contamination.
- Control of human and organisational issues.
- Knowledge retention.
- Ensuring adequate funding of D&D activities.

The examples below indicate how these issues are evolving. More detailed information is provided in the appendices to this report for certain member countries: France, Germany, Italy, Spain, the United States.

3.1. Health and safety

There is no suggestion that standards or criteria for health and safety protection of the workforce are being reduced upon transition from operation to D&D. Indeed, in Italy for example, controls for protection of workers operating in areas potentially contaminated by plutonium have been increased and performed with more sophisticated methodologies. External contractors are also very carefully monitored and, as a result of new legislation in 1995, radioactive dose limits for the general public exposed to nuclear plant D&D activities are now lower than those applied when the plant was in operation.

It is recognised, however, that nuclear hazards decrease as radioactive material is removed from the site and, conversely, that the various new activities associated with D&D introduce new or increased levels of conventional industrial hazards. This recognition is exemplified in part by new nuclear Safety Assessment Principles, published in 2006 by the UK Health and Safety Executive. In the specific context of decommissioning they say,

> *"As decommissioning proceeds the radiological hazards posed by a facility will eventually reduce, particularly once the bulk of radioactive substances has been removed (although in some cases there may be a short-term increase in risk as a result of specific operations, such as when the removal of radioactive substances takes place). The need to apply the principles in a proportionate manner is therefore particularly important when each decommissioning phase is being considered."*

In this context, "proportionate" means that the requirements of safety and regulatory attention should be commensurate with the magnitude of the hazard, although issues such as novelty and uncertainty will also be factors. These principles use the internationally accepted work of IAEA as a benchmark, so it would be expected that they are generally typical of the situation in other NEA Member Countries.

As regards the new or increased level of conventional industrial hazards, the question arises as to whether a nuclear safety body has all the skills necessary to regulate them. In the United Kingdom, for example, the Nuclear Installations Inspectorate is responsible for regulation of all aspects of health and safety on nuclear licensed sites but it has long been their practice, in specific situations involving conventional industrial hazards, to call on the support of fellow Health and Safety Executive colleagues who have more experience in regulation of conventional industrial installations. These support services are now being used increasingly in the transition from routine nuclear site operations to the various activities of D&D.

However, it is not entirely clear how other member countries propose to handle the changing balance between nuclear safety and conventional industrial safety on nuclear plant undergoing D&D, and it is identified as an emerging issue that needs further discussion. This is particularly so, in regard to situations where there is no new licence designed specifically for D&D, and where there is some concern amongst operators that operating licence conditions will simply be carried forward into the decommissioning phase without consideration of proportionality.

3.2. Modification or installation of plant and equipment

The point above, about the potential for simple carry-over of operating licence conditions, is reflected also in the concerns of some operators that plant and equipment used for decontamination and dismantling activities are still subject to the same qualification procedures as applied to major items of plant during the operational phase. This can result in delay and additional cost.

In France, the new decommissioning regulatory framework requires continuously up-to-date and applicable safety documentation. This is a particular challenge during decommissioning because of the highly changing nature of facilities during decommissioning projects, and because some future situations may be difficult to describe in detail, because of inherent uncertainties. To allow the necessary flexibility, it was decided to allow the licensee to authorise internally small modifications that stay within the overall safety case for the facility. The safety authority has provided a clear list of conditions that the operator must respect in order to demonstrate this. The internal authorisation system implemented by the licensee has to be auditable by the safety authority and allow sufficient transparency so as to show, at any time, what the state of the facility is and what operations are being currently carried out.

In the United Kingdom, the general safety principle is that qualification procedures should be in place to confirm that structures, systems and components that are important to safety will perform their required safety function(s) throughout their operational lives, and that the qualification procedures should demonstrate a level of confidence commensurate with the relevant safety classification. This latter point is emphasized in the D&D context by reference to the need for proportionality.

In principle, general acceptance and implementation of these types of approach should deal with any concern that a piece of simple industrial equipment, for removal of low levels of radioactive contamination, for instance, might be subject to the same level of qualification requirement as an item of

nuclear fuel handling equipment, for example. To the extent that this remains an emerging issue of concern to operators, in their dealings with regulators, it needs further exploration.

3.3 Control of radioactive contamination

The control of radioactive contamination in the working environment is a matter just as important in the D&D context as in the operational context. Consequently, related licence conditions generally carry over from the operating phase of the plant into the D&D phase recognising, obviously, that work activities and plant configuration are changing continuously as D&D progresses, and that dismantling and cutting up of pipework and vessels carry a substantial potential for unexpected release of radioactive material.

In the D&D context, however, contamination of plant and buildings has a wider significance. It has a direct effect on the amount of decommissioning radioactive waste created, the extent of resources required for subsequent clean-up and could, in principle, restrict the options for future use of facilities, if that is foreseen for the site end-state. It therefore requires careful attention to be given to selection of the engineering systems and procedures for dismantling operations. This selection must balance the issues of nuclear safety, protection of the workforce, minimisation of waste creation, environmental protection, overall cost and the socio-economic issues associated with site end-state. Although all of these issues are relevant also during the operational phase of the plant, and the nuclear safety issues continue to be important into the D&D phase, the waste management, environmental and socio-economic issues need increased attention in this selection process. This is clearly reflected in the trends of importance attached to the various regulatory aspects identified in Germany, for example. There, it is reported that transition to D&D involves increasing importance for aspects concerned with modification of plant and systems for dismantling, decontamination and dismantling techniques and work permit procedures, flow of material within the plant, clearance of radioactive material and waste management aspects.

Against this background, the question arises again as to whether a nuclear safety body alone can deal effectively with all of the relevant aspects without involvement of bodies with responsibilities for waste management, conventional industrial safety, environmental protection and spatial planning. If not, the emerging issue is how these matters are handled in such a way that all interests are satisfied without placing conflicting requirements on the operator.

3.4 Human and organisational issues

Routine operation of a nuclear plant involves a stable, well-understood pattern of work activities and a stable workforce that is well trained and qualified for its functions. Regulatory control, by way of the site licence, generally involves agreed goals or safety cases for overall site operation, within a framework of established nuclear safety principles and standards, and agreement on an overall set of arrangements for compliance prepared by the operator. Precise details of the regulatory system vary from country to country depending, for example, on how prescriptive the legislation is. The common feature, however, is that regulatory supervision is facilitated by the stability of the plant function, management arrangements and workforce, and by sound regulatory understanding of the relevant plant and processes.

The transition from routine operation to D&D, however, involves substantial change in these factors. Instead of being focused on relatively few stable business objectives, the site activities reduce to a collection of diverse, and changing, projects and objectives such as dismantling or decontaminating individual items of equipment, clearing individual buildings or removing specific materials from the site. The focus and stability of site function are lost, the nature of the work force changes with employment of specialist contractors and their sub-contractors, and introduction of new activities and processes, with more conventional industrial hazards, requires nuclear site regulators to have, or have access to, a wider range of professional skills.

This new situation creates an emerging challenge for regulators. In Sweden, for example, it is reported that intensive supervisory activities are needed during decommissioning because of the emergence of so many new issues. This is not to imply that their regulatory requirements ignore the reduction in overall site hazard following removal of the bulk of radioactive material. Rather, it reflects the relative novelty of D&D regulation and the need to pay close attention to it until a larger body of experience is built up. In some other countries, such as the United Kingdom, D&D is seen as a continuously evolving task of progressive reduction of on-site hazards that comprises a variety of identifiable projects for which the continued use of existing operational management and regulatory arrangements is regarded as unsuitable.

The emphasis is now on management of change and is moving towards arrangements based on a project management approach. This places a responsibility on operators to devise a management system that delivers agreed objectives for each project, subject to defined regulatory hold points if appropriate. After agreement on the management system, this allows regulators to focus scrutiny on implementation of the system and delivery of its objectives

to an extent commensurate with the scale of hazard involved, the novelty of the work and the operator's record of performance. This also allows operators the flexibility to proceed with a minimum of delay, within agreed rules, which is also a feature of new D&D licensing arrangements in France. As with all standard management systems, it has to address the issues of staff numbers, training, qualifications, instruction, guidance and supervision. This latter issue is emerging as an important matter in regard to management and supervision of contractors and, even more importantly, their sub-contractors.

In France, in order to support the internal authorisation system, mentioned above in the specific context of plant modification, licensees are asked to implement within their own organisations a safety expert committee that shall be as open as possible outside their own organisations, e.g. by integrating experts from other national or international licensees, or technical experts from universities or non-nuclear organisations. Those members of an organisation who produce committee papers should not, themselves, be committee members. Furthermore, committee reports, discussions and conclusions shall be appropriately documented so as to allow inspection of the overall system by the regulatory authority. In response to this, *Électricité de France* (EDF) has established a national safety expert committee for decommissioning of power reactors. The same type of national committee has also been implemented by the *Commissariat à l'Énergie Atomique* (CEA). These arrangements allow a consistent approach on all power reactor sites in the process of decommissioning.

The first feedback on this internal authorisation system is very encouraging. The proposals that are internally authorised are often of a very good quality and independent assessors and committees take their role very seriously, because of the responsibilities involved. It has allowed very welcome safety empowerment of the licensees where, in the past, they had tended rely too much on the assessments and approvals of the regulatory authority, although they still legally responsible for safety. This system also allows the regulatory authority to focus its attention and resources to a smaller number of issues that have a major importance for safety. The emerging picture is that some form of internal authorisation system becomes a necessity when faced with the numerous and simultaneous projects in D&D.

3.5 Knowledge retention

The retention of knowledge has at least three distinct and very important aspects for effective D&D. As previously noted, it has long been recognised that plant design documentation with details of any modifications, and operational records with details of any untoward incidents, are of inestimable value in

characterising a plant and planning D&D activities. Although not strictly relevant to regulation of D&D it is worth emphasising the need for such record keeping during the operational phase. This is now widely accepted and it is generally included as a formal requirement in operational site licenses.

Equally, continuous documentation of the state of plant as it is dismantled is essential for safety of D&D activities. For example, if the use of existing pipework and vessels for movement and handling of radioactive materials in D&D is different from standard procedures during the operational phase, knowledge of this must be available for when such pipework and vessels are themselves dismantled. There are obvious analogies in regard to structural modifications, to avoid inadvertent collapse of plant and buildings at a later stage of dismantling, and in regard to electrical systems, to avoid the conventional hazards of electrocution and fire. In principle, such matters should be effectively covered by requirements of the relevant project management system but, with a workforce comprising temporary contractors and sub-contractors, that may be difficult to achieve in practice. This seems to be emerging as an issue of concern to operators and regulators, and might benefit from compilation of specific examples of how to deal most effectively with the matter.

A third aspect concerns the collective knowledge of individual members of the operational workforce and its value in planning and implementing D&D activities. This is perhaps an issue whose importance will reduce over time. It is currently important in those countries that were involved in early nuclear developments when priorities were different from those of today, and when thinking ahead to plant decommissioning was not a major issue. This has resulted in a legacy of experimental and prototype plant and equipment without full design and operational documentation. The same may be true of more recent plant, but to a lesser extent. In this situation, recovery of the knowledge of original operators is very valuable. The matter is also important in the separate context of a D&D strategy that involves maintaining a plant in its shut down state for a period of time before returning to use existing equipment for D&D activities. If the equipment is then obsolete, and unfamiliar to contemporary operators, it would be useful to be able to call on the experience of its original operators. Concern about the latter issue has caused France, for example, to move from a D&D strategy of delay for radioactive decay to one of early dismantling.

In either of these contexts, the difficulties associated with dependence on the knowledge of previous plant operators may be compounded in countries that abandon nuclear power, because they may no longer have access to a domestic workforce with sufficient knowledge of nuclear technology. This is an emerging

issue that is now being dealt with, in Europe at least, by way of programmes for maintaining relevant skills.

3.6 Funding of D&D activities

As explained previously, it is now widely accepted that secure arrangements for funding D&D should be made at an early stage in plant life. Most NEA member countries have requirements to address this. The details vary from country to country but the modern arrangements in Canada are broadly typical of how it is being addressed.

In Canada, the Nuclear and Safety Control Act (NSCA) and its regulations require that applicants and licensees make adequate provisions for the safe operation and decommissioning of existing or proposed operations. This includes the authority to include a condition in a licence requiring applicants to provide financial guarantees in a form that is acceptable to the Commission. To be acceptable to the Canadian Nuclear Safety Commission (CNSC), a funding measure must provide assurance that adequate resources will be available to fund decommissioning activities, based on information provided to the CNSC. The financial guarantee must be at arm's length from the licensee and the CNSC must be assured that it or its agents can, upon demand, access or direct adequate funds if a licensee is not available to fulfil its obligations for decommissioning.

Measures to fund decommissioning may involve various types of financial security. The acceptability of any of these measures is determined by the CNSC on the basis of the general criteria of liquidity, certainty of value, adequacy of value and continuity. Financial guarantees must be sufficient to fund the cost of decommissioning work resulting from licensed activities. If these funds or funding arrangements are not available, the possibility exists that the licensee may not be financially able to conduct the decommissioning activities that would be required to retire a facility permanently from service and to release the site from licensed control. The implication of this situation is that the regulator may be required, at the onset, to intervene to assure that the requirements of the NSCA are met. In addition, the regulator may also be required to assess legal avenues to determine if any assets or responsible parties remain, which would have an obligation to fund decommissioning activities. If a responsible party cannot be identified, and if the site is truly abandoned, as a remediator of last resort and in consideration of the public good, the government may be required to fund the decommissioning activities.

In practice, however, there may be situations when it is already too late to generate the necessary funds from operational revenues. In other situations it

may be difficult to fix the level of funding required for D&D because of uncertainty about the end-state, or arrangements for waste disposal, for example. In the European Community, nuclear reactor decommissioning is regarded a project that requires a formal environmental impact assessment. This is part of the process of licensing the D&D activity. It generally occurs quite late in the life of the plant and involves consultation with a range of bodies such as spatial planning authorities, highways authorities, various environmental authorities responsible for radioactive and conventional waste management, nature conservancy and natural heritage, the public and neighbouring Member States if appropriate. It also requires submission of information on plans for waste disposal to the European Commission, under the Euratom Treaty. Not until these matters are complete can there be certainty about end-state and waste management. Further difficulties may arise where there are no definitive plans for long-term management of the radioactive waste arising from D&D. In some cases, as in the United Kingdom for example, this may require the construction of new stores on sites undergoing D&D, to accommodate waste until its long-term fate is decided. This involves additional cost by way of their construction and then subsequent demolition.

4. CONCLUSIONS AND KEY MESSAGES

The WPDD has reviewed the accumulating experience of operators and regulators in dealing with the transition of nuclear plant from operation to D&D. This has confirmed that there are no systematic weaknesses in nuclear safety regulation. It has also identified some issues and trends that are emerging as a result of the reduction of nuclear hazards, the increasing emphasis on conventional industrial hazards and environmental matters, and the changing nature of work patterns. The associated messages are as follows.

- In regard to protection of overall health and safety, details of the simultaneous regulation of nuclear safety and conventional industrial safety may need some development as the latter becomes increasingly significant in D&D activities.
- Arrangements for qualification of plant and equipment for D&D activities may need further consideration. These need to ensure that qualification requirements are flexible, commensurate with the related safety implications and do not simply carry over from the operational phase without reconsideration.
- In D&D, radioactive contamination of plant and buildings, in addition to affecting radiological safety in the work place, has significant influence on matters such as waste management and environmental protection, socio-economic issues associated with site end-state, and overall cost. It is important, therefore, that selection of engineering options for D&D involve bodies with responsibility for these wider issues.
- On transition from operation to D&D, nuclear site activities reduce to a collection of diverse, and changing, projects and objectives. The emerging question is how best to transform management and regulatory systems to cope with the new activities and work patterns. A particular issue is about how to maintain current high standards with a workforce that is partly comprised of temporary contractors and their sub-contractors. Internal licensee authorisation systems seem to have an important part to play in this.

- Retention of knowledge is emerging as an issue of concern to operators and regulators. It concerns the recording of important plant information as D&D progresses, recognising the involvement of temporary staff, and the recovery of knowledge held by previous plant operators for use in planning and implementing D&D. The issue might benefit from compilation of specific examples of how to deal most effectively with the matter.
- The need for arrangements to secure adequate and timely funds for D&D is well understood. The necessary framework is already in place in many countries but it can only be implemented effectively with a realistic and timely estimate of the overall costs and timing of spend. Uncertainties, about site end-states and waste management and disposal arrangements in particular, are emerging as a hindrance in this regard, and need further consideration.

A final observation is that many of these issues involve a range of authorities, in addition to the nuclear safety authority, so arrangements for effective communication and co-ordination are essential.

Appendices

National Examples of Recent Evolution in Nuclear Site Licensing for D&D: Relevant issues and Emerging Practices

Appendix 1

FRANCE

1. Introduction

The Nuclear Safety Authority (ASN) now strives to integrate relevant experience feedback from past dismantling projects in France and abroad. The ASN encourages complete dismantling either immediately or after slight postponement, provided that upstream of the regulatory process, the operator is able to present and justify the chosen dismantling scenario, from the final cessation of production up to the final dismantling of the installation (end-state). Regulatory practices concerning nuclear installations dismantling operations were updated along these lines from 2003 (unique decommissioning license) to 2006 (safe termination of practices). A new regulatory framework was introduced in 2006 with the act of the 13 June 2006.

2. Overview of decommissioning in France

2.1 French approach and history to regulatory review until the new regulatory framework in 2006

2.1.1 Before and during the 1990s, until early 2000s

The general regulatory framework was modified at the end of the 1980s to cope with the necessity of regulating the first shutdown power reactors. This general regulatory framework regarding nuclear facilities is given by the amended decree of 11 December 1963. Before 1990, this decree did not include any provisions for the decommissioning of nuclear facilities. Some small research facilities, located on complex nuclear sites, have been decommissioned before that date; this was done under a case-by-case licensing process. It has to be noted that at the end of the 1980s, the general context was a power reactor licensee's strategy involving systematically a deferred complete dismantling. This strategy consisted of extracting the fissile material, removing the easily recoverable parts, reducing the contained zone to a minimum and fitting out the external barrier. Complete dismantling of the installation was then envisaged by

EDF (NPP operator in France) after several decades of containment, in particular to take advantage of the natural radioactive decay of ^{60}Co in the reactors cores. At that time, the regulatory approach was to license decommissioning as successive modifications of the facility (step-by-step approach); each of these modifications was to be licensed on the basis of a safety report corresponding to the future decommissioning phase. The framework referred to the IAEA decommissioning levels and required at least a license to move from Phase 2 to Phase 3. An approach of this type had its drawbacks, notably in that it could lead to a gradual loss of knowledge of the facility, as its operators departed, which could be prejudicial to the dismantling operations. The financial cost of the care-and-maintenance period is very high, and the advantage of the natural radioactive decay of ^{60}Co is less important after the first decade (exponential decrease).

After the first applications of this framework in the 1990s, this regulatory approach appeared to have also the following drawbacks:

- Decommissioning of a power reactor would have needed often at least 2 or 3 successive licenses, whereas only one is needed for the creation of a new facility, which did not seem to fit the relative low safety hazard level of a facility under decommissioning.
- The regulatory framework was written for power reactors and was not easily applicable to other types of facilities, in particular smaller facilities like prototype or research facilities, where the complicated licensing requirements were clearly not proportionate to the hazard levels.
- The framework did not require from the licensee, nor allow the regulator, to have an overview of the overall decommissioning project, that could allow to examine the global optimisation and impact of the project.

From the safety point of view, the nuclear safety authority concluded that there was a need to promote immediate decommissioning approaches, mainly because of knowledge loss and ageing management issues of the facilities. The regulatory framework was not compatible, as it did not favour such immediate decommissioning approaches, because of the regulatory burden it involved. Also, it did not contain any provision for the license termination process, as this problem was not to be dealt with until many years. As a result, the ASN asked EDF to review this strategy and to evaluate the feasibility of reducing the time needed to undertake complete dismantling work.

At the beginning of the 2000s, some decommissioning projects had been licensed and had begun. The first licenses delivered on the decommissioning of power reactors contained a license condition requiring EDF to periodically evaluate its decommissioning strategy from the safety point of view. The studies undertaken in response to the ASN request persuaded EDF to review its strategy, and to adopt an accelerated dismantling scenario for its first-generation reactors.

On the other hand, the financial difficulties of the Atomic Energy Commission (CEA) for decommissioning were overcome through the organisation of a dedicated decommissioning fund. Many decommissioning programs that had been postponed were hence to begin rapidly or to be finished, which required an adequate licensing process.

All the preceding considerations lead to the necessity to modify in-depth the regulatory framework for decommissioning.

2.1.2 The regulatory framework introduced in 2003

The nuclear safety authority defined a licensing framework for decommissioning that responded in particular to the following considerations:

- Allow an overview of the global decommissioning project, including an intended end-state.
- Issue only one license for the whole decommissioning project.
- Proportionate the regulatory activities to the actual hazard of the facility (develop a graded approach).
- Introduce a regulatory framework for the license termination process.

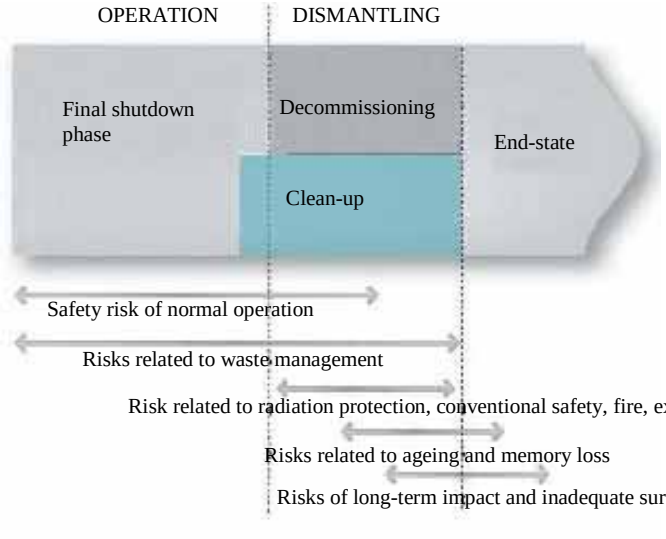
All of these new provisions are detailed in note SD3-DEM-01.The advantages of requiring an overview of the decommissioning project are thought to be far greater than the drawbacks associated with the fact that the last decommissioning phases occurring on the long term cannot be described in detail at that stage. Taking into account the intended end-state from the beginning of the decommissioning project can lead to its overall optimisation, influencing possibly even the very first decommissioning operations.

For the licensing process, the licensee hence has to produce a report on its strategy, including the safety assessment of each successive decommissioning phases or main operations. The first phases or operations have to be described and assessed in detail, while later phases or operations can obviously be

described and assessed involving only the main safety options. The particular license for the decommissioning project, basing on an in-depth assessment, will specify, if needed, particular future phases or operations that will necessitate a particular regulatory authorisation, based on a detailed safety assessment, if it is thought that they are of particular importance from a safety point of view.

The chart shown below (Figure 1), which is an illustration of the new regulatory framework, gives the two phases of the life of a facility, and the related risks. Each phase is authorised by one decree.

Figure 1: **Plant shutdown phases and associated risks**



While increasing the ambition of the initial licensing process, it was felt necessary to allow the licensee more flexibility in the details of decommissioning operations. This move was consistent with the wish to adapt the regulatory burden to the hazard, but also because decommissioning always involves its stake of unexpected findings that need sufficient flexibility to be dealt with. This is why an internal authorisation system has been fostered (see section 2.3).

2.2 The new regulatory framework introduced in 2006

In France, major improvements have been included in two acts in 2006.

2.2.1 The Act of 13 June 2006 on transparency and security in the nuclear field (TSN Act)

The act of 13 June 2006 on Transparency and Security in the Nuclear Field specifies that decommissioning has to be taken into account at the creation of a basic nuclear installation. The licensee must prove that the general principles proposed for decommissioning are likely to prevent or limit sufficiently the risks or drawbacks presented by the facility. The technical and financial capacities of the licensee which must allow him to cover the costs of decommissioning the installation and conduct remediation work, and to monitor and maintain its location site, must be demonstrated. A decommissioning plan, including technical and financial capacities to perform decommissioning, must be provided at the creation of a nuclear installation. This plan has to be updated, if needed, during the facility life cycle. Three years before the final shutdown, an updated version of the decommissioning plan has to be provided to the regulatory body. One year before the final shutdown, the operator has to apply for a decommissioning license. The license application file must include, *inter alia*: a safety report, the general supervisory and maintenance rules for decommissioning, an updated document proving the technical and financial capacities of the operator to perform the decommissioning, an environmental impact assessment, and, if needed, a project of public easement.

This new regulatory framework should allow to anticipate, as much as it is possible, the decommissioning phase, and to shorten the transition period from the operational period to the implementation of the decommissioning plan.

A decree on licence application examination procedures should be published soon and detail the decommissioning procedure.

2.2.2 The Act of 28 June 2006 on sustainable management of radioactive material and waste

According to this Act, operators must assess the costs of dismantling their installations. In the same way, they must assess the management costs of their spent fuels and radioactive wastes. A report of these assessments is sent to ASN every three years. A national financial evaluation commission is created to assess the funding of the costs in dismantling and managing spent fuels and radioactive wastes.

2.3 The internal authorisation system

2.3.1 Description

The new decommissioning regulatory framework reaffirms the need to have at any moment in the facility an up-to-date and applicable safety documentation. This is a particular challenge during decommissioning because of the highly changing nature of facilities during decommissioning projects, and because some future situations may be difficult to describe in detail, because of inherent uncertainties.

To allow this needed flexibility, it was decided to allow the licensee to authorise internally small modifications that stay within the overall safety demonstration of the facility. The safety authority has provided a clear list of conditions that the operator must respect to prove that the intended operations stay within the overall safety demonstration.

From the safety authority point of view, the internal authorisation system implemented by the licensee has to be auditable (by means of on-site inspections), and allow sufficient transparency so as to know at any time what the state of the facility is and what operations are being currently carried out.

To achieve this goal, the licensee is asked to implement within its own organisation a safety expert committee that shall be open as possible outside its own organisation, e.g. by integrating experts from other national or international licensees, or technical experts from universities or non-nuclear organisations. A particular care shall be taken that the members of the committee charged with the examination of a file be different from the file writers; this is particularly important in the case of small licensee organisations. This has lead, in the case of decommissioning of power reactors at EDF to implement only one national safety expert committee. The same type of national committee was also implemented by the CEA. This choice was also made so as to implement a consistent approach on all power reactor sites in the process of decommissioning.

For each file that is examined by the expert committee, a critical report shall be established and presented to the committee by independent assessors from the file writer. The critical report, committee discussions and conclusions shall be appropriately documented so as to allow inspection of the overall system by the regulatory authority. The final decision is taken by the licensee representative, legally responsible for safety. To allow sufficient transparency with regard to the regulatory authority, a program of the operations and

modifications foreseen in the next year has to be established by the licensee and updated as required.

After each internally authorised operation or modification has been implemented, a feedback document is established by the licensee, and sent to the regulatory authority. This allows the regulatory authority to increase its knowledge of the possible problems encountered and make them share with other licensees if appropriate. This feedback document is also to include information such as dosimetry, waste production and management routes, etc.

Of course, the safety authority implements inspections of the whole internal authorisation system to check whether, in particular, independence of assessment and serious critical review is actually implemented by the licensee. Inspections are also performed, as usual, within the facilities.

2.3.2 Feedback

Numerous decommissioning license applications are currently being assessed (NPP or research facilities). The license termination process has been successfully applied to some small facilities (accelerator, fuel manufacturing plant…). The first feedback of the internal authorisation system is very encouraging. The files that are internally authorised are often of a very good quality and independent assessors and committees take their role very seriously, because of the responsibilities involved. This has also allowed a very much wished safety empowering of the licensees: although they are legally responsible for safety, they had tended in the past to rely too much on the assessments of the regulatory authority and subsequent authorisations, which was not a trend to wish for. This system also allows the regulatory authority to focus its attention and resources to a smaller number of issues that have a major importance for safety. Internal authorisation systems become a necessity when faced with numerous and simultaneous decommissioning projects.

The TSN Act deals with the internal authorisation system.

3. The Safe Termination of Practices

3.1 Regulatory framework for the complete clean-up of facilities building structures

As already stated, the complete clean-up of facilities under decommissioning is the regulator's favourite option. The safety authority issued a regulatory document at the beginning of 2006, to state its requirements in the field of clean-up of building structures (e.g. concrete walls), which may contain

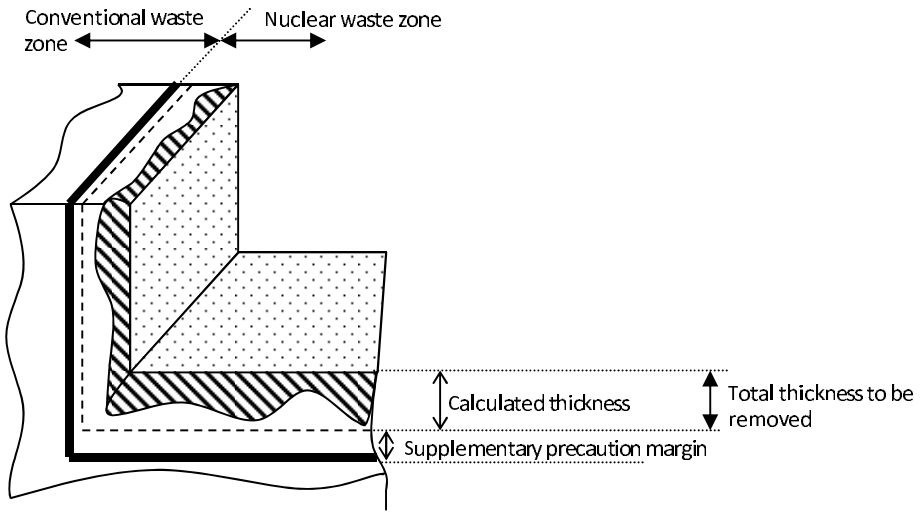
artificial radioactivity, mainly due to activation or contamination migration phenomena.

When an operator wants to remove all the active parts of a building structure – in order to declassify a “radioactive waste zone” in a “conventional waste zone” it must develop a methodology based on the defence in-depth concept.

Three independent and successive defence lines must be implemented:

- Based on his knowledge of the facility (history, incident…) and the comprehension and quantification of the physical phenomenon (activation or contamination migration), the operator must define a clean-up depth (within the structure), which will be applied during clean-up operations. The integration of all uncertainties must be included in a supplementary precaution margin (Figure 2).
- The remaining structure must be controlled and meet the clean-up objectives.
- All the waste that is evacuated from the site must be controlled.

Figure 2: **Definition of zones of contamination**



As there are no universal clearance levels in France, the clean-up objectives set by the operator may be justified on the basis of residual impact assessment. The clean-up methodology must be presented to the ASN three months before the beginning of the clean-up operations. This methodology should include all relevant information concerning the structures stability, the protective measures to avoid the spreading of contamination, the waste management, and the monitoring measures. All of these new provisions are detailed in note SD3-DEM-02.

On the basis of a results report including the quantities of generated waste, the residual radiological map, and all relevant information to prove that the clean-up objectives have been met, the "nuclear waste zone" can be declassified to a "conventional waste zone". This declassification must be approved by the nuclear safety authority. When all the "nuclear waste zones" of a facility have been declassified to "conventional waste zones", the facility itself can be declassified (it has not the administrative status of "basic nuclear installation" anymore). If the remaining building structures should be dismantled afterwards, the generated waste will be considered as conventional waste. It has to be noted that the "green-field" condition is not requested as an end-state by the ASN.

4. Conclusion

In France, there are nearly 160 nuclear facilities. Since the beginning of 2003, the nuclear operators have submitted numerous decommissioning plans in accordance with the guidelines of the regulatory framework. Nowadays 32 facilities are in the final shutdown phase or in the decommissioning phase; 14 decommissioning licenses have been provided.

Twenty facilities have been declassified since the beginning of the 1980s, and four of them have been declassified under the new regulatory framework for declassification.

In the next three years, 16 decommissioning licenses should be provided and 5 of them will be instructed with le TSN act process; eight facilities should be declassified before 2010.

Appendix 2

GERMANY

1. Legal and regulatory framework for D&D

In Germany, the legal bases for licensing procedures for the decommissioning of nuclear facilities are the Atomic Energy Act (*Atomgesetz*, AtG), statutory ordinances promulgated on the basis of the AtG, as well as general administrative provisions. Section 7, para. 3 of the AtG contains the basic requirement for the licensing of decommissioning. It stipulates that for any installation which has been licensed according to Section 7, para. 1 of the AtG, the decommissioning, safe enclosure or dismantling of that installation or of parts thereof once operation has been permanently suspended shall require a licence.

The licensing procedure for the decommissioning of nuclear facilities is governed by the Ordinance Relating to the Procedure for the Licensing of Facilities (*Atomrechtliche Verfahrensverordnung,* AtVfV) in accordance with Section 7 of the Atomic Energy Act. It contains regulations pertaining to decommissioning, particularly with regard to third party involvement and environmental impact assessment (EIA).

The Radiation Protection Ordinance (*Strahlenschutzverordnung*, StrlSchV) is also relevant for the decommissioning of nuclear facilities, as it specifies technical and operational measures, procedures and precautions to prevent damage caused by ionising radiation. This includes the definition of the principles of radiation protection, the regulations concerning transport and transboundary shipment of radioactive materials, for clearance, for knowledge in radiation protection, for in-plant organisation of radiation protection, for protection of individuals in radiation protection areas, including physical supervision of radiation protection, for the protection of the public and the environment, for the protection against significant safety-related events as well as for radioactive wastes.

The necessity of an environmental impact assessment (EIA) for D&D of nuclear facilities is stipulated in the German Environmental Impact Assessment Act (*Gesetz über die Umweltverträglichkeitsprüfung*, UVPG). Also the AtG and the AtVfV provide regulations relevant for the performance of the EIA.

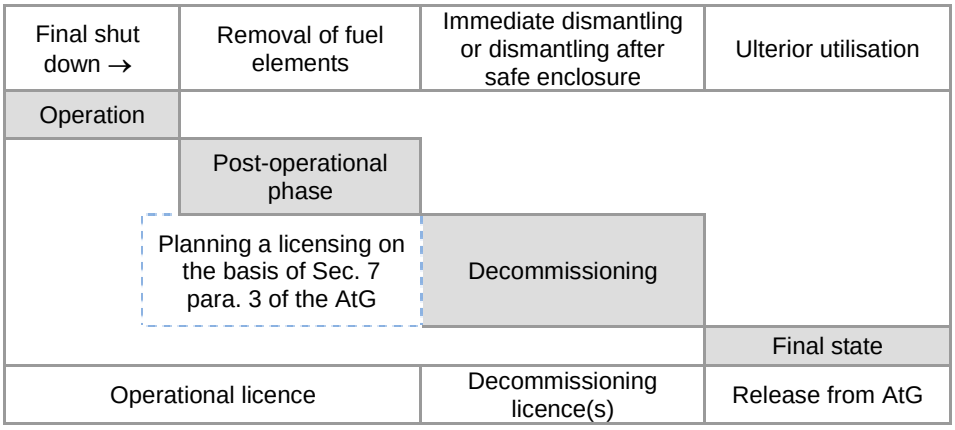
A whole range of codes and guidelines of a predominantly technical nature exists below the level of laws and ordinances on the so-called sub-legal level. These are, in particular, the publications of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), administrative instructions and recommendations by the Commission on Radiological Protection (SSK) and the Reactor Safety Commission (RSK), as well as regulations of the Nuclear Technical Committee (KTA).

2. Participants in the nuclear licensing and supervisory procedure

When a nuclear facility is to be decommissioned, the licensee or plant owner has to apply for a decommissioning licence. In the case of larger facilities, the licensing procedure is often divided into several steps. Partial permits are issued for each step.

The licence application, supplemented by specified documents, has to be submitted to the regulatory body of the respective Federal State (Land). These documents describe among other things the decommissioning process, the planned dismantling measures, the associated techniques to be used, the environmental impact, the safety assessment, and the provisions for radiological protection. The full particulars are given in the AtVfV.

Figure 1: **Procedure of decommissioning of nuclear facilities**

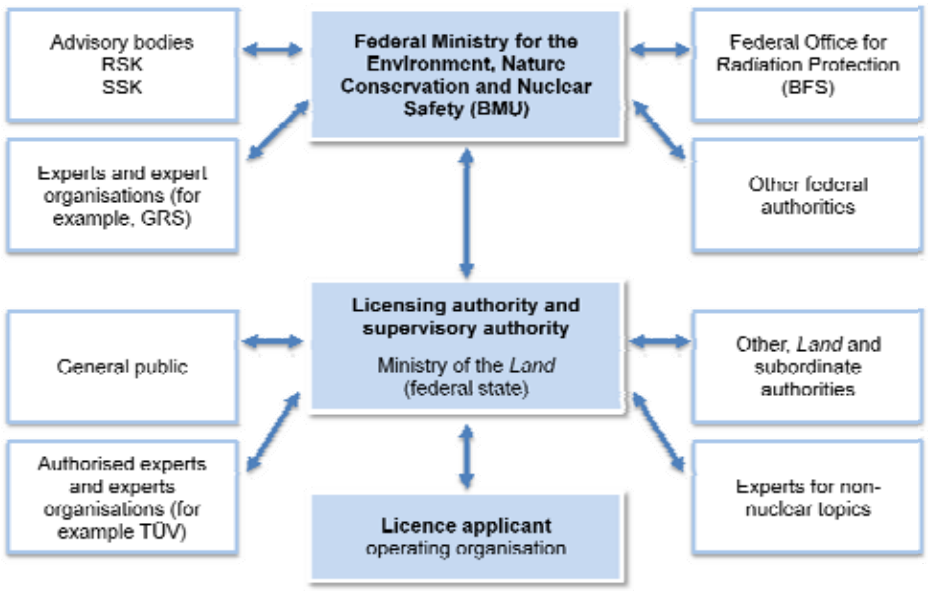


The planning for in-time licences is an important task for the applicant. In the case of the first application for a decommissioning licence it is required to describe the overall D&D concept and to ensure that it is meaningful. The EIA is part of the licensing process and reviews the whole range of impacts of a given project on the environment. In general, the operational licence is suspended by the decommissioning licence.

The Federal States execute the AtG under the supervision of the Federal Government (federal executive administration). The competence for granting, cancelling or withdrawing a licence lies with the regulatory body which is the respective Federal State ministry responsible for nuclear regulations. The work authorised by the decommissioning licence is supervised by the responsible regulatory body of the Federal State in order to assure compliance with specified conditions and restraints. Independent experts are typically involved to carry out supplementary controls and assessments by order of the regulatory body.

The BMU is supervising the licensing and supervising activities of the Federal states and is entitled to give directives to the Federal states. In this context, the BMU may request technical and scientific advice from the Reactor Safety Commission (RSK), the Commission on Radiological Protection (SSK), expert organisations [for example, Society for Facility and Reactor Safety (GRS)], and the Federal Office for Radiation Protection (BfS).

Figure 2: **Relations among the parties involved in D&D**



3. Guide to decommissioning

The Guide to Decommissioning of Facilities under Section 7 of the AtG has been adopted since 1996 as a consensus between the Federal Government and the authorities of the Federal States to foster an effective and harmonised approach in licensing procedures for decommissioning. It pursues the following aims:

- to compile the aspects of licensing and supervision which are relevant in decommissioning procedures;
- to develop a common understanding between the Federal Government and the Federal States on how to carry out decommissioning procedures; and
- to harmonize the opinions and approaches as far as possible.

In particular, the Guide to Decommissioning contains proposals for a practical approach concerning decommissioning as well as the safe enclosure and the dismantling of nuclear installations according to Section 7 of the AtG with respect to the application of the sub-legal regulatory framework, the planning and preparation of decommissioning measures as wells as licensing and supervision. At present, the Guide to Decommissioning is under revision and is adapted to the changes in the regulatory framework which have occurred since 1996.

4. Hazard potential and measures to ensure safety during D&D

Unlike during the operation of a nuclear facility, there is practically no energy potential for releases of a considerable quantity of radioactive substances resulting from criticality and decay of radioactive substances or inherent in the pressure and temperature conditions of the operating media. Furthermore the decommissioning of a nuclear facility is characterised by a continuous decrease in the plant's radionuclide inventory, mainly by means of removal of the fuel elements and the high-active operational waste, by decontamination and the dismantling of contaminated and activated material, as well as by the final removal of any residual radionuclides above clearance levels and the release from nuclear regulatory control. Generally speaking, this coincides with a continuous decrease in the hazard potential as dismantling progresses. Allowance is made for this fact by including specific decommissioning regulations and recommendations in the sub-legal regulatory framework, as well as by application of the existing regulatory framework or by revoking supervisory regulations and requirements during the licensing and supervision procedure in line with the decreasing hazard potential.

The same general safety standards apply during decommissioning of a nuclear facility as to its operational phase, although there are some significant differences in certain details. For example, the option of criticality no longer applies to nuclear reactors once all fuel elements have been removed from the plant, and the level of radioactivity which is discharged to the environment with authorised liquid and gaseous releases usually is considerably lower.

As a rule, the following events during decommissioning projects are to be considered and evaluated from the point of view of safety:

- Fire in the facility.
- Leakage of vessels or systems.
- Falling of loads.
- Failure of supply systems.
- Criticality accident (where a relevant quantity of nuclear fuel remains).
- Penetration of water into the safe enclosure.
- External impacts (e.g. earthquakes, storms, floods, penetration of gases).

Nearly all of the accidents within the plant can be assigned to the “basic types” fire, leakage of a vessel containing radioactive fluid and falling loads. The accident fire in the facility is radiologically representative of these “basic types”, in particular if failure of the filter system in consequence of fire.

Continuous regulatory inspection and supervision from the start of the construction to the end of the decommissioning is an important instrument to ensure safety. The responsibility for inspection lies with the respective Federal State (Land) authority. Basically, the philosophy and programme for regulatory inspections are similar during operation and decommissioning. The supervisory authority pays particular attention to the compliance with the legal framework and the licensing requirements. It monitors, with the help of authorised experts, in particular,

- compliance with operating procedures;
- discharge limits;
- criteria for the release of materials, buildings and sites from nuclear regulatory control; and
- occupational and public radiation protection.

Experience accumulated from various decommissioning projects of nuclear facilities in Germany shows that the expert knowledge of the plant's operating staff is extremely valuable for the safe and efficient execution of D&D. For this reason, the operator aims at involving the operating staff in the decommissioning phase as far as possible.

5. Knowledge retention and documentation

The keeping of records of information important to decommissioning concerns, firstly, records pertaining to the construction and operation of nuclear facilities which will need to be accessed later in the decommissioning phase; and secondly, records generated during decommissioning and which are relevant to the long-term documentation of decommissioning itself.

The basic requirements for documentation are essentially laid down in the BMI Guidelines "Basic principles for the documentation of technical data by the applicant/licensee for the construction, operation and decommissioning of nuclear power stations", "Requirements of documentation for nuclear power plants" and KTA Safety Standard 1404 "Documentation for the construction and operation of nuclear power plants". The need for all relevant documentation to be kept available is derived from criterion 2.1 of the Safety Criteria which stipulates that all documentation necessary for quality assessment must be kept available.

Not only the state of the plant at the start of operation must be fully documented but this documentation must also be adapted to all changes and must reflect the actual state of the plant at all times. This ensures that all relevant information from the operating phase is available when required for the decommissioning phase. The period for which records have to be kept depends on the type of documents and the necessity to keep them available. Within the context of nuclear regulatory supervision, the competent authority satisfies itself that the records have been duly updated and correctly filed.

As for the operating phase, information from the decommissioning phase which have to be kept for longer periods of time cover a number of topics, such as operation, surveillance and radiation protection, in particular:

- protocols from the shifts;
- protocols of surveillance and measurements of activity releases;
- reports on accidents and incidents as well as the chosen counter-measures;
- record keeping of measurements of individual doses and body doses;

- record keeping on extraction, production, acquisition, transfer and other dispositions of radioactive substances;
- protocols of contamination measurements in cases where limits were exceeded; and
- data concerning the release of radioactive and non radioactive materials including methods of measurement and clearance procedures.

Records and documentation must be deposited with the competent authority at the request of the latter.

For decommissioning projects in the future a recapitulatory final decommissioning report shall be prepared that documents, in particular, the decommissioning, dismantling and the end state of the facility or site and this report shall be preserved together with the documentation. An accordant demand will be included into the presently updated Guide to Decommissioning.

6. Funding of D&D activities

In the case of publicly owned or inherited facilities (research reactors; facilities within research centres or at universities; prototype reactors and the Greifswald and Rheinsberg nuclear power plants), decommissioning funds are being provided within the annual Federal budget. In the case of research and prototype facilities the Federal Government typically covers 90% of the costs, while the rest is borne by the respective Land. The decommissioning of the nuclear power plants in Greifswald and Rheinsberg, inherited from the former GDR, is completely financed by the Federal Government. Financing includes all expenses incurred for the post-operational and transition phase, disposal of the fuel assemblies, execution of the licensing procedure, dismantling of the radioactive part of the facility, and disposal of the radioactive wastes, including all preparatory steps.

In the case of privately owned facilities (for example, NPPs and fuel cycle facilities) financial reserves have to be accumulated during the operational phase by the owner of the respective facility. The legal basis for accumulating and managing of financial reserves is provided by an interaction of several laws:

- the Atomic Energy Act (AtG) requires the removal of waste;
- the Commercial Code (HGB) requires to accumulate financial reserves for future liabilities;
- the Income Tax Law (EStG) regulates the taxation of reserves.

These reserves include the costs of the post-operational phase in which the facility is prepared for dismantling after its final shutdown (including removal of fuel elements and operational wastes), the costs for the licensing procedure and supervision, the costs of dismantling (dismantling and interim storage of all components and all buildings of the controlled area), and the cost of the interim and final storage of all radioactive wastes from decommissioning. The reserves are held in the portfolio of and managed by the owners of facilities. Reserves reduce the income of the operators subject to taxation. Annual cost calculations have to be prepared in order to justify the amount of the respective reserves which are reviewed by tax authorities.

7. Emerging practices

7.1 Removal and transport of complete large components

A new development in dismantling is increasingly the removal of complete undismantled large components and their transport to and storage in interim storage facilities. In 2007 licences were granted to the Greifswald (units 1 to 4) and Rheinsberg NPPs (both EWN GmbH) for the removal of the complete undismantled reactor vessels and their transport to the interim storage facility at Lubmin. During the period of interim storage, the radionuclide inventory of the components will decrease due to radioactive decay and the following segmentation of the component can be done with less radiation protection measures. After start of operation of a final disposal facility it must be decided, whether the segmented components can be released from nuclear regulatory control or must be disposed of as radioactive waste. One further example is the high-temperature reactor in Jülich (AVR GmbH, subcompany of EWN GmbH). It is planned to fill the reactor tank of AVR with light-weight concrete and to lift the complete reactor tank (weight about 2 000 Mg) out of the reactor building. Subsequently the reactor tank will be stored in a nearby interim storage facility.

7.2 Radioactive waste management

The Konrad repository had been licensed on 22 May 2002 for all kinds of radioactive waste with negligible heat generation. All legal suits that were filed against the granting of a licence had been rejected by the competent Court by 8 March 2006. Complaints against the Court's decision have been definitely rejected by the Federal Administrative Court on 3 April 2007. Following necessary planning adjustments the former iron ore mine will then be converted into a repository for radioactive waste with negligible heat generation. On 30 May 2007 BMU designated the Federal Office for Radiation Protection (BfS) as the competent authority to conduct this work. BfS has set up a project

group and immediately started the work, which is planned to be completed within a period of six years, i.e. in the year of 2013.

As a consequence, the KWL decommissioning project in Lingen – at present in the state of safe enclosure – has announced its intention to apply for dismantling in the year 2008 on the grounds that a repository for the emerging decommissioning waste will be useable in the predictable future.

It is possible that the expected availability of a repository will influence the planning of D&D in terms of selection of a decommissioning strategy, waste management and the need (or not) for interim storage of decommissioning waste.

Appendix 3

ITALY

1. Introduction

The following examples are primarily related to the nuclear licensing by the relevant regulatory authorities.

Licensing rules have not changed significantly in the last 5 years. While the decommissioning licensing procedure is defined in the law, in general no specific technical ground rules have been developed for the decommissioning phase.

Authorisations to the overall decommissioning plans established by the nuclear Act have not yet been granted mainly due to the lack of a national site for waste storage. Nonetheless some decommissioning related activities, not involving parts or components of nuclear islands, have already been performed and are in progress on the basis of authorisations granted according to specific provisions of the nuclear Act.

The experience resulting from the management of NPPs shutdown since many years clearly indicates some other priorities before starting the bulk of the dismantling activities. In particular there is the need to remove the spent fuel still present in the pools and to manage (conditioning and storage), the waste already existing on the sites, generated by the past operation.

2. Health and safety of the workforce

No specific evolution may be identified in this field in the last 5 years.

Radioprotection controls are kept at the same level as during operation. In some cases, as in the case of the workers operating in areas potentially contaminated by plutonium the controls have been even increased and also performed with more sophisticated methodologies. These practices are followed with the full agreement of the Safety Authorities.

Also external contractors are monitored with a high degree of attention.

It is worth mentioning that the Legislative decree n° 230 of 1995 introduced new limits for nuclear practices, aimed at maintaining doses to the general public below radiological concern values. The dose limits now applicable to the dismantling activities are therefore lower than those applied at the time when the nuclear installations were in operation.

3. Approval of modification or installation of new plant and equipment

The transition from plant operation to decommissioning has not seen a parallel implementation of different requirements for the modifications and the installation of new systems and components functional to the safe management of spent fuel and radioactive waste.

The requirements for the construction and operation of new installations needed to carry out the decommissioning activities are graded on the bases of the risk connected to the activity. The graded approach has been implemented, for instance, to external event protection consideration, redundancy, safety margins, equipment qualification, etc. Due to the evolution of the standards and to the extended conservation period, these requirements are sometimes even stricter than the original requirements applied to the rest of the plant to be decommissioned. The tuning of the most appropriate set of requirements is sometimes leading to delays, inconsistencies with existing equipment, and additional costs. In most cases the full licensing procedure has been followed for added systems, with a level of assessment commensurate to the relevance of the risk.

4. Control of radioactive contamination

Practices in the field of defining boundaries of the controlled areas and radioprotection practices remained practically the same as in operation.

Same considerations apply to the ventilation systems that should be adapted to the evolving configuration of the plant, while keeping the same air flow paths from rooms at lower contamination to room at higher contamination.

5. Control of human and organisational issues

In many cases the same basic organisation of the operation phase is still in place in particular for the positions required by regulations. These include control room operators and shift supervisors as well as the security guards. Detailed planning for manpower evolution is difficult to prepare, since there are

no consolidated regulation and guidelines on the possible ramp down with the parallel reduction of hazards.

For other positions several reorganisation processes took place after the definitive shutdown of the plants that partially prevented the achievement of a consolidated organisation structure.

An important point is the adaptation of the Emergency Plan to the evolving situation during decommissioning. At present the current requirements have not changed from those during plant operation. The possible downgrading of emergency planning requirements is evaluated in the context of the overall decommissioning plan evaluation.

6. Knowledge retention

Knowledge retention is a primary concern also for the implementer. This concern ranges from keeping and improving safety culture, to maintaining archives of plant drawings and also of the history of plant operation, to keeping the more general knowledge of know-how and also know-why.

The licensing process cannot take appropriate benefit from a strong technical support and international partnerships.

7. Others

The role of the local authorities is significantly increased as a consequence of Italian constitutional changes and European directives and the corresponding powers delegated to local level (Regional, Provincial, and Municipal).

In this sense the evolution of the research for larger consensus has seen the start of parallel “informal” licensing paths.

Appendix 4

SPAIN

1. Introduction

The reference regulatory framework for the decommissioning of the Spanish nuclear facilities is established in the Royal Decree 1836/1999 adopting the current regulation on nuclear and radioactive facilities that provides, for the first time, the administrative process of licensing the decommissioning of nuclear and radioactive facilities, and regulates the whole administrative procedure, specifying the documentation that the licensees of such facilities must provide. Chapter VI of this regulation on nuclear and radioactive installations is dedicated fully to the system of administrative authorisations for the decommissioning of such installations.

Two basic authorisations are required for the decommissioning of a nuclear facility: the dismantling permit to be granted once its operation has ended and the decommissioning statement which would release the operator from his nuclear responsibility.

The dismantling permit allows the licensee to perform the decommissioning works and requires the submission of the following documentation:

- Safety analysis report.
- Operating regulation.
- Technical specifications applicable to dismantling phase.
- Quality assurance manual.
- Radiological protection manual.
- On-site emergency Plan.
- Radioactive waste Management plan.
- Site restoration plan.
- Financial/economical study.

In addition to nuclear regulation, the dismantling permit requires a positive evaluation of the Environmental Impact by the Ministry of Environment.

2. Health and safety of the workforce

The transition from plant operation to plant decommissioning requires a change in the workforce culture from a purely “nuclear mentality”, associated with the safe and reliable operation of a nuclear power plant to a more “industrial safety and radiological protection mentality” involved in what will be a construction site during decommissioning.

Radiological protection of workers should take into account the lost of physical barriers, the proximity of radiation sources to workers and the control of radioactive contamination during decommissioning. In addition, a detailed knowledge of the radiological conditions in the different working areas and its evolution with time is required.

Staff training and monitoring of the work environment are important aspects required by the Regulatory body.

Industrial Safety is becoming more important during decommissioning than during the operation and constant attention should be dedicated to minimize the extra hazards of adding a construction environment on top of a nuclear dismantling.

Once the spent fuel has been removed from the plant, the consequences of accidental risks are much lower than for a plant in operation. In this case, the applicable annual effective doses limits to the public members, considering all radioactive pathways is reduced to 5 mSv/a.

3. Control of radioactive contamination

During the dismantling activities, mainly cutting activities and those which release radioactive particles to the work environment, workers may be exposed to a risk of internal contamination with radioactive material. Therefore the regulator requires a more extensive monitoring program of workplace and individual contamination than during the operation, in particular alpha contamination.

Ventilation systems should be adapted to the expected environmental contamination levels and should take into account the evolving configuration during decommissioning.

4. Approval for modification or installation of plant and equipment

The first step is the definition whether or not a system, plant or equipment is important for safety or radiological protection. If a system is important for the safety, according to the Accident analysis, it should be included in the Technical specifications and the approval for modification follows the same process as in operation.

Systems considered important for the radiation protection are those not credited in the accident analysis but which contributes to prevent any impact off-site assuring adequate confinement and risks reduction (i.e. fire protection, ventilation, radioactive waste treatment etc.). These systems are not included in the Technical specifications and specific surveillance programmess are developed for them. These programmess include a description of the system as well as the operating conditions, actions, and surveillance criteria.

Modifications of these systems do not require approval as long as conditions, actions and surveillance criteria are not modified.

5. Control of human and organisational issues

The operating regulation during the operational phase does not apply to the decommissioning and dismantling phase. However, the integration of people with operational experience is very important due to their knowledge of the plant systems and the potential contaminated areas. Following, it is a typical site organisation chart for the dismantling phase.

The dismantling operating regulation does not require the operation shifts. This licensing document regulates only the presence of operators/supervisors in the surveillance and control room during the working time.

The number of responsible operator/supervisors required by the Regulator is significantly lower than during operation.

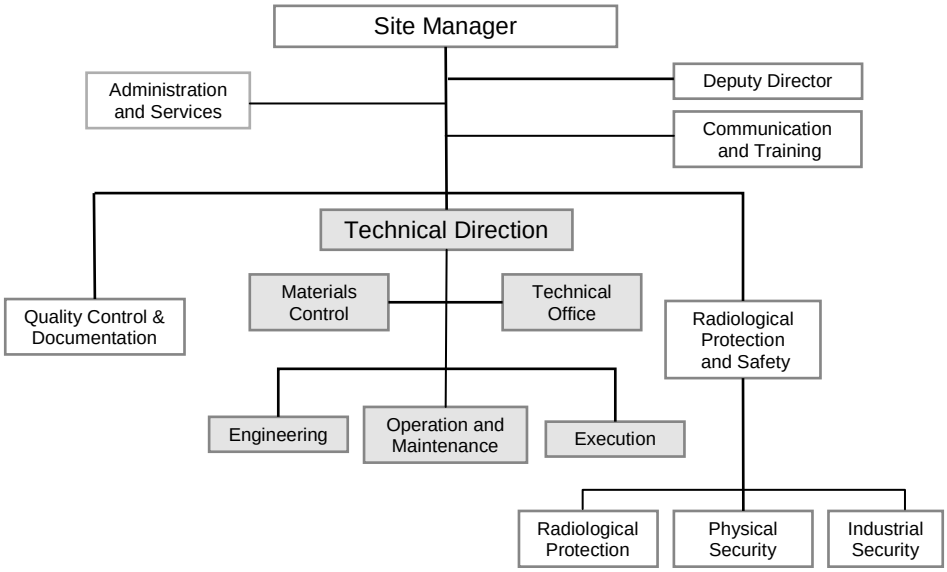
Human resources related to the emergency plan are also adapted to the lower risks during decommissioning.

6. Knowledge retention

Knowledge retention is an important issue for the regulator. In the case of Spain it is ensured by the agreement of co-operation between the utilities and

ENRESA which cover the transfer of information, the collaboration during the transition phase, and the transfer of key personnel as required.

Figure 1: **ENRESA on site dismantling organisation**



7. Funding of D&D activities

In accordance with Royal Decree 1522/1984, by which the creation of ENRESA was authorised, and with R.D. 1349/2003 by which the financial activities were arranged, the costs of radioactive waste management and decommissioning of nuclear installations are financed by the producers of such wastes. The financing of these responsibilities is by way of a fund set up for this purpose.

The scenario considered in the VI Spanish General Radioactive Waste Plan contemplates 2 main periods of funding:

- the historical period, from the origins in 1985 to the year 2006, with 31 March 2005 being a particularly important date, since it was when a new system for the financing for the NPPs, to be described below, was established; and
- the future, from 2007 to the end of the management period, around the year 2070.

The total cost of waste management amounts to 13,023 M€, of which 48% would correspond to spent fuel/highlevel waste, 20% to dismantling and decommissioning of the facilities, 12% to Low and Intermediate Level Waste, 3% to R&D, 16% structural and the remaining 1% to other activities. The costs actually incurred to the end of 2005 are approximately a quarter of the total.

The costs are financed by incomes coming from different financing routes:

- Fee on electricity price to cover the management of the radioactive waste and spent fuel generated at the nuclear power plants and dismantling and decommissioning of the latter, attributable to operation of the plants prior to 1 April 2005, as well as the management of radioactive waste from research activities directly related to the generation of electricity by nuclear means and the dismantling and decommissioning operations to be performed as a result of uranium mining and milling prior to 4 July 1984.
- Invoices to the nuclear power plants to cover the management of the radioactive waste and spent fuel generated at the nuclear power plants and dismantling and decommissioning of the latter, attributable to operation of the plants after 1 April 2005.
- Invoices to other radioactive facilities to cover the cost of the management of radioactive waste generated at those installations.

The total amounts collected and deposited in the Fund via the different financing routes, including the financial yield, should cover the costs incurred, such that the resulting balance be zero. The values presented in this General radioactive waste plan may be revised annually by the government, by Royal Decree, on the basis of an updated economic-financial report on the cost of the corresponding activities.

This system of prepayment has been established such that the income from the provisions made through application of the percentage is accumulated and will finance the costs to be incurred in the future. The accumulated funds, which are the difference between income and annual expenses plus financial yield, are administrated by ENRESA under the supervision of the competent governmental authorities.

Appendix 5

UNITED STATES

1. Introduction

Over the past several decades, operations at licensed nuclear facilities in the United States have caused radiological contamination at a number of sites. This contamination must be reduced or stabilised in a timely and efficient manner to ensure protection of the public and the environment before the sites can be released and the license terminated.

Decommissioning in the United States involves safely removing a facility or a site from service and reducing residual radioactivity to a level permitting the property to be released for unrestricted, or restricted use, and termination of the license. The decommissioning action is typically taken by a licensee before termination of its license. In certain cases, non-licensed facilities may be required to decontaminate and decommission the site in order to meet the required release limits. This report is concerned with decommissioning aspects of facilities licensed by the U.S. Nuclear Regulatory Commission (NRC). It provides an overview of the decommissioning programme which has been evolving for the past two decades to become a mature, safe, efficient, and effective programme.

2. Overview of NRC Decommissioning Programme

2.1 Historical development

In 1988, NRC issued regulations in 10 CFR Parts 30, 40, 50, 51, 70, and 72 (53 FR 24018; June 27, 1988) establishing criteria to decommission licensed facilities. In 1990, clean-up criteria based in part on residual radioactivity concentrations were proposed in a Site Decommissioning Management Plan (SDMP). More effective and risk informed criteria based on calculated dose were proposed for public comment in 1994 (59 FR 43200; August 22, 1994) with the final rule issued in 1997 as Subpart E to 10 CFR Part 20 (62 FR 39058; July 21, 1997), known as the License Termination Rule (LTR).

The NRC staff was directed by the Commission in July 1998 to prepare guidance documents for the Final Rule on Radiological Criteria for License Termination. In this context, NRC staff completed several guidance documents including a Standard Review Plan, SRP (NUREG-1727, September 2000) to help licensees prepare decommissioning documents and provide the staff with uniform criteria for reviewing licensee submittals. The NRC conducted several workshops with stakeholders to obtain input and develop further the SRP. In September 2003, the NRC consolidated and updated numerous decommissioning guidance documents including the SRP, into a three-volume guidance called NUREG-1757, "Consolidated Decommissioning Guidance," superseding all previous material guidance for decommissioning materials sites.

Following implementation of the LTR, a small number of materials licensees were unable to comply with the criteria because their facilities, hereinafter called "legacy sites," were in a decommissioning status and the licensees could not complete the decommissioning work for technical or financial reasons. For these and any other "legacy site" incapable of funding site remediation, the last option available to NRC was to pursue Congressional funding for site clean-up with another agency (State or Federal) directing the remediation efforts. NRC staff addressed this issue and implemented a more aggressive regulatory programme for a limited number of sites. In June 2002, the Commission directed the staff to further analyze LTR issues particularly the prevention of legacy sites. In May, 2003, the staff recommended a set of measures to prevent future legacy sites. The set of measures had two parts: (1) change licensee operations; and (2) change decommissioning financial assurance. In May 2004, the NRC issued a Regulatory Issue Summary to all holders of operating licenses for power reactors, research and test reactors, and decommissioning sites to inform them of the proposed rule plan and its technical basis. On June 17, 2004, the elimination of the Site Decommissioning Management Plan (SDMP) designation was announced in the Federal Register (69 Federal Register 33946). NRC now manages materials decommissioning sites as "complex sites," under a comprehensive decommissioning programme.

2.2 Initiatives for self-assessment and improvement

USNRC has started an initiative to continually improve the licensing process for decommissioning sites and terminating USNRC licenses in accordance with 10 CFR Part 20, Subpart E. This effort is referred to as the "Integrated Decommissioning Improvement Plan (IDIP)." Its specific purposes include: describing a "continuous improvement" plan for decommissioning during FY 2004-2007; and integrating and tracking regulatory improvements from the License Termination Rule (LTR) Analysis, programme management improvements from the Decommissioning Program Evaluation, and other staff

improvements. More recently, the NRC focused on the IDIP issues and lessons learned from decommissioning to consider further aspects of improvement in its decommissioning programme and consideration of design improvement in licensing of new facilities.

3. The regulatory process of decommissioning and safe termination of license

3.1 Decommissioning criteria

The NRC public protection levels from all sources and practices must not exceed 1 mSv/year. Each nuclear facility or other licensed operation (e.g. medical laboratory) is held to a fraction of this limit upon its decommissioning and license termination. Subpart E of 10 CFR Part 20 specifies that a site will be considered acceptable for unrestricted use if the residual radioactivity distinguishable from background radiation results in a total effective dose equivalent to an average member of the critical group not exceeding 0.25 mSv per year, including contribution from ground water sources of drinking water, and the residual radioactivity has been reduced to levels as low as reasonably achievable (ALARA). Determination of the ALARA levels takes into consideration any detriments, such as deaths from transportation accidents, expected to potentially result from decommissioning, and waste disposal. ALARA evaluations in some simple cases only include a qualitative assessment of levels ALARA; in more complicated cases ALARA evaluations may include a quantitative cost-benefit assessment. The non-radiological risks of death from transportation accidents and other causes are included as costs in such cost-benefit assessments. The calculated risk of death is converted to cost by using a monetary value per fatality. That value is consistent with the acceptable cost to avoid future doses (monetary cost per "Person-Sievert" averted). In addition to the requirements in10 CFR Part 20, Subpart E, regulations for decommissioning a nuclear power plant are also set out in 10 CFR Parts 50.75, 50.82, 51.53, and 51.95.

3.2 Power reactors decommissioning process

Before a nuclear power plant begins operations, the licensee must establish or obtain a financial mechanism – such as a trust fund or a guarantee from its parent company – to ensure that there will be sufficient money to pay for the ultimate decommissioning of the facility. Licensees must update the NRC on the status of these mechanisms every two years (annually within five years of the planned end of plant operations). This requirement provides the public reasonable assurance that funds will be available when needed to clean

up a plant site and avoid costly legacy sites that must be cleaned up at taxpayer expense.

Several major steps make up the reactor decommissioning process: notification; submittal and review of the Post-shutdown decommissioning activities report (PSDAR); submittal and review of the license termination plan (LTP); implementation of the LTP; and completion of decommissioning.

3.2.1 Notification

When the licensee has decided to permanently cease operations, it is required to submit a written notification to NRC. In addition, the licensee is required to notify NRC in writing once fuel has been permanently removed from the reactor vessel.

3.2.2 Post-shutdown decommissioning activities report (PSDAR)

Before, or within two years following, cessation of operations, the licensee must submit a PSDAR. The PSDAR must include:

- A description and schedule for the planned decommissioning activities;
- An estimate of the expected costs; and
- A discussion that provides the means for concluding that the environmental impacts associated with the decommissioning activities will be bounded by appropriately issued environmental impact statements (EISs).

NRC will notice receipt of the PSDAR in the Federal Register and make the PSDAR available for public comment. In addition, NRC will hold a public meeting near the licensee's facility to discuss the PSDAR. NRC does not approve the PSDAR.

The licensee cannot perform any major decommissioning activities until 90 days after NRC has received the PSDAR. After this period, the licensee can perform decommissioning activities as long as the activities do not:

- foreclose release of the site for unrestricted use;
- result in significant environmental impacts not previously reviewed; or
- result in there no longer being reasonable assurance that adequate funds will be available for decommissioning.

In taking actions permitted under 10 CFR 50.59 following submittal of the PSDAR, the licensee must notify NRC in writing before performing any decommissioning activity inconsistent with, or making any significant schedule change from, those actions and schedules in the PSDAR.

3.2.3 License termination plan (LTP)

Each power reactor must submit an application for termination of its license. The application must be accompanied or preceded by an LTP submitted for NRC approval. The LTP must include:

- a site characterisation;
- identification of remaining dismantlement activities;
- plans for site remediation;
- detailed plans for the final radiation survey;
- a description of the end use of the site, if restricted;
- an updated site-specific estimate of remaining decommissioning costs and
- a supplement to the environmental report describing any new information or significant environmental change associated with the licensee's proposed termination activities.

In addition, the licensee must demonstrate that the applicable requirements of the license termination rule (LTR) will be met.

3.2.4 Implementation of the LTP

NRC will notice receipt of the LTP and make it available for public comment. In addition, NRC will hold a public meeting near licensee's facility to discuss the LTP and the LTP review process. The review process is similar to that for material and fuel cycle licensees. The technical review is guided by NUREG-1700, "Standard Review Plan for Evaluating Nuclear Power Reactor License Termination Plans". The LTP is approved by license amendment.

Similar to material and fuel cycle facilities, NRC staff will inspect the licensee during decommissioning operations to ensure compliance with the approved LTP. These inspections will normally include in-process and confirmatory radiological surveys.

Decommissioning must be completed within 60 years of permanent cessation of operations unless otherwise approved by the Commission.

3.2.5 Completion of decommissioning

At the conclusion of decommissioning activities the licensee will submit a final radiation survey report. NRC will terminate the license if it determines that:

- The remaining dismantlement has been performed in accordance with the approved LTP; and
- The final radiation survey and associated documentation demonstrates that the facility and site are suitable for release in accordance with the LTR.

3.3 Materials sites decommissioning process

3.3.1 Complex site decommissioning process

The materials decommissioning process is initiated by any one of the following conditions:

- the license expires;
- the licensee has decided to permanently cease principal activities at the entire site or in any separate building or outdoor area;
- no principal activities have been conducted for 24 months; or
- no principal activities have been conducted for 24 months in any separate building or outdoor area.

Several major steps make up the complex materials site decommissioning process: notification; submittal and review of the decommissioning plan (DP); implementation of the DP; and completion of decommissioning.

Notification

Within 60 days of the occurrence of any of the triggering conditions, the licensee is required to notify NRC of such occurrence and either begins decommissioning or, if required, submits a DP within 12 months of notification and begin decommissioning upon approval of the plan. Alternative schedules are authorized under the regulations, with NRC approval.

Decommissioning plan

A DP must be submitted if required by license condition or if the procedures and activities necessary to decommission have not been previously approved by NRC and these procedures could increase potential health and safety impacts to workers or the public, such as in any of the following cases:

- procedures would involve techniques not applied routinely during clean up or maintenance operations;
- workers would be entering areas not normally occupied where surface contamination and radiation levels are significantly higher than routinely encountered during operation;
- procedures could result in significantly greater airborne concentrations than are present during operations; or
- procedures could result in significantly greater releases of radioactive material to the environment than those associated with operations.

The DP review process begins with an acceptance review. While primarily an administrative review, the acceptance review includes, but is not be limited to (a) completeness of the application; (b) legibility of drawings; (c) general adequacy of information; (d) justification for proprietary information; and (e) obvious technical inadequacies. The objective of the acceptance review is to verify that the application contains sufficient information before the staff begins an in-depth technical review. In addition, a limited technical review will be conducted. The purpose of the limited technical review is to identify significant technical deficiencies at an early stage, thereby precluding a detailed technical review of a technically incomplete submittal. At the conclusion of the acceptance review, the DP will either be accepted for detailed technical review or rejected and returned to the licensee with the deficiencies identified. For DPs proposing unrestricted release, a full technical review will be initiated after the successful conclusion of the acceptance review. The staff's review is guided by NUREG-1757, "Consolidated NMSS Decommissioning Guidance". The results of the staff's review will be documented in an Environmental Assessment (EA) and a safety evaluation report (SER). The EA will be shared with the appropriate State, and State comments will be considered in finalising the EA. The final EA must be summarised in the Federal Register in the form of a finding of no significant impact (FONSI), provided an EIS is not necessary.

For reviews of DPs proposing restricted release, the review will be conducted in two phases. The first phase of the review will focus on the

financial assurance (FA) and institutional control (IC) provisions of the DP. The review of the remainder of the DP will be initiated only after the staff is satisfied that the licensee's proposed IC and FA provisions will comply with the requirements of the license termination rule (LTR) (10 CFR Part 20, Subpart E). The applicable portions of NUREG-1757, Consolidated NMSS Decommissioning Guidance, will be used to guide this phase of the review. Phase II of the review will address all other sections of the technical review as guided by NUREG-1757 and will include the development of an EIS. Therefore, one of the first steps in Phase II is the publication of a Notice of Intent to develop an EIS. The basic EIS development steps are:

- notice of Intent;
- public scoping meeting;
- preparation and publication of the scoping report;
- preparation and publication of the draft EIS;
- public comment period on the draft EIS including a public meeting;
- preparation and publication of the final EIS; and
- preparation and publication of the Record of Decision (ROD).

In parallel with the development of the EIS, the staff will develop a draft and final Safety Evaluation Report (SER). The development of the draft SER will be coordinated with the development of the draft EIS so that any requests for additional information (RAIs) can be consolidated.

Regardless of whether an EA or EIS is developed, the staff structures its reviews so that the number of RAIs is minimised, without diminishing the technical quality or completeness of the licensee's ultimate submittal.

Following publication of the FONSI (for a DP involving an EA) or the ROD (for a DP involving an EIS), a license amendment will be issued approving the DP along with any additional license conditions found to be necessary as a result in the EA/EIS and/or the SER.

Implementation of the decommissioning plan

Following approval of the DP, the licensee must complete decommissioning in accordance with the approved DP within 24 months or apply for an alternate schedule. NRC staff will inspect the licensee during decommissioning operations to ensure compliance with the DP. These inspections will normally include in-process and confirmatory radiological surveys.

Completion of decommissioning

As the final step in decommissioning, the licensee is required to:

- certify the disposition of all licensed material, including accumulated wastes, by submitting a completed NRC Form 314 or equivalent information; and
- conduct a radiation survey of the premises where licensed activities were carried out (in accordance with the procedures in the approved DP, if a DP is required) and submit a report of the results of the survey, unless the licensee demonstrates in some other manner that the premises are suitable for release in accordance with the LTR;
- properly dispose of licensed material;
- make reasonable effort to eliminate residual radioactive contamination, if present;
- ensure the site meets the approved DP; and
- perform a radiation survey or demonstrate that the premises are suitable for release in accordance with the LTR.

3.4 Fuel Cycle Facility Decommissioning Process

In general, the decommissioning process for fuel cycle facilities and complex material sites is the same. Project management responsibility for fuel cycle facilities resides in the division of fuel cycle safety and safeguards (FCSS) during licensee operations. Project management responsibility for decommissioning activities transfers to division of waste management and environmental protection (DWMEP) for entire site decommissioning in support of license termination. However, the transfer from FCSS to DWMEP only occurs after the critical mass of material no longer remains at the site.

3.5 Uranium recovery sites decommissioning process

3.5.1 Uranium recovery facility decommissioning process

Decommissioning requirements for uranium recovery facilities are contained in 10 CFR 40.42 and supplemented by the criteria in Appendix A to Part 40. Examples include the following:

- criterion 5 provides ground-water protection requirements;

- criterion 6 provides cover design requirements for uranium mill tailings impoundments and includes radiological criteria for decommissioning [Criterion 6(6)];
- criterion 6A requires a Commission-approved reclamation plan;
- criteria 9 and 10 provide financial assurance requirements;
- criterion 11 specifies site ownership requirements; and
- criterion 12 specifies long-term surveillance requirements.

Guidance concerning the license termination process is contained in Appendix E of NUREG-1620, Rev. 1, June 2003, Standard Review Plan for the Review of a Reclamation Plan for Mill Tailings Sites under Title II of the Uranium Mill Tailings Radiation Control Act of 1978. For the license termination of UMTRCA Title II sites under Agreement State jurisdiction, guidance is provided in Procedure SA-900 of the Office of State and Tribal Programs (STP).

3.5.2 Role of the nuclear regulatory commission

In accordance with Section 83c of the Atomic Energy Act of 1954, as amended (AEA), NRC determines whether the licensee has met all applicable standards and requirements or whether a licensee-proposed alternative meets the standards. This determination will involve NRC review of licensee submittals relative to the completion of decommissioning, reclamation, and, if necessary, groundwater cleanup. In addition, the staff will review the site long-term surveillance plan (LTSP) submitted by the custodial agency, for both NRC and Agreement State sites. On NRC acceptance of the LTSP, NRC terminates the specific license and places the long-term care and surveillance of the site by the custodial agency under the general license provided at 10 CFR 40.28.

A final NRC responsibility is the determination of the final amount of long-term site surveillance funding. Criterion 10 of Appendix A specifies a minimum charge of $250 000 (1978 dollars), revised to reflect inflation, which may be escalated on a site-specific basis because of surveillance and long-term monitoring controls beyond those specified in Criterion 10 of Appendix A.

3.5.3 Role of uranium mill licensees

Before license termination, licensees are required by license conditions to complete site decontamination, decommissioning, and surface and groundwater remedial actions consistent with decommissioning, reclamation, and ground-

water corrective action plans. Licensees must document the completion of these remedial actions in accordance with procedures developed by NRC. This information will include a report documenting completion. Because the LTSP must reflect the remediated condition of the site, the licensee will work with the custodial agency in preparing the LTSP. Most likely, this coordination will involve supplying the custodial agency with appropriate documentation (e.g., as-built drawings) of the remedial actions taken and reaching agreements (formal or informal) with the custodial agency regarding the necessary surveillance control features of the site (e.g., boundary markers, fencing). It is the responsibility of the custodial agency to submit the LTSP to NRC for approval. However, the licensee may elect to help prepare the LTSP, to whatever degree is agreed upon between the licensee and the custodial agency.

Finally, the licensee provides the funding to cover long-term surveillance responsibilities in accordance with Criterion 10 of Appendix A. NRC will determine the final amount of this charge on the basis of final conditions at the site.

After termination of the existing license and transfer of the site and byproduct materials to the custodial agency, the remaining liability of the licensee extends solely to any fraudulent or negligent acts committed before the transfer to the custodial agency, as provided for in Section 83b(6) of the AEA.

3.5.4 Role of the custodial agency

Section 83 of the AEA, as amended, states that before termination of the specific license, title to the site and byproduct materials should be transferred to (a) the DOE, (b) a Federal agency designated by the President, or (c) the State in which the site is located, at the option of the State. It is expected that the DOE will be the custodial agency for most, if not all, of the sites.

It is the responsibility of the custodial agency to submit the LTSP to NRC for review and acceptance. Provisions and activities identified in the final LTSP will form the bases of the custodial agency long-term surveillance at the site. The NRC general license in 10 CFR 40.28(a) becomes effective when the licensee's current specific license is terminated and the Commission accepts the LTSP. Custodial agencies are required, under 10 CFR 40.28(c) (1) and (c) (2), to implement the provisions of the LTSP.

4. Overview of decommissioning recent development and activities

4.1 Overall summary

NRC regulates the decontamination and decommissioning of materials and fuel cycle facilities, power reactors, research and test reactors, and uranium recovery facilities. The purpose of the decommissioning programme is to ensure that NRC-licensed sites, and sites that were or could be licensed by NRC, are decommissioned in a safe, timely, and effective manner so that they can be returned to beneficial use and that stakeholders are informed and involved in the process, as appropriate. A broad spectrum of activities associated with these programme functions is summarized in this report.

4.2 General status of decommissioning sites

Approximately 200 materials licenses are terminated each year. Most of these license terminations are routine, and the sites require little, if any, remediation to meet NRC's unrestricted release criteria. The decommissioning programme discussed in this report focuses on the termination of licenses that are not routine, because the sites involve more complex decommissioning activities.

There are 14 nuclear power reactors, 11 research and test reactors, 25 complex decommissioning materials facilities, one fuel cycle facility (partial decommissioning), and 11 uranium recovery facilities that are undergoing non-routine decommissioning or are in long-term safe storage, under NRC jurisdiction. The NRC Public website contains site status summaries for the facilities managed under the decommissioning programme. These summaries describe the status of each site and identify the current technical and regulatory issues impacting completion of decommissioning. For those licensees that have submitted a decommissioning plan (DP) or license termination plan (LTP), the schedules are based on an assessment of the complexity of the DP or LTP review. For those licensees that have not submitted a DP or LTP, the schedules are based on other licensee information available, and the anticipated decommissioning approach.

Through the Agreement State Program, 35 States have signed formal agreements with NRC, by which those States have assumed regulatory responsibility over certain byproduct, source, and small quantities of special nuclear material, including the decommissioning of some complex materials sites. Agreement States do not have regulatory authority over operating or decommissioning nuclear power plants. NRC co-ordinates with the Agreement States decommissioning programs.

4.3 Summary of FY 2007 decommissioning activities

4.3.1 Decommissioning of power reactors

- NRC power reactor decommissioning activities include: (a) project management for decommissioning power reactors and technical review responsibility for licensee submittals in support of decommissioning; (b) core inspections; (c) supporting development of rulemaking and guidance; (d) conducting public outreach; and, (e) participating in industry conferences and workshops.

- During the past year, FSME completed decommissioning activities at the Big Rock Point Plant and approved release of areas other than the footprint of ISFSI from Yankee Rowe's Part 50 license. Additionally NRC issued an amendment approving Rancho Seco's LTP. For list of reactors and details on reactor decommissioning activities go to NRC website:

  www.nrc.gov/about-nrc/regulatory/decommissioning/process.html#rea

- One of the goals identified in NRC's Strategic Plan is to ensure openness in its regulatory process. The Strategic Plan identifies the development of communication plans for specific activities associated with the regulation of radiological decommissioning, as a means to support the openness strategy. The staff continues to implement communication plans for all decommissioning reactors. Communication plans are useful tools to help ensure that the appropriate stakeholders are identified and contacted and focuses the staff on messages NRC wants to convey. In order to enhance the efficiency of the use of communication plans, NRC has developed a generic communication plan for the decommissioning of nuclear facilities. Additionally, in support of ensuring openness during the regulatory process, the staff held many public meetings. Examples of public meetings the staff held during the past year include: a Rancho Seco license termination plan meeting to accept public comments; and a public meeting with Humboldt Bay to discuss partial site release.

4.3.2 Research and test reactor decommissioning

In general, the decommissioning process for research and test reactors and power reactors is similar due to the fact that the decommissioning for both

types of facilities is regulated under 10 CFR Part 50.82. At the beginning of FY 2007, the NRC had regulatory project management responsibility for 14 decommissioning research and test reactors. For list of research and test reactors undergoing decommission go to NRC website:

www.nrc.gov/about-nrc/regulatory/decommissioning/process.html#rea

Plant status summaries for all decommissioning research and test reactors are provided at:

www.nrc.gov/info-finder/decommissioning/power-reactor/
www.nrc.gov/info-finder/decommissioning/research-test/.

NRC research and test reactor decommissioning activities include: (a) project management for decommissioning research and test reactors and technical review responsibility for licensee submittals in support of decommissioning; (b) core inspections; (c) supporting development of rulemaking and guidance; (d) conducting public outreach; and (e) participating in industry conferences and workshops. In summary, in FY 2007, the NRC terminated the licenses of three research and test reactors: Cornell University-TRIGA, Cornell University- ZPR, and University of Washington- TRIGA.

4.3.3 Complex materials sites decommissioning activities

There are 25 complex materials sites undergoing decommissioning. A list of complex decommissioning sites and status summaries for the complex materials sites undergoing decommissioning are provided at:

www.nrc.gov/info-finder/decommissioning/complex/

Material facilities decommissioning activities include: (a) maintaining regulatory oversight of complex decommissioning sites; (b) undertaking financial assurance reviews; (c) examining issues and funding options to facilitate remediation of sites in non-Agreement States; (d) interacting with the U.S. Environmental Protection Agency (EPA) and Interagency Steering Committee on Radiation Standards (ISCORS); (e) inspecting complex decommissioning sites; (f) conducting public outreach; (g) participating in international decommissioning activities; (h) conducting a programme evaluation; and (i) participating in industry conferences and workshops.

- Since last year, seven sites were removed from the complex site list through license termination or completion of NRC decommissioning actions: (1) Battelle Columbus; (2) Eglin Air Force Base; (3) Kaiser Aluminum; (4) Pathfinder Atomic Plant; (5) S.C Holdings Inc.; (6)

United Nuclear Company (UNC) Naval Products; and (7) Westinghouse Electric-Churchill.

- Activities associated with the complex site decommissioning programme include: (a) review and approval of DPs; (b) conduct of pre-DP development meetings with licensees; (c) review of licensee FSSRs and conduct of confirmatory surveys; (d) conduct of in-process inspections; and (e) preparation of EAs and SERs. In FY 2007, the staff approved DPs for: (1) Cabot Performance Materials Inc.; (2) Quehanna; (3) UNC Naval Products; and (4) Whittaker Corp. The staff is currently reviewing DPs for the following sites: (a) Shieldalloy; and (b) Westinghouse- Hematite.
- Staff routinely reviews financial assurance submittals for materials and fuel cycle facilities, and maintains a financial instrument security programme. Approximately 25 financial assurance submittals were re-viewed in FY 2007, including two complex reviews for fuel enrichment license applications.
- One of the goals identified in NRC's Strategic Plan is to ensure openness in its regulatory process. The Strategic Plan identifies the development of communication plans for activities associated with the regulation of radiological decommissioning, as a means to support the openness strategy. The staff continues to implement communication plans for all complex sites. A generic com-munication plan was developed for all complex sites in order to enhance the efficiency of the staff's ability to reach out to stakeholders. One of the activities identified in the communication plans for each site is participation in public meetings to inform the public about major licensing actions. During the past year, the staff participated in public meetings for: (a) Jefferson Proving Ground; (b) Mallinckrodt Chemical, Inc.; (c) Shieldalloy; (d) West Valley Demonstration Project (WVDP); and (e) Westinghouse-Hematite.

5. Conclusion

The United States has a mature, safe, and efficient programme which evolved over two decades for decontamination and decommissioning of nuclear power reactors, research and test reactors, materials sites, as well as fuel cycle and uranium recovery facilities. In FY 2007, the NRC decommissioned over 200 simple material facilities, several complex materials decommissioning sites, and a few power reactors as well as research or test reactors. Currently, there are 14 nuclear power reactors, 11, research and test reactors, 25 complex

decommissioning materials facilities, one fuel cycle facility (partial decommissioning), and 11 uranium recovery facilities that are undergoing non-routine decommissioning or are in long-term safe storage, under NRC jurisdiction. The following NRC public websites contain more details on site status and summaries for the facilities managed under the NRC decommissioning programme:

www.nrc.gov/about-nrc/regulatory/decommissioning/process.html
www.nrc.gov/about-nrc/regulatory/decommissioning/process.html#rea
www.nrc.gov/about-nrc/regulatory/decommissioning/process.html#mat
www.nrc.gov/about-nrc/regulatory/decommissioning/process.html#ura
www.nrc.gov/reading-rm/doc-collections/fact-sheets/decommissioning.html

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