

The UK Process for Assessment of Waste Conditioning Proposals - 9500

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ABSTRACT

This paper describes the Nuclear Decommissioning Authority's process for assessment of waste conditioning proposals through the Letter of Compliance process.

The Radioactive Waste Management Directorate of NDA has been nominated by Government as the implementing body for the UK's Geological Disposal Facility for higher activity waste, including intermediate level and high level wastes and spent fuel and nuclear materials should these be designated for disposal.

This paper describes arrangements for assessment of the disposability of higher activity wastes by the Radioactive Waste Management Directorate. The Letter of Compliance process is described and its role within the UK regulatory regime explained. The output from the process, the Assessment Report is described as is its use within the required Radioactive Waste Management Case. The paper concludes by describing the expected evolution to GDF Waste Acceptance Criteria.

INTRODUCTION

The Radioactive Waste Management Directorate (RWMD) of the Nuclear Decommissioning Authority (NDA) has been established with the remit to implement the geological disposal option for the UK's higher activity radioactive wastes. The NDA is currently working with Government and stakeholders through the *Managing Radioactive Waste Safely* (MRWS) consultation process to plan the development of a Geological Disposal Facility (GDF).

As the ultimate receiver of wastes, RWMD, acting as GDF implementer and future operator, has established waste packaging standards and defined package specifications to enable the industry to condition radioactive wastes in a form that will be compatible with future transport and disposal. In this respect RWMD is taking forward waste packaging standards and specifications which were originally developed by United Kingdom Nirex Ltd, which ceased trading on 1st April 2007 and whose work has been integrated into the NDA.

The primary document which defines the packaging standards and specifications for Intermediate Level Waste (ILW), and certain Low Level Wastes (LLW) not suitable for disposal in other LLW facilities is the Generic Waste Package Specification (GWPS) [1]. The GWPS is supported by a comprehensive suite of user-level documentation.

This paper has been produced to provide a guide to the LoC process, describing its role within current regulatory arrangements, its application throughout the life-cycle of a waste packaging plant and providing definition of the scope of key outputs from the process.

BACKGROUND

Nirex was established in 1982 by the UK nuclear industry with the objective of developing a deep geological disposal facility for ILW and long-lived LLW. As part of this role Nirex developed Waste Package Specifications to define the packaging standards and specifications that should be used as the basis for the design, assessment and production of waste packages to ensure compatibility with long-term waste management plans, including disposal in an underground repository. This process culminated in 2005 with the production of the GWPS which defines and justifies the standards and specifications required of waste packages to be managed in accordance with the Phased Geological Repository Concept (PGRC) [2].

Since the mid-1980s, many waste producers in the UK have invested in new waste retrieval and packaging plant using the Nirex packaging standards and specifications to guide their development. Though not in a position to 'accept' such proposed waste packages, Nirex has been able to assess them and indicate to waste producers whether they were compatible with the disposal concept being developed. This Nirex 'endorsement' of waste packaging plans was signified by the issue of a 'Letter of Comfort'.

During the early 1990s, the LoC process matured to a point that the underlying assessments undertaken by Nirex were established on a more structured footing with detailed advice (designated Advice Reports) being issued to waste producers highlighting further information needs, or need for further development and/or research before a LoC could be issued. At this time, the LoC process was also modified to integrate better with the implementation of a packaging plant project, with staged interactions occurring at concept stage, pre-construction, and finally, before active operation of the packaging plant. This status of the LoC process was strengthened in January 2004, when support was provided by UK nuclear regulators, and it was recognised within improved regulatory arrangements for nuclear licensed sites [3].

In April 2007 Nirex was dissolved and its responsibilities assumed by RWMD. This included the role of assessing and endorsing Site Licence Companies' (SLCs) waste packaging proposals through the LoC assessment process.

REGULATORY ARRANGEMENTS

On 1 January 2004 improved arrangements relating to the conditioning of ILW on nuclear licensed sites were introduced by nuclear regulators [3]. These improved arrangements require that safety cases covering the operation of plants built to retrieve and condition ILW, also address the disposability of the waste packages that will be produced. This change gives increased confidence to regulators and other stakeholders that the long-term management of waste packages is considered before they are manufactured. This is consistent with international conventions and standards that advise that interdependences between different steps in radioactive waste management are taken into account and that we avoid imposing undue burdens on future generations.

To service this requirement, the Environment Agency of England and Wales (EA), and the Scottish Environment Protection Agency (SEPA), have established Nuclear Waste Assessment Teams (NWAT) to facilitate the provision of advice to the Nuclear Installations Inspectorate (NII) on long-term environmental protection matters, in accordance with relevant statutory provisions and Memoranda of Understanding (MoU) between the Agencies and Health and Safety Executive (HSE). The improved arrangements recognise the important role of the LoC process and assessment in this manner is seen as the primary vehicle for demonstrating disposability of waste packages. In order for the regulators to have confidence in the LoC and underlying assessments, RWMD and its technical assessments are now subject to a process of scrutiny by the environment agencies' Nuclear Waste Assessment Teams (NWAT). A series of scrutiny projects have been initiated and attendant reports of the findings are being produced and published.

The revised arrangements are recognised within the Government's updated policy on decommissioning of UK nuclear facilities issued in September 2004 [4]. The policy statement covers all (existing and new) nuclear industry facilities and their sites. This includes power stations, other reactors, research facilities, fuel fabrication and reprocessing plants and laboratories on nuclear licensed sites. It also includes fusion research facilities and, where appropriate, facilities on sites owned by the Ministry of Defence, nuclear submarines and their liabilities. The policy update confirms that operators should continue to process decommissioning wastes in accordance with LoC arrangements. The improved regulatory arrangements are illustrated in Figure 1.

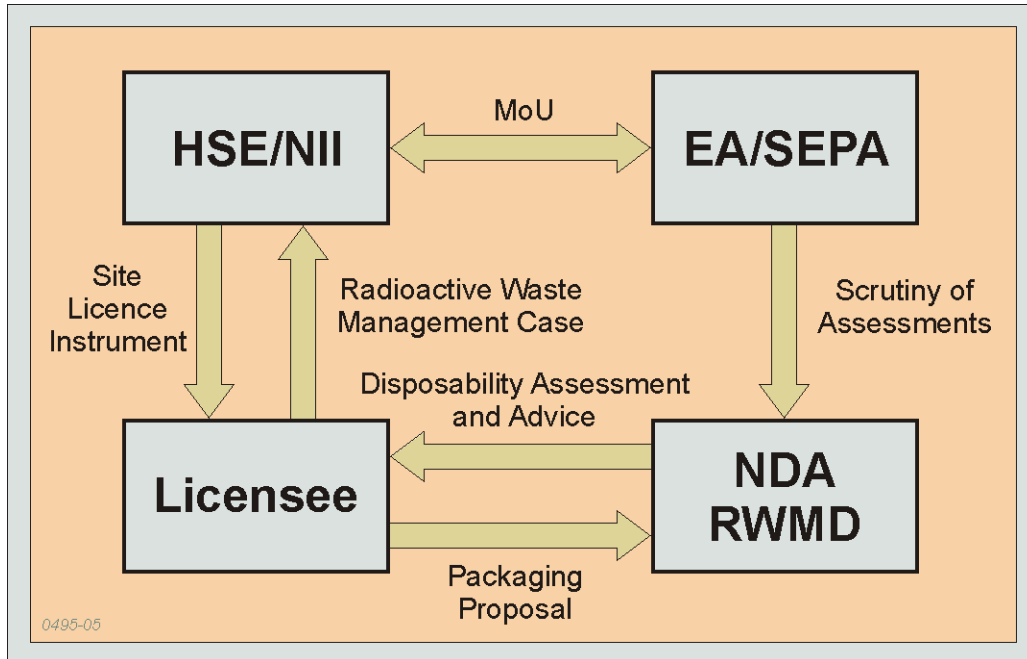


Figure 1 Improved regulatory arrangements for ILW packaging.

In March 2005, NII, EA and SEPA issued Guidance to Industry on the operation of the improved arrangements [5]. In summary, these require that SLCs produce an 'ILW Conditioning Proposal' as part of the overall safety case for the planned plant, process etc. This proposal should set out the strategy for retrieving, conditioning, storage and ultimate disposal of wastes, whether as low or intermediate level. The ILW Conditioning Proposal is required to justify the selected packaging option based on consideration of BPEO (Best Practicable Environmental Option) and BPM (Best Practicable Means).

The main output of a LoC assessment, an Assessment Report (see Section 0) which may be accompanied by the issue of a LoC endorsing the packaging proposal, is now seen by the regulators in their recently updated guidance [6] as an important component of the packaging plant operator's Radioactive Waste Management Case.

THE LOC ASSESSMENT PROCESS

Objectives of the LoC Assessment Process

The overall objective of LoC assessment process is give confidence to all stakeholders that the future management of waste packages has been taken into account as an integral part of their development and manufacture. This is achieved by the SLC working to RWMD packaging standards and seeking input

from RWMD to explicitly demonstrate that the waste packages produced by a proposed packaging process will be compliant with RWMD packaging standards and be compatible with the underlying requirements of geological disposal, as understood at the time of assessment. This is achieved through production of a comprehensive disposability safety case which is started at an early stage and progressively developed as the packaging process is developed and the packaging plant is built. Issue of a LoC and provision of a disposability assessment allows a SLC to construct the Conditioning Proposal and provides confidence for the SLC and/or owner of the liability for the waste, that the risk of inappropriate treatment and the potential for future repackaging is minimised.

Staged Submissions and Assessment

The LoC process is applied throughout all the phases in the development of a waste packaging facility, starting when the SLC is identifying package concepts, through design and construction phases, to final commissioning and active operations.

The various interactions between RWMD and a SLC on a typical project are illustrated in Figure 2. Activities are shown in chronological order although not necessarily to scale as, in practice, assessment of options, design, construction and test phases together may last between 5 and 10 years, whereas the operational period may cover up to 20 years, depending on the volume of waste to be processed. RWMD’s activities are also shown and these indicate the approximate points in the process when LoC assessment would be sought.

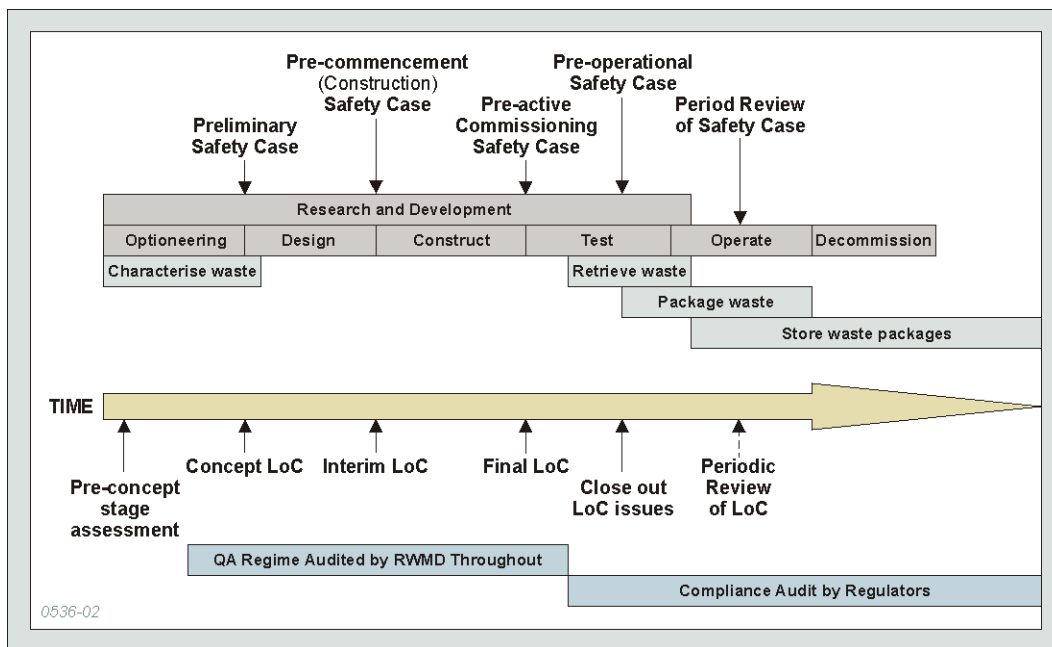


Figure 2 Interactions between RWMD and waste packager on a typical large project

In practice, interactions may not always follow this course, as the packaging plant once established, may then be used to process other waste streams or waste types. Where this is the case the general philosophy as described in the following sections will still largely apply.

The LoC assessment process can be divided into 3 key stages corresponding to the stages of initial consideration of the packaging concept, development of the concept and packaging facility, and facility licensing.

Conceptual Stage

At this early Conceptual stage RWMD assesses the compatibility of the proposed waste treatment and packaging with anticipated long-term waste management requirements. RWMD's views would be based on information describing the expected waste inventory and volume, outline packaging proposals and development plans. The Conceptual stage disposability assessment, which would be expected to feed into the Preliminary Safety Case, would be developed in outline and information requirements to fill 'gaps' within the assessment identified. Where it is considered that the proposed process will be capable of producing packages that are anticipated to be consistent with the standards and specifications and requirements for geological disposal, a Conceptual stage LoC can be issued.

Interaction prior to the Conceptual stage is also extremely valuable and encouraged. RWMD input to optioneering studies when the SLC is identifying preferred treatment options and packaging processes can be very helpful and save time and effort during the Conceptual stage assessment if the optioneering has already taken due account of disposability requirements.

Interim Stage

At the Interim stage RWMD assesses detailed inventory data and final design specifications, including results from research and development. Normally, the Interim stage submission would be made by the SLC prior to seeking financial commitment for construction of the packaging plant or facilities. At this stage RWMD would want to confirm that the intended waste packages will be compliant with the standards and specifications defined within the GWPS and that this is backed up by results from the operator's research and development. The disposability assessment at this stage should be well advanced with no major uncertainties preventing the issue of an Interim stage LoC, and is expected to feed into the Pre-commencement (i.e. packaging facility construction) Safety Case.

Final Stage

At this stage all the research and development related to the waste package should be complete and all the information needed to support the disposability assessment available. Confirmation that the waste packages proposed to be manufactured in the as-built plant would be compliant with the GWPS and the requirements of geological disposal will be signified by the issue of the Final stage LoC.

In some cases it will be necessary to issue the Final stage LoC with attached 'qualifications' as described below:

- exclusion – specifically identifies a component or components of a waste stream that are not covered by the endorsement;
- condition – the endorsement is conditional upon further action, e.g. final confirmation is required that can only be obtained as part of plant operation;
- caveat – there is an issue that may manifest itself dependent upon circumstances and, hence, remedial action may be required, e.g. depending upon the timescale of storage, overpacking of concrete waste packages may be required due to diffusion of activity through the concrete walls.

As illustrated in Figure 2, it is anticipated that the Final stage disposability assessment will feed into the Pre-active Commissioning Safety Case, and where qualifications have been appended to the LoC these should be reviewed for close-out as part of the Pre-operational Safety Case.

Managing the LoC Process

In order to provide assurance as to the robustness and traceability of the assessments undertaken as part of the LoC process, RWMD has developed a structured assessment process as described below and illustrated in Figure 3.

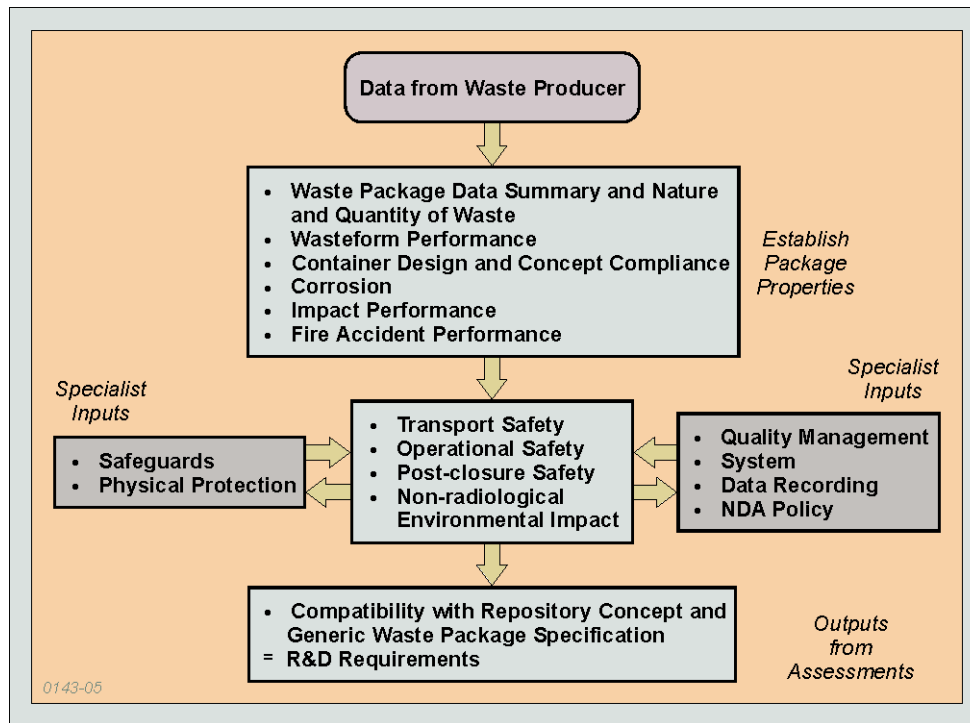


Figure 3 The Waste Package Assessment Process

The LoC assessment process is initiated when a SLC contacts RWMD with a request for assessment of plans for conditioning particular wastes or waste streams. The assessment is conducted as a contractual deliverable under standard terms and conditions agreed between RWMD and all major SLCs.

The LoC assessment process has two distinct components or stages;

- i) to allow RWMD to establish a good understanding of the properties of the waste and proposed waste package, and;
- ii) to compare the performance of the packaged waste against the safety, environmental and security assessments for transport and the operational and post-closure periods of a GDF.

The assessment process requires that the characteristics of the waste package (i.e. the waste container and the wasteform) are established in sufficient detail to form an effective basis for the assessments which are subsequently undertaken. This will require:

- an independent review by RWMD of the radionuclide and physical/chemical inventory of the waste and, where necessary, augmentation to ensure that the assessment inventory is comprehensive and that potential information 'gaps' have been addressed;
- determination of the expected performance of the waste package under normal and potential impact and fire accident conditions, based on waste package specific modelling or analogue data;

- prediction of the behaviour of the package (i.e. wasteform and waste container) under extended storage and disposal conditions.

The understanding derived in the initial phase of the process is reviewed at a Proposal Review Meeting (PRM) to confirm the robustness of the packaging proposal and the suitability of the understanding for input to the assessment phase of the process. This involves a comparison of the waste packages and their predicted characteristics against the three key safety, environmental and security assessments produced as part of the overall assessment of the geological disposal system.

These comprise:

- Generic Transport Safety Assessment (GTSA) [7];
- Generic Operational Safety Assessment (GOSA) [8], and;
- Generic post-closure Performance Assessment (GPA) [9].

Each of these assessments have been undertaken for a defined assessment inventory based on RWMD's understanding of the wastes that will come forward for management and ultimate disposal in a GDF. The assessments have been based on various assumptions regarding the form of packaging that will be applied to each waste stream together with estimates of radionuclide inventory and waste package performance characteristics. The assessment phase involves the substitution of the generic assumptions with real waste package characteristics applicable to the wastes in question. The waste packaging proposal is tested against the published generic assessments to determine whether the 'real' package data changes the conclusions of the generic assessment or raises significant issues that were not visible at the generic assessment level.

In order to ease the assessment process, RWMD has a number of automated toolkits that can readily test the waste package against the deterministic transport 'contents specification', transport risk assessment and components of the operational safety assessment. For the post-closure assessment the proposal is first screened to determine whether there are any radionuclides or materials present in sufficient quantity to be significant to long-term safety and if so whether the form of packaging could jeopardise the post-closure performance assessment.

At the Conceptual stage a non-radiological environmental assessment is undertaken to provide the opportunity for a check that there are no aspects of the packaging proposal that are inconsistent with wider environmental protection considerations.

At this time RWMD will also review the status of the proposed waste package from the perspective of various specialist functions which will influence the design and/or required characteristics of the waste package. Specialist inputs will be provided as follows:

- review status of package from perspective of international safeguards – will the package be consistent with the safeguards arrangements currently envisaged for a GDF;
- review status of package from perspective of physical security – will the package be compliant with the security plan developed for transport and operations at a GDF, advice from the Office for Civil Nuclear Security (OCNS) will often be sought;
- confirmation that the SLC is meeting the RWMD waste package specification criteria for quality management and recording of data pertaining to the waste package during manufacture and storage;
- review the waste packaging proposal from the perspective of RWMD environmental and safety policy statements.

It is recognised that the design and safety and environmental assessments that support geological disposal are not at this stage fixed and therefore RWMD has some flexibility to modify the concept under 'change

control' where this is seen to offer the best solution for specific wastes, or waste packages. In most cases RWMD will guide the SLC to maintain compatibility with established packaging standards and specifications, this is essential given that the a GDF will be required to accommodate some 200,000 individual waste packages, but the option of special treatment for unusual or difficult wastes will always remain as an option if safety and disposability are not compromised.

OUTPUT OF THE LOC ASSESSMENT PROCESS - THE ASSESSMENT REPORT

The LoC assessment process will result in the production of an Assessment Report. The Assessment Report, summarises and draws together the assessments undertaken and presents them in the form of a Disposability Assessment. The Disposability Assessment is intended to show in a transparent and visible way in which respects the packaging proposal is compliant with RWMD packaging standards and specifications and with the underlying safety, environmental and security assessments.

At the Conceptual stage it is to be expected that the Disposability Assessment will be in outline form only, but sufficiently developed to judge the overall feasibility of the packaging concept. As the packaging concept and plant is developed through Interim and Final stages it is to be expected that the Disposability Assessment will become progressively developed such that at the Final stage it is robustly supported by all necessary design and research and can be presented to the waste packager as a Disposability Case. In line with regulatory guidance [7] it is envisaged that the Disposability Case presented in the Final stage Assessment Report will be adopted by the SLC and incorporated into the overall safety case for the packaging plant.

At the Conceptual and Interim stages the Assessment Report will in addition to the Disposability Assessment, include RWMD's technical evaluation of the proposed waste package. This will highlight areas where further development or information is required and any actions necessary to take the disposability assessment to the next stage. Any issues flagged as requiring resolution or where further information, research or development is needed, are denoted as Action Points. All Action Points are given a unique identifier for tracking purposes and state at which stage the issue should be closed out.

This means that for a typical waste packaging project, the Conceptual stage Assessment Report would feature an outline disposability case and potentially several Action Points, and would end at the Final stage with a completed Disposability Case and no outstanding Action Points. At this stage RWMD endorsement would be signified by the issue of a Final stage LoC. In some cases the Final stage LoC may be issued subject to conditions or other qualifications as discussed further in the next section.

THE LETTER OF COMPLIANCE

The Letter of Compliance is a development of, and supersedes, the former Letter of Comfort. The change in name from Letter of Comfort to Letter of Compliance was introduced in January 2005 to give greater clarity as to the form and significance of the endorsement being offered. The Letter of Compliance signifies that the proposed waste packages have been assessed and judged to be compliant with RWMD standards and specifications and the requirements for geological disposal, as defined by current generic designs and safety and environmental assessments.

The Regulators' Guidance to Industry [5] highlights that there may be specific situations (e.g. for reasons of overriding safety) where the regulators consider that wastes should be retrieved and conditioned even if the SLC has not yet satisfied all of the disposability criteria determined by RWMD. In such a case, the SLC will be in receipt of an Assessment Report but may not have achieved a LoC. In such a case, the Assessment Report takes on increased importance as this document will provide the vehicle to understand in what ways the waste packages fall-short of the normal expected packaging standards. The Assessment

will identify and describe the so-called 'compliance gap' and will provide an assessment of whether there are credible plans in place to complete the waste package and work it into a RWMD compliant disposable form. Armed with this information, the SLC and regulator will be in a position to understand the limitations of the proposed waste package, and of the consequences, in terms of future actions, if the decision were made to proceed with producing the waste packages.

The issue of a LoC gives the SLC confidence that the waste package has been assessed by an independent waste management organisation in accordance with procedures that are scrutinised by the regulators, and has been found to be compliant with the concept for geological disposal as presently understood. It does not remove the need for assessment of the waste package against future Waste Acceptance Criteria (WAC), but the provision of a Final stage LoC is an essential component of the package record that will be required at that time.

The packaging standards and specifications and underpinning safety, environmental and security assessments are based on a generic design and generic UK site. This means that the design and safety assessments have been established against a sufficiently wide safety envelope that could be adopted at a range of sites in the UK. The eventual acceptance criteria are expected to fall within the bounds of the defined generic envelope, which has been specifically designed to incorporate margins for safety. As the concept is developed and becomes site-specific, the margins for safety can be re-evaluated and the packaging criteria made less generic and closer to the eventual WAC.

THE LOC ROLE IN FUTURE WASTE ACCEPTANCE

The issuing of a LoC is not a one-off event but is one step in the process of managing radioactive wastes. The LoC signifies that packaging of the waste can be undertaken in compliance with RWMD standards and specifications. This requires:

- packages are produced against a defined Waste Product Specification¹ (WPrS);
- data on the waste and conditioned waste package are generated and recorded;
- processes are undertaken in accordance with controlled quality management systems (QMS);
- independent checks are made to confirm that the operator is actually making the packages according to the operator's own specification and the RWMD LoC.

The LoC and information and records thus generated are all part of the 'package record' and have to follow the waste package throughout subsequent stages of its life. These elements of the package record play an essential role as the waste package passes from one stage of management to the next.

After a waste package has been produced, current practice would see the waste package being sent to an interim store, typically located adjacent to the packaging plant. The store will have an associated safety case and the store operator will ensure that waste packages received are safety compliant, by assessment against store WAC.

During the storage period, the operator will operate the store in accord with the safety case, and will be required to maintain the waste packages under appropriate environmental and safety control. This will imply continued application of quality management systems and periodic checks by the regulator to give confidence of continued compliance.

¹ The Waste Product Specification is produced by the waste packager to define the package that they are setting out to make

In the future, the operator may need to transfer the waste packages from the store and to another site, such as a GDF. If this requires transport through the public domain, then the transport operation will need to be compliant with UK legislation for road, rail or sea transport of radioactive materials, which are based on the IAEA Transport Regulations [10]. This places absolute requirements to demonstrate that the radioactive contents (i.e. the waste packages) are compliant with the Design Safety Report (DSR) applicable to the transport container. This requires:

- confirmation of appropriate quality management systems applied to manufacture and storage;
- records to demonstrate compliance with the transport ‘contents specification’ (i.e. waste inventory is compliant and can be carried);
- confirmation that waste package performance is compatible with the DSR;
- confirmation that the overall transport package is compliant with the DSR.

These aspects are all covered by a Disposability Assessment which again gives confidence that a package that is covered by a Final stage LoC will also meet transportation safety requirements.

Before waste packages are received into a new facility, such as a GDF, the receiver would require confidence that the waste packages are compliant with the WAC for that facility. The WAC would be generated (as for the store) based on the appropriate safety cases (operational and post-closure), site licence issued by the HSE NII and authorisations received from the EA/SEPA (as appropriate).

In the case of a GDF, the WAC would be derived in a similar manner to the criteria that make up the GWPS but would be specific to the selected geographical location, host geology and specific design of the facility. As noted above, RWMD’s strategy is that a range of possible WAC will be bounded by the GWPS envelope and hence it is expected that any waste package coming forward with a Final stage LoC and the remainder of the ‘package record’, would be acceptable. It is expected that assessment against WAC and checks to determine that the package record is in place and complete would be conducted before transport, with checks on receipt to confirm the identity of the waste package. The need for further compliance checks would be discussed further with regulators.

Based on the above, it can be seen that issuing of a LoC is one step within the process to demonstrate that waste packages can be accepted into a future facility. The LoC and assembled package record has to be maintained, added to and updated appropriately throughout subsequent stages of the long-term management of the waste package. RWMD has also identified the need for periodic review of issued LoCs so that LoCs and associated package records, including the Disposability Case, are maintained ‘live’. RWMD has issued specific guidance on the scope of “periodic reviews”.

KEEPING THE PUBLIC INFORMED

As part of the improved regulatory arrangements, RWMD is committed to keeping the public and stakeholders informed of progress that is being made in recovering and packaging ILW and long-lived LLW. An annual résumé of interactions on waste packaging matters, in particular where Assessment Reports and Letters of Compliance were produced, was published by for a number of years by Nirex. The publication of this information has been continued by RWMD and the most recent update report issued in July 2008 [11].

REFERENCES

- 1 Nirex, *Generic Waste Package Specification*, Nirex Report N/104 Issue 2, 2007.
- 2 Nirex, *The Nirex Phased Disposal Concept*, Nirex Report N/074, 2003.
- 3 HSE/EA/SEPA, *Improved regulatory Arrangements for the Conditioning of ILW on Nuclear Licensed Sites. Regulators' Position Statement*, 2003.
- 4 HM Government, *The Decommissioning of the UK Nuclear Industry's Facilities, Policy Statement*, 2004.
- 5 HSE, EA and SEPA, *Conditioning of Intermediate Level Waste on Nuclear Licensed Sites – Guidance to Industry*, 2005
- 6 HSE/EA/SEPA, *The Management of Higher Activity Radioactive Waste on Nuclear Licensed Sites, Part I The Regulatory Process*, Guidance from the HSE, EA and SEPA to Nuclear Licensees, 2007.
- 7 Nirex, *Generic Transport Safety Assessment*, Nirex Report N/078, 2003.
- 8 Nirex, *Generic Operational Safety Assessment*, Nirex Report N/079, 2003.
- 9 Nirex, *Generic Post-closure Performance Assessment*, Nirex Report N/080, 2003.
- 10 IAEA, *Regulations for the Safe Transport of Radioactive Material (As Amended 2003)*, IAEA Safety Series No. TS-R-1, 2004.
- 11 NDA, *NDA RWMD interactions with Waste Packagers on plans for packaging radioactive wastes – April 2007 to March 2008*, NDA Report NDA/RWMD/008, March 2008.