

NUCLEAR SAFETY DIRECTORATE - BUSINESS MANAGEMENT SYSTEM		
TECHNICAL ASSESSMENT GUIDE DECOMMISSIONING ON NUCLEAR LICENSED SITES		T/AST/026
		ISSUE 002
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1. Purpose and Scope

1.1 This internal guidance describes the approach of HM Nuclear Installations Inspectorate (NII), which is part of the Health and Safety Executive's (HSE) Nuclear Safety Directorate (NSD), in respect of its responsibilities for the regulation of decommissioning on nuclear licensed sites. The objectives of the guidance are:

- to draw together those aspects of legislation, Government Policy and international standards which are relevant to the work of NII in regulating decommissioning; and

- to provide a framework for the inspection and assessment of decommissioning on a consistent basis.

1.2 Decommissioning is the set of actions taken at the end of a nuclear facility's operational life to take it permanently out of service with adequate regard for the health and safety of workers and the public and the protection of the environment. The ultimate aim of decommissioning is to make the site available for other purposes. It includes actions taken to systematically and progressively reduce the level of hazard on a site, and it may include the physical dismantling of the facilities. It is not necessarily a single step process and may involve stages spread over a number of years. Decommissioning activities are increasing at nuclear licensed sites in the UK as the oldest commercial nuclear power stations reach the end of their production life and other nuclear facilities become redundant.

1.3 This guidance is intended to be applicable to all types of nuclear facilities on nuclear licensed sites, including nuclear power plant, nuclear chemical plant and other types of plant. The decommissioning process and the management of radioactive materials and radioactive waste are closely linked issues that require an integrated approach.

1.4 The target audience within NII for this guidance is primarily assessment inspectors and site inspectors for nuclear sites where there are significant radioactive waste management and decommissioning activities. This guidance is incorporated on the Business Management System (BMS) as a Technical Assessment Guide and inspectors will be directed to it as a main reference from the corresponding Inspection Guides. The guidance aims to set down a consistent framework for the assessment of licensees' proposals, but it is not intended to be prescriptive and inspectors should be flexible and prepared to consider alternative approaches that are put forward by licensees. As for all guidance, inspectors should use their judgement and discretion in the depth and scope to which they apply it.

1.5 Although the guidance has been produced for NII's internal use, it can be made available to external organisations and individuals who wish to inform themselves of NII's regulatory approach. Inspectors wishing to transmit the guidance outside NII should contact Unit 4c.

1.6 NII continuously reviews its regulatory approach and responds to developments, both national and international. This guidance will be updated to reflect such changing circumstances.

2. Legislation

2.1 The main legislation concerning the safety of nuclear installations is the Health and Safety at Work Act 1974 (HSWA74), the associated relevant statutory provisions of the Nuclear Installations Act 1965 (as amended) (NIA65) and the Ionising Radiations Regulations 1999 (IRR99). Environmental protection is afforded through the regulation of the management of radioactive materials and radioactive waste, for which the principal legislation includes NIA65, the Radioactive Substances Act 1993 (as amended by the Environment Act 1995) (RSA93) and the Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 (EIADR99).

Nuclear Installations Act 1965

2.2 Under NIA65, no person may use any site for the purposes of installing or operating a nuclear installation unless a licence so to do has been granted by the HSE and is in force. NIA65 enables HSE to attach conditions to the nuclear site licence in the interest of safety, or which HSE thinks fit with respect to the handling, treatment and disposal of nuclear matter. Once a licence has been issued, the licensee's period of responsibility and the provisions of NIA65 continue to apply throughout operation and decommissioning until, in the opinion of HSE, there has ceased to be any danger from ionising radiations from anything on the site. HSE has delegated its roles under NIA65 to NII. The site licence gives NII a number of powers including the use of consents, approvals, directions, agreements, notifications and specifications. NII will use these powers as appropriate to exercise its regulatory role with respect to licensee's decommissioning projects.

2.3 The standard conditions associated with nuclear site licences are described in **Ref. 1**. All the licence conditions apply and are relevant to activities during decommissioning. However, the purpose of a number of licence conditions which are particularly relevant to decommissioning and to the management of radioactive materials and radioactive waste are summarised below:

Licence Condition 4: Restrictions on nuclear matter on the site

The purpose of this LC is to ensure that the licensee carries out its responsibilities to control the introduction and storage of nuclear matter on a licensed site. Nuclear matter being nuclear fuel, radioactive material and radioactive waste.

Licence Condition 6: Documents, records, authorities and certificates

The purpose of this LC is to ensure that adequate records are held by the licensee for a suitable period to demonstrate compliance with licence conditions.

Licence Condition 11: Emergency arrangements

The purpose of this LC is to ensure that the licensee has adequate arrangements in place to respond effectively to any incident ranging from a minor on-site event to a significant release of radioactive material.

Licence Condition 14: Safety documentation

The purpose of this LC is to ensure that the licensee sets up arrangements for the preparation and assessment of the safety related documentation comprising 'safety cases' to ensure that the licensee justifies safety during design, construction, manufacture, commissioning, operation and decommissioning.

Licence Condition 15: Periodic review

The purpose of this LC is to ensure that the plant remains adequately safe and that the safety cases are kept up to date throughout its lifetime. The safety cases should be periodically reviewed in a systematic manner against the current design, safety objectives and practices.

Licence Condition 17: Quality assurance

The purpose of this LC is to ensure that the licensee sets out the managerial and procedural arrangements that will be used to control and monitor those actions

necessary in the interests of safety, and to demonstrate compliance with the site licence conditions and any other relevant legislation.

Licence Condition 23: Operating rules

The purpose of this LC is to ensure that all operations that may affect safety are supported by a safety case and that the safety case identifies the conditions and limits that ensure that the plant is kept in a safe condition.

Licence Condition 25: Operational records

The purpose of this LC is to ensure that adequate records are kept regarding operation, inspection and maintenance of any safety-related plant and includes recording the amount and location of all radioactive material, including nuclear fuel and radioactive waste.

Licence Condition 26: Control and supervision of operations

The purpose of this LC is to ensure that safety related operations are carried out only under the control and supervision of suitably qualified and experienced personnel.

Licence Condition 28: Examination, inspection, maintenance and testing

The purpose of this LC is to ensure that all plant that may affect safety is scheduled to receive regular and systematic examination, inspection, maintenance and testing, by and under the control of suitable personnel.

Licence Condition 32: Accumulation of radioactive waste

The purpose of this LC is to ensure that the production rate and accumulation of radioactive waste on the site is minimised, held under suitable storage arrangements and that adequate records are made. This LC is equally applicable to the decommissioning phase of a nuclear facility which can produce radioactive waste.

Licence Condition 33: Disposal of radioactive waste

The purpose of this LC is to give discretionary powers to NII to direct that radioactive waste be disposed of in a specified manner. This is related to the similar powers available to the environment agencies under section 30 of RSA93. Such disposals will need to be in accordance with authorisations granted under RSA93.

Licence Condition 34: Leakage and escape of radioactive material and radioactive waste

The purpose of this LC is to ensure so far as reasonably practicable that radioactive material and radioactive waste is adequately controlled or contained so as to prevent leaks or escapes, and that any unauthorised leak or escape can be detected and reported.

Licence Condition 35: Decommissioning

The purpose of this LC is to require the licensee to make adequate provisions for decommissioning. It also gives discretionary powers to NII to direct that decommissioning of any plant or process be commenced in accordance with the

decommissioning programme or halted. The provisions include arrangements for the decommissioning of any plant or process which may affect safety, the provision of adequate documentation to justify safety and the production and implementation of decommissioning programmes for each plant. The arrangements shall, where appropriate, divide the decommissioning into stages and, if specified by NII, the licensee shall not commence or proceed from one stage to the next without the consent of NII.

Licence Condition 36: Control of organisational change

The purpose of this LC is to ensure that the licensee makes and implements adequate arrangements to control any change to its organisational structure and resources which may affect safety on the site.

2.4 HSE keeps the licence conditions under review and it will revise them, or add new conditions, as it judges appropriate with respect to its regulatory responsibilities.

Ionising Radiations Regulations 1999

2.5 Requirements for the radiological protection of workers and the public are contained in IRR99 which is enforced on nuclear licensed sites and on certain Ministry of Defence sites by NII.

Radioactive Substances Act 1993

2.6 Regulation under RSA93 is enforced by the environment agencies, the Environment Agency (EA) in England and Wales, and the Scottish Environment Protection Agency (SEPA) in Scotland. The purpose of RSA93 (sections 6, 7, 13 and 14) is to regulate the keeping and use of radioactive material, to prevent loss to the environment and to control accumulation and disposal of radioactive waste to minimise the impact on the environment. Disposal of radioactive waste includes discharges of aerial and liquid effluent, deposit or burial of solid waste, and transfer of waste from a site.

2.7 Licensees of nuclear licensed sites are exempt from RSA93 requirements for an authorisation to accumulate radioactive waste and from registration to keep and use radioactive material (section 8(1)). This exemption does not apply however to an operator of a facility on a licensed site who is not the licensee. In this case, the operator is required to be a registered user of radioactive material. Regulation of the disposal of radioactive waste is the responsibility of the environment agencies. NII has statutory powers under NIA65 for the regulation of the safe management of radioactive material, including waste, on nuclear licensed sites, prior to disposal, and it consults the views of the environment agencies as required (see **section 4 below**).

Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 (EIADR99)

2.8 The EIADR99 Regulations require an Environmental Impact Assessment (EIA) to be carried out by the licensee before NII considers granting consent for a dismantling or decommissioning project for a nuclear reactor or nuclear power station to commence. NII must ensure that an adequate EIA is carried out. This it does by consulting relevant bodies and the public on an Environmental Statement (ES) provided by the licensee. It then takes the results of such consultation into account when considering consent. NII may attach conditions to any consent to start

the decommissioning project as may appear desirable in the interests of limiting the impact of a project on the environment. A consent to decommission under these regulations does not imply that the requirements of other legislation have been satisfied.

2.9 Decommissioning projects which were in progress when the regulations came into effect do not need an EIA to be provided, unless there are changes or extensions to the projects which may have significant adverse environmental effects. Inspectors are referred to separate guidance on the EIADR99 Regulations (**Ref. 2**).

European Commission

2.10 Decommissioning is one of the activities for which the European Commission requires a submission by governments of Member States under Article 37, identifying the potential impacts on Member State countries of the decommissioning strategy. DETR or the Scottish Executive lead on this submission which is prepared by the environment agencies in consultation with NII. Separate guidance is being developed within NII on the processing of licensee's Article 37 submissions.

3. Government Policy

3.1 Primary responsibility for civil radioactive waste management policy in the UK lies with the Department of the Environment, Transport and the Regions (DETR) and, as appropriate, the National Assembly for Wales, the Scottish Executive and the Northern Ireland Environment and Heritage Services. The primary responsibility for decommissioning policy lies with the Department of Trade and Industry (DTI).

3.2 Government Policy on radioactive waste management was reviewed in 1994/95 and the conclusions of that review were set out in "Review of Radioactive Waste Management Policy, (Cm 2919)" (**Ref. 3**). This includes the policy concerning decommissioning which is given in **Annex 1**.

3.3 Following the publication of the report of the House of Lords Select Committee Enquiry into Nuclear Waste Management (**Ref. 4**), issued in March 1999, the Government has announced a review of this policy which should commence in 2001. This Guidance document will need to be reviewed when the outcome of the review is known to ensure that any developments or changes in policy are reflected.

3.4 The OSPAR/Sintra agreement, which the Government signed in July 1998, commits the UK to a progressive and substantial reduction of the radioactivity in liquid discharges by adopting best available techniques, such that additional concentrations in the marine environment above historic levels, are close to zero by 2020. With respect to regulation by HSE and the environment agencies, this agreement may impact on existing disposal routes and requirements for discharges during decommissioning.

4. The Respective Roles of HSE and the Environment Agencies

4.1 The regulation of decommissioning requires close liaison between HSE and the environment agencies due to the common interests in radioactive waste management and the need to regulate in a consistent manner. This section outlines the respective roles of HSE and the environment agencies. It is provided for information to inspectors and is not meant to provide detailed description of the regulatory approach of the environment agencies who are preparing their own guidance.

4.2 Under NIA65, HSE is responsible for regulating operations on a nuclear licensed site. It does this by granting licences to the operators of the sites. Under NIA65, it is able to attach conditions to the licences which it considers necessary or desirable in the interests of safety, covering both normal circumstances, accidents and emergencies (NIA65, section 4(1)). In addition, HSE may attach such conditions it may think fit with respect to the handling, treatment and disposal of nuclear matter (NIA65, section 4(2)). The term nuclear matter includes radioactive material and radioactive waste and these particular conditions can therefore extend to matters other than safety.

4.3 As described in **section 2.6**, the environment agencies are responsible for regulating, under the RSA93, disposals of all forms of radioactive wastes on nuclear licensed sites. The agencies have no statutory powers over waste storage on nuclear licensed sites until the licensee seeks permission to dispose of the waste. On sites that are not licensed, such as hospitals and universities, the agencies regulate storage of radioactive wastes as well as disposals.

4.4 Although HSE and the environment agencies have different statutory powers for the regulation of radioactive waste management at licensed nuclear sites, they work closely to ensure that site licensees are subject to consistent regulatory requirements. NIA65 (as amended by Schedule 22 of the Environment Act 1995) places a requirement on HSE to consult the environment agencies on issues which affect the creation, accumulation or disposal of radioactive waste before issuing, amending or varying nuclear site licences, or attaching conditions to them. In addition to these statutory consultation requirements, the HSE and the EA have set down and jointly agreed their responsibilities and working arrangements on matters of mutual interest within a Memorandum of Understanding (MoU) which is kept under review. A similar MoU is being drawn up between HSE and SEPA. The MoUs are aimed at facilitating effective and consistent regulation of radioactive waste management on nuclear licensed sites and avoiding conflicting requirements being placed on site licensees. For information on their working arrangements, inspectors are advised to consult the guidance given within the MoU.

4.5 Government Policy requires HSE to carry out quinquennial reviews of licensee's decommissioning strategies. HSE are required to consult with the environment agencies in this process.

4.6 HSE and the environment agencies will wish to see that decisions made by licensees on whether/how to retrieve, store, treat, contain and package radioactive wastes have regard to Government Policy, as set out in para 113 of Cm 2919, and take into account all relevant factors. Where activities concern solid radioactive wastes for which there is no current disposal route, the agencies will wish to ensure that waste treatment and packaging activities do not adversely affect the disposability of these wastes.

4.7 The environment agencies are concerned with the effects on the public and the environment arising from radioactivity in the discharges of liquids and gases and solid radioactive waste disposal. Where waste has to be disposed off-site, such disposals will require authorisation by the agencies who will wish to ensure that "Best Practicable Means" (BPM) are being used to mitigate the impact of any such discharges. They will also wish to see that available waste management options have been considered and reasoned arguments presented for the selection of the preferred option, which represents the Best Practical Environmental Option (BPEO).

5. Agreements with Other Organisations

Food Standards Agency

5.1 A working agreement is to be set up between the newly formed Food Standards Agency and HSE to cover areas of common interest, namely, protection of the food chain from radioactive wastes and discharges and the delicensing of nuclear sites.

Ministry of Defence

5.2 MOD and HSE have agreed principles which apply to the MOD's observance of health and safety legislation for both military and civilian employees affected by their activities on non-licensed sites. These principles apply equally to decommissioning and to the management of radioactive materials and radioactive waste and are intended to facilitate inspections, recognising the statutory right of HSE to carry them out under the HSWA in such a way as not to compromise national security and the operational capability of MOD. On licensed sites where a commercial organisation is in significant control of nuclear related work on behalf of MOD, the regulation of nuclear and radiological safety is the duty of NII.

6. Statement of Regulatory Strategy

6.1 This section introduces NII's regulatory strategy to ensure safety in the decommissioning of nuclear facilities. NII has four fundamental expectations for decommissioning, which should be met so far as is reasonably practicable. These expectations are as follows:

- i. **In general, decommissioning should be carried out as soon as it is reasonably practicable, taking account of all relevant factors.**
- ii. **Hazards associated with the plant or site should be reduced in a progressive and systematic manner.**
- iii. **Full use should be made of existing routes for the disposal of radioactive waste.**
- iv. **Remaining radioactive material and radioactive waste should be put into a passively safe state for interim storage pending future disposal or other long term solution.**

6.2 The following statements of regulatory strategy provide general guidance on particular elements of licensees' arrangements that NII will assess to determine the extent to which the above expectations are met:

- licensing and delicensing;
- strategic planning;
- decommissioning programmes;
- decommissioning safety cases;
- timing;
- systematic and progressive reduction of the hazard;
- management and maintenance of an appropriate organisation;
- costs of decommissioning;
- quality assurance;
- quinquennial review; and
- international standards and developments.

These statements are discussed in turn in the following sections. The attention of inspectors is drawn to the statements that describe recent developments in the regulatory approach including the timing and costs of decommissioning and the quinquennial reviews. More detailed guidance appears in the Appendices.

6.3 Licensing and Delicensing

Decommissioning will be subject to the same licensing regime as that applied during the preceding design, construction, operation and shut down phases. The licensee's period of responsibility will continue until HSE is able to advise the licensee that, in its opinion, there has ceased to be any danger from ionising radiations from anything on the site.

The licensee's responsibilities under the nuclear site licence continue during decommissioning and NII will continue to exercise its regulatory powers. Once a nuclear site licence has been granted then, unless a licence is issued to another corporate body for the same site, the original licensee's period of responsibility continues until HSE has expressed an opinion that there has ceased to be any danger from ionising radiations from anything on the site. Requirements for nuclear licensing of the site, or part of it, can then be removed and the site can be delicensed. When a licensee wishes to end its period of responsibility, NII expects similar arrangements to be applied to this process as are applied to an operational plant. These include arrangements for the assessment of safety documentation.

During the assessment of a case for delicensing, NII is required to consult with the environment agencies (Environment Act 1995) and will consult with others (for example, Government Departments, local authorities and advisory bodies) as considered appropriate in each case. The environment agencies will need to agree that there is nothing on the site that will be of regulatory concern to them if the site, or part of the site, is delicensed.

There is no generic criterion for demonstrating 'that there has ceased to be any danger from ionising radiations' and each case for delicensing is treated on its own merits by professional judgement. HSE is, however, developing criteria for delicensing which will assist in justifying such a decision. These criteria need to take account of forthcoming regulation on radioactively contaminated land and any change to RSA93 as a result of implementing the Euratom Basic Safety Standard Directive (**Ref. 5**).

Further guidance on delicensing is given in **Appendix 1**.

6.4 Strategic Planning

NII requires licensees to undertake strategic planning for decommissioning including the future management and disposal of all the radioactive waste which may result.

In line with Government Policy, NII requires licensees to produce and maintain a strategy for the decommissioning of all the nuclear facilities for which they are responsible. Because of the common interests of HSE and the environment agencies, the licensee should develop the strategy by liaising with the regulatory bodies to avoid unnecessary conflicts and oversights. If a licensee is responsible for a number of nuclear sites then it may be appropriate to provide a corporate strategy supported by series of site specific strategies.

The licensee's strategy should identify the inventory of its liabilities and describe the means of dismantling each part of the facility and the management of all the radioactive material until it is ultimately disposed of. The timescales over which decommissioning will take place should be defined and a programme included for the dismantling of major plant and buildings. The strategy should be linked to, or integrated with, the strategy for the management of existing radioactive waste and waste which is produced during decommissioning.

Licensees should demonstrate that their strategy is consistent with Government Policy and identify and justify any differences. Consideration should also be given to the extent to which their strategy is consistent with the concept of sustainable development.

In selecting a preferred strategy, licensees should demonstrate that they have examined an adequate range of options for decommissioning. The options should cover different timescales, technical factors, social factors and financial factors. The major assumptions and uncertainties should be identified together with the approach for their resolution.

The strategy should describe how the licensee will provide and maintain the arrangements to ensure that the nuclear facilities and the decommissioning process is managed safely until the site is delicensed, including the provision of an appropriate organisation and supporting infrastructure, and the need to maintain the records required for the future management of the radioactive material. The strategy should describe how the costs of implementing the strategy have been estimated and how the appropriate funds will be provisioned.

The strategy should be maintained and reviewed by the licensee in order to respond to changing circumstances and influences.

More detail on decommissioning strategies is given in **Appendix 2**.

6.5 Decommissioning Programmes

NII requires licensees to prepare programmes for decommissioning which, where appropriate, will be approved by NII.

The future requirements for decommissioning should be first considered during the design of a plant. The planning and preparatory activities for decommissioning continue during plant operation and are carried out in increasing detail towards the end of plant life. For any new plant, the licensee should prepare an outline decommissioning plan which shows that the design of the plant will facilitate its safe decommissioning and dismantling. Operating arrangements should also take due account of the needs of decommissioning, particularly with the making and retention of adequate plant records.

A detailed decommissioning programme, scheduling the activities that will be carried out to address the complete inventory of liabilities will be required prior to the planned cessation of use of a plant. The programme should also include the provision of safety documentation and similar arrangements for the management of change in the organisation during decommissioning.

Where appropriate, decommissioning should be divided into stages, in which case, NII may specify where consent is required to commence a stage or to proceed from one stage to the next. The decommissioning programme should include sufficient

milestones with associated dates to enable progress against the plan to be monitored.

6.6 Decommissioning Safety Cases

NII requires licensees to prepare safety cases for decommissioning which, where appropriate, will be assessed by NII.

Licensees should provide safety case documentation describing their arrangements and justifying the safety of the site and the safety of the operators at all times during decommissioning of a plant. The safety case should be consistent with the licensee's decommissioning programme and should address the changing hazards from a plant which may occur as a result of modifications to the plant which take place during the stages of decommissioning. The safety case should also cover delicensing of the site (see **Appendix 1**).

NII expects the safety case to demonstrate that the safety of the decommissioning operations meets legislative requirements (for example, the Licence Conditions) and that they are consistent with modern standards and take account of best practices from other decommissioning projects. The safety case should also demonstrate that risks are reduced in line with the ALARP principle. Parts of the safety case may be assessed by NII, if it decides that it merits it because of the hazards posed or for some other reason. The Safety Assessment Principles (SAPs) (**Ref. 6**) provide a framework for the assessment of safety cases.

In line with Government Policy, decommissioning safety cases should demonstrate that hazards presented by the plant are reduced in a systematic and progressive way. It is expected that decommissioning safety cases will continue to be reviewed through the Periodic Safety Review process.

Further guidance on decommissioning safety cases is given in **Appendix 3**.

6.7 Timing

In line with Government Policy, NII requires licensees to decommission their nuclear facilities as soon as it is reasonably practicable, taking account of all relevant factors. Licensees should justify the timing of decommissioning that is part of their strategy, through discussion and quantification of these factors. If necessary, in the interests of safety, NII may require decommissioning to be completed on an earlier timescale than originally planned.

In line with Government Policy, NII requires licensees to decommission their nuclear facilities as soon as it is reasonably practicable, taking account of all relevant factors. It will seek to ensure that licensees take steps to reduce the hazards associated with their facilities in a progressive and systematic manner, over an appropriate period. The rate at which work proceeds will be determined by several factors, each of which will exert a particular influence, and licensees will need to demonstrate that they have considered and balanced these influences in reaching and justifying their proposals. These factors are presented below, although the list is not exhaustive, and their influence on timing is discussed in **Appendix 4**:

- radioactive decay;
- operator radiation exposure;
- public radiation exposure;

- structural safety;
- radioactive waste management and available disposal routes;
- management and maintenance of an appropriate organisation;
- corporate memory;
- costs and financial provisions;
- developments in technology;
- national and international experience;
- sustainable development;
- environmental impact; and
- future uncertainties.

This list of factors is applicable to all types of nuclear facilities, and NII expects licensees to consider them for each installation on a case-by-case basis. Licensees should justify the timing of decommissioning, as part of their strategy, through appropriate discussion and quantification of the relevant factors. NII's view is that most of these factors drive towards the early decommissioning of nuclear facilities.

In the particular case of reactor decommissioning, NII recognises that there are potential safety benefits from deferring final reactor dismantling for several decades in order to reduce operator and public radiation exposure. In addition, deferral will allow for radioactive decay so reducing the quantity and possibly the classification of radioactive waste that is produced. However, the benefits in radiological safety and waste generation from deferral diminish with time and there will be a point at which there is little further gain.

The benefits of delay must be balanced against those of placing any hazardous material into a state of passive safety as soon as practicable. In addition, if periods of deferral are proposed, licensees will need to demonstrate that they can ensure long-term safety by maintaining an appropriate organisation, supporting infrastructure and corporate memory. There is also the risk that the physical structures will degrade leading to an increased possibility of leakage of radioactive materials.

Early dismantling will be more expensive initially, but this must be compared to the long-term costs of deferral, because of the need to maintain the facility in a safe condition, the increasing risk of unforeseen routes for environmental releases and the likely future tightening of standards expected (see **Appendix A6.4**). Licensees' financial analyses generally seem to favour delaying decommissioning because of the use of discounting techniques to calculate future costs. In considering options, licensees should illustrate their case with examples of total non-discounted costs for several scenarios with different timings of stages, as well as testing the sensitivity to discounting rates. In addition, it is noted that, internationally, the approach is for early decommissioning which is in marked contrast to the approach of some UK licensees.

Licensees will need to decommission their facilities on a timescale that is acceptable to NII. If necessary, in the interests of safety, NII may require decommissioning to be completed on an earlier timescale than originally planned.

Detailed guidance on the timing of decommissioning is given in **Appendix 4**.

6.8 Systematic and Progressive Reduction of the Hazard

NII will require the decommissioning programme proposed by a licensee to achieve a systematic and progressive reduction of the hazards presented by the nuclear facilities or site.

Decommissioning may proceed as a continuous activity, or if there are safety benefits, as a series of sequential stages, the end result of each stage being a significant reduction in hazard. The order, timing and extent of each stage will be influenced by the hazard posed by a particular plant on a site. Actions should be prioritised on the need to reduce the large hazards or those with high risk. NII will require licensees to justify the order and timescales on which they address each hazard.

In general, NII would expect the removal and/or immobilisation of the most active or mobile material to be carried out on the shortest timescale with further actions following on timescales appropriate to the remaining hazards they address. The elimination of the highest hazards in a nuclear facility should not diminish the consideration of the residual hazard. In some circumstances, actions may be required which temporarily increase risk to enable hazard reduction to take place. This will require substantiation and demonstration that risks at each stage of the activity are acceptable and ALARP.

6.9 Management and Maintenance of an Appropriate Organisation

NII requires licensees to manage the organisational change throughout decommissioning to ensure safety.

Decommissioning, coming after plant shutdown, can be a time of significant change for an organisation and its personnel. Licensees will be required to demonstrate appropriate management of the organisational change, in advance of shutdown, to ensure that safety standards are maintained. NII will require licensees to prepare detailed programmes and describe their arrangements before each phase of decommissioning and these will include the demonstration of an appropriate management structure and staffing levels, both to fulfill key roles associated with licensees' responsibilities as an intelligent customer under the site licence and to provide the general infrastructure to support the project. NII will require licensees to make responsible use of contractors and to retain control of operations on the site.

Benefits, in terms of doses and costs, can be gained from using workers from the former operating team who have good knowledge of the facilities and the site. If decommissioning is deferred, then it is unlikely that this resource will still be available when dismantling starts. In that case, licensees must make arrangements to capture and maintain the knowledge base, and should assemble and train teams of workers to undertake activities when required.

Further guidance on this topic is given in **Appendix 5**.

6.10 Costs and Financial Provisions

NII requires licensees to estimate the future costs of radioactive waste management and decommissioning in order to demonstrate that their arrangements will provide the necessary financial provisions to implement the strategies.

NII requires licensees to estimate the future costs of radioactive waste management and decommissioning in order to demonstrate that their arrangements will provide

the necessary financial provisions to implement the strategies and that there is flexibility to accommodate alternative strategies should circumstances change. They should also estimate costs to support their selection of preferred strategies and timescales.

Cost estimates should be comprehensive and take into account all the activities, and necessary supporting infrastructure that will be required over the timescale of any particular decommissioning project, and take account of the increasing uncertainty as estimates are made for long periods in the future. Licensees compare costs incurred at different times by converting them to a present value using a discount rate. Where the result of an assessment is dependent on the value of the discount rate employed, the application of discounting requires careful consideration: licensees should justify the values they use. NII expects licensees to present the estimated costs for decommissioning strategies on an undiscounted and discounted basis.

Further guidance on this topic is given in **Appendix 6**.

6.11 Quality Assurance

In response to LC 17 (Quality Assurance), licensees are required to develop and implement QA arrangements that cover all relevant phases of their activities e.g. design, construction, manufacture, commissioning, operation and decommissioning.

These arrangements should, as a minimum, encapsulate the requirements of IAEA 50-C-Q series, which in turn cover the principles of ISO 9000 series and BS 5882. In addition, the documented arrangements are expected to include, or at least clearly signpost, the management systems and procedures established to meet all other site licence conditions. A number of licensees have, or are developing, integrated management systems that are designed to meet quality, safety and environmental requirements. Guidance on licensees' arrangements for quality assurance can be found on BMS. Inspection and quality control activities are integral elements of an effective QA programme, particularly as these apply to products and services, for example, waste packaging (see the complimentary guidance on radioactive waste management (**Ref. 7**)).

6.12 Quinquennial Review

Government Policy requires HSE, in consultation with the environment agencies, to carry out quinquennial reviews (QQR) of licensees' decommissioning strategies.

For the QQR process (see **Annex 1**, Extracts from Cm 2919, para 183), NII will request licensees to produce a publicly available document setting out their decommissioning strategy. NII, in consultation with the environment agencies, will review the information presented and the licensee's arrangements for maintaining and reviewing the strategies. The strategies and associated timescales should be practicable and within the constraints of legislation, Government Policy, safety and environmental requirements and should remain soundly based as circumstances change.

Licensees should provide information on the basis and assumptions on which the strategies have been costed such that the adequacy of the financial provisions can be judged.

Further guidance on this topic is given in **Appendix 7**.

6.13 International Standards and Developments

Internationally accepted standards, guidance and practice are an important source of the modern standards that NII will take into account in assessing the acceptability of licensees' proposals and safety cases for the decommissioning of nuclear facilities.

Where standards or guidance produced by international consensus exist, such as those of IAEA and ICRP, NII will take these into account in assessing the acceptability of proposals and safety cases for decommissioning. NII will also maintain awareness of, and involvement in, national and international developments in the field of decommissioning. NII expects licensees to take full account of the experience that has been gained, and which will become increasingly available, from UK and international decommissioning projects in developing their strategies and other arrangements.

In order to effectively carry out its responsibilities, NII maintains close involvement with national and international bodies in appropriate fields of waste technology and decommissioning, including research and development. This specifically includes maintaining close liaison with DETR, DTI, the environment agencies, the European Commission, IAEA and OECD/NEA.

7. Documentation Structure

7.1 This guidance is structured in the form of a head document describing the framework of legislation, Government Policy and the fundamental principles NII expects to see achieved in decommissioning. This is supported by a series of Appendices covering specific aspects in more detail. This structure permits individual Appendices or the head document to be maintained and updated separately, without each change requiring a reissue of the complete guidance. Further guidance is provided in attached Appendices under the seven topic headings listed below.

Appendix 1 Delicensing of Nuclear Sites

Appendix 2 Decommissioning Strategies

Appendix 3 Decommissioning Safety Cases

Appendix 4 Timing of Decommissioning

Appendix 5 Management and Maintenance of an Appropriate Organisation during Decommissioning

Appendix 6 Costs of Radioactive Waste Management and Decommissioning

Appendix 7 Quinquennial Review

7.2 Inspectors are also referred to the guidance covering the management of radioactive materials and radioactive waste on nuclear licensed sites (**Ref. 7**) which has a similar structure of a head document supported by appendices with the following topic headings:

Appendix 1 Basics of the Management of Radioactive Materials and Radioactive Waste

Appendix 2 Waste Management Strategies

Appendix 3 Safety Cases for Radioactive Waste Management Facilities

Appendix 4 Passive Safety in the Storage of Radioactive Materials and Radioactive Waste

Appendix 5 Radioactive Waste Minimisation

Appendix 6 Inspection of Accumulated and Stored Radioactive Materials and Radioactive Waste

Appendix 7 Records for Radioactive Waste Management and Decommissioning

Appendix 8 Management of Radioactively Contaminated Land

8. References

1 Nuclear Site Licences under the Nuclear Installations Act 1965 (as amended) - Notes for Applicants, HSE, 1994.

2 HSE. Guidance on compliance with the Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999. Draft in preparation.

3 Review of Radioactive Waste Management Policy – Final Conclusions, UK Government Cm 2919, HMSO 1995.

4 Management of Nuclear Waste. House of Lords Select Committee on Science and Technology, Third Report. March 1999.

5 EC (1996) Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers from ionising radiation. OJ No L159, 29.6.96.

6 Safety Assessment Principles for Nuclear Plants, HSE, NII, 1992.

7 Management of Radioactive Materials and Radioactive Waste on Nuclear Licensed Sites. **T/AST/024.**

Annex 1 - Extracts from Government White Paper Cm 2919 (1995)

Decommissioning strategies

Para 124 The Government believes that, in general, the process of decommissioning nuclear plants should be undertaken as soon as it is reasonably practicable to do so, taking account of all relevant factors. In future, it will ask all nuclear operators to draw up strategies for decommissioning their redundant plant. These will need to include justification of the timetables proposed and demonstration of the adequacy of the financial provision being made to implement the strategies.

Para 125 As with all other operations on nuclear sites, decommissioning will be undertaken in accordance with conditions attached to the nuclear site licence and subject to HSE/NII controls, in order to ensure the safety of the site, workers and the public. Disposal of wastes arising from decommissioning will be subject to regulation under RSA 93. In considering proposals for decommissioning nuclear plant put forward by the operators, HSE/NII will assess them to ensure that the proposals assure the safety of the site at all times, and that the hazards presented by the plant (or site in the case of nuclear power stations) are reduced in a systematic and progressive way. The expected outcome of such consideration will be a plan to remove and/or immobilise the most active and potentially mobile radioactivity on a relatively short timescale, with further actions following at appropriate intervals consistent with the hazards they seek to address. The rate at which the work proceeds will be determined by the potential hazards posed to the public, workers and the environment (recognising the benefits obtainable from radioactive decay), the availability of disposal routes for the wastes and – subject to ensuring public safety – the financial implications of proceeding on different timescales.

Para 126 Given that regulatory approval for decommissioning is required on a case-by-case basis, the Government reaffirms the preliminary conclusions of the review that it would be unwise at present for the operators of nuclear power stations to take steps which would foreclose technically or economically the option of completing Stages II and III on an earlier timescale should that be required, and that they should recognise, when provisioning, the potential uncertainties regarding the timing of Stage II and Stage III decommissioning. Nevertheless, the Government also confirms its preliminary conclusion that there are a number of potentially feasible and acceptable decommissioning strategies for nuclear power stations available to the operator, including the safestore strategy proposed by NE and SNL. To ensure that operators' decommissioning strategies remain soundly based as circumstances change, they will be reviewed quinquennially by HSE, who will consult the Environment Agencies.

Para 127 The Government recognises that, in addition to nuclear power stations, a variety of other nuclear facilities are in the process of being decommissioned, or are to be decommissioned in the future. As with power stations, decisions on decommissioning these facilities should be taken on a case-by-case basis and the same general principles apply in respect of timing. Proposals for dealing with such facilities will need to be included in the operators' decommissioning strategies.

Para 128 For decommissioned nuclear-powered submarines, MOD's current policy is that they should be stored afloat in safe and secure facilities at the naval bases at Devonport and Rosyth. HMS Dreadnought has been stored at Rosyth since 1982; six others have been similarly stored, the first having been taken out of service in 1991. Two more nuclear-powered submarines have been withdrawn from service and will undergo their decommissioning process in due course. MOD has based its long-term plans for the disposal of radioactive wastes arising from the reactor compartments on the availability of the UK Nirex repository in about 2010. However, this policy is kept under review.

Financial provision

Para 131 The Government has given careful consideration to the question of provisioning, in the light both of the responses to the review and of the conclusions of the nuclear review regarding privatisation. The Government believes that it is right that, for those parts of the industry which are privatised, segregated funds for decommissioning should be established. In addition, the Government will examine what improvements can be made in the way in which the unprivatised sections of the industry report on their progress towards decommissioning and on their provisioning policies. The periodic reviews by the regulators (see **paragraph 126**) should provide the right focus for improved reporting of this kind.

Summary of Conclusions

Para 181 In general, the process of decommissioning nuclear power plants should be undertaken as soon as it is reasonably practical to do so, taking account of all relevant factors.

Para 182 Since regulatory approval will continue to be required on a case-by-case basis, it would be unwise for the operators of nuclear power stations to take steps which would foreclose technically or economically the option of completing Stages II and III on an earlier timescale should that be required. Nevertheless, the Government believes that there are a number of potentially feasible and acceptable decommissioning strategies for nuclear power stations, including safestore.

Para 183 Nuclear operators will be asked to draw up strategies for decommissioning their redundant plant and these will be reviewed quinquennially by HSE in consultation with the Environment Agencies.

Para 184 Segregated funds for decommissioning should be established for those parts of the industry which are privatised. The Government will examine what improvements can be made in the way in which the unprivatised sections of the industry report on their progress towards decommissioning and on their provisioning policies.

Appendix 1 Delicensing of Nuclear Sites

Contents

A1.1 Introduction

A1.2 Experience of Delicensing

A1.3 Current Developments

A1.4 Safety Case for Delicensing

A1.5 References

A1.1 Introduction

A1.1.1 A licensee may decide that the end-point for decommissioning on a nuclear site is delicensing. Delicensing involves the release of the land from regulation under NIA65 and the release of the operator of the facilities from his period of responsibility for any nuclear liability. Delicensing may not always be the end point of a decommissioning project, for example, the licensee may plan to operate another nuclear facility on a site or to maintain institutional control.

A1.1.2 Delicensing requires HSE to express an opinion that there has ceased to be any danger from ionising radiations from anything on the site. This implies that there should be no need for regulatory control of the site under NIA65, RSA93, or IRR99. Those nuclear sites which have been delicensed by NII in the past, have involved relatively minor hazards and it has been possible to adopt a pragmatic approach in interpreting this requirement. However, operators of nuclear sites with major nuclear facilities are also planning for decommissioning and delicensing and, in these cases, the extent and degree of contamination, and therefore risk, may be much more significant. There is therefore a need for more practical criteria for demonstrating 'that there has ceased to be any danger from ionising radiations'. HSE is currently developing such criteria in consultation with the environment agencies, DETR and NRPB. HSE/NII's experience and current thinking on delicensing have been reported in a number of conference papers (**Refs. 1 to 5**). Inspectors requiring up to date briefing on this issue should consult the appropriate unit within NII (currently 4C).

A1.1.3 NIA65 does not apply to MOD sites. However, the standards of control are similar (by agreement with MOD, NII and the environment agencies) to nuclear licensed sites and it is therefore expected that MOD will apply similar standards before releasing any part of those sites for unrestricted use.

A1.2 Experience of Delicensing

A1.2.1 Between 1962 and 1999, NII has delicensed 12 sites, or parts of sites. Applications for delicensing were treated on their merits and took account of the site history and comparisons of the levels of residual radioactivity on the sites with the surrounding area. The approach to demonstrating 'that there has ceased to be any danger from ionising radiations' was based on the following principles:

- i. Residual radioactive material on the site has been reduced below exemption criteria defined by relevant UK legislation (for example, RSA93 and IRR99), and
- ii. the licensee has taken action to reduce levels of radioactive material on the site below the levels defined in (i), so far as is reasonably practicable.

- iii. The licensee has demonstrated that the requirements of (i) and (ii) have been met by showing that the cleared site is radiologically indistinguishable from the surrounding area adjacent to, but remote from, the influence of previous nuclear operations on the site.
- iv. An independent check on behalf of NII has confirmed that the requirements of (i) and (ii) have been met.

A1.3 Current Developments

A1.3.1 For many of the remaining nuclear sites, existing levels of ground contamination will present a significant obstacle to delicensing using the above principles. As a result, HSE is developing criteria for the assessment of future delicensing applications based on the following sources:

- i. For solid material, criteria may be based on the exemption levels in RSA93 or clearance criteria derived from the European Community Basic Safety Standards (**Ref. 6**).
- ii. For groundwater, drinking water standards may be applied (World Health Organisation Guidelines and EC Directives).
- iii. NRPB advises (**Ref. 7**) that the principles to be applied on the release of ground where there has been contamination, should be the same as those for the protection of the public from any practice (i.e. justification, optimisation and the limitation of dose and risk).
- iv. NRPB recommends that the excess risk of death or serious harm to an individual should not exceed 10^{-5} per year which is equivalent to a dose of 0.3 mSv per year. They also recommend that any expenditure to reduce risks below 10^{-6} per year would not be justified. This is consistent with the broadly acceptable level of risk proposed in TOR (**Ref. 8**).

A1.3.2 DETR is also currently developing regulations and statutory guidance for the remediation of radioactively contaminated ground. Although these will not apply to contaminated ground on nuclear licensed sites, the criteria that DETR develops for the release of radioactively contaminated ground will be of direct relevance in ensuring consistency of regulation.

A1.4 Safety Case for Delicensing

A1.4.1 A licensee's application for delicensing of the site will need to be supported by an appropriate safety case which should cover, as a minimum, the following issues:

- i. The reasons for excluding the land from regulatory control.
- ii. The history and use of the land.
- iii. The identification of areas where radioactivity could contribute significantly to radiation exposure, now or in the future, and an assessment of reasonably practicable methods for their remediation.
- iv. Documentation, records and results of a radiological survey and analysis of samples from the site for comparison with background data from the vicinity of the site.
- v. An assessment of dose and risk to the public following delicensing, based on conservative assumptions regarding future use of the site and exposure pathways, i.e. to demonstrate that any future use of the land represents no danger.

A1.5 References

1 Robinson I.F. and Simister D.N. A regulatory view of de-licensing at UK nuclear sites. Proceedings of the 6th Society of Radiological Protection International Symposium. Southport, 14 June 1999.

2 Robinson I. F. A nuclear inspector's perspective on decommissioning at UK nuclear sites. J Radiol. Prot. vol 19 no 3 p203-212, 1999.

3 Robinson I. F. Delicensing Nuclear Sites in the UK. Proceedings of the 10th International Radiation Protection Association Congress, Hiroshima, May 2000.

4 Robinson I.F. Regulatory experience of ALARA and decommissioning at UK Nuclear Sites. European ALARA Network Workshop, Saclay, France 1 December 1997.

5 Griffiths J.S. and Burgess P.H. Delicensing of nuclear sites in the UK. IRPA9:1996 Vienna.

6 Basic Safety Standards for the Protection of the Health of Workers and the General Public against the Dangers arising from Ionising Radiation, European Community, Council Directive 96/29/Euratom, L159 Vol 39, June 1996.

7 Radiological protection objectives for land contaminated with radionuclides. Documents of the NRPB, vol 9, no 2, 1998.

8 The Tolerability of Risk from Nuclear Power Stations, HSE, 1992.

Appendix 2 - Decommissioning Strategies

Contents

A2.1 Introduction

A2.2 Relationship between Decommissioning Strategies, Plans and Safety Cases

A2.3 Content of Decommissioning Strategies

A2.4 Maintenance and Review

A2.5 References

A2.1 Introduction

A2.1.1 Government Policy has required licensees to draw up strategies for the decommissioning of their redundant plant. A decommissioning strategy is intended to provide an overview of a licensee's approach to decommissioning its nuclear liabilities. The strategy is expected to describe a programme for the future operation, shutdown and decommissioning of the plant on its nuclear sites. It should justify the licensee's selection of a preferred strategy and the associated timescales. Further guidance on the issues to be covered in decommissioning strategies is given in this Appendix.

A2.1.2 Government Policy also requires HSE, in consultation with the environment agencies, to carry out quinquennial reviews (QQRs) of licensees' decommissioning strategies. Detailed guidance on the QQR process is provided in **Appendix 7**.

A2.2 Relationship between Decommissioning Strategies, Plans and Safety Cases

A2.2.1 Decommissioning strategies are distinct from, but related to, the detailed decommissioning plans and safety cases for the decommissioning of nuclear facilities. There is a need for each licensee to produce a justifiable, and acceptable, strategy in order to ensure that they are making adequate preparations and arrangements for safety, that are consistent with the approach to decommissioning the nuclear facilities. In order to demonstrate that the relevant current and future issues are being addressed, the plans and safety case require information from, and should make reference to, the decommissioning strategy. The safety case and the strategy should be regularly maintained and updated, and should remain mutually consistent.

A2.2.2 The future requirements for decommissioning should be first considered during the design of a plant. The planning and preparatory activities for decommissioning commence during plant operation and are carried out in increasing detail towards the end of plant life. Where appropriate, the decommissioning should be divided into stages and, if NII specifies, the licensee may not proceed to the next stage without issuing of the appropriate licence instrument by NII. At all stages, the licensee will submit detailed plans and programmes, and describe their arrangements for safety, as required under LC35. The licensee will also be required to carry out a Periodic Safety Review (PSR) every 10 years. The review cycles for PSR and QQR are not currently coordinated.

A2.3 Content of Decommissioning Strategies

A2.3.1 The manner and form in which they choose to prepare, maintain and document the information relating to their decommissioning strategies is a matter for the licensees. However, for licensees with extensive liabilities, an overview document, representing the corporate strategy, supported by further documentation on the strategies for different sites and different types of

facilities, would be appropriate. For those licensees with limited nuclear liabilities a single document may be appropriate. It should be noted that the QQR is carried out on the corporate strategy.

A2.3.2 The content of a decommissioning strategy will be dependent on the type of facility under consideration. For example, the potential hazards associated with decommissioning a commercial power reactor, a training or research reactor and a nuclear chemical plant, are different in nature and magnitude and the strategies for their decommissioning are expected to reflect this.

A2.3.3 Description of the Strategy

A2.3.3.1 Licensees should define their decommissioning objectives and policy. The extent (inventory) of the decommissioning liabilities should be described. The proposed strategy for decommissioning each nuclear facility should be described, including the timescale, project milestones and targets, method of implementation, and proposed disposal routes for the radioactive and non-radioactive wastes.

A2.3.4 Consistency with Government Policy

A2.3.4.1 Licensees should demonstrate that their proposed strategy is consistent with Government Policy and identify and justify any differences.

A2.3.5 Selection of Preferred Option

A2.3.5.1 Licensees should examine a full range of options, taking account of all relevant factors, before selecting their preferred strategy. They should include in their strategy a description of the options that have been considered, those factors that have been taken into account, together with the major assumptions, such as the reasonably foreseeable closure scenarios, the availability of disposal routes for radioactive wastes, the development of technology and the financial implications of proceeding on different timescales. Any significant uncertainties should be identified together with the approach for their resolution. The process by which the preferred option has been selected and justified should be described and licensees should maintain appropriate records of the decision process.

A2.3.6 Timescales for Decommissioning

A2.3.6.1 The strategy should define and justify the timescales over which decommissioning will take place. This is discussed in more detail in **Appendix 4**. Details provided should include the programme for the main stages of decommissioning, dates for the shutdown of major plant and buildings, and the dates when buildings and land will be available for reuse, as a licensed site or otherwise. If alternative and fallback options have been specified, then the major decision dates for selecting options should be presented. The strategy should show that earlier options for decommissioning are not being foreclosed either economically or technically.

A2.3.7 Progressive and Systematic Reduction of the Hazard

A2.3.7.1 The strategy should meet the requirement to reduce the hazards represented by the nuclear facilities in a progressive and systematic manner. Licensees should justify the order and timescales on which they will address each hazard. In general, the most active and potentially mobile radioactive material should be removed and processed, either for disposal or for passive safe storage pending disposal, on the shortest practical timescale. The rate at which further actions are

undertaken should be appropriate to the remaining hazards that they address, the availability of disposal routes and the financial implications of proceeding on different timescales. The elimination of the highest hazards should not diminish the consideration of the residual hazards.

A2.3.8 Methods

A2.3.8.1 The methods that will be used for each stage of decommissioning, including dismantling, decontamination, waste processing and storage, should be described. It should be demonstrated that these methods are technically practicable and any development work, especially of techniques to be used at a later stage, should be identified and undertaken at the appropriate time.

A2.3.9 Structured Approach

A2.3.9.1 A structured approach to decommissioning should be demonstrated. Licensees should ensure that the decommissioning strategies for individual nuclear facilities on the same site are integrated and coordinated. If a number of facilities are being decommissioned, the interactions or common features should be considered in developing the strategy and programme. This could include, for example, making best use of equipment which is available for a limited period only (for example, encapsulation plant or decontamination equipment), or taking the opportunity to process similar waste streams at the same time.

A2.3.10 Radioactive Waste Management and Disposal

A2.3.10.1 Detailed guidance on radioactive waste management is provided in **Ref. 1**. The decommissioning strategy should be coordinated with the strategy for radioactive waste management.

A2.3.10.2 Licensees should take account of those quantities of radioactive wastes that are accumulated within the nuclear facilities at the end of operation and in addition should provide estimates of the volume, character and activity of radioactive waste that will result from decommissioning. The processes associated with dismantling and decontamination will generally produce secondary radioactive waste, in the form of solid waste, or liquid and gaseous effluent. The strategy should avoid the unnecessary creation of radioactive waste and aim to minimise the quantities produced and discharged. Licensees must ensure that they are able to obtain appropriate authorisations, granted by the environment agencies under RSA93, for the disposal of solid, liquid and gaseous wastes.

A2.3.10.3 There is currently no disposal route for HLW, ILW, or for long-lived LLW. Licensees will therefore need to plan for the long term interim storage of these radioactive wastes in a passively safe state. Guidance on passive safety is included in **Ref. 1**. Although there is presently a disposal route for operational LLW, namely the Drigg facility, its capacity will be reached around 2040. The operators of Drigg are unlikely to accept the large volumes of LLW produced in decommissioning because of the premium on available space and, therefore, licensees will also need to plan for the long term interim storage of this waste.

A2.3.10.4 The strategy should include the management and disposal of any non-radioactive wastes (particularly hazardous wastes such as asbestos and toxic chemicals).

A2.3.11 Monitoring and Surveillance

A2.3.11.1 In all cases and, in particular for those strategies that involve the deferral of decommissioning for extended periods of time or the long term storage of radioactive wastes, licensees are required to have adequate arrangements in place for the continued surveillance, maintenance and monitoring of the facilities and the site.

A2.3.12 Corporate Management System, Supporting Infrastructure and Retention of Records

A2.3.12.1 Licensees should indicate the extent of the corporate management system and supporting infrastructure that will be required to support the decommissioning strategy over the full term of the project. The topic of the level of manning on a decommissioning site is the subject of separate guidance in **Appendix 5**.

A2.3.12.2 In all cases but, in particular, for those strategies that involve the deferral of decommissioning for extended periods of time, licensees should indicate how they intend to secure and retain the appropriate resources of suitably qualified and experienced staff and similarly, and how they intend to secure and maintain the existing knowledge base relating to the nuclear facilities which is required to support the decommissioning project.

A2.3.13 Environmental Impact

A2.3.13.1 Separate guidance is being developed within NII on compliance with EIADR99. Decommissioning activities will have an impact on the environment and it is important that this is taken into account in developing the strategy.

A2.3.14 Demonstration of Financial Provision

A2.3.14.1 Comprehensive estimates of the costs of decommissioning should be provided and linked to the activities to be carried out. All significant activities should be taken into account including corporate and general infrastructure responsibilities; radioactive waste management, storage and disposal; decontamination and dismantling works; care and maintenance; monitoring and surveillance and any other associated activities. Major cost components should be identified together with the distribution of costs with time. Any assumptions made on discount rates and the timescales over which they have been applied should be justified (see **Appendix 6**).

A2.3.14.2 Licensees should provide details of the arrangements for the funding of their nuclear liabilities. In the case of the privatised industry the financial provision is expected to be contained in segregated funds, kept separate from other company funds. The state owned industry should describe their corresponding arrangements. Licensees should provide a demonstration of the adequacy of the financial provision being made to implement the strategies. This should show that the strategy does not economically foreclose on earlier options for decommissioning, including an explanation of how the costs will change and the money will be provided if alternative options are chosen.

A2.3.15 Public Expectations

A2.3.15.1 NII and licensees should be aware of societal concern and public expectations with respect to decommissioning. Licensees may choose to consult the public and other stakeholders on their decommissioning strategy and to report the results of that consultation and its impact.

A2.4 Maintenance and Review

A2.4.1 Licensees are expected to keep their decommissioning strategies under continuous review to take account of changes in such areas as: Government Policy; environmental protection; safety requirements; the availability of disposal routes for radioactive wastes; the development of new technologies; progress in financial provisioning; and the financial implications of proceeding on different timescales. After decommissioning work has commenced on a nuclear site, subsequent issues of the strategy report should describe the progress achieved, highlight any significant experience that has been gained and describe any impact this has had on the strategy.

A2.4.2 The review process should not necessarily be concentrated on the QQR cycle. The frequency and degree of both the licensee's and the regulator's attention to strategy issues should be based on the requirement to ensure safety, the decommissioning programme, the potential hazard represented by the facility, uncertainties and any other relevant issues.

A2.5 References

1 Management of Radioactive Materials and Radioactive Waste on Nuclear Licensed Sites. **T/AST/024.**

2 Review of Radioactive Waste Management Policy – Final Conclusions, UK Government Cm 2919, HMSO 1995.

Appendix 3 - Decommissioning Safety Cases

Contents

A3.1 Introduction

A3.2 Licence Conditions and Safety Assessment Principles

A3.3 Issues for Decommissioning Safety Cases

A3.4 References

A3.1 Introduction

A3.1.1 NII requires licensees to provide safety cases demonstrating the safe operation of their facilities at all stages of their life, including decommissioning. The decommissioning safety case will be developed in increasing detail towards the end of the operational life of the facility, in conjunction with the decommissioning strategy. During decommissioning, the safety case should be updated when necessary to reflect the impact of modifications to the facilities and to address the changing nature of the hazard. A final safety case will be required to support the delicensing of the nuclear site (see **Appendix 1**).

A3.1.2 Decommissioning of nuclear installations may become of increasing societal concern for which the public expects high standards of safety and environmental protection. Some older plants may be physically deteriorating and it is necessary to recover the radioactive material they contain and dismantle the buildings on a relatively short timescale. Other plants remain in a good condition and licensees may seek to justify deferring decommissioning.

A3.1.3 Guidance on HSC's policy on enforcement, which underpins NII's approach to regulating safety on nuclear sites, including decommissioning, has been described in detail in **Appendix 3 of Ref. 1**. A safety case should demonstrate that the decommissioning of a facility can be carried out in a manner that meets modern standards, legislation and Government policy, and that the remaining risks have been reduced ALARP. This approach of demonstrating a robust engineering approach and use of current best practice is fundamental to the demonstration of safety. Quantified Risk Assessment (QRA) can help to prioritise safety issues and to investigate the benefits of further safety improvements, but it should not be used to justify poor practice.

A3.1.4 General guidance on the content of safety cases for all types of nuclear facilities, including their decommissioning, is available to inspectors in **Ref. 2**. The guidance on the content of safety cases for radioactive waste management facilities (**Ref. 1, Appendix 3**) is also particularly relevant to decommissioning. This appendix aims to focus on the issues that are particularly relevant to decommissioning which need to be addressed in the safety cases.

A3.2 Licence Conditions and Safety Assessment Principles

A3.2.1 LC14 requires licensees to make and implement arrangements for the production of safety cases and LC23 requires licensees to produce an adequate safety case for any operation that may affect safety. The safety case should justify safety throughout the projected life of the facilities, and LC15 requires the licensee to implement arrangements for the periodic and systematic review of safety cases to ensure their continuing validity.

A3.2.2 NII's SAPs, which have the status of guidance, form a framework for a consistent approach to the assessment of licensee's safety cases. Last published in 1992, the SAPs are currently being reviewed by NII and this guidance will inform the update.

A3.2.3 It is not possible to define the relevant SAPs for any particular plant but, in the spirit of guidance, the following SAPs will be important for assessing the engineering aspects of a decommissioning safety case: Key Principles (P61 and P76), Containment and Ventilation (P223, P230, P231 and P233), Control of Nuclear Matter (P281), Radioactive Wastes (P294 - P307), Radioactive Scrap (P308), Nuclear Matter (P309 - P314) and decommissioning (P330). In addition, P65 introduces the concept of Defence in Depth and the need to provide multiple physical barriers to the release of radioactive materials to the environment.

A3.3 Issues for Decommissioning Safety Cases

A3.3.1 Inspectors have been referred above to **Refs. 1 and 2** for detailed guidance on NII's expectation for the content of safety cases which is equally applicable to decommissioning. This section introduces a number of issues that are particularly relevant to safety cases for decommissioning.

A3.3.2 In line with Government policy, the safety case should demonstrate that hazards are reduced in a systematic and progressive way. In general, the most active and potentially mobile radioactive material should be removed and processed, either for disposal or for passive safe storage pending disposal, on the shortest practical timescale. The elimination of the highest hazards should not diminish the consideration of the residual hazards.

A3.3.3 Some decommissioning activities may temporarily modify the hazard and increase the risk in order to achieve an overall reduction in the hazard. In such instances, the safety case must identify the impact of the changes and demonstrate that the risks remain at an acceptable level whilst the work is undertaken. Examples of such activities include partial dismantling of structures, removal of systems, decontamination (including post-operational clean out, POCO) and radioactive waste retrieval and processing.

A3.3.4 If buildings, structures or equipment have an ongoing role in the decommissioning of a nuclear facility, then the safety case should demonstrate their continuing safety for the periods required, in line with the principles for passive safe storage of radioactive material and waste. An assessment of the continuing safety of the nuclear facility involves determining the current physical condition and establishing how it will change in the future. This is particularly relevant to decommissioning strategies involving the deferral of dismantling. The safety case should describe the arrangements for the continued surveillance, maintenance and monitoring of the facilities that will ensure that any unexpected degradation will be detected. Similarly, adequate arrangements should be made for detecting leakage of radioactivity and to ensure that unforeseen incidents are detected (for example, damage caused by natural events, failure of systems, intrusion).

A3.3.5 Radioactive material contained, accumulated or stored in nuclear facilities that do not meet modern standards, or that are deteriorating, or radioactive waste that is inadequately characterised, packaged or segregated, such that continuing safe management cannot be demonstrated, should be retrieved as soon as practicable.

A3.4 References

1 Management of Radioactive Materials and Radioactive Waste on Nuclear Licensed Sites. **T/AST/024.**

2 Guidance on the Purpose, Scope and Content of Nuclear Safety Cases. Draft in preparation.

Appendix 4 Timing of Decommissioning

Contents

A4.1 Introduction

A4.2 NII's Expectations on the Timing of Decommissioning

A4.3 Factors Affecting the Timing of Decommissioning

A4.4 References

A4.1 Introduction

A4.1.1 Government Policy (**Ref. 1**) is that, in general, the process of decommissioning nuclear plants and facilities should be undertaken as soon as it is reasonably practicable, taking account of all relevant factors. It requires nuclear operators to draw up strategies for decommissioning their redundant plant and these should include justification of the timetable. Government Policy on decommissioning of nuclear facilities (Ref. 1) contains a number of statements that are directly relevant to timing, namely paras. 124, 125, 181 and 182 (see **Annex 1**).

A4.1.2 This Appendix provides guidance on the factors that NII expects licensees to take into account in determining the timing of decommissioning and the influence that the factors might have.

A4.2 NII's Expectations on the Timing of Decommissioning

A4.2.1 NII's fundamental expectations with respect to the timing of decommissioning of nuclear facilities, which should be met so far as is practicable and cost effective, are summarised in the following statements:

- Decommissioning of nuclear facilities should be carried out as soon as it is reasonably practicable, taking account of all relevant factors.
- Hazards associated with the plant should be reduced in a progressive and systematic manner.
- Full use should be made of existing routes for the disposal of radioactive waste.
- Remaining radioactive material and radioactive waste should be put into a passively safe state for interim storage pending future disposal or other long term solution.

A4.2.2 NII has identified a number of factors that influence the timing of decommissioning and has concluded that most of these factors drive towards early decommissioning. NII considers that decommissioning techniques are sufficiently developed and proven for licensees to undertake decommissioning of facilities in the near term but recognises that there are potential safety benefits from deferring dismantling of some installations containing short-lived radionuclides (see **section A4.3.2**). These benefits are reduced operator and public radiation exposure, and a reduction in the quantity and classification of radioactive waste produced. In such cases, however, the safety benefits from deferral diminish with time and there will be a point at which there is little further gain. It is noted that licensees' financial analyses generally favour deferred decommissioning because of the use of discounting techniques to calculate future costs. When a licensee proposes to defer decommissioning, NII considers that a comprehensive justification for why it is not reasonably practicable to decommission earlier should be provided. This should include issues other than costs and financing.

A4.2.3 In NII's view, early decommissioning, particularly where there are few safety benefits from deferral, is more in line with the Government Policy of sustainable development and the use of the precautionary principle.

A4.3 Factors Affecting the Timing of Decommissioning

A4.3.1 Decisions on the timing of decommissioning will need to have regard to a number of factors, each of which will have a particular influence. Some factors favour early decommissioning and others favour deferred decommissioning. In addition, because the guidance aims to address all types of nuclear facilities, including both nuclear chemical plant and reactors, some of the factors may be more or less relevant to any particular facility. The licensee will be expected to demonstrate that all relevant factors have been considered and their respective impact balanced in arriving at the proposed timing for decommissioning. These factors, and their impact, are discussed under the following headings:

- Radioactive Decay
- Operator Radiation Exposure
- Public Radiation Exposure
- Structural Safety
- Radioactive Waste Management and Available Disposal Routes
- Maintenance of the Organisation
- Corporate Memory
- Costs and Financial Provisions
- Developments in Technology
- National and International Experience
- Sustainable Development
- Environmental Impact
- Future Uncertainties

The list is not exhaustive and licensees should include any other factors which they believe to be relevant. The factors are summarised in **Table A4.1** together with guidance on their impact with respect to the choice of timing (i.e. whether they favour early or deferred decommissioning). The table provides a comparison between the influence of factors for reactors and Pu contaminated facilities in order to illustrate important differences. There are other types of facilities for which the influences could be different, for example, uranium facilities and isotope production facilities.

A4.3.2 Radioactive Decay

A4.3.2.1 The principal activation product in steel components within the core of a nuclear reactor is Co60. This radionuclide has a relatively short half-life of 5.3 years. Delaying decommissioning activities may therefore result in a reduced radiation hazard for the workers. For material containing radioactivity with a longer half-life, for example, the fission product Cs137 (half-life of 30.1 years), there is no significant benefit to be gained from delaying activities over the short and medium term. In the case of plutonium contaminated facilities, ingrowth occurs of the more radiologically significant Am241, from the decay of Pu241, resulting in a radiological hazard that increases with time. In this case, there is a benefit from carrying out the decommissioning activities without delay.

A4.3.2.2 From the above, it is clear that radioactive decay of nuclides is a central consideration in the justification of the deferral of decommissioning and the optimum time to dismantle reactors. For example, for steel components, after some decades, a time is reached when any further reduction in the radiological hazard is insignificant due to the presence of the much longer lived radionuclides. The time, and value, at which the hazard levels off depends on the relative concentrations of

different elements, some of which may be present only at trace levels in the reactor vessel components at the time of manufacture, quantities which are not well known. This uncertainty can be reduced by measurement of dose rates after shutdown of the installation.

A4.3.2.3 Licensees should also consider the impact of radioactive decay on the volume of radioactive waste that is produced as a result of decommissioning. Radioactive content determines the amount of radioactive material that may be placed in waste packages, and in some cases it may be possible to minimise the volume of waste for storage and disposal by choosing an appropriate timescale.

A4.3.3 Operator Radiation Exposure

A4.3.3.1 Except in the case of plutonium contaminated facilities, the radiological hazard to the operators will reduce progressively through radioactive decay. However, whenever a facility is dismantled, the radiation dose the operators receive will depend on the techniques that are used, including the extent to which remote or manual techniques are employed and the amount of shielding that is provided. A realistic assessment of operator doses will also need to take account of the distribution of radioactivity within the facility. In principle it is feasible, using existing technology, to safely dismantle reactors at any time. Early decommissioning will require more remote operations and shielding, whereas later decommissioning may allow more operations to be carried out manually.

A4.3.4 Public Radiation Exposure

A4.3.4.1 There is always the potential for the public to be exposed to radioactivity released from the site following faults. As mentioned above, in general, the radiological hazard associated with a nuclear facility will reduce progressively through radioactive decay. This means that the consequences of accidental releases occurring during dismantling would be reduced by a period of deferral. On the other hand, deferral of dismantling runs the risk that the structures will deteriorate and thereby increase the possibility that radioactive material might be released or become less safe for dismantling. Early dismantling has the benefit of the radioactive material being placed sooner in a passively safe state for long term storage.

A4.3.5 Structural Safety

A4.3.5.1 Licensees will need to demonstrate in their safety case that the civil and other structures that contain the radiological hazard will remain adequately safe, and functional, throughout the full extent of their life including the whole of the decommissioning period. Note that the weight of shielded equipment needed to retrieve radioactive wastes may be considerable, and due account should be taken of any additional loadings which may be placed on the structure. Examination, inspection and maintenance regimes for the structures will need to be justified, and research may be required to underpin their longer-term use. Delaying decommissioning will require longer lifetimes from the structures and place additional onus on the supporting justification. Similarly, the radioactive waste stores will need to be designed to function safely for the potentially very long period of time they will be required to contain waste.

A4.3.6 Radioactive Waste Management and Available Disposal Routes

A4.3.6.1 There are a number of ways in which radioactive waste management and its disposal can impact on the timing of decommissioning. These are discussed below.

A4.3.6.2 There is currently no disposal route for the ILW or long-lived LLW, that will be produced from the dismantling of nuclear facilities, and it is unlikely that one will be available for at least 50 years. In the case of LLW, the present disposal route, Drigg, will only be available for around 40 years and is unlikely to accept large volumes of LLW from decommissioning before its closure. As a result, licencees will need to plan for the long term interim storage of much of the radioactive waste produced during decommissioning. In addition, the timing of decommissioning cannot be linked with any certainty to the timing of the availability of a disposal route.

A4.3.6.3 In the case of reactors, deferring decommissioning can change the specific activity of radioactive waste produced during decommissioning through radioactive decay. This may influence the final volume of radioactive waste if, for example, more waste can be placed in individual packages without the need for additional shielding. Other wastes may change in classification from ILW to LLW or may be able to be recycled or cleared as inactive. This benefit needs to be evaluated with care, taking account of the distribution of radioactivity within the reactor. A variety of options for managing the waste exist now, and in the future there may be changes in waste classification or new waste management practices may emerge. As an illustration, a move to a classification system based on half-life would negate the benefit of delaying to allow ILW to decay to LLW.

A4.3.6.4 Throughout the decommissioning programme, many of the activities will have the potential to generate liquid and gaseous effluent containing radioactivity. Political pressure (e.g. OSPAR) is leading to significant decreases in the levels of discharges that will be allowed in the future. If this trend continues and decommissioning is deferred, it is likely that methods used for dismantling in the future may need to be supplemented to a greater extent by plant capable of reducing the radioactivity in liquid and gaseous discharges to extremely low levels.

A4.3.6.5 Government Policy is that radioactive waste should be managed in a manner that is compatible with future disposal requirements. Early dismantling will enable the waste to be placed in passive safe storage but will run a certain risk that the waste form could require reworking for disposal in the future. The deferral of decommissioning extends the time before any waste is generated and therefore is treated and packaged. A Letter of Comfort from Nirex (or other appropriate organisation) is an important part of ensuring that waste will be compatible with future disposal requirements.

A4.3.7 Maintenance of the Organisation

A4.3.7.1 Licensees' responsibilities under NIA65 continue throughout decommissioning until the site is delicensed. Licensees will need to give careful consideration to the means by which they will ensure that they maintain an appropriate organisation which is capable of fulfilling these responsibilities for a very long time into the future. The requirements may change during the different stages of decommissioning, but the licensee must preserve the capacity to manage the final dismantling stage and the remediation of any contaminated ground. Throughout a care and maintenance period, the licensee will need to maintain an organisation that understands and maintains the safety case, interprets monitoring, inspection and surveillance results, which can take remedial action if required and support emergency response arrangements. There will also be a need to ensure site security and prevent unauthorised access to the site. If contractors are used for some decommissioning work then the licensee must retain sufficient expertise to act as an intelligent customer. When final dismantling is undertaken, and this could be earlier

than planned, the organisation must be capable of expanding to undertake the work, it will need to recruit and train new teams. The greater the period of deferral, the greater the uncertainty concerning the maintenance of the responsible organisation.

A4.3.8 Corporate Memory

A4.3.8.1 If decommissioning activities are to be deferred then the organisation will need to retain the appropriate records and information that describe the facility in a secure form for future reference. This will include not only the records required by legislation but also the plant knowledge held by experienced operators, which experience has shown can facilitate safe decommissioning. This should be obtained by systematic debriefing before the employees leave the site. The greater the period of deferral the more difficult it will be to pass on these records between subsequent generations.

A4.3.9 Costs and Financial Provision

A4.3.9.1 In selecting a preferred decommissioning strategy, licensees will compare the costs of a range of options in order to determine the financial implications of proceeding on different timescales. Comprehensive cost estimates should be prepared for realistic options taking into account all the activities that will need to be undertaken, including the maintenance of a viable organisation and the supporting infrastructure required for the whole period of decommissioning. Experience from current decommissioning projects is that the costs associated with maintaining licensed sites in the long term are often underestimated and that there are significant savings to be made from early decommissioning. On some sites the early release of land for other purposes can bring financial benefit.

A4.3.9.2 Licensees commonly use discounting to compare costs incurred at different times. This approach favours the deferral of decommissioning since comparative costs reduce as they are projected into the future. The application of discounting to costs that will be incurred over very long time periods can have a dramatic impact, should be undertaken with caution, and requires careful justification.

A4.3.9.3 The privatised parts of the nuclear industry are required to make financial provision for decommissioning that is separate from other company funds. They should demonstrate that their arrangements will support their selected strategy and also that there is flexibility to accommodate alternative strategies should circumstances change, including the option of undertaking final dismantling on an earlier timescale should that be required. The same general considerations apply to the state owned parts of the nuclear industry.

A4.3.9.4 Further guidance on the costs of decommissioning is given in **Appendix 6**.

A4.3.10 Developments in Technology

A4.3.10.1 The techniques required in decommissioning are, in most cases, similar to those used where toxic materials are encountered in the non-nuclear industry, but are modified, as required, to give better performance or to take account of the radioactivity present. Methods exist for the characterisation of radioactivity, decontamination, cutting, dismantling, remote handling, demolition and waste treatment. **Refs. 2 and 3** provide reviews of the range of available techniques and experience with their use on decommissioning projects.

A4.3.10.2 In some cases, it may be necessary to develop and fabricate specialised tools, based on existing techniques, for use in areas where high radiation fields or

limited access arise. Any development activities should be commenced in the near term to reduce the uncertainty associated with the strategy.

A4.3.10.3 In general, however, it can be assumed that the technical means for decommissioning a nuclear facility safely already exist, and NII would not readily accept arguments for deferral based on non-availability of techniques.

A4.3.11 National and International Experience

A4.3.11.1 International experience is an important source of information on best practice, which NII will take into account in assessing licensees' proposals. Originally, most countries favoured deferred decommissioning for reactors to allow for radioactive decay and because the option was perceived to be less costly. In recent years there has been a growing trend to earlier decommissioning. The UK licensees' deferred decommissioning strategy is now in marked contrast to the approach in the USA, France, Germany, Spain, Japan, Italy and other countries, where several nuclear reactors have already been decommissioned and early dismantling is planned for many reactor sites. The main contributory factors have been concerns that deferred decommissioning will lead to higher waste management costs, a greater appreciation of care and maintenance costs, insurance liabilities and the imposition of burdens on future generations.

A4.3.11.2 International experience of the decommissioning of nuclear fuel cycle facilities, including Pu contaminated plant, is increasingly available as many countries proceed to decommission redundant plant. Although the timescales may vary between countries, there is general consensus (including UK licensees) that there is no safety benefit from deferring decommissioning of this type of facility.

A4.3.12 Sustainable Development

A4.3.12.1 Government policy requires radioactive waste management to comply with the principle of *sustainable development*, which requires those who have created and are responsible for decommissioning liabilities to manage them in a manner that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. It is NII's view that decommissioning as soon as reasonably practicable is most in line with sustainable development. To defer decommissioning is to leave complex and hazardous tasks for future generations. At the very least, this generation should leave the financial provision and preserve the capability and information that future generations will need.

A4.3.13 Environmental Impact

A4.3.13.1 The implementation of EIADR99 aims to ensure that any environmental impacts associated with decommissioning reactors are taken into account at an early stage. The consultation process that will be required to comply with EIADR99 will result in greater public and stakeholder awareness of decommissioning proposals. Relevant environmental impacts could include a number of issues such as: the physical presence of buildings on the site; industrial activity; and the benefits for local employment; which would lead to a preference for early decommissioning.

A4.3.14 Future Uncertainty

A4.3.14.1 Decommissioning of nuclear facilities will continue for many decades in to the future. The next 50 to 100 years will undoubtedly see many changes in the

social, political and environmental arenas. The perception of risk by society is changing and people are becoming more averse to those risks which are imposed upon them, are unevenly distributed, affect future generations or the environment. Many of the factors presented here that influence decisions on the timing of decommissioning become very uncertain as they are projected into the future. Other trends such as stricter regulation of radiation exposure, radioactive waste disposal, increased regulation from Europe may place further responsibilities on licensees in the future. The effects of climate change may challenge the design bases on which the plant and structures were originally designed.

A4.3.14.2 Licensees should also take into account the relative certainty with which costs can be estimated in the near term and the increasing uncertainty for long periods in the future. As well as unforeseen events that can lead to additional costs, there are a number of costs which are virtually certain to rise in the future such as those associated with waste management and disposal. Similarly, there is an uncertainty associated with the projection of investment returns into the future to demonstrate adequate financial provision.

A4.3.14.3 The *Precautionary Principle* describes a philosophy for addressing potentially serious risks subject to high scientific uncertainty, particularly where they are in the environmental field and where there are risks that could affect future generations. It basically prescribes that as uncertainty increases then emphasis should increase on reducing the hazard by cost-effective means. Early decommissioning rather than deferred would appear to be consistent with this approach.

A4.4 References

- 1 Review of Radioactive Waste Management Policy – Final Conclusions, UK Government Cm 2919, HMSO 1995.
- 2 Decommissioning of Nuclear Facilities other than Reactors, Technical Reports Series No 386, IAEA, 1998.
- 3 Safe Enclosure of Shut Down Nuclear Installations, Technical Reports Series No 375, IAEA, 1995.

Table A4.1 Factors that influence decisions on the timing of decommissioning of nuclear facilities

Factor	Suggested Influence (reactors/Pu contaminated ¹)
Risk to Operator Radiation dose rates	Deferral/early
Risk to Public Reduction in source term Probability of releases Deterioration of the structures Passive safe storage	Deferral/early Early Early
Radioactive Waste Management	

Volume of packaged waste Availability of disposal route Compatibility with disposal requirements Radioactive discharges	Deferral/neutral Deferral Neutral Early
Licensees Organisation Maintain an organisation capable of fulfilling the conditions of the nuclear site licence Maintain the supporting infrastructure Maintain corporate memory and records Use of experienced operators Regeneration of the organisation	Early Early Early Early Early
Costs and Financial Provision Dismantling costs Care & maintenance, infrastructure costs Insurance liabilities Investment returns on segregated funds Cost discounting	Deferral/neutral Early Early Unknown Deferral
Future uncertainties Changes to waste classification Changes to radiation exposure limits Changes to regulatory regime Climate change Organisation survival Cost increases Investment uncertainty	Neutral Early Early Early Early Early Early
International standards Current practice in other countries	Early
Social and Political factors – Government Policy Sustainable development Environmental impact Public perception of risk Precautionary principle Public acceptability	Early Early Early Early Early

Note 1: A comparison is provided between the influence of factors for reactors and Pu contaminated facilities in order to illustrate important differences. There are other types of facilities for which the influences could be different.

Appendix 5 - Management and Maintenance of an Appropriate Organisation During Decommissioning

Contents

A5.1 Introduction

A5.2 Licence Conditions and Safety Assessment Principles

A5.3 Guidance on the Management and Maintenance of an Appropriate Organisation During Decommissioning

A5.4 References

A5.1 Introduction

A5.1.1 This Appendix provides guidance on the issues associated with determining and managing the appropriate manning of a decommissioning site.

A5.1.2 Decommissioning, coming after plant shutdown, can be a time of significant change for an organisation and its personnel. In addition, the potentially long timescales associated with decommissioning and the changes that occur on the sites, make the provision of appropriate staff levels and supporting infrastructure throughout the duration of a project an important issue.

A5.1.3 NII will require licensees to demonstrate appropriate management of the organisational change to ensure safety standards are maintained. Licensees will be required to prepare detailed programmes and describe their arrangements in preparation for decommissioning and before each phase of decommissioning. These will include the demonstration of an appropriate management structure and staffing levels, both to fulfill key roles associated with licensee's responsibilities under the site licence and to provide the general infrastructure to support the project.

A5.2 Licence Conditions and Safety Assessment Principles

A5.2.1 Licence Condition 36 (Control of organisational change) requires licensees to make and implement adequate arrangements to control any change to their organisational structure and resources which may affect safety on the site

A5.2.2 SAPs P315 - P322, covering life-cycle requirements, introduce the expectation that a licensee will have in place an effective management system, including the development of a safety culture and arrangements for quality assurance, maintenance and preservation of documentation as well as training. P328, on operating limits, expects the licensee to specify the staff levels required, and the qualifications and experience necessary to ensure safety. These SAPs apply during decommissioning.

A5.3 Guidance on the Management and Maintenance of an Appropriate Organisation During Decommissioning

A5.3.1 Site Licence Responsibilities

A5.3.1.1 Operators of nuclear facilities are granted nuclear site licences by NII. The licences form part of the continuous process of regulation that runs from construction and start-up, through operation to shutdown and throughout decommissioning, until the site is finally delicensed and released for other use. Conditions, attached to these licences, require the licensees to make and implement adequate

arrangements relevant to safety, including maintenance of an effective management system and adequate staffing levels to discharge the obligations and liabilities connected with the licence. These arrangements should be described in, or referenced from, the safety case. The type of organisation and the level of resource need to be commensurate with the activities being carried out and the risk from the site. NII is responsible for monitoring and regulating a licensee's compliance. A statement of the criteria NII use to judge the adequacy of licensee's arrangements for the management of safety are given in **Ref. 1**.

A5.3.1.2 For new licence applications, NII expects to receive a management prospectus which should address issues of organisation and staffing. Guidance on the content and organisational issues to be covered in a management prospectus is given in **Ref. 2**. For existing licensees undergoing significant changes, such as those that might be associated with the end of plant operation and the onset of decommissioning, NII will also expect to receive a justification of the arrangements for the management of change, showing how safety will be maintained through the changes.

A5.3.2 Staffing Profile

A5.3.2.1 When a plant or facility is shutdown, decommissioning begins and the detailed decommissioning plan is implemented. The staffing profile with time will depend on the type of facility, the details of the decommissioning strategy, the decommissioning programme and the particular disciplines required. In addition, where there are a number of facilities on a site, licensees should take into account the need to provide staff for the site as a whole and the potential for conflicting demands on staff.

A5.3.2.2 The strategies and programmes that licensees propose for the various types of nuclear facilities can be quite different and require different staffing profiles, as is illustrated by the two examples below.

A5.3.2.3 Nuclear Power Plants

In the UK, licensees have proposed strategies for the decommissioning of the Magnox and AGR nuclear power plants based on the safestore concept. In this approach, all spent fuel is removed from the reactor and storage ponds as soon as possible following shutdown. The first stage of decommissioning is to remove most inactive plant and buildings and to prepare the remaining active plant and buildings for an initial period of care and maintenance. At the end of this period, the remaining structure and buildings will be upgraded for a second period of care and maintenance (termed safestore). At the end of this second period, the remaining structures, including the reactor, will be dismantled and if possible the site will be cleared to green field status.

The staffing profile required to implement the strategy described above will involve peaks and troughs and different competencies, reflecting the levels and nature of decommissioning activity. An increase in staffing levels may be required to implement the preparations for the two stages of care and maintenance, and for the final dismantling and site clearance. In between, there are the periods of care and maintenance when lower staffing levels may be appropriate.

A5.3.2.4 Other Nuclear Facilities

The decommissioning strategies for other nuclear facilities, such as radiochemical processing plant generally involve the following stages. Upon shutdown, an initial cleanup and preliminary decontamination (Post-operational Clean Out, POCO) is carried out. This is followed by the progressive dismantling and removal of plant with decontamination. Finally, the building and structures may be demolished or refurbished for reuse. The timescales over which these stages are completed depends on the particular facilities.

Again the staffing profile will reflect the levels of decommissioning activity. However, in general terms, as decommissioning progresses there will be a progressive reduction in staff levels, consistent with a reduction in the hazard and workload. However, activities may arise that require temporary increases in staffing.

A5.3.2.5 As described above, the necessary staffing levels will depend upon the activities to be carried out and will be determined on a case by case basis. The staffing levels will be maintained at the appropriate level until the site is delicensed. The following list of functions and activities is provided as guidance for consideration by inspectors who may assess licensee's manning proposals. It is not a comprehensive list for any particular situation or stage of decommissioning:

- corporate infrastructure;
- compliance with legislation;
- safety management system;
- project management;
- dismantling and decontamination;
- radioactive waste management;
- site support infrastructure (security, administration etc.);
- preparation and retention of records;
- training;
- radiological protection;
- maintenance, inspection, monitoring, surveillance and surveys; and
- response to incidents and emergency arrangements.

A5.3.2.6 The early completion of decommissioning and consequential release of facilities, can reduce the site infrastructure requirements, including staff levels. Experience from recent decommissioning projects has shown that this can result in substantial cost savings.

A5.3.2.7 The Periodic Safety Review (PSR) and Quinquennial Review (QQR) processes, or similar reviews, will continue during decommissioning and licensees should maintain appropriately experienced staff to support the reviews and subsequent phases of decommissioning and, also, to produce the relevant documentation.

A5.3.2.8 Not all the responsibilities and activities need be fulfilled by staff permanently based on site throughout decommissioning. During care and maintenance periods, for example, some activities could be accomplished by teams sent from other locations. However, the adequacy of these arrangements would need to be justified. In particular, it is HSE's view that control of the site and plant security, can best be assured by the presence of staff based permanently on site. It is noted that, even with continuous security arrangements in place, incidents of intrusion have occurred at nuclear sites.

A5.3.3 Utilisation of Experienced and Knowledgeable Staff

A5.3.3.1 There is general recognition of the considerable advantage in using workers from the former operating team who, if decommissioning starts promptly, can provide direct support and share their knowledge of the installation with other members of the decommissioning team. Experience from some recent decommissioning projects is that a team with good site/facility understanding can have a significant beneficial influence on the safety and effectiveness of decommissioning. There is, therefore, a benefit to be gained from early decommissioning, before the knowledge base is lost, while suitably qualified and experienced workers are available.

A5.3.3.2 If the decommissioning of facilities is to be deferred for more than a few years, it is less likely that the staff with detailed first hand knowledge will be available. In any case, measures should be implemented to ensure that their knowledge is captured within the records, detailed plans and safety cases, prior to the release of such key staff from employment.

A5.3.3.3 NII will expect operators to include within their plans the future infrastructure, costs and resources that will be required to maintain the knowledge base and ultimately to assemble and train teams of Suitably Qualified and Experienced Personnel (SQEP) to carry out those decommissioning activities that are deferred to the future.

A5.3.4 Commercial Pressures

A5.3.4.1 Both the privatised and state owned nuclear operators are facing increasing commercial pressures to become more efficient. One of the ways in which they can respond is by cutting costs and staff. NII continues to monitor these developments carefully, to be satisfied that the necessary resources for safety are maintained and that decommissioning work is not unduly delayed on economic grounds such that safety is compromised.

A5.3.5 Use of Contractors

A5.3.5.1 In line with practice within industry in general, decommissioning work is being increasingly done on a contract basis, rather than by the licensee's staff themselves. Contractors are generally employed where it is not cost-effective to retain permanent staff and, in some areas, they possess and maintain the specialist skills and experience.

A5.3.5.2 While this approach offers some advantages, the use of contractors has licensing implications. NIA65 requires the licensee to be the user and in control of operations on site at all times. A licensee's responsibilities can only be seen to be fulfilled if it is a corporate body, is in day-to-day control of the site, has the capability to understand the safety case and has the expertise to understand the safety

significance of bought in services and advice. The extent to which contractors should be used on nuclear sites is an issue of regulatory concern, see for example, **Ref. 3**.

A5.3.6 Management of Staff Changes

A5.3.6.1 As facilities reach the end of their operational life, shutdown, and enter the decommissioning stages, there are a number of staff management issues that can be expected to arise that may potentially have a detrimental impact on safety and the site safety culture. These issues require careful planning and management by licensees, and close attention by NII, to ensure that safety and site licence responsibilities are not prejudiced. Licensees should demonstrate that they are aware of these issues and are taking appropriate measures. NII will continue to use its inspection programme to monitor staff management issues, through LC36 and others, and also by general discussions with staff on site.

A5.3.6.2 As an example, detailed planning of resource requirements during the final period of operation, shutdown and the onset of decommissioning, will be required to manage the change effectively. During this time some staff may be made redundant, others may be retained because of specialist skills, others may be retrained and some new staff may be recruited. These significant changes introduce many staff concerns such as those associated with career changes and uncertainty over future employment. Proper planning of projected staffing levels during decommissioning, together with openness of information, will be of benefit and can help to reduce staff anxiety about an uncertain future and maintain morale and motivation. Poor planning can lead to the loss of staff, with specialist skills and knowledge, and even a requirement for the same people to be re-employed in the short term.

A5.3.6.3 An ageing nuclear programme has implications for the staff working at older plants and facilities. Uncertainty over the future direction of the industry, future employment and career prospects can have a negative impact on staff morale. Consideration should be given to maintaining an acceptable age profile within the organisation.

A5.3.6.4 Nuclear sites can provide significant levels of local employment. Changes at sites may have a significant negative impact on local employment prospects affecting both the perceptions of the local community and, in particular, staff morale.

A5.4 References

1 Managing for Safety at Nuclear Installations, HSE, 1996.

2 Nuclear Site Licences under the Nuclear Installations Act 1965 (as amended), Notes for Applicants, HSE, 1994.

3 Taylor F. E. Regulatory view of the nuclear licensee as an intelligent customer. Nuclear Energy, 2000, 39 No 3, June, 175-178.

Appendix 6 - Costs of Radioactive Waste Management and Decommissioning

Contents

A6.1 Introduction

A6.2 Cost Estimates

A6.3 Cost-benefit Analyses

A6.4 Uncertainties

A6.5 Funding Arrangements

A6.6 International and UK Decommissioning Experience

A6.7 References

A6.1 Introduction

A6.1.1 Government Policy (**Ref. 1**) is that the producers and owners of radioactive waste are responsible for providing the finance for the management of radioactive waste, including disposal, and for decommissioning. Ref. 1 also contains a number of statements relating to costs of radioactive waste management (for example, paras 51, 52 and 113, which are repeated in Annex 1 to **Ref. 2**) and decommissioning (for example, para 125, 126 and 131, repeated in **Annex 1** to this document)

A6.1.2 NII requires licensees to estimate the future costs of radioactive waste management and decommissioning in order to demonstrate that their arrangements will provide the necessary financial provisions to implement the strategies and that there is flexibility to accommodate alternative strategies should circumstances change. This Appendix provides guidance on the issues associated with estimating the costs of radioactive waste management and decommissioning.

A6.2 Cost Estimates

A6.2.1 Cost estimates, for radioactive waste management and decommissioning, should be comprehensive and take into account all the activities, the associated uncertainties and necessary supporting infrastructure that will be required over the complete timescale of a particular project. Cost estimates should be prepared for realistic and feasible options, and can usefully identify the most important cost components and the distribution of costs with time. The following paragraphs illustrate components that NII would expect to be included in such estimates although it is not intended to be comprehensive for any particular case.

A6.2.2 For example, the costing of radioactive waste management will need to include all the activities associated with characterisation, accumulation, processing, packaging, storage, inspection, retrieval, transport and disposal. Similarly, the costing should cover all the activities in decommissioning including preparatory activities (e.g. surveys, sampling and inspections), dismantling and decontamination, construction of safe enclosures, care and maintenance, management of contaminated land and site remediation.

A6.2.3 In addition, there will be costs to a licensee in maintaining an organisation that is responsible for complying with all the aspects of relevant legislation. These activities will include corporate management, site licence compliance, maintenance of strategies, safety cases and records, project management, training, maintenance, inspection, monitoring, surveillance,

security, response to incidents and emergency arrangements. There will also be costs associated with the arrangements for maintaining the financial provisions.

A6.3 Cost-benefit Analyses

A6.3.1 Cost-benefit analysis is an accepted method of comparing the merits and cost effectiveness of a range of options. Sensitivity studies can be used to investigate the influence of important assumptions and uncertainties. Examples of the areas that are expected to introduce future uncertainties are described in **A6.4**. If the costs of particular materials, services or other items are expected to increase or decrease with time relative to other components then this can be taken into account.

A6.3.2 Although many of the costs and benefits can be expressed in monetary terms, it is generally never possible to derive a value for all of the influencing factors and it is appropriate to record those factors which have not had a value assigned. It is therefore noted that the decision to select a preferred option will generally involve taking account of wider dimensions than simply costs alone.

A6.3.3 Cost discounting is the comparison of costs incurred at different times by converting them to a present value using a discount rate. For further information relating to the application of discount rates, inspectors are referred to 'The Treasury Green Book' (**Ref. 3**), which describes their application within the appraisal and evaluation of Government funded projects. At present, a long term discount rate of 6% is proposed in Ref. 3 but this is under review and a lower rate may be recommended. Licensees may choose to use alternative discount rates provided they are justified. Where the result of an assessment is unduly sensitive to the value of the discount rate employed then the application of discounting requires careful consideration. Discount rates applied over long periods can have very significant impacts. As a result, licensees should justify the discount rates used, particularly if they are applied beyond the short and medium term.

A6.4 Uncertainties

A6.4.1 Many radioactive waste management and decommissioning projects will run over long periods of time, resulting in the introduction of significant uncertainty in the estimation of the costs of future activities. While costs may be estimated reasonably accurately in the near term, the potential for changing circumstances becomes increasingly significant in the medium and long term. Some of these changing influences can be predicted from current trends but others, of equal or greater importance, could emerge. The following paragraphs describe a few of the areas where changes can be expected.

A6.4.2 It is reasonable to expect that the next 100 years will see continuing changes in the social, political and environmental arenas that will significantly impact on the assessment and acceptance of strategies that are conceived now. The perception of risk by society and individuals is continuously changing (**Ref. 4**) and people are at present becoming more averse to those risks which are imposed on them, are unevenly distributed, affect future generations more or which impact on the environment. The regulation of environmental impact is becoming an increasingly important consideration in the assessment of all projects. The OSPAR/Sintra agreement for example, which the Government signed in July 1998, commits the UK to a progressive and substantial reduction of the radioactivity in liquid discharges in the future.

A6.4.3 The future direction of the project for the provision of a national radioactive waste repository is currently under review. As a result, a national repository is not expected to be available for a considerable period of time, at least 50 years in the future. As a result, the cost of disposing of radioactive waste to a repository in the future, or storing it for long periods, is uncertain.

A6.4.4 NII expects licensees to take account of current predictions of the predicted trends for the degree and rate of climate change in the future, which could impact on the design of facilities that are expected to operate safely for long periods in the future. NII is monitoring developments on this issue, and Inspectors are referred to guidance from the Department of the Environment on Environmental Appraisal for Government Departments (**Ref. 5**).

A6.4.5 In general, it can be assumed that the technical means for the safe decommissioning of a nuclear installation already exist. However, the continuing development of methods and techniques can be expected to lead to safer and more efficient methods which may be more cost-effective.

A6.5 Funding Arrangements

A6.5.1 Government Policy is that the privatised parts of the nuclear industry should make financial provision for radioactive waste management and decommissioning which is separate from other company funds. Ideally, the provision should be in a segregated fund and managed separately. In the case of the larger licensees (the major power generators) which have very significant decommissioning liabilities, it is particularly important that the financial provisions are demonstrated to be robust to the satisfaction of NII. In the case of the smaller licensees (operators of research sites, isotope production companies) where the liabilities are less significant, the justification of the financial provisions should be proportionate to the scale of the risks and costs.

A6.5.2 For the state owned parts of the nuclear industry, the Government is committed to providing the financial provision for radioactive waste management and decommissioning. The Government is committed to reviewing what improvements can be made in the way the state owned parts of the nuclear industry report on their provisioning arrangements for decommissioning. The Quinquennial Review process is intended to serve as the focus for improved reporting, to provide better visibility of progress in decommissioning and a measure of cost effectiveness. One third of nuclear site licensees are engaged in defence related activities and have the Ministry of Defence (MoD) as their customer. In these cases, the MoD undertakes to fund decommissioning and radioactive waste management liabilities.

A6.5.3 If, in exceptional circumstances, a licensee is unable to provide financial provision for decommissioning on a timescale consistent with its strategy, as a minimum, it will be essential that the licensee is able to provide resources to ensure that the safety of the site is assured in the meantime.

A6.6 International and UK Decommissioning Experience

A6.6.1 A significant number of nuclear power plants and other facilities have reached, or are approaching, the end of their operational lives. As a result, considerable experience will become available from projects in the UK and internationally. This experience, will include information on costs which can be taken into account.

A6.6.2 **Refs. 6 to 10** provide examples of available information on decommissioning experience. The following examples are a selection of the views that are expressed as a result of experience gained:

- only comprehensive estimates of current and future costs can be compared on a consistent basis;
- decommissioning activities may be most cost effectively carried out in the near term by existing experienced teams and under current safety arrangements; and

- infrastructure costs can be reduced significantly as areas of a site are decommissioned and released for other use.

A6.6.3 In **Refs. 6 and 7**, the IAEA provides a brief commentary on international views on those factors that are seen to influence decommissioning costs. The main points are reproduced below:

- the costs of disposing of radioactive waste are escalating in some countries to the point where they are becoming the major cost factor;

- in theory, dismantling costs decrease with time because of radioactive decay, however, surveillance, maintenance and radioactive waste disposal costs increase with time;

- internationally there is no uniform trend for deferring reactor decommissioning to increase or decrease overall costs, rather underlying facility or country specific factors are the greatest influence on costs;

- for nuclear fuel cycle facilities overall decommissioning costs increase with time due to surveillance and maintenance requirements and little benefit is gained from radioactive decay; and

- in the case of plutonium contaminated facilities, there is an ingrowth of the more radiologically significant Am²⁴¹, from the decay of Pu²⁴¹, resulting in a radiological hazard that increases with time and increased costs of decommissioning.

A6.6.4 The European Commission has supported the development of an ORACLE database, containing accumulated experience of costs and radiation exposure data for individual decommissioning steps. The database, named EC DB-COST, is summarised in **Ref. 11**.

A6.7 References

- 1 Review of Radioactive Waste Management Policy – Final Conclusions, UK Government Cm 2919, HMSO 1995.
- 2 Management of Radioactive Materials and Radioactive Waste on Nuclear Licensed Sites. **T/AST/024**.
- 3 Appraisal and Evaluation in Central Government, Treasury Guidance, The Green Book, 1997.
- 4 Reducing Risks, Protecting People, HSE, Discussion Document, Draft Dec 1998.
- 5 Environmental Appraisal in Government Departments, Department of the Environment, HMSO, 1994.
- 6 Safe Enclosure of Shut Down Nuclear Installations, Technical Reports Series No 375, IAEA, 1995.
- 7 Decommissioning of Nuclear Facilities other than Reactors, Technical Reports Series No 386, IAEA, 1998.
- 8 International Conference on Nuclear Decommissioning, I MechE. October 2000.
- 9 Decommissioning Experience, IBC Conf, London Feb 1997.

10 End of Life Management on the Harwell Site, K F Langley and R A Simpson, I Nuc E Conf, Nov 1998.

11 The EC Decommissioning Database on Specific Data suitable for Cost and Dose Estimates, EC DB-COST, P Petrasch, J M Dufaud and S Whitty, pp579-590, Conference Proceedings, Decommissioning of Nuclear Installations, EC, Luxembourg, Sep. 1994.

Appendix 7 - Quinquennial Review

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A7.1 Introduction

A7.2 Guidance on the Quinquennial Review Process

A7.3 References

A7.1 Introduction

A7.1.1 Government Policy (**Ref. 1**) requires HSE, in consultation with the environment agencies, to carry out quinquennial reviews (QQR) of licensee's decommissioning strategies to ensure that they remain soundly based as circumstances change. Inspectors should be aware that QQRs are carried out in response to Government Policy and not under HSWA74. As a result, NII does not have the power under HSWA74 to obtain information from a licensee (section 27(1)) and licensees are not protected from the disclosure of information which they do provide (sections 27(4) and 28(2)). This Appendix provides guidance on the QQR process.

A7.2 Guidance on the Quinquennial Review Process

A7.2.1 Process

A7.2.1.1 NII has the responsibility for requesting and leading the assessment of licensee's decommissioning strategies. Licensees of all nuclear licensed sites, which had not already had a request for a decommissioning strategy, were sent a letter in October 1996 requesting their strategies. This letter includes a description of HSE's interpretation of the requirements placed on licensees by the QQR process. For new licensees, the request for strategies will be made as part of the licensing process. Requests for strategies may also be made when significant relicensing steps are being taken, such as a major restructuring within the nuclear industry. NII's intention is to carry out the first QQR, for each licensee, following the receipt of the initial strategy submission, and to continue thereafter on a 5 year cycle.

A7.2.1.2 Licensees should submit copies of their QQR submission to NII and the environment agencies. NII will formally consult the views of the environment agencies when they receive a submission. This process of consultation will continue throughout the review to ensure that their views are fully represented. NII will also keep the Secretary of State, DETR, informed about its consideration of the decommissioning strategies, including the major stages achieved and decisions reached. When NII judge that the QQR has been completed, it will prepare and issue, in consultation with the environment agencies, a public statement.

A7.2.1.3 EIADR99 requires licensees to conduct an EIA and provide an ES for their nuclear reactor decommissioning proposals. HSE/NII must ensure that an adequate EIA is carried out before considering granting consent for the decommissioning project to commence. As a result, any conclusions drawn with respect to a licensee's decommissioning strategy through QQR, cannot prejudge the outcome of the formal assessment of the detailed ES.

A7.2.2 Format and Content of QQR Submission

A7.2.2.1 NII will expect licensees to produce a publicly available document setting out their decommissioning strategy. This document will be referenced by NII in its

report on the findings of its assessment of their strategy. For those licensees with extensive liabilities, an overview document, representing the corporate strategy, supported by further documentation on the strategies for different sites and different types of facilities, would be appropriate. For those licensees with limited nuclear liabilities, a single document may be appropriate.

A7.2.2.2 Detailed guidance on the content of decommissioning strategies is given in **Appendix 2**. The following list provides guidance on the issues that NII expects to be included within the licensee's presentations of their decommissioning strategies for QQR. The list is not obligatory, nor is it intended to be comprehensive or of universal applicability, since in some cases, certain items will be inappropriate, while in others, additional information may be needed:

- decommissioning objectives and policy;
- description of decommissioning liabilities;
- description of preferred strategy (programme, methods, contingency options, end point of decommissioning);
- range of options considered and selection process (including factors taken into account, weighting of factors, the significant assumptions and uncertainties);
- justification of timing;
- an appraisal of uncertainties and their impact;
- consistency with legislation and Government Policy (including a demonstration that decommissioning is being carried out as soon as reasonably practicable and that hazards are being reduced in a progressive and systematic manner);
- arrangements to ensure safety;
- the strategy for the management of radioactive waste;
- management and remediation of contaminated land;
- decommissioning methods and technological feasibility;
- management system and infrastructure for decommissioning;
- arrangements for maintenance of records;
- costing of strategies;
- demonstration of adequate financial provision; and
- progress achieved in implementing the strategy.

A7.2.3 Assessment

A7.2.3.1 NII will review the adequacy of the information presented and the licensee's arrangements for maintaining and reviewing decommissioning strategies. The preferred strategy should be practicable and consistent with existing legislation, Government Policy, technical knowledge, safety and environmental requirements. Government Policy (see Annex 1) is, in general, to undertake decommissioning as soon as reasonably practicable, taking account of all relevant factors and to achieve a progressive and systematic reduction in the hazard. NII will satisfy itself that the strategies remain soundly based as circumstances change.

A7.2.3.2 NII's Safety Assessment Principles (**Ref. 2**), the regulatory guidance on radioactive waste management (**Ref. 3**) and this guidance on decommissioning are applicable to the assessment of decommissioning strategies. A number of IAEA safety series reports describe international standards that are generally applicable to the development of decommissioning strategies. Inspectors are referred to **Refs. 4 to 8** as examples of the available information.

A7.2.3.3 Assessment of the financial provisions can only be completed once the major technical aspects of the strategies have been judged to be adequate. The basis on which the strategies have been costed needs to be explained in sufficient detail such that judgements can be made on the extent to which the estimated costs are both adequately comprehensive and robust. Licensees should demonstrate that their arrangements will provide the necessary financial provisions to meet the costs of decommissioning. The provisioning arrangements should be flexible in order to take account of changes as they become apparent, and licensees should describe the extent to which they are adequate to carry out decommissioning on an earlier timescale should that be required. The provisions should take into account reasonably anticipated changes in the regulatory environment, technical and disposal problems. Licensees should demonstrate the sensitivity of returns on investments to economic assumptions and uncertainties. Further guidance on costs of decommissioning is given in **Appendix 6**.

A7.2.3.4 The technical assessment of the strategies may involve various units from within NII including both assessors and site inspectors. In addition, NII will consult with other Government departments and may use consultants to assess specific aspects of the strategy as required, such as those related to financial provisioning.

A7.2.3.5 Where necessary, NII will seek additional information and clarification from the licensees. As noted above, NII will consult with the environment agencies to ensure that the strategies contain realistic assumptions about radioactive waste disposal including discharges. Where NII is not satisfied, it may request further information or ask the licensee to further develop the strategy.

A7.2.4 Publication of NII's Conclusions

A7.2.4.1 NII will expect licensees to produce a publicly available document which sets out their decommissioning strategy. This document will be referenced by NII in its report on its findings. Requests from members of the public for detailed descriptions of the strategies and financial provisions are expected to be dealt with by the licensees rather than by NII.

A7.2.4.2 Once it judges that its assessment has been completed, NII will provide a public statement of its view of the licensee's strategy and an explanation of its views. The explanation will cover:

- the strategy which has been assessed;

- the proposed timetables;
- the range of options that were considered;
- how the rate at which work is to proceed has been determined by consideration of factors including the potential hazards to the public, workers and the environment, the availability of disposal routes for wastes and financial considerations; and
- whether NII considers that there is adequate financial provision being made for both the chosen strategy and for alternative options which may be required to assure long term safety.

A7.2.4.3 Where NII is not satisfied, there will be an indication of the steps that the licensee should take to improve the strategy.

A7.3 References

1 Review of Radioactive Waste Management Policy – Final Conclusions, UK Government Cm 2919, HMSO 1995.

2 Safety Assessment Principles for Nuclear Plants, HSE, NII, 1992.

3 Management of Radioactive Materials and Radioactive Waste on Nuclear Licensed Sites. **T/AST/024.**

4 The Principles of Radioactive Waste Management, Safety Series No. 111-F, IAEA, 1995.

5 Factors Relevant to the Decommissioning of Land-based Nuclear Reactor Plant, Safety Series No. 52, IAEA, 1980.

6 The Regulatory Process for the Decommissioning of Nuclear Facilities, Safety Series No. 105, IAEA, 1990.

7 Decommissioning of Nuclear Facilities other than Reactors, Technical Reports Series No 386, IAEA, 1998.

8 Safe Enclosure of Shut Down Nuclear Installations, Technical Reports Series No 375, IAEA, 1995.