

EA Waste Management

ENVIRONMENT AGENCY

**ENVIRONMENT AGENCY GUIDANCE ON THE
CONDITIONING OF INTERMEDIATE LEVEL WASTE**

ENVIRONMENT AGENCY



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EA Waste Management-Box 4-

SUMMARY

This guidance is for use by Environment Agency site inspectors when responding to consultation by the Nuclear Installations Inspectorate (NII) on proposals by waste producers for retrieving, treating or conditioning intermediate level wastes (ILW). It is also being made more widely available in order that other organisations are aware of Agency expectations and are thus able to provide appropriate information on a timely basis.

Management of radioactive waste on nuclear licensed sites is regulated by the Health and Safety Executive (HSE) through the NII. Under the terms of the Memorandum of Understanding between the Environment Agency and HSE, NII will take into account the environmental considerations of radioactive waste management by consulting the Agency and will not agree to projects until the Agency has expressed its satisfaction.

The background to this guidance document is explained covering Government policy, the regulatory framework for the Agency and NII, and the nuclear industry's internal assessment process whereby waste packaging proposals can be assessed by Nirex.

For the purposes of this guidance, the process for the conditioning of radioactive waste is divided into the following stages:

- preliminary and options study stages;
- design and construction stages;
- commissioning stage;
- operational stage.

The Agency's involvement at each of these stages is set out, together with details of the issues that the Agency will wish to address. The information that the Agency needs to be able to address these issues is identified, together with details of where the Agency expects to find that information. This will help waste producers appreciate which documents should be made available to the Agency at each stage.

Additional factors relating to early conditioning that need to be addressed by the Agency include disposability, reworkability, and policy issues. Guidance is provided on the way these are addressed by the Agency.

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1. Introduction

The UK strategy for the long-term management of intermediate level wastes (ILW) has yet to be decided. It could be based on permanent storage above ground, deep disposal or some other option or combination of options. All options would necessitate certain stringent conditions being placed on the conditioning of waste, but deep disposal would place certain unique requirements.

The conditioning of ILW is often being carried out many years before a final waste management strategy is agreed, and possibly decades before a strategy is implemented. The Environment Agency (the Agency) is concerned about the potential environmental impact of current decisions and actions concerning waste treatment, packaging and conditioning. The Agency wishes to ensure that the waste will be suitable for ultimate disposal while recognising the need to ensure safety and environmental protection during interim storage. This document gives guidance for use by Agency site inspectors to evaluate cases for early conditioning.

A research and development project (1) has been carried out on behalf of the Agency to review the procedure followed by waste producers when they wish to condition ILW, and to identify the Agency's information requirements related to the conditioning of ILW. The project's findings were used to develop this guidance.

This guidance provides some background information on the current Government policy on the conditioning of ILW, on the regulatory framework in place and on the nuclear industry's internal assessment process. Guidance is provided on both the information required by the Agency to enable it to reach a reasoned position on a particular case and on the appropriate timing of the provision of this information. Sources of relevant information are also identified. Finally, additional factors relating to the early conditioning of ILW are discussed.

Safety issues related to waste management are a major concern and it is important that waste is stored in a safe and suitable manner prior to eventual disposal. Regulation of conditioning and storage of ILW on licensed nuclear sites lies solely with the Health and Safety Executive (HSE), which has delegated its role under the Nuclear Installations Acts to the Nuclear Installations Inspectorate (NII). However, waste producers need to be aware that the NII will not give its formal agreement to projects until the Agency has expressed satisfaction with the radioactive waste management (including radioactive waste disposal) implications.

Safety and environmental protection for engineered disposal of radioactive waste are achieved by the multi-barrier principle. The barriers provided are a combination of natural and man-made or engineered barriers. Natural barriers, such as geochemistry and hydrology, are site dependent, whereas engineered barriers are provided by the facility design. Packaging of conditioned waste constitutes one of a number of engineered barriers and, as such, provides an important contribution to the effectiveness of a repository.

Waste producers should ensure that, where wastes are being conditioned as part of a waste management strategy, the packages produced would be suitable for engineered deep disposal. However, they must bear in mind that other options might be chosen.

Early conditioning of wastes introduces a risk that the packaged waste will not ultimately meet the conditions for acceptance at a repository. This may be due to a shortcoming in the waste as conditioned or to deterioration during storage prior to disposal. It may be possible to compensate for shortcomings by overpacking waste or by changes to the design of a repository. However, there may be shortcomings for which it is difficult to compensate and the disposability of the waste comes into question. In such circumstances, reworking of the waste will probably be required. Reworking of conditioned waste is likely to be a major undertaking involving the production of secondary wastes.

Section 2 outlines the regulatory framework for the conditioning, storage and disposal of radioactive waste. Section 3 sets out the Agency's involvement, and the information the Agency expects from waste producers to enable it to fulfil its responsibilities. Section 4 addresses some specific factors relating to early conditioning of ILW. A glossary of terms used in this guidance is provided in section 6.

2. Background

2.1. Government policy

The last formal review of radioactive waste management policy in the UK was carried out in 1995 and published in a White Paper (Command 2919)(2). This White Paper was prepared and published at a time when UK Nirex had identified a preferred site for a deep repository for ILW. The Government concluded that deep disposal of ILW was preferable to its indefinite storage and that there was no advantage in delaying the development of a deep repository for ILW.

However, it was accepted that such a repository would not be available to receive ILW until 2010 at the earliest. As a result, it was recognised that ILW would have to remain in interim storage for a further 15-20 years. Previous policy had been that until a waste disposal facility became available, ILW should remain untreated for as long as it was safe to do so (although treatment might be justifiable in order to improve the safety of storage). This reflected the possibility that a particular form of treatment might prove incompatible with the characteristics of a future repository site or design, and that treatment could thus effectively foreclose disposal options for the wastes.

The Government expressed its views on this issue of early waste treatment in Paragraph 113 of Command 2919 as follows.

"The Government believes that where the demands of safety are overriding, ILW must be treated as necessary to improve storage conditions. In addition, where early treatment of waste will secure worthwhile safety benefits, or worthwhile economic benefits without prejudicing safety, the general presumption against action which might foreclose future waste management options may be relaxed. The relevant costs and commercial risks must be borne by the owner of the waste. Decisions by operators and regulators will need to have regard to all relevant factors, including the following:

- a) *the need for continuing safe storage of the waste, treated and/or contained as necessary;*
- b) *the benefits of placing the waste in a chemically and physically stable form, so that safety may be achieved by passive means;*
- c) *the risk that treated waste will be incompatible with future disposal requirements and the practicability of re-working treated waste in the future, for disposal or for a period of further storage, should this be necessary;*
- d) *the state of storage facilities, including the benefits that would be derived from refurbishment or upgrading;*
- e) *the need to minimise waste degeneration, secondary waste arisings and releases to the environment;*
- f) *the need to minimise dependence on active safety systems, maintenance, monitoring and human intervention;*
- g) *the retrievability of the waste from storage."*

As part of its programme to develop a deep repository for ILW and some low level wastes, Nirex sought planning permission for a rock characterisation facility (RCF) at Sellafield in order to carry out more detailed investigations of the suitability of the rock for a repository. However, following a public inquiry, planning permission for this RCF was refused in March 1997. With the rejection of this planning application and appeal, the UK was left with no practical plan for the disposal of ILW and progress towards a deep repository was stalled.

The House of Lords Select Committee on Science and Technology has since prepared a report on the management of nuclear waste (3), to which the Government has responded (4). The Government noted the Select Committee's preference for deep disposal of ILW, and agreed that the national policy for long-term management of nuclear wastes should be as comprehensive as possible. Various management options for radioactive wastes would be considered, but before coming to a final decision, the Government stated that it wished to undertake widespread public consultation.

A further development has been the publication of a consultation document on the Government's proposed UK National Discharge Strategy (5). This draft strategy has been issued to meet the UK's commitments under the Oslo and Paris (OSPAR) and Sintra agreements to reduce discharges of radioactive substances to the marine environment.

2.2. Regulatory framework

Implementation of national policy on radioactive waste management and legislative provisions on the regulation of radioactive waste management are the responsibility of the Department of the Environment, Transport and the Regions (DETR). Regulation of radioactive waste management at licensed nuclear sites is carried out by both the HSE and the Agency. These two regulators, however, have different statutory powers as a result of various legislation introduced during the past 40 years. HSE's statutory powers arise from the Health and Safety at Work etc Act 1974 (HSW74) and the Nuclear Installations Act 1965 (as amended) (NIA65). HSE has delegated its roles under the NIA65 to the NII. The Agency's statutory powers are provided for by the

Radioactive Substances Act 1993 (RSA93), the Environment Act 1995 (EA95) and the Environmental Protection Act 1990 (EPA90).

The responsibilities of the NII and the Agency for regulating nuclear installations differ. NII is concerned with the prevention of accidents and the protection of the workforce and the public, while the Agency is concerned with the effects on the public and the environment arising from any radioactive wastes disposed of from the site. Disposal includes the transfer of wastes, including the deposit and burial of solid radioactive wastes, and discharges to water and the atmosphere. Protection of the public and the environment from the disposal of radioactive waste is covered by RSA93; in the case of nuclear sites, prior authorisation is required for disposal. Responsibility for regulation under RSA93 rests in England and Wales with the Agency, in Scotland with the Scottish Environment Protection Agency (SEPA) and in Northern Ireland with the Environment and Heritage Service (an Agency within the Department of the Environment for Northern Ireland).

Policy and legislative provisions relating to radioactive waste disposal in Scotland have been devolved and are now the responsibility of the Scottish Executive.

On nuclear licensed sites, the Agency's statutory powers under RSA93 cover contemporary disposals and releases of radioactive wastes and effluents. Exercise of these powers also allows the Agency to deliver its broader responsibilities for the environment under EA95 and the Habitats Directive. However, these powers do not effectively cover factors that may have environmental effects in the future, such as the treatment, packaging and storage of wastes pending disposal. As the vast majority of ILW is produced on nuclear licensed sites, which are licensed by the NII, regulation of conditioning and storage of ILW on these sites lies solely with the NII. The Agency's responsibility at these sites is limited to authorising waste disposals. However, waste producers need to ensure that the waste packages which they produce are ultimately suitable for disposal, that these aspects are considered at an early stage, and that the Agency is kept fully informed.

NIA65 (as amended) is a relevant statutory provision for the purposes of HSW74 and requires the licensing of nuclear installations. The management of radioactive wastes on nuclear licensed sites is regulated by NII, which has specific regulatory powers under NIA65 for the accumulation and management of radioactive wastes prior to discharge or disposal. Section 4.1 of NIA65 (as amended) allows the NII to attach conditions to the nuclear site licence in the interest of safety. In addition, Section 4.2 of NIA65 (as amended) enables conditions to be attached to the nuclear site licence that encompass any aspect NII thinks appropriate with respect to the accumulation, handling, treatment and disposal of radioactive waste.

2.3. Memorandum of Understanding

In order to ensure effective co-ordination of regulatory activities on licensed nuclear sites, the Agency and the HSE have produced a Memorandum of Understanding (MOU) (6), which specifies their responsibilities and working arrangements on matters of joint interest. HSE's role under this MOU is fulfilled by the NII. Working arrangements are set out in a series of sections in a schedule attached to the MOU.

For each section, both the primary and secondary responsibilities of the Agency or HSE are identified. Details of the working arrangements are set out, including an indication of whether the Agency or HSE is the normal point of contact for the licensee for all matters relevant to that particular interface. Under the MoU, the other regulatory body will be consulted by the one designated the normal point of contact.

Section 6 ("Design assessment of plant on nuclear licensed sites") is the section relevant to the conditioning and storage of ILW by the nuclear industry and to this guidance. Under this section, the primary responsibilities of the two regulatory bodies are as follows:

- the NII is responsible for assessing the safety case for new nuclear installations or modifications to existing licensed facilities;
- the Agency is responsible for assessing the effects of radioactive waste disposal on the public resulting from new nuclear installations or modifications to existing licensed facilities. It is also responsible for regulating prescribed processes at nuclear installations.

For matters relating to the NIA65 and radioactive waste management, the following working arrangements have been agreed:

- the NII will be the normal contact point for the operator (because the application for a license or modification will be made to the NII);
- the NII will negotiate the submission of safety documents and the programme for licensing or plant modification;
- the Agency will receive copies of relevant documents from the operator in order to assess the implications for radioactive waste management, including radioactive waste disposal;
- the Agency may contact operators on points of clarification;
- when the Agency is satisfied, it will inform the NII and the operator;
- the NII will submit consents to the operator or licence applicant only after the Agency has expressed satisfaction with the radioactive waste management (including radioactive waste disposal) implications.

For matters relating to Part I of EPA90, the Agency will consult the NII about proposed changes to prescribed processes which may result in a new authorisation or variation of an existing authorisation.

Although the NII has the lead role in the regulation of all facilities for the handling or packaging of ILW, the Agency must be satisfied with the proposed arrangements for radioactive waste management (including radioactive waste disposal) before the NII gives its agreement to the licensee for any relevant project.

A benefit of the MOU is that it sets up a process to ensure that all safety and environmental aspects, are considered properly. It also helps to resolve any potential differences between the NII and the Agency arising from the fact that there is likely to be a significant delay in the

availability of a long-term management route for ILW. Conditioned ILW is now likely to be stored on-site for long periods, but arrangements will need to take account of the fact that approval for eventual disposal of wastes rests with the Agency. Thus, while passive safety is important for ILW storage, there is also a requirement to ensure that actions taken in the short-term also take into account the need for the waste to meet envisaged disposal requirements.

In some cases, there may be a conflict between the requirement of achieving passive safety with the need to meet envisaged disposal requirements. In such cases, all factors will need to be taken into account and a judgement made to achieve an appropriate balance. A dialogue between the waste producer, HSE, the Agency and Nirex will be important for decision-making.

2.4. Nuclear industry's internal assessment

To provide confidence that waste currently being packaged will meet future waste management requirements (including potential disposal requirements) Nirex has developed standards and performance specifications for waste packages. These include waste form and waste container design, quality assurance and data requirements and are known as the Waste Package Specifications and Guidance Documentation (WPSGD). Nirex also provides detailed advice on the suitability of specific packaging proposals and plant designs against anticipated requirements for future transport, handling, storage and potential disposal following a formal assessment and review process.

This process covers 16 packaging assessment areas:

- twelve of these test compliance with the WPSGD;
- one relates to Nirex principles underlying packaging advice;
- the remainder cover transport, operational and post-closure packaging assessments.

Further details of these 16 packaging assessment areas are given in Table 1.

Letters of Advice (LoA) are issued as a result of this assessment process. LoAs identify outstanding issues and requirements for additional information or research. They may include recommendations for changes to the process or package. Where packaging proposals meet Nirex's requirements, Nirex endorses the proposed approach through the issue of a Letter of Comfort (LoC) to the waste producer.

In issuing a LoC, Nirex is not guaranteeing that the waste packages will be suitable for disposal, but is providing a high degree of confidence that they will be suitable for disposal in a future repository. Nirex therefore plays an important role as an advisor to the nuclear industry through its assessment of waste producers' proposals.

There is no regulatory requirement for a waste producer to obtain a LoC from Nirex, but the NII will normally not permit a waste packaging plant to start active operation until the licensee has obtained a LoC from Nirex.

3. Agency involvement, information requirements and sources of information

3.1. Main waste management stages

The Agency's involvement, and hence its information needs, vary according to the particular stage of development of a conditioning plant. The likely main stages, which correspond to stages at which submissions will normally be made to the NII, are shown in 0, together with the main outputs from each stage. It is important to recognise that while this represents one model, there will be variations from one wastestream to another. For example, while the concept of a wastestream is normally used for describing waste types and sources, in practice waste characteristics vary within streams. In some instances it is therefore necessary to break down wastestreams into smaller sub-units for assessment purposes. In other instances where wastestreams have similar characteristics, it may be appropriate for them to be addressed in the same option study, to use the same conditioning process or package, or to be covered by the same Waste Product Specification.

The action that the Agency will take at each of these stages, together with the information that it needs to enable it to carry out that action, is discussed in the remainder of this section. The detailed issues that may be considered by the Agency at various stages are set out in Table 2

It is assumed that the facilities for conditioning ILW will be categorised at a level such that a suite of safety reports would be submitted to NII for approval. However, there may be circumstances, such as plant modifications having little safety significance, where safety reports do not need to be submitted to the NII for approval. These cases are dealt with through the licensees' internal arrangements. It may therefore be appropriate for Agency inspectors to examine operators' modification lists to consider whether there activities are planned that may impact on future waste disposal, such as:

- A possible significant increase in the number of waste packages;
- changes in the wastestreams to be packaged;
- significant changes to the waste product specification (but not, for example, minor ones that are frequently made in the early stages of operation of a packaging plant).

3.2 Sources of information

The main sources of information that the Agency will use to carry out an assessment at each stage are set out in sections 3.4 - 3.7. These sources are a mixture of information that is already available to the Agency and that which needs to be supplied by the waste producer on a case by case basis.

As well as ensuring that wastes and waste packages are fully characterised, Agency inspectors will need to be satisfied that waste producers generate and record all the data required for subsequent waste management steps (including potential disposal). Detailed record-keeping and long-term preservation of information are particularly important.

Where reference is made to safety cases the Agency is interested in the parts relating to:

- details of the facility;
- discharges to the environment;
- specification and control of the environment within a storage facility;
- deterioration during storage of waste packages.

It is suggested that either only relevant parts of safety cases are submitted to the Agency or, alternatively, these parts are clearly and separately addressed in safety submissions.

Similarly, the Agency will not normally wish to review the full detail of LoC submissions. It is likely that a top level document will have been prepared for use by Nirex assessors and that this will provide an appropriate level of detail for the Agency's purposes. If this has not been done and the information is spread between a number of supporting documents, a summary should be prepared by the operator for the Agency.

3.3 Categorisation of waste packaging proposals

Nirex allocates waste packaging proposals to one of three categories (7) depending on the degree to which the proposal complies with the WPSGD and falls within previous assessments that Nirex has carried out. The basis for these categories is as follows.

3.3.1 Nirex Category 1

The nature or content of the waste, and/or the technology proposed for its encapsulation, falls outside Nirex's experience, and it is judged that significant new issues may be raised concerning waste transport, handling, storage or potential disposal.

In these cases, it is necessary to consider altering the relative reliance on different system components (in transport, handling, storage or potential disposal, as appropriate) to deliver the required overall safety performance, and the potential or necessity to invoke mitigating features. Consequently, this will require careful assessment of the implications for system design and safety cases.

3.3.2 Nirex Category 2

The nature or content of the waste, and/or the technology proposed for its encapsulation, falls outside previous Nirex experience, but produces packages or revises the inventory in a manner consistent with previously assessed concepts. Assessment of its compatibility with future waste management can therefore be evaluated using existing assessment methods.

If the assessment reveals that the performance of the proposed waste package falls within previously agreed bounds, a LoC (or LoA) can be issued. If the performance is found to be outside these bounds, only advice can be given to the waste producer by Nirex and not a LoC.

3.3.3 Nirex Category 3

The physical nature, the chemical composition and the radionuclide content of the waste, are judged to fall fully within previous Nirex experience (as reflected in the WPSGD and safety assessments), and the proposed packaging process uses known technology in a standard manner.

3.3.4 Agency use of Nirex Categories

The Agency will take account of these categories when reviewing LoCs and LoAs issued by Nirex and any issues of concern raised by Nirex in their assessment process.

For a Category 3 proposal, the Agency review of the output of Nirex assessments will be limited to ensuring that:

- an assessment has been carried out by Nirex;
- the basic information, such as the waste inventory and waste packaging proposal, is consistent with that contained in the best practicable environmental option (BPEO) study for the waste;
- a final LoC has been issued (a final LoC may be issued with caveats and with a LoA where issues have to be resolved by information provided by active commissioning or operational experience);
- any issues of concern can be readily addressed.

For a Category 1 proposal, the Agency should consider carrying out a detailed review of the Nirex assessment output to determine whether any of the issues relating to the disposability and reworkability of the proposed waste packages mean that the proposal is not acceptable to the Agency.

The extent of review of Category 2 proposals depends upon whether the Nirex assessment reveals that the performance of the proposed waste package falls within the previously agreed bounds. If it does, then the Agency review would be as for a Category 3 proposal. If it does not, the proposal becomes a Category 1 proposal and the approach set out for Category 1 proposals should be followed.

3.4 Preliminary and options study stages

The preliminary stage occurs when early conditioning of the wastestream (or part of a wastestream) is first considered. For facilities that will generate waste but have yet to be operated, the storage of wastes, together with the possibility of early conditioning of these wastes, should be considered as an integral part of the development of the facility design.

The Agency would expect basic data on all existing wastes and any strategic plans for the future management of all wastes to be available to its inspectors. This will allow it to identify any significant issues and enter into discussions with the waste producer over the future management of the wastes.

The Agency would not expect to make a waste producer to make a formal submission at this stage, but would expect to be kept up-to-date on the waste producers' intentions and programmes.

The main sources of documented information at this preliminary stage are likely to be:

- the site's waste inventory or the UK National Radioactive Waste Inventory, together with anticipated future waste arisings;
- site-wide waste management strategy documents;
- relevant extracts from safety cases covering the facilities within which the waste is being stored.

Options for management of the waste should be considered in more detail at the options study stage. Potential options for the future management of the waste, including the "do-nothing" option, should be considered by the waste producer in a formal way. Waste management options should include changing the characteristics of the wastes, such as volume reduction, radionuclide removal and composition change, as appropriate.

The Agency expects the waste producer to establish BPEO for the waste. BPEO should be decided by evaluating alternative options on the basis of factors such as occupational and environmental risks, environmental impacts, costs and the social implications, as well as the likely continued integrity and suitability for disposal of any waste packages produced. The outputs of BPEO studies should become an integral part of the licensee's site-wide waste management strategic plan. The degree of detail in BPEO studies will vary; in some cases, there will be relatively few options available and the factors to be considered may be clear cut. In other cases, a more detailed analysis will be required to identify and consider all relevant factors.

The waste management strategic plan should cover all the licensed site. It should provide justification to both NII and the Agency of the preferred strategy for the future management of all ILW currently stored on the site and predicted arisings in terms of waste inventory, treatment options and disposal plans. The strategy should also justify both present and future safety, and be compatible with Government policy and best international practice.

Although the BPEO study report is not produced at a stage when safety case is submitted to the NII, the Agency is unlikely to be able to "express satisfaction" with any subsequent safety case submission without having received a satisfactory BPEO study at this stage.

The main issues that the Agency should assess in their review of BPEO studies are:

- have all reasonable options, including "do-nothing" been considered;
- does the BPEO study address all the factors contained in Paragraph 113 of Command 2919 (2);
- is the methodology used in the BPEO study robust and does it take account of areas of uncertainty;
- do any aspects of the proposed waste package mean that it may not be disposable or reworkable;
- the extent of any liquid and gaseous discharges associated with the options, and their impacts;

- whether any foreseeable policy issues (see section 4.3) would result in an engineered disposal facility containing the intended waste packages not receiving a disposal authorisation from the Agency.

Table 2 Table 1 sets out additional and more detailed issues that the Agency would also consider.

Early liaison between the waste producer and Nirex will often help to establish whether any of the options being considered could result in difficulties in the future acceptance for disposal in a repository, and consequent problems in obtaining a LoC. Pursuit of such options should be avoided.

Operators should consider periodic reviews of BPEO studies which continue to be used as references. Such reviews should consider whether additional information has become available since the original study was carried out. Additional information to be considered may include changes in available technologies, and changes to regulatory requirements or to Government policy.

The main sources of documented information for the options study stage are likely to be:

- the BPEO study report covering the wastestream, or part of a wastestream, under consideration;
- the site's waste inventory or the UK National Radioactive Waste Inventory (8), together with anticipated future waste arisings;
- site-wide waste management strategy documents.

3.5 Design and construction stages

Having established a preferred waste management option by means of the BPEO study, the next stages are:

- development of conceptual designs for the packaging facility and for the waste package;
- development of detailed designs for the packaging facility and for the waste package;
- construction of the waste packaging plant.

By the time this is complete, all outstanding issues of concern should have been dealt with and any development work associated with the waste package, such as formulation of the conditioning grout, should have been completed.

In some cases the stages will vary, particularly where existing plants and packages are to be used for new wastestreams. Conceptual designs may also be developed before final BPEO assessments are carried out. The inspector and waste producer should give careful consideration to what is appropriate in each case.

At these stages, the Agency's aims are to establish at least at a conceptual level:

- that all issues of concern raised at previous stages by the Agency or Nirex have been satisfactorily dealt with;
- that all information is consistent, especially with the BPEO study report, the waste management strategy document, the waste inventory and previous submissions;
- that waste packages resulting from the intended waste packaging process will be disposable;
- that there have been no changes to regulatory requirements or to Government policy that would invalidate the conclusions of the BPEO study, or would make it impossible for an engineered disposal facility containing the intended waste packages to receive a disposal authorisation from the Agency;
- that the waste packages are reworkable should changing circumstances (for example, unforeseen deterioration or changes in regulatory requirements) mean that the waste packages are no longer disposable. The degree to which reworkability should be demonstrated will depend on the degree of confidence in the disposability of the wastes;
- whether the approach to areas of uncertainty is robust;
- whether any issues of concern raised by Nirex in its assessment of the waste packaging proposals suggest that the proposed approach to waste packaging is unacceptable and that any areas of uncertainty will be addressed fully in the commissioning stage;
- the likely acceptability of the proposed discharge levels from the waste packaging facility;
- that the quality management system (QMS) covering the commissioning of the waste packaging facility meets the requirements of BS EN ISO 9001 (9).

Table 2 sets out additional and more detailed issues that the Agency would also consider.

The main sources of information available at the conceptual design stage are:

- the site's waste inventory and the UK National Radioactive Waste Inventory;
- the waste product specification;
- LoC submissions (conceptual and pre-commitment);
- LoAs and LoCs issued by Nirex in response to submissions;
- relevant parts of safety reports (for example, the Preliminary Safety Report (PSR); the Pre-Commissioning Safety Report (PCmSR); and the Pre-Commencement Safety Report (PCSR);
- any application for revised discharge authorisations;
- the (QMS) for commissioning of the waste packaging facility.

3.6 Commissioning stage

Satisfactory completion of the commissioning (both inactive and active) of the waste packaging facility is necessary before the facilities can begin operating. Reliable and consistent production of waste packages in line with the waste product specification must be demonstrated. All issues of concern must have been dealt with and all development work completed satisfactorily.

The Agency's main aims at this stage are to establish, as far as is practicable:

- that all areas of uncertainty have been fully addressed in the commissioning stage;
- that the wasteform formulation envelope has been validated (where required);
- that the waste package continues to be disposable or reworkable should any changes to the waste product specification or waste packaging process become necessary as a result of commissioning;
- that the facility has been commissioned in accordance with the QMS covering the commissioning of the waste packaging facility;
- that any discharges during active commissioning are within limits and consistent with predictions;
- that the QMS covering the operation of the waste packaging facility meets the requirements of BS EN ISO 9001.

Table 2 sets out additional and more detailed issues that the Agency would also consider.

The main sources of information relevant to the commissioning stage are:

- inspection reports from any non-destructive and destructive examination carried out on inactive and active waste packages produced during commissioning of the waste packaging facility;
- pre-operational LoC submission (normally provided after inactive commissioning of the plant);
- relevant parts of the Pre-Operational Safety Report (POSR);
- quality assurance (QA) audit reports for the operation of the waste packaging facility.

3.7 Operational stage

Once commissioning has been completed satisfactorily and NII agreement has been obtained, the waste packaging facility can begin operation. The scope of the Agency's interest includes conditions in the packaged waste stores.

The Agency's main aims at this stage are to establish, as far as is practicable:

- that the discharge limits for the waste packaging facility are not being exceeded during operation of the facility and best practicable means (BPM) are being used to minimise discharges;
- that the facility is being operated in accordance with the QMS covering the operation of the waste packaging facility;
- that there is no significant degradation of the waste packages in the store.

The main sources of information relating to operations are:

- the operator's plant operating and discharge monitoring records;
- relevant parts of the Operational Safety Report (OSR) and/or the Continued Operational Safety Report (COSR);
- QA audit reports for the operation of the waste packaging facility;
- periodic safety and environmental reviews;
- reports of inspections of waste packages in store.

4 Additional factors relating to early conditioning

Three key additional factors are addressed by the Agency when conditioning of waste is being considered ahead of construction of a disposal facility. These are disposability, reworkability and policy issues.

4.1 Disposability

Disposability of a waste package is defined as the likelihood that a package of conditioned ILW produced in current circumstances (that is before a site and a repository design is available) will be, as far as is reasonably practicable, acceptable for disposal in a future repository. It will not be possible to issue Waste Acceptance Criteria or Conditions for Acceptance for a deep repository until such a facility is operational. It is therefore not possible to be absolutely sure that a waste package produced at the present time will be accepted for disposal at a future deep repository.

In the absence of an identified disposal facility and of Conditions for Acceptance, Nirex has produced WPSGD to enable waste producers to package waste ahead of a disposal site being available. This sets standards and provides guidance. The WPSGD aims to minimise the risk of future reworking of packages, and to provide a basis against which waste packagers can develop packaging proposals. If waste packages are developed so that they fall within the performance envelopes set out in the WPSGD, Nirex believes that the packages will be compatible with future requirements for transport to, handling and disposal at a future ILW disposal facility.

On the basis of current knowledge, the risk of a waste package that complies with the WPSGD being unsuitable for disposal in the future is very low.

However, a disposal facility will not be available for some time. This introduces a risk that a waste package produced now may not be suitable for future disposal. There may be potential changes in the condition of the waste package as a result of degradation, changes in regulations, and improvements in the understanding of the post-closure process.

The Agency considers Nirex's assessment of waste packaging proposals against the technical areas in Table 1 as generally determining whether the resulting waste packages would be disposable. However, the Agency would wish to assure itself on an ongoing basis as to the adequacy of the scope and quality of Nirex's reviews. This will be done by a combination of:

- reviewing the adequacy of Nirex's QMS;

- examining a selection of waste packaging proposals submitted to Nirex and the LoA and/or LoC issued by Nirex;

- determining whether the issues that have been identified are complete and reasonable.

Nirex does not carry out a formal assessment of LoC submissions at the options study stage. However, there may be liaison between the waste producer and Nirex on the acceptability of packages for disposal. The Agency should review the implications for disposability of the proposed waste packages at this stage, as well as those stages where Nirex carry out assessments.

The Agency will assess whether disposability has been addressed within the BPEO study report. If it has not, the BPEO study report is unlikely to be accepted by the Agency. It is acknowledged that, at this early stage, it would not be possible for a detailed consideration of disposability to be carried out. However, as a minimum, any issues that could affect the disposability of a waste package should be identified.

Once commissioning has taken place and the next step is to begin operation of the waste packaging facility, there should be no changes to the waste packaging plans from those that existed prior to commissioning. Provided this is the case, disposability need not be addressed further, as it will have been satisfactorily considered at the end of the construction stage. However, if the commissioning process has resulted in any changes to the waste packaging plans (for example, the waste conditioning formulation) disposability must be addressed. This should be done by preparing of a revised LoC submission; this and the subsequent LoC from Nirex should be supplied to the Agency.

Nirex's assessments are extensive and address the question of disposability. The Agency does not intend to replicate these assessments. Instead, the Agency should concentrate on the key aspects of the assessments, such as:

- are the wastes unusual when compared with other wastes that have previously been considered disposable? Are they being classified by Nirex as Category 1;

- what, if any, issues have Nirex raised in a LoA and how are these being addressed;
- is the waste packaging proposal consistent with the site waste management strategy and with the conclusions of the BPEO study report;
- is the waste well-characterised and, if not, how is the characterisation to be carried out;
- how is fissile material being managed to avoid criticality;
- how are those radionuclides that are particularly significant to the post-closure safety of a disposal facility (for example, iodine 129) being managed;
- are there any materials present (for example, organics) that could affect the post-closure safety of a disposal facility;
- could there be significant degradation during storage of the waste package.

4.2 Reworkability

If waste packages are intended to be disposable and no issues of concern were raised when their disposability was assessed, the risk that waste packages need to be repackaged should be low. The term "reworking" is used to cover repackaging of waste that has already been packaged in a waste container. "Reworkability" is a measure of the feasibility of repackaging conditioned waste.

Any reworking that involves having to process the conditioned waste is likely to incur significant cost, generate secondary wastes and, unless it can be carried out remotely, potentially result in significant dose uptake. These impacts should be reduced if reworking can be performed by using overpacks. Further processing of the conditioned waste would probably be required if the waste had degraded to an unacceptable condition. The use of an overpack should be feasible if only the waste container has deteriorated.

Agency inspectors should assure themselves that the practicability of reworking waste packages has been addressed to an appropriate level of detail; for example, if there appears to be a significant possibility that reworking is required, its feasibility should be firmly established.

Reworking may be required as a result of either unforeseen deterioration detected during periodic monitoring, or due to a tightening of the Conditions for Acceptance. Reworking may be required:

- during storage of the waste package by the waste producer;
- as a result of an accident (for example, the waste package being dropped) or other unplanned event;
- following the completion of storage of the waste package by the waste producer, and before transport of the waste package to the disposal facility.

Issues that the Agency should check are addressed when assessing the feasibility of reworking packaged waste include:

- considering the significance of any reduction in waste package performance and where this would have most impact (for example, handling, transport or post-closure);
- identifying compensating activities or hardware that could be used to provide the overall required level of safety without the need to carry out repackaging;
- the potential for placing the waste package in an overpack, taking into account the feasibility of handling, transporting and disposing of the resultant waste package, which will be larger than the handling, transport and disposal systems would have been designed for;
- identifying any features, either of the waste container or the wasteform, that could have a significant effect on the feasibility of repackaging;
- the ease and safety of removing the waste package lid;
- potential methods for the removal and/or breaking down of the conditioned waste from within the waste package;
- the feasibility of removing the waste container from around the waste and then fabricating a new waste container around the conditioned waste;
- the extent of dose uptake and overall risks of the repackaging process, compared with the risk reduction resulting from the increased level of safety as a result of repackaging;
- the generation of additional wastestreams.

In some instances, may be essential to condition wastes to improve short-term safety, even though there may be considerable uncertainty about the long-term performance of the conditioned waste in a repository. It is therefore possible that a potential need to rework wastes in the future may have to be offset against other benefits.

4.3 Policy issues

Agency inspectors should satisfy themselves that consideration has been given to whether other issues would make it unlikely for the Agency to authorise disposal of the packaged waste. Such issues include current and anticipated regulatory requirements, Government policy and public concerns. If there is any uncertainty about a particular wastestream, the Agency may need to be satisfied that the waste can be reworked, even though a LoC has previously been granted.

5 References

- (1) Environment Agency, 2001. *Development of Agency Guidance for Nuclear Industry Submissions for Conditioning Intermediate Level Waste*. R&D Technical Report P411. Environment Agency, Bristol.
- (2) UK Parliament, July 1995. *Review of Radioactive Waste Management Policy. Final Conclusions*. Cm. 2919. The Stationery Office, London.
- (3) House of Lords Select Committee on Science and Technology, July 1995. *Third Report on Management of Nuclear Waste*. HL41. The Stationery Office, London.
- (4) Department of the Environment, Transport and the Regions (DETR), October 1999. *The Government's Response to the House of Lord's Select Committee Report on the Management of Nuclear Waste*. The Stationery Office, London.
- (5) Department of the Environment, Transport and the Regions (DETR), June 2000. *UK Strategy for Radioactive Discharges 2001-2020. Consultation Document*. DETR, London.
- (6) Environment Agency and Health and Safety Executive (HSE), March 1996. *Memorandum of Understanding between the HAS and the Environment Agency on Matters of Mutual Concern at Licensed Nuclear Sites in England and Wales*. Environment Agency, Bristol, and HSE, London.
- (7) Palmer, J.D. and Wisbey, S.J., 2000. *Packaging of wastes: Nirex assessment and endorsement process*. International Conference on Nuclear Materials – Containment and Disposal, held Windermere, UK.
- (8) Department of the Environment, Transport and the Regions (DETR) and UK Nirex Ltd (Nirex), 1999. *The 1998 UK Radioactive Waste Inventory – Main Report*. DETR/RAS/99.009. Nirex N3/99/01. DETR, London and Nirex, Oxfordshire.
- (9) British Standards Institution (BSI), 1994. *Quality Systems. Model for Quality Assurance in Design, Development, Production, Installation and Servicing*. BS EN ISO 9001. BSI, London.

6 Glossary

Best Practicable Environmental Option (BPEO)

A concept developed by the Royal Commission on Environmental Pollution which involves decisions on waste management being based on the evaluation of alternative options on the basis of factors such as occupational and environmental impacts, costs and the social implications.

Best Practicable Means (BPM)

Within a particular waste management option, the BPM is that level of management and engineering control which minimises, as far as practicable, the radiological impact of the option while taking account of a wider range of factors, including cost-effectiveness, technological status, operational safety, social factors and environmental factors.

Disposal

The emplacement of waste in an authorised, specialised facility without the intent to retrieve it at a later time (retrieval may be possible but, if intended, the appropriate term is ***storage***). Disposal also covers the authorised discharge of aerial wastes (gases, mists and dusts) and liquid wastes to the environment.

Disposal facility

An engineered facility for the disposal of solid radioactive wastes

Intermediate level waste (ILW)

Wastes with radioactivity levels exceeding the upper boundaries for Low Level Wastes, but which do not require heating to be taken account in the design of storage or disposal facilities.

Letter of Advice (LoA)

A Letter of Advice is a document prepared by Nirex following the assessment of a waste packaging proposal submitted by a waste producer. The LoA gives advice on the packaging proposal, identifies further information requirements and/or highlights issues that need further attention.

Letter of Comfort (LoC)

A Letter of Comfort is a document prepared by Nirex which provides assurances to the waste producer that the proposed waste package is compatible with Nirex plans, as currently foreseen, for the repository and associated transport systems.

Low level waste (LLW)

Wastes containing radioactive materials other than those acceptable for disposal with ordinary refuse, but not exceeding 4 GBq/t alpha or 12 GBq/t beta/gamma activity

Storage

The emplacement of radioactive waste in a facility with the intent to retrieve it at a later time.

Waste container

The vessel that remains in direct contact with the wasteform and is disposed of along with the wasteform.

Wasteform

The waste in the physical and chemical form in which it will be disposed of, including any conditioning media but not including the waste container

Waste package

The wasteform and its waste container as prepared for storage and disposal

Waste Product Specification

A document prepared by the waste producer which describes the quality (properties and composition) and performance characteristics of each distinct type of waste package produced in a waste packaging plant.

7. List of Acronyms

BPEO	Best Practicable Environmental Option
COSR	Continued Operational Safety Report
DETR	Department of the Environment, Transport and the Regions
EA95	Environment Act 1995
EPA90	Environmental Protection Act 1990
HSE	Health and Safety Executive
HSW74	Health and Safety at Work etc Act 1974
IAEA	International Atomic Energy Authority
ILW	Intermediate level waste
LLW	Low level waste
LoA	Letter of Advice
LoC	Letter of Comfort
MOU	Memorandum of Understanding
NIA65	Nuclear Installations Act 1965
NII	Nuclear Installations Inspectorate
OSR	Operational Safety Report
PCmSR	Pre-commissioning Safety Report
PCSR	Pre-commencement safety report
POSR	Pre-operational Safety Report
PSR	Preliminary Safety Report
QA	Quality Assurance
QMS	Quality Management System
RCF	Rock characterisation facility
RSA93	Radioactive Substances Act 1993
SEPA	Scottish Environment Protection Agency
WPSGD	Waste Package Specifications and Guidance Documentation

Table 1

Summary of technical areas considered by Nirex in their assessments of waste packaging proposals

Technical area	Summary of main issues considered
Nature and quantity of waste	Amount of waste, number of packages of each type, variation in activity between packages
Wasteform	Suitability of wasteform design and behaviour under storage and disposal conditions
Criticality	Criticality safety of packages in a deep waste repository, both initially and after degradation
Container design	Consistency of the container with Nirex standards and performance requirements
Container corrosion	Adequate corrosion performance of the container for handling and containment of short-lived activity
Impact performance	Sufficiently low releases from the waste package under impact accidents
Fire accident performance	Sufficiently low releases from the waste package under credible fire accidents
Quality Assurance	Production of waste packages under an appropriate Quality Assurance system
Data recording	Recording of appropriate data on packages to allow their transport and disposal
Physical protection	Necessity for special physical protection measures on the basis of package contents
Safeguards	Necessity for keeping the wastes under safeguards on the basis of package contents
Policy	Consistency of packages with the Nirex remit and with UK and international regulatory guidance
Transport safety	Transport in accordance with IAEA* requirements and consistency with transport safety requirements
Operational safety	Consistency of the possible package releases with repository operational safety requirements
Post-closure safety	Consistency of package releases with anticipated repository post-closure performance
Non-nuclear environmental assessment	Appropriate use of resources for package manufacture and transport (conceptual stage only)

* International Atomic Energy Authority

Table 2

Detailed issues to be considered at various stages

Options study stage
<p><i>Issues relating to the option of continuing to leave the waste in the existing storage facility</i></p> <ul style="list-style-type: none">• Have releases, leakage, contamination and generation of secondary wastes from the storage process been minimised?• Would deterioration of the waste in the store foreclose disposal options?• Is the raw waste adequately characterised in terms of both its radioactive and non-radioactive properties and taking into account changes with time?• Are operational histories of the waste and the waste store available?• Are adequate records maintained?• Does the assessment of accidents take account of all potential environmental impacts?• Does the potential for release vary with the period of storage?• Do the effects of the design and operation of the store upon critical groups, pathways and the environment vary with time?• Is there an adequate monitoring regime for the waste and the waste store?• Are there contingency plans, which take account of the radioactive and non-radioactive properties of the waste?• Are all the activities associated with waste storage being carried out under an appropriate QMS, which takes account of potential future information needs?• Is the storage process being carried out in accordance with BPM?• Have issues of interest to NII, such as storage integrity and retrievability of wastes from stores, been addressed?

Table 2 cont'd

Issues relating to the option of retrieving, treating and packaging the waste, either in a conditioned or unconditioned form

- Would all options meet requirements to minimise releases, leakage, contamination and generation of secondary wastes during the retrieval, treatment and packaging process?
- Have all options been properly examined using BPEO, including a "do-nothing" option? Does the examination look well ahead?
- Does the BPEO study consider foreclosure of options?
- Does the BPEO study take into account all factors identified in Paragraph 113 of Command 2919?
- Does the container considered for packaging the waste take account of future plans?
- Should the need arise, is the packaged waste capable of being repackaged in the future?
- Has disposability been taken account of?
- Has consideration been given to the practicality of future reworking of the packaged waste?
- Has each waste package been fully characterised?
- Are adequate records maintained?
- Does the assessment of accidents take account of all potential environmental impacts?
- Does the BPEO study take account of transport?
- If it proved necessary to transport the waste in the public domain as part of an option, would the planned transport package meet the relevant regulations?
- If there is a need to move the waste on the licensed site as part of an option, has an adequate assessment been carried out of the movement, including taking account of the environmental impact during both normal and accident conditions?
- Where conditioning is considered as part of an option, does the conditioning process take account of the long-term performance of the conditioned waste?
- Are sufficient inspection and monitoring carried out to characterise each waste package for any options where waste packages are produced?
- Would all the activities associated with waste retrieval, treatment and packaging be carried out under an appropriate QMS, which takes account of potential future information needs?

Would the waste retrieval, treatment and packaging process be carried out in accordance with BPM?

Table 2 cont'd

Conceptual design, detailed design, construction and commissioning stages

Issues relating to the retrieval, treating and packaging of the waste, either in a conditioned or unconditioned form

- Would releases, leakage, contamination and generation of secondary wastes from the retrieval, treatment and packaging process be minimised?
- Have the conclusions of the BPEO study been incorporated in the site-wide waste management strategy?
- Does the development of the preferred option identified in the BPEO study affect any of the factors addressed in the BPEO study, such as foreclosure of options?
- Does the development of the preferred option comply with the BPM principle?
- Does the container considered for packaging the waste take account of future plans?
- Should the need arise, is the packaged waste capable of being repackaged in the future?
- Has disposability been taken account of?
- Has each waste package been fully characterised?
- Are adequate records maintained?
- Does the assessment of accidents involving the waste package take account of all potential environmental impacts?
- If it proved necessary to transport the waste package off-site, would the planned transport package meet the relevant regulations?
- If there is a need to move the waste package on the licensed site, has an adequate assessment been carried out of the movement, including taking account of the environmental impact during both normal and accident conditions?
- Does the conditioning process take account of the long-term performance of the conditioned waste?
- Are sufficient inspection and monitoring to be carried out in order to characterise each waste package properly?
- Would all the activities associated with waste retrieval, treatment and packaging be carried out under an appropriate QMS, which takes account of potential future information needs?
- If required, have wasteform formulation envelopes been validated during the commissioning phase?
- Would the waste retrieval, treatment and packaging process be carried out be in accordance with BPM?

Table 2 cont'd

Issues relating to the eventual retrieval of the waste packages from storage and transport to a disposal facility

If conditioning of the waste is carried out as part of this process, issues relating to conditioning under the previous heading are also applicable.

- Would there be full characterisation of each waste package?
- Would the waste package design prevent the despatching facility from dealing with packages that are damaged during transport and returned to the despatching site?
- Does the assessment of accidents take account of all potential environmental impacts?
- Would the transport package meet the relevant regulations, taking account of any deterioration of the waste package during storage?
- Would the waste package design preclude any transport modes from being used?
- Could the long-term performance of the waste package be affected by transport, for example if damage occurred during transport?
- Would the waste package design prevent inspection of the retrieved waste package such that it would not be possible to demonstrate that the package accords with package records, and that there has been no significant deterioration during storage?
- Would all the activities associated with the retrieval of waste packages and transport be carried out under an appropriate QMS, which takes account of potential future information needs?
- Would the waste package design prevent the retrieval of waste packages and transport being carried out in accordance with BPM?

Table 2 cont'd

<p><i>Issues relating to the eventual receipt, handling and transport of the waste packages at a disposal facility</i></p> <ul style="list-style-type: none">• Would the waste package design prevent the disposal facility from handling packages that are out-of-specification, for example as a result of damage during transport?• Does the assessment of accidents involving the waste package take account of all potential environmental impacts?• Is the waste package suitable for operations, retrievable emplacement and final disposal at the disposal facility, taking account of relevant issues such as fissile content, Wigner energy, cellulosic material and actinides?• Has an assessment been carried out of the timescale at which the waste package would no longer be disposable as a result of issues such as grout stability and crevice corrosion?• Would the waste package design prevent all the activities associated with the receipt, handling and transport of waste packages being carried out under an appropriate QMS that takes account of potential future information needs?• Would the waste package design prevent receipt, handling and transport of waste packages being carried out in accordance with BPM?
<p><i>Issues relating to the emplacement and operation of the waste packages at a disposal facility</i></p> <ul style="list-style-type: none">• Does the assessment of accidents take account of all potential environmental impacts?• For underground disposal facilities, could there be accelerated corrosion as a result of the higher underground temperatures?• Would the waste package design prevent all the activities associated with emplacement and operation of waste packages from being carried out under an appropriate QMS, which takes account of potential future information needs?• Would the waste package design prevent the emplacement and operation of waste packages being carried out in accordance with BPM?

Table 2 cont.'d

Issues relating to the eventual post-closure performance of the waste packages at a disposal facility

- Would the waste package design prevent a satisfactory post-closure safety case from being developed for the repository, taking account of all potential environmental impacts?
- Would the waste package design prevent a decision being taken to close and seal the disposal facility, and instigate institutional management because of the performance of the waste packages following retrievable emplacement at the disposal facility?
- Would the waste package design prevent all the post-closure activities being carried out under an appropriate QMS?
- Would the waste package design prevent all the post-closure activities being carried out in accordance with BPM?

Table 2 cont'd

Operational stage
<p><i>Issues relating to the storage of packaged waste as part of the operational stage, either in a conditioned or unconditioned form</i></p> <ul style="list-style-type: none"> • Is there a potential for a significant total release made up of small releases from a large number of waste packages? • Does the assessment of gas generation from the waste packages take account of variations in gas generation rate, such as would be caused by variations in temperature? • Have options for trapping gases such as tritium been considered? • Are the required storage conditions defined, and how does the design of the storage facility ensure that environmental conditions are met? • What is the means of controlling the chloride content in the store atmosphere? • Has condensation in the store been fully addressed? • Does the assessment of accidents take account of all potential environmental impacts? • Is there a potential for any long-term deterioration of any feature of the (un)conditioned waste or the waste container, such as the filter? • Are there plans to carry out monitoring of waste packages, which may require packages to be periodically withdrawn from store for inspection? • Are these plans being implemented and records retained of the inspections? • Are the environmental conditions in the store being monitored, recorded and compared with the required environmental conditions? • Are all the activities associated with storage of waste packages being carried out under an appropriate QMS, which takes account of potential future information needs? • Is the waste package storage process being carried out in accordance with BPM?

Figure 1 Key waste management stages and their main outputs

