

Geological Disposal:

Waste Package Data and Information Recording Requirements: Explanatory Material and Guidance

December 2015



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**WASTE PACKAGE SPECIFICATION AND GUIDANCE DOCUMENTATION
WASTE PACKAGE DATA AND INFORMATION RECORDING SPECIFICATION:
EXPLANATORY MATERIAL AND GUIDANCE**

Executive Summary

This document forms part of the Waste Package Specification and Guidance Documentation (WPSGD), a suite of documents prepared and issued by Radioactive Waste Management Ltd (RWM). The WPSGD is intended to provide a 'user-level' interpretation of the RWM packaging specifications, and other aspects of geological disposal, to assist UK waste packagers in the development of plans for the packaging of higher activity waste in a manner suitable for geological disposal.

Key documents in the WPSGD are the Waste Package Specifications (WPS) which define the requirements for the transport and geological disposal of waste packages manufactured using standardised designs of waste container. The WPS are based on the high level requirements for all waste packages as defined by the Generic Waste Package Specification and are derived from the bounding requirements for waste packages containing a specific category of waste, as defined by the relevant Generic Specification.

This document provides guidance to waste packagers on the data and information recording requirements to cover the history of the packaged waste from the time of waste arising, through initial waste characterisation, waste package development, to package production, storage, transport and disposal in a GDF.

The WPSGD is subject to periodic enhancement and revision. Users are therefore advised to refer to the RWM website to confirm that they are in possession of the latest version of any documentation used.

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Abbreviations and Acronyms used in this Document

| | |
|--------|--|
| CCAD | Criticality Compliance Assessment Document |
| CSA | criticality safety assessment |
| DIRR | Data and Information Recording Requirements |
| DRS | Disposability Record Specification |
| DSSC | Disposal System Safety Case |
| DSTS | Disposal System Technical Specification |
| GDF | geological disposal facility |
| GWPS | Generic Waste Package Specification |
| IAEA | International Atomic Energy Agency |
| ILW | intermediate level waste |
| LLW | low level waste |
| LSA | low specific activity |
| LoC | Letter of Compliance |
| MOX | mixed oxide fuel |
| NDA | Nuclear Decommissioning Authority |
| PCM | plutonium contaminated material |
| QA | quality assurance |
| RWM | Radioactive Waste Management Limited |
| UK RWI | UK Radioactive Waste Inventory |
| WAC | Waste Acceptance Criteria |
| WPS | Waste Package Specification |
| WPrS | Waste Product Specification |
| WPSGD | Waste Package Specification and Guidance Documentation |

1 Introduction

The Nuclear Decommissioning Authority (NDA), through Radioactive Waste Management Limited (RWM), is responsible for implementing UK Government policy for the long-term management of higher activity radioactive wastes, as set out in the *Implementing Geological Disposal White Paper* [1]. The White Paper outlines a framework for managing higher activity radioactive waste in the long term through geological disposal, which will be implemented alongside the ongoing interim storage of waste packages and supporting research.

RWM produces packaging specifications as a means of providing a baseline against which the suitability of plans to package higher activity waste for geological disposal can be assessed. In this way, RWM assists the holders of radioactive waste in the development and implementation of such plans, by defining the requirements for waste packages which would be compatible with the anticipated needs for transport to and disposal in a geological disposal facility (GDF).

The packaging specifications form a hierarchy which comprises three levels:

- the *Generic Waste Package Specification (GWPS)* [2]; which defines the requirements for all waste packages which are destined for geological disposal
- *Generic Specifications*; which apply the high-level packaging requirements defined by the GWPS to waste packages containing a specific type of waste
- *Waste Package Specifications (WPS)*; which apply the general requirements defined by a Generic Specification to waste packages manufactured using standardised designs of waste container

These documents, together with a wide range of explanatory material and guidance to aid users in the development of proposals to package waste, make up a suite of documentation known as the *Waste Package Specification and Guidance Documentation (WPSGD)*. For further information on the extent and the role of the WPSGD, all of which can be accessed via the RWM website, reference should be made to the *Introduction to the RWM Waste Package Specification and Guidance Documentation* [3].

The requirements for waste packages containing low heat generating waste (LHGW), and wastes with similar radiological properties, are defined by the *Generic specification for waste packages containing low heat generating waste* [4]. These requirements are applied to the waste packages that can be manufactured using the current range of standardised waste containers (as identified in the *Disposal System Technical Specification (DSTS)* [5]) in the WPS that make up the WPS/300 Series of documents that form part of the WPSGD.

In order that every waste package can be assessed against the requirements for safe and cost-effective handling, storage, transport and eventual disposal, RWM requires that waste packagers use all reasonable endeavours to acquire and record sufficient data and information for waste packages, and compile it into a *disposability record*¹. In particular, this information would be used to demonstrate conformance with future acceptance criteria for the anticipated transport system and disposal at a GDF.

The purpose of this document is to provide waste packagers with explanatory information and guidance on the interpretation of the *Waste Package Data and Information Recording Requirements (DIRR)*, WPS/400 [6], allowing waste packagers to develop an overarching *data and information recording system* that is tailored to the needs of the *waste packaging project*. RWM requires that the waste packager produces a Disposability Record Specification (DRS) for each waste packaging project, which provides a concise statement

¹ Terms in this document that are intended to have a specific, defined meaning are indicated in italic script at their first usage, and defined in the Glossary.

of this overarching system and defines the documents containing the data and information that are required for a compliant waste package disposability record.

2 Background

2.1 The concept of geological disposal

Whilst the precise manner in which geological disposal would be implemented in the UK is not yet defined, we envisage that any approach to long-term management of waste (including disposal) would comprise a number of distinct stages, which could include:

- the manufacture of passively safe and disposable waste packages
- a period of interim surface storage, usually at the site of waste arising or packaging
- transport of the waste packages to a GDF
- transfer of waste packages underground and emplacement in the disposal facility
- back-filling of the disposal areas
- eventual sealing and closure of the facility

The exact nature, timing and duration of each stage would depend on a number of criteria, including the geographical location and host geology of a GDF, as well as the disposal concept selected for implementation for each distinct category of waste.

2.2 The role of the waste package in geological disposal

The waste package provides the most immediate barrier to the release of radionuclides and other materials that may be deemed to be hazardous from the waste it contains both during interim storage, transport and when it forms part of a multiple barrier geological disposal system. It can also play a role in protecting individuals from the radiation emitted by the radionuclides it contains during interim storage, transport and the GDF operational period.

The barrier provided by a waste package can be considered to comprise two components, each of which can act as a barrier in its own right:

1. The waste container, which provides a physical barrier and also enables the waste to be handled safely during and following waste package manufacture. Containers can be manufactured from a range of materials with designs selected to suit the requirements for the packaging, transport and disposal of the wastes they contain.
2. The wasteform, which can be designed to provide a significant degree of physical and/or chemical containment of the radionuclides and other hazardous materials associated with the waste. The wasteform may be manufactured such that activity in the waste has been immobilised by encapsulation, for example by the use of a conditioning medium such as cement, or that which may have received more limited pre-treatment prior to packaging, for example size reduction and/or drying.

It is the performance of the barrier(s) provided by the waste package that packaging specifications seek to address by defining requirements for waste packages that have been derived from the needs of their long-term management.

2.3 Types of waste package

A variety of waste container designs have been proposed for the packaging of low heat generating waste (LHGW) (that is low level waste (LLW) and ILW) for geological disposal. These designs can be grouped into three basic types, on the basis of the general nature of the waste packages that they can be used to produce:

- for use with ILW and LLW with low specific activity, such as would not generally require the extensive use of remote handling techniques, waste containers incorporating integral radiation shielding² can be used to create *shielded waste packages*
- for higher activity ILW, such as would generally require the use of remote handling techniques, relatively thin-walled (that is a few mm thick) metal containers can be used to create *unshielded waste packages*. Because of their high external radiation dose rate, or requirements for the containment of their contents, such waste packages would be expected to be transported through the public domain in reusable shielded transport containers
- for all types of ILW, thick-walled (that is 10's of mm thick) waste containers can be used to provide both radiation shielding and physical containment of their contents, and to create *robust shielded waste packages*. Such waste packages are capable of being stored, transported and disposed of without the need for remote handling techniques or for additional shielding or containment

2.4 The assessment of packaging proposals

RWM has established the Disposability Assessment (Letter of Compliance (LoC)) process [7] to support waste packagers in the development of plans to package higher activity wastes. Specifically, the Disposability Assessment process is used by RWM to demonstrate that proposals to package waste should, if implemented, result in 'disposable' waste packages. In this context, a disposable waste package is one that is compliant with all of the relevant regulations and safety cases for transport to and disposal in a GDF, and in line with regulatory Joint Guidance for the long term management of the waste, including the provision of disposability records [8].

The Disposability Assessment process also plays an important role in underpinning the generic *Disposal System Safety Case* (DSSC) [9] by providing confidence that the safety cases, which are based on generic assumptions regarding the wastes that are anticipated to be accommodated by a GDF, are compatible with the 'real' waste packages that are being manufactured. The performance of disposability assessments also helps RWM to show that the disposal concepts considered within the generic Disposal System Safety Case will be appropriate for the wastes they will be expected to cover as well as identifying wastes that could challenge current disposal concepts and allow early consideration of what changes may be required to these concepts to permit these wastes to be accommodated.

Guidance is available on the manner by which waste packagers should prepare submissions for the disposability assessment of packaging proposals [10].

2.5 Practical management of information and data

The purpose of this document is to provide guidance to assist waste packagers in satisfying the data and information recording requirements, as specified in the DIRR. It is not intended to address or provide guidance on the practical implementation of the required systems or the arrangements for retaining records.

Notwithstanding the above, it should be recognised that the implementation of such practical arrangements may influence the development of the data and information recording system. Waste packagers should therefore consider the subsequent management of information, as well as the means of recording it, in developing the data and information recording system. This is particularly important in, for example, avoiding the unnecessary duplication of records, minimising the scope of required documentation

² If needed, to ensure that external radiation dose rates do not exceed the regulatory limits for transport.

and ensuring efficiency in populating package-specific records. The complementary development of the system and the arrangements for implementing that system can be facilitated by the early development of the management arrangements and, in particular, the DRS, through engagement with RWM. Further guidance on practical arrangements is provided in *Long-term Management of Information and Records: Explanatory Material and Guidance*, WPS/870.

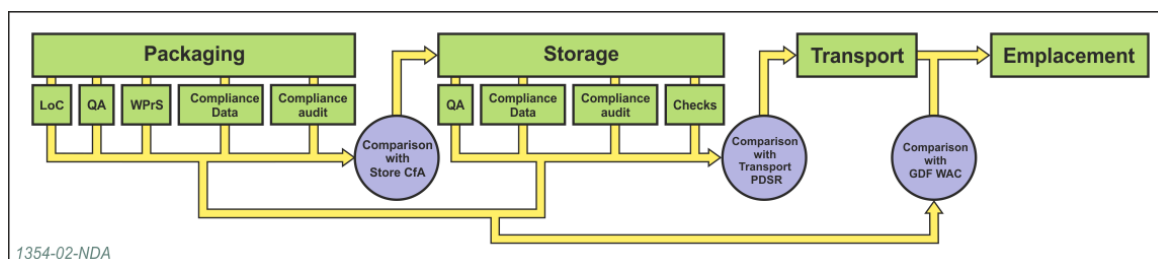
3 Aims and principles

This document is intended to provide clear guidance on the establishment of an overarching data and information recording system that is tailored to both the needs of current waste management activities and the anticipated information requirements of future custodians of the waste package. Due to the diversity in packaging options for LHGW, as described in Section 2.3, it is not possible to be prescriptive; further guidance on specific proposed systems will be provided by RWM as part of the Disposability Assessment process.

The GWPS requires that information shall be recorded for each waste package covering all relevant details of its manufacture and interim storage. The information needs to be sufficient to enable assessment of the characteristics and performance of the waste packages against the requirements of all stages of long-term management. Data and information are expected to be generated throughout the various periods of management of waste packages, but the reliability of the current data rests upon the quality and integrity of all earlier data. The process must therefore begin with the design and production of each individual waste package.

RWM therefore requires that waste packagers establish a data and information recording system, which enables production of the waste package disposability record; the waste package is not considered to be complete without its associated disposability record. Ultimately, this information will be used as the principal basis for demonstrating the *compliance*³ of waste packages with the requirements for transport and conformance with future Waste Acceptance Criteria (WAC) at a GDF, as illustrated in Figure 1.

Figure 1 Role of the Disposability Record in Waste Acceptance



The requirements stated in the DIRR [6] have been derived from an understanding of the criteria that are important to waste package performance and safety over the extended timescales encompassed by all periods of waste package management, including disposal at a GDF. The recognised uncertainty of these future requirements means that a broad-based approach is necessary. The justification for the derivation of these requirements is based on consideration of current UK legislation and associated guidance, and on international regulations and guidance relating to the transport and disposal of all higher activity waste (HAW), including LHGW [11].

³ Strictly, the term 'compliance' relates to obligations laid down by regulation; however, it is used throughout this document to mean compliance or conformance.

The relevant requirements for data and information are listed in the DIRR [6], where a hierarchical structure has been adopted, based on classes, categories and fields. Guidance on identification and acquisition of data and information to satisfy the various categories and fields that form the three high level classes is given in Sections 6 to 8 respectively. The collation of this information would produce a disposability record that would:

- describe the physical, chemical and radionuclide content of a waste package thus providing an accurate and trustworthy record of the nature and contents of the package
- identify and define waste package properties and performance that are relevant to future management options
- provide sufficient data and information relating to the provenance of the waste to:
 - allow the radionuclide inventory to be extended as required (through the application of suitable extrapolation methods)
 - predict the likely evolution of the package with time, the effect of interactions with other packages and disposal system components and the effect of environmental conditions on package integrity

To facilitate the development of a data and information recording system, the means of recording the information and its subsequent management should also be considered. The data and information should be considered as falling into two categories:

- *recorded information* – information directly associated with a waste package that would accompany the waste package electronically, and to which access is likely to be required throughout all periods of waste package management. Examples include the waste package radionuclide and compositional inventories, information produced during the processing of wastes *etc.*
- *traceable information* – information or documents referenced from the recorded information, and to which access would be required by exception. Examples might include manufacturing specifications, Disposability Assessment submissions (and the resulting LoC and Assessment Report), Waste Product Specifications (WPrS) and management system documents

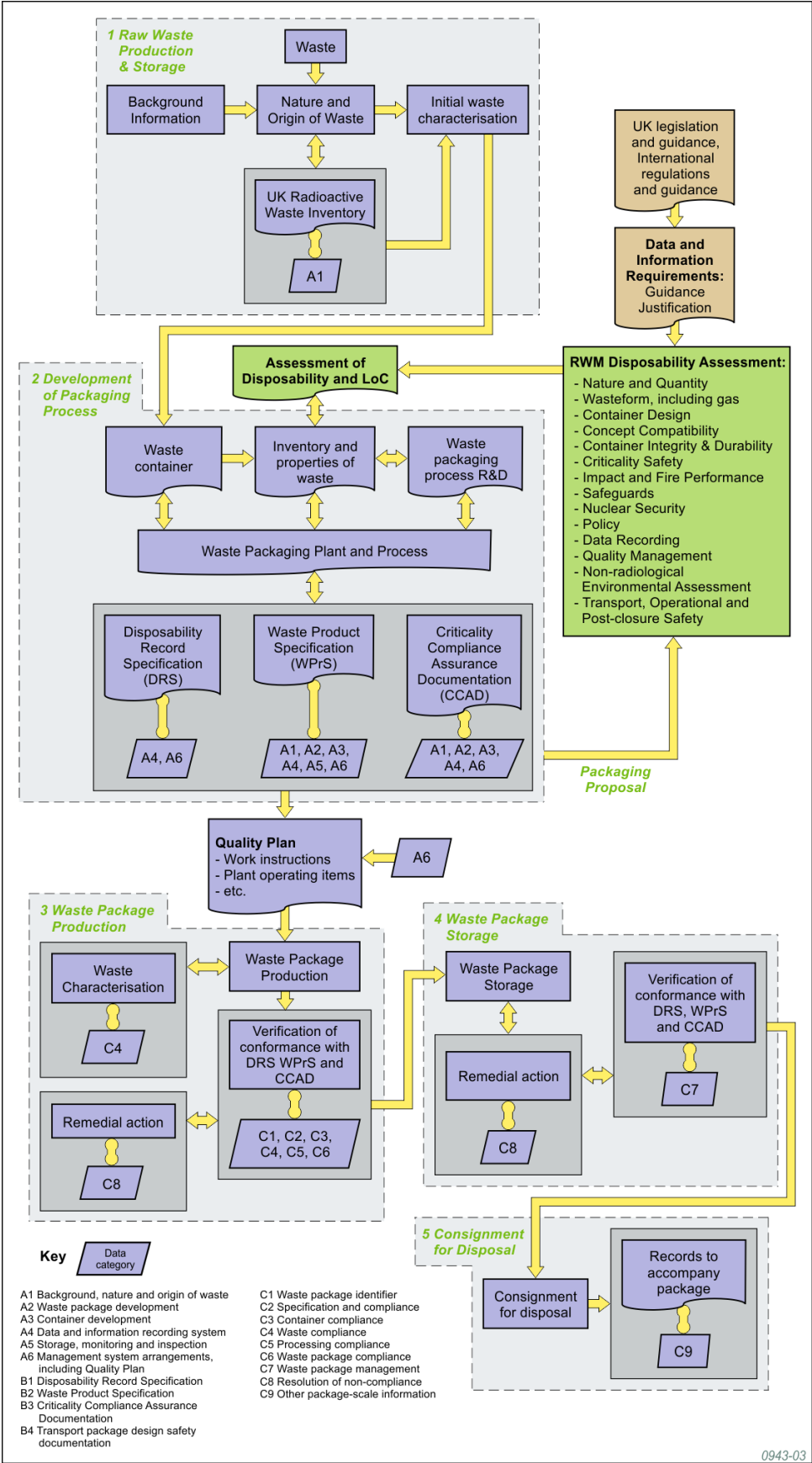
This guidance document provides suggestions concerning a possible framework for the management of information that may be appropriate (Section 2.5), but it is not intended to be prescriptive. Hence, the identification of the appropriate means of recording the various parts of a disposability record is an important aspect of the tailoring of the data and information recording system.

4 Responsibilities of the waste packager

The waste packager is responsible for the development of a data and information recording system that would establish the means of capturing information in order to create the disposability record for each *waste package*. However, the range of information that would need to be recorded for each distinct waste package will be unique and the development of a tailored system may be required for each *waste type* and packaging campaign.

Information would be created over the entire lifetime of the waste package, from conception of the packaging process, through process development, waste package production, storage, transport and ultimately disposal. The main opportunities for defining and acquiring information are summarised in Figure 2, which illustrates the various stages in packaging of a typical waste type (although the illustrated opportunities should not be regarded as prescriptive). The figure clearly shows that the various categories (and fields) are likely to be populated at different stages.

Figure 2 Opportunities for the definition and acquisition of waste package data



Although much relevant information would arise during the development of the packaging process, information acquisition will continue into the waste package production stage and beyond. The information acquired after production would generally focus on storage conditions, interim movements and package evolution.

The assessment by RWM of packaging proposals, as part of the Disposability Assessment process leading to potential endorsement, would assist in the development of the data and information recording system through discussion and agreement of the particular disposability record requirements. These discussions may lead to the identification of areas where further system development or refinement would be beneficial. The Disposability Assessment document, including supporting references, compiled by RWM is itself a valuable source of underpinning information for waste packages (for example, as a means of recording arguments and analogies, referencing research and defining methods) and should be managed accordingly.

5 Summary of the Data and Information Recording Requirements

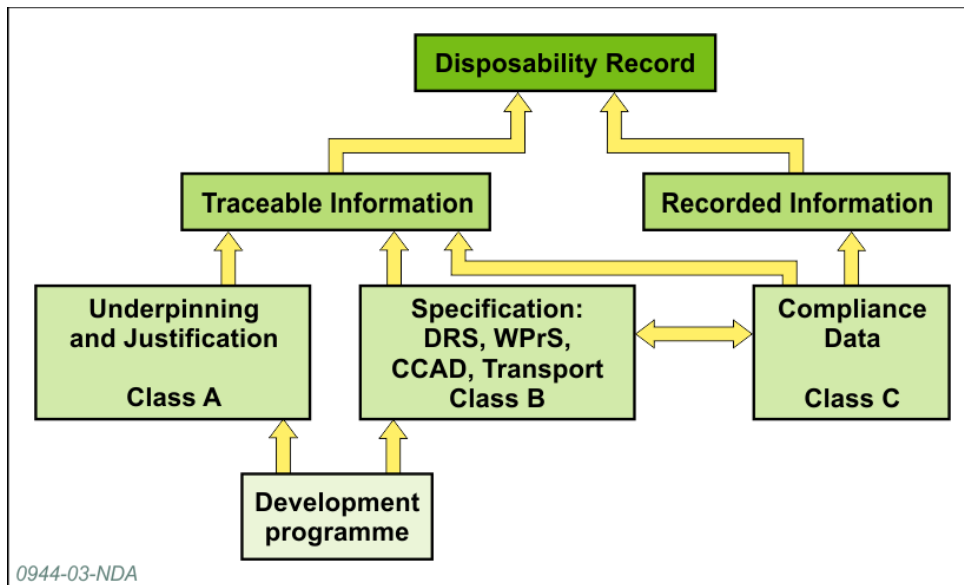
It is recognised that the information associated with a waste package may take a number of different forms and that the requirements identified may be populated by different means. The revised structure presented in the DIRR has been developed to recognise three different functions that the data and information may fulfil in the disposability record, separated into Classes, as follows:

- Class A – underpinning and justification; information that applies to the waste type as a whole, in particular the documents that define the origin of the waste, the packaging process, the results of a *development programme*, waste container manufacturing specifications, the anticipated properties of the waste package and the waste package disposability record. This information provides the basis for, and justification of, the specification documents that form Class B
- Class B – specification; a concise statement of the precise requirements to produce a waste package that would be compliant with the obligations for storage, transport and disposal
- Class C – compliance; information collected about the as-manufactured waste packages, primarily required to demonstrate compliance with the specifications

The relationships between these classes, their link to traceable or recorded information, and their relationship to the disposability record are illustrated in Figure 3. In general, information required for Classes A and B is expected to be traceable, whilst Class C compliance data are expected to be recordable.

It is recognised that some data and information may apply to a subset of waste packages, regardless of which Class of information it belongs to, this may be termed as ‘batch-specific’ information. Examples may include manufacturing and purchasing information for a batch of waste containers, or analytical data pertaining to a quantity of waste that would be distributed between several packages. Such data may be duplicated in individual disposability records or, preferably referenced as traceable information. The appropriate means of recording such information would depend on the nature of the information and is at the discretion of the waste packager. RWM would be prepared to discuss and advise on the application of efficient management arrangements for preserving such information.

The three Classes of information largely correspond to different scales of recording to better enable the waste packager to design a DRS; the classes are considered further below.

Figure 3 Classes of information

5.1 Underpinning and justification (Class A)

The data and information necessary to be recorded under Class A is intended to provide the basis of, and justification for, the specification documents that form Class B (Section 5.2). The information would provide evidence of the performance of the waste package and demonstrate why compliant waste packages would be suitable for interim storage, transport and disposal. In addition, it should include the definition of how compliance with the requirements may be demonstrated and recorded at the package-scale.

This information is expected to arise mostly through the development programme for a waste packaging process; the programme should take due consideration of the records relevant to the properties of the complete waste package during all periods of its management. The disposability record should include sufficient information to provide:

- evidence of waste package properties and performance
- the relationship between these and the nature and quantity of waste
- waste conditioning and packaging materials and processes

In this manner, the parameters that are of significance to *product quality* would be identified and recorded. In addition, those parameters that do not significantly influence product quality may also be identified, thereby providing a justification for not controlling or recording them.

The results of the development programme form an important component of the disposability record. This information is likely to be generic to all waste packages and would be referenced from the DRS, or from other documents such as the WPrS; this is commonly referred to as *generic information*.

The generic information also should include information on how the waste was created, stored and retrieved prior to packaging. This would provide important information regarding the provenance of the waste.

5.2 Specification (Class B)

RWM requires that each waste package, including its associated disposability record, is manufactured according to specification to ensure it would be compliant with the requirements for safe storage, transport and disposal at a GDF. Most of these requirements are defined by the waste packager and are recorded in a suite of

specification documents. Additional requirements are also placed on the waste package based on the transport configuration, although definition of these is not within the remit of the waste packager. RWM considers that these specifications form the central core of the waste package disposability record.

The DRS would define the content of the waste package disposability record; it should include reference to documents that contain all of the required underpinning and justification information, as well as the relevant specifications under which each waste package was manufactured. The DRS should also specify the waste package-specific compliance records that will be produced during and following waste package manufacture.

The WPrS would define the intended product resulting from a waste packaging process. It provides a bridge between the development programme and the process as it is implemented and should identify any limits and conditions to be met during processing. It is recommended that a separate WPrS be prepared for each waste type and packaging method to provide greater clarity. The WPrS should be referenced from the package-specific information and included in the DRS.

The *Criticality Compliance Assurance Documentation* (CCAD) is required to demonstrate how the safe fissile mass limits, defined either by *package-specific* criticality safety assessments (CSA) or by the relevant fissile material screening level, would be met during waste package production. Criticality safety may impose more stringent limits or recording requirements than those derived from general product quality issues. Verification of conformance should also be addressed by the definition of the appropriate compliance data to be recorded and the method of deriving that information. The CCAD should be referenced from the package-specific information and included in the DRS.

In addition to the waste packager-defined DRS, WPrS and CCAD, the design of the waste package is also subject to requirements specific to the chosen transport container, as defined by the *Design Authority*. These are embodied in a contents specification, underpinned by analysis, specific to each type of transport container, as defined in the relevant Package Design Safety Report. The waste packager should ensure that these requirements are embodied within the DRS, WPrS and CCAD.

The important correspondence between the specifications and package-specific compliance information (discussed in Section 5.3) should be recognised.

5.3 Compliance (Class C)

Compliance data and information generally constitutes that collected during waste package production and storage in order to demonstrate compliance with the requirements specified under Class B. Much of this information is expected to be *waste package specific*. This may include identification of the package, data required to demonstrate compliance with *specified limits* and more general information on the nature and contents of the package. The required data and information should be obtained through suitable *data acquisition systems*, where applicable. These may include measurements made either on the constituent parts of the waste package, perhaps during package production, or on the waste package itself following production. Of particular importance are the *process records* produced during packaging, which are expected to provide much of the compliance data. Process records which form part of the waste package disposability record should be limited to those data required to demonstrate compliance.

Decades may elapse between the packaging of the waste and its ultimate disposal. To demonstrate that the waste package would continue to conform to the specified requirements, it would be necessary to record information regarding history of the package, including any potentially significant events to which the waste package had been exposed (that is minor impacts, excursions in storage environment conditions).

In addition to those data and information discussed, some information is required to fulfil administrative and regulatory requirements, generally those related to transport or disposal of the waste. Such information should accompany the waste package during transport and populate some of the required categories. In general, this information would not be required until the time of consignment of the waste for long-term storage or disposal.

6 Guidance for Class A: underpinning and justification

The data and information necessary to satisfy the requirements of Class A is expected to amount to a significant component of the waste package disposability. However, it should comprise a single suite of documents linked to the waste package-specific compliance data (Class C) through the DRS, and other specification documents (Class B), to be retained as traceable information.

6.1 Background, nature and origin of the waste

Information relating to the history of the raw waste provides important support to the waste package development programme and can also provide necessary context to the decision making process.

6.1.1 Description of nature and origin of the raw waste (A1.1)

A simple description of the raw waste should be provided. This should include the name of the plant, process and/or operations that gave rise to the waste. A simple description such as “Fuel Pond Sludge” or “Plutonium Contaminated Material (PCM) from Mixed Oxide (MOX) Fuel manufacture” may suffice. Where a collection of waste streams of the same general origin may have different characteristics, some distinction between the individual streams should be included in the description (for example, by reference to “Tanks 1 to 5”).

Information on the nature and origin of the waste could be provided within the WPrS. Alternatively, the information may be traceable through the UK Radioactive Waste Inventory (UK RWI) waste stream identifier.

6.1.2 UK RWI identifier (A1.2)

The relevant UK RWI identifier or identifiers should be supplied, where this is available. This will facilitate tracking of the identified waste to disposal. Any use of, or reference to UK RWI information, will require an accompanying reference date and issue of the UK RWI to enable accurate interpretation, as inventory identifiers and waste stream descriptions can change between issues. This can be included in the WPrS. In cases where waste streams are combined for packaging, or the UK RWI Identifier covers an amalgamation of waste streams, the information held in the UK RWI may not be sufficient. In such cases, a clear description of all the constituents of the waste stream should be provided.

6.1.3 General background information (A1.3)

Background information that may be of relevance to the nature of the raw waste should be included in the disposability record. This could include any relevant information, for example atypical operating history of the reactor or plant giving rise to the waste, which affects the nature and inventory of the waste.

In addition, a description of the history of the waste since its arising should be provided, including the identity of any storage facility in which the raw waste has been stored, as this would facilitate the tracking of the waste to its ultimate disposal. Where appropriate, processes that indirectly change the waste compositional inventory (for example, a pond water change that removes soluble caesium) should be described.

6.2 Waste package development

The function of the waste package is to allow the waste to be stored, handled and potentially disposed of safely and efficiently. Confidence in the properties and performance of the waste package is usually established through a development programme. The disposability record must therefore include sufficient information regarding the development of the waste package to underpin and justify the requirements set out in the WPrS and CCAD.

A record of the development of the waste container component of the waste package is considered separately (Section 6.3), although it is recognised that there may be some overlap between information relating to the demonstration of waste package properties and container testing.

6.2.1 Process development (A2.1)

In order to provide guidance on the type and extent of data and information relating to process development to be included in a disposability record, it is necessary to provide some general background on the programme of work that might be required for the development of a packaging process.

In developing the waste packaging process, waste packagers need to consider the nature of the waste and the wasteform, in addition to the process conditions under which the waste package is produced, as these can all have a significant influence on product quality. This stage of the development is expected to generate a large amount of information.

Waste

Data and information regarding the nature and quantity of the waste to be packaged are required to underpin the development programme and provide a basis for the methodologies for determining the waste package-specific inventories (Sections 6.4.2 and 6.4.3). This may comprise waste characterisation data, including detailed analytical reports and sampling strategies. In addition, pertinent information may be included in operating records for the plant where the waste arose, or has been stored following its arising; these records may also be retained as part of the disposability record. The extent of information required will depend on the nature of the waste itself and its potential to impact on product quality, and should be discussed with RWM early in the Disposability Assessment process.

The disposability record should include information regarding any waste material which may present a hazard⁴ such that a process can be developed to manage these materials effectively. The degree to which the wastes can be characterised will be an important factor in determining the packaging process and may also inform the choice of waste container (Section 6.3).

Wasteform

The data and information required to underpin the wasteform formulation development will be dependent on whether the design is based on a manufactured wasteform, produced by the addition of a conditioning material (for example cementitious grout, polymer, ceramic or glass) to produce a single, coherent item within the waste container, or one where the waste itself is the wasteform (non-encapsulated or non-immobilised). In any case, an appropriate means of recording the desired formulation is the WPrS, including suitable references to the results of the development programme. These results should demonstrate the linkage between the formulation and product quality. The formulation should be specified to a suitable accuracy in the WPrS, based on development work.

⁴ A hazard may present from wastes that contain flammable, explosive, pyrophoric, chemo-toxic and oxidising materials, sealed containers and objects containing stored energy.

For manufactured wasteforms, justification of the wasteform formulation may be provided by documents reporting the experimental trial results; these documents should also record a justification for any exclusions. The formulation should define the necessary quantities, including the acceptable range, of the principal constituents of the wasteform. In addition to the as-retrieved waste, the constituents of manufactured wasteforms might include, for example:

- chemical pre-conditioning material and process materials
- immobilisation material or encapsulant (cement-based or otherwise)
- capping grout

It is generally expected that for non-encapsulated and non-immobilised wasteforms, the only constituent would be the waste itself. Again, a justification for any limits or exclusions on individual waste components should be recorded. Should the raw waste be subject to any pre-treatment where other material is added, for example by neutralisation, similar information regarding this material is required and may be provided by experimental trial results. In addition, should it be determined by RWM that the void space within such waste packages is not consistent with ensuring post-closure safety, suitable void-filling material would be required to minimise the void space. A record of the specification and justification for this material should also be included.

Process conditions

The conditions under which a wasteform is produced will determine, to a large extent, the properties and characteristics of that wasteform. The range of acceptable process conditions and the accuracy with which these should be controlled should be established in the development programme and by evaluation of trial products; evidence based on reports of the trial results should be recorded. It is usual that a practical envelope of process conditions is recorded in the WPrS; this is usually verified during plant commissioning and evidence in plant commissioning reports, see Section 6.2.4.

Any limits or exclusions on the process conditions necessary to guarantee acceptable performance should be recorded in the WPrS. Similarly, any pre-treatment of the waste may impose additional process constraints and therefore require that further information be recorded. In other cases, physical parameters such as supercompaction force and degree of compaction may be identified as significant process information.

6.2.2 Small and/or full scale testing (A2.2)

The nature and scale of any testing would be dependent on the nature of the wasteform. Evidence of any tests performed would be required to demonstrate the suitability of the defined product and process, and to justify the performance of the wasteform. It should include a description of the trials performed to justify applicability to the active waste and packaging process. Multiple tests may be performed to demonstrate the different properties and performance of the wasteform, and could include active testing with active waste samples. It is expected that the WPrS would include a brief overview of the testing, with reference to reports containing the results, which should be included in the disposability record.

6.2.3 Demonstration of waste package properties (A2.3)

Data and information relating to the expected properties and performance of the waste package, when manufactured according to the specification, should be recorded to provide evidence that all relevant properties and performance characteristics of the waste package are consistent with the product quality requirements identified by RWM. Such information would typically be included in reporting the development work and there is no requirement to collate this information into a separate record.

The range of properties to be considered will depend on the nature of the waste and waste container, and the sensitivity of package performance to variations in composition and processing. Waste packagers therefore should identify the relevant properties of the wasteform and design the development programme accordingly. Relevant properties may include:

- demonstration of conformance with the requirements for performance under impact and fire accident conditions
- thermal conductivity
- voidage
- thermal, chemical, radiation and mechanical stability
- corrosion rates of waste container materials
- gas generation and migration
- mobility of radionuclides and aqueous migration properties
- compatibility with alkaline disposal environment
- stability of filters and seals

As a wasteform may be manufactured within a formulation envelope under a range of process conditions (see Section 6.2.1), the recorded information should reflect the breadth of products that may be produced.

It is unlikely that substantial information on wasteform properties need be generated during packaging. However, confirmatory tests may be required for some processes and specific measurements may be required for individual packages, as discussed in Section 8.

Product quality information may be re-stated in the recorded information or, perhaps more commonly, a reference to traceable information should be recorded. Where information is re-stated, it should be made obvious whether the quoted values are intended as examples of typical values, expected ranges of values based on experimental observation or necessary limits based on argument or observation. References are likely to be cited in documents such as the WPrS or packaging submissions and associated documentation.

6.2.4 Evidence of plant commissioning (A2.4)

It is usual that a practical envelope of process conditions is defined and verified during a commissioning phase, prior to waste package production. This requires a suitably justified commissioning plan for the plant, which should be included in the disposability record, along with evidence of successful demonstration. Commissioning may include the production of inactive and active packages, as appropriate.

6.2.5 Package-specific criticality safety assessment (A2.5)

In cases where a package-specific CSA is required to determine the fissile material limits, rather than by reference to screening levels produced for a generic packaged waste type, the assessment should be either cross-referenced or included in the CCAD (see also Section 7.3). The CSA should consider all stages of waste management and whether any limits on inactive materials that may influence reactivity are required; examples of these might be moderators and reflectors, such as graphite, beryllium and polythene.

6.3 Container development

It is expected that the results of a specific development programme will be reported, underpinned with suitable evidence, to define the properties and performance of the waste container and demonstrate its contribution to the performance of the waste package.

In addition to waste container development, information is also required on the transport container, except where RWM is the Design Authority, for example the Standard Waste Transport Container (SWTC).

6.3.1 Container development (A3.1)

The waste container is a significant component of the waste package and may determine, or at least strongly influence, overall waste package performance and product quality. The design and development of waste containers is an important part of the development programme and the disposability record should include information about the development process, including justification for the choice of waste container type.

The disposability record should provide a description of the waste container, including any internal furniture. This information may be provided by the design drawings and manufacturing specification for the waste container. A general description and references to the detailed specifications of the waste container also may be included in the WPrS.

Further information to underpin the performance and properties of the waste container may be required; this will be dependent on the type of waste container. Amongst the information that might be provided is:

- material specifications and certificates
- manufacturing process controls
- waste container transport, delivery and storage conditions prior to use

In some cases, the waste container may be partially manufactured during the packaging of waste, for example where a lid is cast over the wasteform in a concrete container. Where this is the case, a manufacturing specification for this process should be recorded or referenced.

RWM has developed WPS for a range of standardised designs of waste container. Although the relevant WPS may be cited in disposability record, these should be supplemented by more detailed manufacturing specifications.

Further information may be required for waste containers that are also approved as transport containers, in order to satisfy any explicit requirements placed by the DA.

The record of waste container development should also include definition and justification of the criteria for individual waste container acceptance (Section 8.3).

6.3.2 Container testing (A3.2)

The requirements for container testing depend on the type of waste container, and may include the following:

- lifting features
- stacking performance
- performance under fire and impact accident conditions (this may require consideration of the nature of the wasteform)

6.4 Data and information recording system

6.4.1 Arrangements and justification for the waste package disposability record (A4.1)

Each waste packaging project is expected to generate a significant amount of data and information through the various stages of waste management, as shown in Figure 1. Most of this information would usually arise during the development stage (Sections 6.2 and 6.3); however, not all of the information generated will be required as part of the waste package disposability record. It is therefore important that waste packagers determine a strategy that defines the content of the disposability record and provides further justification of the

content, where necessary. In some cases, a justification for why certain data or information is not included may be required.

Importantly, the waste packager should also develop and record a strategy to define the data and information that will be collected and recorded as evidence of compliance with the specifications. This will be based on information generated as part of development of the waste packaging process, and therefore should be tailored to the waste packaging project. The method of acquisition, with appropriate consideration of uncertainties, should also be recorded. Key waste package-specific data required are the radionuclide and composition inventories and the disposability record should describe the methodology used to derive this information; these are discussed in more detail in Sections 6.4.2 and 6.4.3.

The retention of information relating to these strategies is best ensured through a methodology statement. It is of particular importance to record the justification for the proposed strategy, referring to appropriate sources of information, for example the development programme and the primary characterisation of the waste.

Waste packagers are advised that the methodology statement also provides a suitable means of recording the derivation and justification of limits on package contents (recognising that the numerical limits would also be reported in the WPrS and CCAD) and arguments demonstrating the management of hazardous materials. The methodology statement would then provide a reference to be cited in the specification documents.

Based on the strategies defined in the methodology statement, the DRS should provide a comprehensive list of the documents that will form the complete disposability record. It should also consider how waste package-specific compliance data are to be recorded, for example by including template forms that would be completed during manufacture and, potentially, storage.

The arrangements for managing the disposability record, in accordance with the *Waste Package Quality Management Specification*, WPS/200 and WPS/870, should also be included.

6.4.2 Derivation of waste composition (A4.2)

In many cases, it will be necessary to establish, describe and justify a methodology for determining the quantity of selected individual components of the waste composition at the waste package-specific level. Any such requirement would be influenced by the nature of the waste, compositional data, the packaging process and the sensitivities established during the development programme. In some cases, it may be possible to justify that sufficient data and information is covered by overall waste composition information recorded under Section 6.1, and that no further quantification at the package scale is required; in this case, a statement to this effect should be recorded as part of the methodology statement.

Where limits are placed on the quantities of specific components of the waste, these should be justified as part of the process development (Section 6.2.1), and explicitly recorded in the WPrS and CCAD, where appropriate. In many cases, limits may be based on the range of compositions used in the development programme, and for which acceptable performance has been demonstrated, rather than a maximum value above which performance is known to be unacceptable. Compliance with some radionuclide-related limits may also be dependent on constraining individual components of the waste. As stated in Section 6.4.1, this should be recorded as part of a methodology statement.

In addition, the waste packager is required to provide a methodology for determining the inventory of *hazardous materials and non-hazardous pollutants* in a waste package, as they relate to the protection of groundwater from groundwater activities and defined Environmental Permitting Regulations 2010.

The inventory of a particular component should be recorded to an accuracy and level of detail consistent with demonstrating that the effect of the component on the performance of that waste package is understood and acceptable. Waste packagers should establish the necessary accuracy and this would be reflected in the data and information recording system. The appropriate means for determining the inventory is at the discretion of the waste packager and would depend on whether package-to-package variability is considered significant and therefore may be provided on a waste type, batch or specific waste package basis.

Suggested methodologies for obtaining compositional information include the following:

- definition of an average package inventory, determined from the composition of the waste stream and the number of packages
- definition of a robust envelope that cannot be exceeded by the waste feed, perhaps including arguments based on a comparison of a limit and the capacity of the container; or process controls to limit package component inventories
- scaling of a compositional fingerprint using a parameter measured for an individual package, for example mass of waste or dose-rate
- recording of individual items of waste or consignments of identified composition as they are sorted and packed
- sampling and analysis of the waste as it is processed, most commonly on a batch basis, where a batch is equivalent to a number of packages

It is recognised that different strategies may be applied to different components within the same waste stream. This is particularly the case where some components are present in relatively small quantities or otherwise are not expected to influence performance significantly, and which, therefore, would not necessarily be subject to specific limits. As stated in Section 6.4.1, this should be recorded as part of a methodology statement.

RWM can provide advice on requirements for the determination of the waste component inventory through the established Disposability Assessment process.

6.4.3 Derivation of radionuclide inventory (A4.3)

RWM requires waste packagers to establish, describe and justify a methodology for determining the individual waste package radionuclide inventory. The radionuclide inventory associated with a waste package is a listing of the identity and quantity of the radioactive isotopes present in that package (see Section 8.4.1). The radionuclide inventory is a fundamental component of the disposability record that enables the significance of the waste to be judged. Realistic and justifiable waste package inventories are also required to ensure the integrity of the accumulated inventory, and its distribution, for future stages of waste management.

In practice, the recorded inventory should be limited to the activity of radionuclides of significance to the transport, operation and post-closure phases, thus avoiding the need to report small quantities of short-lived or otherwise insignificant radionuclides. It is the responsibility of the waste packager to develop the list of significant radionuclides for a waste type, in consultation with RWM. The recording of the basis for such a list would also provide evidence that un-recorded radionuclides are not present in significant quantities, obviating the need for further information on such radionuclides.

The physical or chemical form of a radionuclide may also be significant and, if this is the case, this should be recorded. Particular examples include potentially gaseous species (for example tritium dissolved in metals or corrosion products) and particulate material. The latter is discussed in Section 6.4.2.

The quantities of some radionuclides may need to be limited in waste packages. Such radionuclides might include those giving rise to penetrating radiation (for example, Co-60),

gaseous releases (for example, H-3, Kr-85 and Rn-222 or its precursor, Ra-226) or radionuclides that could, following chemical reactions, become gaseous (for example, C-14) and fissile radionuclides (that is, U-233, U-235, Pu-239 and Pu-241). Any such limits should be included in the WPrS and CCAD, as appropriate, and a suitable method of determining the inventory established.

Waste packagers should design a data acquisition system for obtaining the inventories of significant radionuclides in a waste package. A number of methodologies are possible, depending on the nature of the waste and inventory and factors such as variability, and include the following:

- definition of an average package inventory, determined from the composition of the overall waste stream and the number of packages expected
- sampling and analysis of the waste as it is processed, either on a batch basis or for each package, using radionuclide assay methods such as α - or γ -spectrometry or methods specific to particular radionuclides
- scaling of a pre-defined radionuclide fingerprint using a parameter measured for an individual package, for example mass of waste, dose-rate or the inventory of a particular radionuclide established by spectrometry
- recording of individual items of waste or consignments of previously defined radionuclide inventory as they are sorted and packed, with appropriate checking

It is recognised that different strategies may be applied to different radionuclides within the same waste type. This is particularly the case where some radionuclides are readily assayed (for example γ -emitting species) whereas others may require disproportionate effort and, subject to approval, may be assigned based on a pre-defined fingerprint (for example low energy β -emitting species).

It should be recognised that inventory recording methods will be developed prior to the processing of waste, probably based on the initial characterisation data or limited sampling. Consequently, appropriate allowance for uncertainties should be included in the development of methods and information on these uncertainties included as part of the disposability record.

The methods used to obtain waste package radionuclide inventories should be appropriate and justifiable. The retention of information relating to these methods and their justification is best ensured through a methodology statement. This also provides a means of recording the derivation and justification of limits on particular radionuclides and may be cited in the WPrS.

The methodology statement should be a freestanding document and could also include the strategy for determining the composition of the waste, as discussed in Section 6.4.2, since they may be complementary.

6.5 Storage, monitoring and inspection

6.5.1 Justification for storage, monitoring and inspection arrangements (A5.1)

The evolution of waste packages is inevitable, particularly during any extended period of interim surface storage and the operational period of a GDF. Therefore, the necessary storage conditions should be considered in the development programme to ensure the longevity of the waste package.

The strategy should record a threat analysis that considers the effects of any deviation from the expected storage conditions on the waste packages. Guidance on the environmental conditions during storage of waste packages is provided in Industry Guidance on the interim storage of HAW packages [12] and *Guidance on Environmental Conditions during*

Storage of Waste Packages, WPS/630 [13]. This analysis should identify any factors that may adversely influence waste package evolution and provide justification for any factors that may need to be monitored and/or controlled. The influencing factors may include:

- temperature and humidity
- rate of air flow or number of atmosphere changes
- rate of deposition of potentially corrosive or reactive chemicals from the atmosphere, for example salt or sulphates
- method of stacking packages, including the use of spacers or pallets
- use of overpacks or other protection (for example sheeting), and their specification

The environmental conditions in a store may be actively controlled through ventilation, atmospheric drying or heating. However, where such control is not available, conditions are likely to fluctuate and the expected range of conditions should be assessed. Further justification would be required where this is the case.

In addition, periodic monitoring of the condition of the waste packages would be necessary; the type and extent of monitoring should be underpinned, dependent on the waste package type and store environmental conditions. It may be appropriate to justify monitoring a subset of surrogate waste packages, or inactive dummy waste packages produced during inactive commissioning, where the results would be applicable to all waste packages of a particular type. Baselineing of waste packages on entry to the interim store may be justified as an integral part of waste package monitoring. Guidance on the monitoring of waste packages is provided in the Industry Guidance [14] and *Guidance on the Monitoring of Waste Packages during Storage*, WPS/640.

For waste packages that are also transport packages in their own right, additional requirements regarding storage, inspection and approval for transport may be stipulated by the Design Authority.

6.5.2 Implementation plan for storage, monitoring and inspection (A5.2)

An implementation plan should be developed, based on the strategy, which provides a brief description of how the arrangements for storage, monitoring and inspection of the store and waste packages would be physically implemented. It should:

- identify the methods and procedures to be used for acquisition of relevant data
- specify performance criteria and/or indicators
- specify arrangements for remedial action

6.6 Management system arrangements, including quality plan

The waste packages are required to be manufactured under a formal and effective management system with the objective of assuring the quality of both the waste package and the associated disposability record. Guidance on the requirements for quality management as it pertains to waste package production is provided in WPS/210. A subset of the management system documents should be kept to demonstrate that all operations relating to product quality were adequately controlled; these documents should take account of the following:

- process development
- container manufacture
- packaging operations
- data and information
- storage, monitoring and inspection
- non-conformances

In some cases, evidence of robust management system arrangements may be used to provide sufficient evidence of compliance with the waste package requirements, thus reducing the amount of information required at the package level. Where this approach is proposed by the waste packagers, it shall be agreed with RWM through the Disposability Assessment process.

As part of the management arrangements, the waste packager is required to develop a quality plan for the packaging process. The document should define the process control measures that will be in place and identifies the tests, measurements or inspections that will be undertaken and what acceptance criteria will be applied. The quality plan should provide reference to the controlling specifications and any project-specific work instructions required during waste package manufacture and storage. As well as providing a record of the verification that a compliant waste package has been produced, it should also provide a record of verification that all required compliance data and information, as defined by the data and information recording system, during the process has been recorded.

7 Guidance for Class B: specification

The specifications act as controlling documents for the manufacture and storage of waste packages; they provide an important link within the disposability record, between the information required to underpin and justify the specifications, and the compliance data required to demonstrate that each waste package is acceptable for disposal.

7.1 Disposability Record Specification

The purpose of the DRS is to provide a list of the documentation that forms the waste package disposability record. It should distinguish where references contain information that is relevant to all waste packages, a subset of waste packages, or is waste package specific. In the case of the package-specific compliance data, the DRS could include template forms or documents that would be completed for each waste package during, or after processing.

Where necessary, the DRS should be revised to reflect the inclusion of any further data and information recording requirements that have emerged during the packaging or interim storage of the waste. This may be required at the point of transfer of the waste package to a GDF for disposal, at which point, all relevant documentation will be identified.

The DRS is required to be a freestanding document that has been reviewed and accepted by RWM. This document provides guidance on the contents of the DRS, based on the requirements outlined in WPS/400.

7.2 Waste Product Specification

The principal purpose of the WPrS is to provide a definition of the product that a waste packaging process is intended to produce. This would include a general description of the waste package, all necessary specifications of the components of the waste package and any limits on its contents or the process conditions for production. The WPrS should provide cross-referencing to the underpinning information, such as the results of a development programme, which provides the justification for the various specified or limiting values. The WPrS is required to be a freestanding document that has been reviewed and accepted by RWM. The WPrS is described in more detail in *Guidance on the Structure and Format of Waste Product Specifications*, WPS/620 [15].

In practice, the WPrS should define the range of acceptable waste package compositions and processing conditions for which satisfactory waste package performance has been demonstrated (through a development programme).

Compliance of individual packages to the specifications established in this way provides a high level of confidence that the waste package properties will be acceptable for future handling, storage, transport and disposal. This conformance would be demonstrated through the data and information recorded under Class C.

7.3 Criticality Compliance Assurance Documentation

The CCAD should establish the safe fissile mass (SFM) for the fissile material content of the waste package and define how conformance would be demonstrated in practice. This may be through direct measurements of fissile material contents, indirect measurements based on other radionuclides or inactive components or through reasoned argument. It should be noted that limits may be placed on inactive materials where these may influence nuclear reactivity (examples might be moderators and reflectors such as graphite, beryllium and polythene). A requirement to obtain such information has also been defined above. The need to demonstrate conformance with fissile material limits would be an important criterion in establishing the significance of relevant information.

The SFM should be based either on a package-specific CSA (Section 6.2.5), or on screening levels produced for a generic packaged waste type. Cross-references to these assessments should be explicit and provided either in the data records or in the CCAD. Further guidance on the production of CCAD is available in *Guidance on the Preparation of Criticality Compliance Assurance Documentation for Waste Packaging Proposals*, WPS/625 [16].

7.4 Transport package design safety documentation

The mode of transport identified for the waste package will include specific limits and conditions to comply with the requirements for transport. These are embodied in a contents specification, and the underpinning analysis that supports it, as provided by the Design Authority for the transport container. In practice, the Design Authority should retain the relevant documentation; however, given the potentially long timescales between packaging and transport, the waste packager should take steps to ensure the documents are not lost.

Compliance of individual waste packages to the relevant contents specification should be established to ensure that the waste package properties will be acceptable for transport and, therefore, disposal.

8 Guidance for Class C: compliance

Data and information is required to be recorded for each as-manufactured waste package to provide evidence of compliance with the requirements of the appropriate specifications. Many of the requirements would be met by recording process data collected during waste package manufacture, including container manufacture, and it is envisaged that these data may be recorded by populating simple forms developed for the specific packaging process. Whilst most of the data generated would be waste package-specific, the waste packager should recognise where there may be instances of data that would be applicable to more than one waste package, for example information about the interim storage conditions (Section 8.7) and manage the data accordingly.

8.1 Waste package identifier

8.1.1 RWM package identifier (C1.1)

The waste package identifier (as defined in *Specification for Waste Package Identification System*, WPS/410 [17]) is the primary means of uniquely identifying a waste package and linking it to the waste package-specific information in a disposability record. Individual

operational facilities are allocated a defined series of numbers, within the range of numbers available, that would clearly link an individual waste package with its origin.

8.1.2 Other identifiers (C1.2)

Any additional waste package-specific identifiers used by waste packager or container manufacturer should also be included in the records, if appropriate.

Some waste container furniture, such as the stillages used for handling and stacking 500 litre Drum waste packages are also given unique identifying numbers. Where appropriate, these also should be included in the disposability record.

8.2 Specification and compliance

Each individual waste package is required to be linked to the specification documents under which it has been manufactured by provision of an explicit cross-reference to the appropriate DRS, WPrS, CCAD and Transport Package Design Safety Documentation, including the version applicable at the time of packaging, see Section 7.

The disposability record should include an explicit declaration of compliance with each relevant specification; this should be based on verification by the waste packager that the compliance data have been recorded and comply with any specified limits.

Demonstrated compliance with the relevant specifications, or appropriate remedial action, is likely to be a necessary precursor to the acceptance of waste package for long-term storage or disposal.

The disposability record should also include reference to any other specifications that have been used in the manufacture of the waste package, for example, the relevant WPS. References may be included in the WPrS and CCAD, as appropriate.

8.3 Container compliance

8.3.1 Evidence of compliance with container design and specification (C3.1)

Evidence should be provided that each waste container has been manufactured according to the appropriate design and specification. The level of evidence required would be dependent on the type of waste container; for waste containers that are also transport containers, additional information may be required to demonstrate compliance, as defined by the Design Authority. Similar evidence is also required for the transport container that, in combination with the waste package, is used to form the transport package.

Amongst the information that might be provided is:

- manufacturing records
- inspection records, conformance details and acceptance test results
- concession forms
- container transport, delivery and storage conditions prior to use

Alternatively, it may be possible to justify compliance of the waste container with the design by retention of the appropriate management system arrangements for procurement, acceptance and storage of the waste containers. In this case, the records relating to management arrangements for container design (Section 6.6) that apply to all waste containers may be sufficient to satisfy this requirement, and a package-specific declaration of compliance should suffice. Thus, the retention of individual manufacturing and inspection records may not be necessary. This approach shall be fully described as part of the data and information recording system and agreed with RWM as part of the disposability assessment process.

For waste containers that are also transport containers, a valid approval certificate, or equivalent documentation, is required for the waste container design. This is provided by the relevant *Approval Authority*, and should be traceable from each waste package.

8.3.2 Acceptance of container for use (C3.2)

A record of formal acceptance of the waste container for use at the point of packaging is required, since it is expected that the empty waste container would be subject to a period of storage between receipt and use. This may take the form of individual inspection, or confirmation that all storage activities and conditions have been met.

8.4 Waste compliance

8.4.1 Waste package radionuclide inventory and waste composition (C4.1)

Each individual waste package disposability record shall include:

- a radionuclide inventory, including relevant reference date
- a waste composition inventory, limited to significant components

These inventories shall be derived according to the methodologies defined by the data and information recording system (Section 6.4). It is expected that the inventories will be used as evidence of compliance with related waste package limits, as specified in the WPrS and CCAD and described in the remainder of Section 8.4. As such, it is not necessary to record these data separately.

8.4.2 Evidence of compliance with inventory limits (C4.2)

The data required to show compliance with specific inventory limits in the WPrS may be provided by the individual package radionuclide inventory.

Some of these limits may be implicit, for instance the requirement to conform to an external dose rate limit for transport may imply an inventory limit, and compliance to some limits may require some estimation, for instance the compliance with a heat output limit may need to be demonstrated based on the radionuclide and compositional inventories.

8.4.3 Evidence of compliance with safe fissile mass (C4.3)

The data required to demonstrate that the SFM has not been exceeded is dependent on the requirements stated in the CCAD. This may be at the waste package scale by direct measurement of fissile material contents or indirect measurements on other radionuclides, with appropriate consideration of any errors or uncertainties. This should also include a record of the quantity of any inactive materials where these may affect reactivity, as defined by the CCAD. These data may be recorded directly as part of the waste package inventories, or derived from them (Section 8.4.1).

Alternatively, if the CCAD states that justification may be supported by reasoned argument, based on the process, in which case evidence of compliance may be provided by demonstration that the requirements of the WPrS and CCAD have been met (Section 8.5).

8.4.4 Evidence of compliance with compositional limits (C4.4)

As with inventory limits (Section 8.4.2), the data required to show compliance with compositional limits can be provided by the individual package composition; these limits are specified in the WPrS and, potentially, the CCAD.

For process control, and to confirm compliance with other requirements of the WPrS, the quantities of individual components of the waste package may need to be recorded directly. Alternatively, information could be recorded that would enable the quantities of such items to be deduced.

8.4.5 Record of exclusions (C4.5)

Any materials that are excluded from the waste package shall be explicitly defined in the WPrS; confirmation of compliance may be provided through fulfilment of the process conditions, which shall include defined procedures to ensure exclusion of these materials.

8.4.6 Evidence that hazardous materials are managed appropriately (C4.6)

Sufficient confidence that hazardous materials have been managed appropriately may be provided by demonstration that the requirements of the WPrS have been met.

8.4.7 Analysis errors and uncertainties (C4.7)

A record of any errors or uncertainties associated with individual measurements made during the waste packaging process, for example from assay equipment.

8.5 Processing compliance

8.5.1 Waste loading

A record of the waste loading may be required to provide evidence of compliance with any waste package-specific limits in the WPrS. The data may comprise a direct measurement of the total mass or volume of waste added to the waste container, or a summation of the quantity of individual waste components, which potentially overlaps with the requirements to record information related to specific compositional limits (Section 8.4.4). In some cases, evidence may be required that waste has been added in a specific order, where this is necessary for product quality.

8.5.2 Record of additions for processing

A record of additions for processing would be generated only for manufactured wasteforms, rather than those where the waste itself is the wasteform; these data would provide evidence of compliance with any limits in the WPrS and may include the following:

- quantity of material used to condition the waste prior to wasteform manufacture
- form and quantity of any material used to infill or encapsulate the waste

In addition, appropriate certificates of conformity for each material should also be recorded to confirm compliance with any requirements specified in the WPrS. In cases where this could result in a significant amount of data, example certificates may be included as evidence, with reference to the appropriate certificate included at the package-scale.

8.5.3 Evidence of fulfilment of process requirements

Evidence that process requirements defined in the WPrS have been met is dependent on the nature of the wasteform and the process employed. Examples are given below for three wasteform types.

- For manufactured wasteforms based on an in-drum mixing process using cement:
 - cement addition rate, position and duration
 - mixing regime, including speed and duration
 - torque
- For manufactured wasteforms based on solid waste encapsulation using a cement grout or the casting of a grout annulus around the waste:
 - grout mixer type and mixer speed
 - cement addition rate and duration
 - water and cement temperature
 - mixing duration
 - hold-up time before waste infilling

- fluidity of the grout
- rate and duration of infilling
- For non-encapsulated wastes, where the waste may be conditioned to remove free water to form the wasteform:
 - conditioning plant
 - conditioning (drying or draining) regime
 - component temperature.

Similarly, any pre-treatment of the waste may impose additional process constraints and therefore require that further information be recorded. In other cases, physical parameters such as supercompaction force and degree of compaction may be identified as significant process information.

8.5.4 Confirmatory testing

The results of any confirmatory testing performed on the wasteform at the completion of the process should be recorded, noting that this may be limited to confirmation that process requirements have been met (Section 8.5.3). However, dependent on the nature of the wasteform, this may involve performing a confirmatory test on the product prior to waste package completion.

For non-immobilised wastes, the waste package may be subject to specific limits on the amount of free water; evidence of confirmation may include a direct measurement of the water content of the waste package, or successful repeat of the defined process at a defined time post-processing.

For manufactured wasteforms, confirmation of set for the encapsulating material may be required; in addition, for those which are completed with the addition of a clean grout cap, confirmation of set for both may be required.

8.5.5 Package completion

A record of completion of the waste package may include confirmation of compliance with the WPrS for the following:

- lid bolt torque (noting that in some cases, the container lid may have been fitted prior to the addition of waste)
- lid seal function

Waste packagers should also be aware that similar tests may be required immediately prior to transport; evidence should also be provided in the disposability record.

8.6 Waste package compliance

8.6.1 Dose rate (C6.1)

The dose rate may be determined by direct measurement on the waste package, or by calculation according to the methodology defined during development. The record should include the distance from the waste package (or bare waste) at which the dose rate applies and the reference date, as appropriate. Consideration should also be given to the requirements placed on the transport package.

8.6.2 Mass (C6.2)

The gross mass of the waste package shall be recorded, either measured directly, or inferred by the sum of the components.

8.6.3 Contamination levels (C6.3)

The non-fixed surface contamination levels on waste packages shall be measured and recorded.

8.6.4 Waste package baseline information (C6.4)

The results of any baseline testing of the waste package prior to interim storage shall be recorded and may include visual inspection, photography or surface chloride contamination. Dependent on the proposed arrangements, this may be performed for each individual waste package, or a statistically significant sub-set. In the latter case, the results may be applicable to all, and should be recognised as such in each waste package disposability record.

8.6.5 Specific activity at time of transport (C6.5)

For waste packages that will be transported under the arrangements for Industrial Packages, the specific activity of the waste shall be recorded, as evidence of compliance with limits for low specific activity (LSA) material; this may be calculated from the radionuclide inventory and waste loading.

8.6.6 Confirmation of containment (C6.6)

Where the waste package is being claimed as providing containment for radioactive material during transport and emplacement operations, the results of any testing to confirm that the package complies with the containment requirements specified in the WPrS should be recorded.

8.7 Waste package management

8.7.1 Basic history (C7.1)

The record of the waste package history should provide information regarding a basic description of the movements to which the package has been subjected after its manufacture and may include some or all of the following:

- date of production
- identity of the waste packaging plant
- dates on which the waste package was placed in and removed from store(s)
- movement or retrieval for inspection

Generally, the waste packaging plant would be generic to all waste packages of a given waste type, and therefore, this may be recorded in the WPrS.

8.7.2 Store arrangements (C7.2)

The record of arrangements for interim storage should provide confirmation of the conditions in which the waste package has been stored; the information is expected to be applicable to all waste packages and may include the following:

- identity and location of the waste package store(s)
- storage environmental conditions
- physical condition of the store building
- checks on surrogate packages and/or materials

A detailed history of the environmental conditions for the whole period of storage is not required; in many cases, evidence may be limited to confirmation that conditions have been maintained within the limits specified. Reporting may be by exception, should any of the defined trigger levels be exceeded, with evidence of the action taken in response. This information is likely to be applicable to more than one waste package and should be recorded appropriately, explicitly cross-referenced in each disposability record.

8.7.3 Evidence of implementation of storage, monitoring and inspection arrangements (C7.3)

Evidence of implementation of the arrangements for storage, monitoring and inspection may be limited to confirmation of conformance with storage requirements, but will be detailed in the implementation plan; the WPrS should also include any specified limits on environmental storage conditions. However, evidence may be required for waste package monitoring during storage, as detailed in the implementation plan, and may include:

- the results of any NDT analysis
- checks on the condition of the waste package in store
- any abnormal occurrences or incidents involving the waste package
- remedial action taken in respect of a waste package that becomes nonconforming (see Section 8.8)

It is noted that although the testing would be performed on individual waste packages, the results may be used to provide information that relates to all waste packages and the information should be managed appropriately.

8.8 Resolution of non-compliance

Evidence of the resolution for any waste package that has not met the specified requirements should be provided; the level of evidence will depend on the nature and severity of the issue, and may be satisfied by provision of minutes of the relevant product quality review committee (or equivalent), or details of any remedial actions taken.

Some issues may apply to a single waste package or may be a systematic issue affecting, for instance, a subset of waste packages. Evidence of resolution should be managed accordingly.

8.9 Other package-scale information

8.9.1 Safeguards (C9.1)

Each waste package disposability record shall include a statement as to whether the waste contains nuclear material that is subject to safeguards, is non-safeguarded (of military origin) or exempt (containing no fissile material). For wastes that are subject to safeguards, evidence of the status is required and can be by provision of written agreement by the relevant regulator. Further information on the application of safeguards during packaging of higher activity waste is provided in *Guidance on the application of safeguards during the packaging of higher activity waste*, WPS/923.

8.9.2 Administrative information (C9.2)

The necessary administrative information will depend on the requirements imposed by regulators and by RWM, or their successor. The required information may comprise the identity of a contact within the waste packager organisation, this contact being responsible for the packaged waste, and a record of the authorisation and agreement for transfer of waste package for disposal. Clearly, the requirement would be completed only at the time of transport of the package to a disposal facility.

8.9.3 Consignment information and records (C9.3)

This record should provide a cross-reference to the consignment documentation covering the transport of the waste packages and include any documentation needed to meet the requirements. A detailed description of the necessary documentation is provided elsewhere and may be subject to revision [18]. Clearly, this category would be completed only at the time of transport.

References

- 1 Department of Energy and Climate Change, *Implementing Geological Disposal, A Framework for the Long-term Management of Higher Activity Radioactive Waste*, URN 14D/235, 2014.
- 2 NDA, *Geological Disposal: Generic Waste Package Specification*, NDA Report No. NDA/RWMD/067, 2012.
- 3 NDA, *Geological Disposal: Introduction to the RWM Waste Package Specification and Guidance Documentation*, WPS/100/04, 2015.
- 4 NDA, *Geological Disposal: Generic Waste Package Specification for Waste Packages Containing Low Heat Generating Waste*, NDA Report No. NDA/RWMD/068, 2012.
- 5 NDA, *Geological Disposal: Generic Disposal System Technical Specification*, NDA Report No. NDA/RWMD/044, 2010.
- 6 NDA, *Geological Disposal: Waste Package Data and Information Recording Requirements*, WPS/400/03, 2015.
- 7 NDA, *Geological Disposal: An Overview of the RWM Disposability Assessment Process*, WPS/650/03, 2014.
- 8 Office for Nuclear Regulation, Environment Agency, National Resources Wales and Scottish Environment Protection Agency, *The Management of Higher Activity Radioactive Waste on Nuclear Licensed Sites: Joint Guidance from the Office for Nuclear Regulation, the Environment Agency, the Scottish Environment Protection Agency and National Resources Wales*, Revision 2, February 2015.
- 9 NDA, *Geological Disposal: An Overview of the Generic Disposal System Safety Case*, NDA/RWM/010, 2010.
- 10 NDA, *Geological Disposal: Guidance on the Preparation of Submissions for the Disposability Assessment of Waste Packages*, WPS/908/04, 2014.
- 11 NDA, *Geological Disposal: Waste Package Data and Information Recording Requirements: Justification*, WPS/840/01 in development, 2015.
- 12 NDA, *Interim Storage of Higher Activity Waste Packages: Industry Guidance – Extended Summary*, November 2012.
- 13 NDA, *Guidance on Environmental Conditions During the Storage of Waste Packages*, WPS/630/02, 2008.
- 14 NDA, *Interim Storage of Higher Activity Waste Packages: Industry Guidance – Extended Summary*, November 2012.
- 15 NDA, *Guidance on the Structure and Format of Waste Product Specifications*, WPS/620/02, 2008.
- 16 NDA, *Guidance on the Preparation of Criticality Compliance Assurance Documentation for Waste Packaging Proposals*, WPS/625/02, 2008.
- 17 NDA, *Specification for Waste Package Identification System*, WPS/410/02, 2008.
- 18 IAEA, *Regulations for the Safe Transport of Radioactive Material*, 2012 Edition, IAEA Safety Requirements No. SSR-6, 2012.

Appendix A Glossary of terms of specific reference to data recording

administrative information

That part of the disposability record that is not directly related to the processing of the waste, for example QA documentation, consignment records and identifiers. May be treated either as recorded information or as traceable information.

Approval Authority

Organisation or individual responsible for the approval of transport package designs.

compliance data

Those parts of the disposability record recorded to demonstrate that limits have been met or not exceeded. Commonly treated as recorded information.

Competent Authority

Any national or international regulatory body or authority designated or otherwise recognised as such for any purpose in connection with the Transport Regulations.

data acquisition system

The methods used to obtain (numerical) information required in the disposability record for a particular waste type. May include both assay or measurement methods and the provision of information through a development programme.

data and information recording system

The tailored system for completing the disposability record. To include appropriate components of the development programme, the data acquisition system(s) and process records, the completion of the recorded information and the acquisition and retention of other traceable information.

Design Authority

Organisation or individual responsible for the specification and design of transport packaging.

development programme

The programme of research and development undertaken to characterise the waste and define and justify the necessary processing and packaging methods. Some results will be part of the generic information and are commonly treated as traceable information.

disposability record

The complete collection of information relating to a waste package required to enable assessment against the requirements for safe and cost-effective handling, transport, storage and potential disposal.

generic information

Information common to all packages from a given waste type. Commonly treated as traceable information.

hazardous substance and non-hazardous pollutants

A hazardous substance is any substance that is toxic, persistent and liable to bioaccumulate.

A non-hazardous pollutant is any pollutant that is not a hazardous substance.

(specified) limit

A limit placed on a particular property of a waste package or its contents to ensure adequate performance, commonly based on the results of a development programme.

package-specific

Information that applies to a specific individual package. Commonly including process records, measured or inferred waste and wastefrom compositions and any other compliance data.

process records

Information acquired during the processing of waste, for example dispensed masses of waste and encapsulating materials, processing conditions and radiological data such as dose rates. May be included directly in the recorded information or used to infer package-specific information.

product quality

The properties of a waste package and its expected performance under foreseeable circumstances. Usually required to meet the standards and requirements defined in the relevant packaging specifications.

recorded information

The means of retaining those parts of the disposability record that comprise information directly associated with a package or its contents that are necessary to demonstrate compliance with the requirements for transport and acceptance at a GDF.

significant (constituent)

Those constituents of a waste package (radionuclides, chemical species, materials, items of waste etc.) that potentially influence some aspect of product quality or which form part of enabling data. Those items for which a limit may be required, to be identified in the development programme.

traceable information

The means of recording and retaining the components of a data record that comprise separate documents, reports and drawings that are cited in the data record (or in other documents) but held separately. Particular items of traceable information may pertain to several waste types.

waste packaging project

Project aimed at producing waste packages defined by the same set of specifications, typically encompassing the implementation of a new packaging plant or process for a defined waste type, or the adaptation or extension of an existing plant or process to a further waste type.

waste type

Waste identified by a waste packager for which a single processing and packaging method has been developed and for which a data acquisition system has been tailored. Commonly, but not necessarily, equivalent to a waste stream as defined in the UK Radioactive Waste Inventory.

Appendix B Mapping to WPS/400/02

For the purposes of comparison, it is assumed that version 2 of WPS/400 can be divided into 'categories' (the 17 listed elements of the specification) and 'fields' (top level bulleted points below the categories). The categories are numbered in WPS/400/02, the 'fields' are not.

Table B1 provides a mapping of the 17 categories and associated fields recognised in WPS/400/02 to the revised version (WPS/400/03).

In preparing the mapping, a number of shortcomings and areas for improvement were noted (and acted upon in preparing the revised version). The principal such observations may be summarised as follows:

- WPS/400/02 is not explicitly based on the requirement to demonstrate compliance
- WPS/400/02 does not clearly recognise classes or attribute categories to classes. However, the introductory text of WPS/400/02 and the associated Guidance document (WPS/850/02) both recognise the equivalent of classes (package-scale records etc.), but this recognition is not extended to the structure of WPS/400/02
- in several fields, it is unclear whether WPS/400/02 is seeking a record of the reference to a document or to include the document itself as part of the record
- there is some ambiguity between recording the specified/required value for a parameter or the actual value of that parameter for an individual package (for example Category 4 in Table B1)
- WPS/400/02 apparently requires records of both the WPrS itself and, separately, many of the typical requirements in a WPrS, which are unpacked as other categories or fields (for example Categories 3-6 in Table B1). This appears to be unnecessary duplication
- some obvious requirements, for example the composition of the waste and wasteform, are not clearly defined, instead being noted under 'inventory of components'
- some categories and fields are apparently specific to cement-based wasteform
- the recording of non-conformances, and corresponding remedial actions, is sought in several places, depending on the source or cause of a non-conformance.

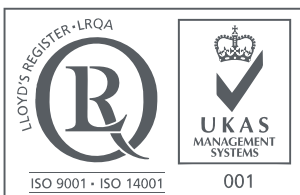
Table B1 Mapping of WPS/400/02 records categories to revised structure of the RWM Waste Package Data and Information Recording Requirements

| Original Requirements (WPS/400/02) | | | Revised Specification | | Comments |
|------------------------------------|--|--|-----------------------|----------|--|
| Category | Field | Category/ Field | Linkage | | |
| 1 | Waste Package Identifier | Unique waste package identifier | C1 | Explicit | |
| 2 | Waste | Description of raw waste | A1.1 | Explicit | Included in A1.1. |
| | | Relevant UK Inventory Waste Stream Identifier | A1.2 | Explicit | |
| | | Origin of the waste | A1.1 | Explicit | Included in A1.1. |
| | | Identity of storage facility for raw waste (if applicable) | A1.1 | Implicit | Included in A1.1. |
| 3 | Waste Container | Type of waste container | B1 | Implicit | Type of waste container is specified in the WPrS. Original field is superfluous. |
| | | Waste container specification, including: <ul style="list-style-type: none"> • manufacturing drawings • dimensions • material specifications • container storage conditions (prior to use) | B1 | Explicit | Interpreting WPS/400 category as encompassing the specification for the container (not a demonstration of compliance with that specification). Field represents requirement to retain explicit copies of the documents (WPrS would specify the applicable documents). |
| 4 | Encapsulant, Capping and Conditioning Material | Encapsulant, capping and conditioning material specification (as applicable), including: <ul style="list-style-type: none"> • chemical components • relevant physical properties • material storage conditions | B1 | Implicit | Encapsulant is specified in the WPrS. Original field is superfluous. Interpreting WPS/400 category as encompassing the specification for the encapsulant etc (not a demonstration of compliance with that specification). Some waste packages do not use encapsulation. Category is not continued to avoid bias towards encapsulation. |
| 5 | Wasteform Formulation | Wasteform formulation, including (as applicable): <ul style="list-style-type: none"> • ratios of waste to encapsulant and conditioning materials • ratios of components of the encapsulant, capping and conditioning materials • envelope(s) of acceptable ratios | B1 | Implicit | Formulation is specified in the WPrS. Original field is superfluous. Interpreting WPS/400 category as encompassing the specification for the formulation etc (not a demonstration of compliance with that specification). Some waste packages do not use encapsulation. Category discontinued to avoid bias. |
| 6 | Process Conditions | Process conditions, including (as applicable): <ul style="list-style-type: none"> • component temperatures • component addition regime • mixing regime • in-process movement times • process verification steps | A2 B1 C5.3 | Implicit | Process is specified in the WPrS. Original field is superfluous. Interpreting WPS/400 category as encompassing the specification for the process etc (not a demonstration of compliance with that specification). Some waste packages do not use encapsulation. Category discontinued to avoid bias. |

| Original Requirements (WPS/400/02) | | Revised Specification | | Comments | |
|------------------------------------|--------------------------------------|--|------------------------------|----------|---|
| Category | Field | Category/ Field | Linkage | | |
| 7 | Nature of the Waste Package | Documentation providing evidence of waste package properties and performance, including (as applicable): demonstration of conformance with the requirements for impact and fire performance; <ul style="list-style-type: none"> • thermal conductivity • macro-voidage • thermal, chemical, radiation and mechanical stability • corrosion rates of waste package materials • rates of gas generation and migration • mobility of radionuclides • compatibility with alkaline disposal environment • arrangements for lid closure • stability of filters and seals | A2.2 A3.2 | Explicit | Field is too detailed and may imply bias. Category A2 is simplified but would require case-by-case consideration to identify what should be included. |
| 8 | Waste Package Radionuclide Inventory | Activities (TBq per waste package) of radionuclides present in significant quantities at a given reference date. | C4.1 | Explicit | |
| | | Methodology statement describing the determination of waste package inventory. | A4.3 | Explicit | |
| | | Physical and/or chemical form of radionuclides | A4.3 | Implicit | Unlikely to be measured parameters. If needed, best incorporated into methodology or fingerprint reports. |
| 9 | Wasteform Component Inventory | Description of wasteform | B1 | Implicit | Field is rather vague. WPrS would provide sufficient information. |
| | | Declaration that wasteform is free of proscribed materials or that hazardous materials have been made safe. | C4.6 | Explicit | |
| | | Inventory of components present in significant quantities, including (as applicable) <ul style="list-style-type: none"> • radioactive material in particulate form • encapsulant, capping and conditioning materials • metals • organic materials • inorganic materials • irradiated graphite | C4.1 C4.1 C5.1 C5.2 | Explicit | Clarifying that the purpose of recording this information is to demonstrate compliance with relevant limits or requirements. Category/field has been restructured for clarity and to remove bias. |
| | | Methodology statement describing the determination of waste package inventory (wasteform components) | A4.2 | Explicit | |
| 10 | Waste Package Properties | Specific Activity (GBq/t) | C6.6 | Explicit | |
| | | Gross mass (kg) | C6.2 | Explicit | |
| | | Surface dose rate (mSv/hr) | C6.1 | Explicit | Unclear why this field is so specific. |
| | | Non-fixed surface contamination levels (Bq/cm ²) | C6.3 | Explicit | |
| | | Heat output (W), including non-radiogenic heat output | C4.1 | Implicit | In practice this is calculated from the inventory and can be treated as an inventory limit. |

| Original Requirements (WPS/400/02) | | Revised Specification | | Comments | |
|------------------------------------|-----------------------------|--|--------------|----------|---|
| Category | Field | Category/ Field | Linkage | | |
| 11 | Waste Product Specification | WPrS in force (with any supporting documentation) at the time of waste package manufacture | C2.1 | Explicit | Field is not clear – interpret as recording of the WPrS under which the package was manufactured, <u>not</u> the retention of an actual copy of the WPrS. |
| | | Declaration of conformance or non-conformance with the WPrS | C2 | Explicit | |
| | | Verification of conformance or non-conformance with the WPrS | C2 | Implicit | Re-structuring of records is based on demonstrating compliance. |
| | | Details of non-conformance with WPrS | C8.1 | Explicit | |
| | | Details of remedial action taken in respect of a waste package initially deemed non-conforming with the WPrS. | C8.2 | Explicit | |
| 12 | Waste Package History | Date of production of waste package | C7.1 | Explicit | |
| | | Identity of waste packaging plant(s) | B1 | Implicit | In practice packaging plant will be specified in the WPrS. |
| | | Identity of waste package store(s) | C7.2 | Implicit | |
| | | Dates on which the waste package was placed in and removed from store(s) | C7.1 | Explicit | |
| | | Storage environmental conditions | C7.3 | Explicit | |
| | | Checks on the condition of the waste package in store | C7.2 | Explicit | Typically packages would be monitored using surrogates. |
| | | Any abnormal occurrences or incidents involving waste package | C7.2 C8 | Explicit | |
| | | Any remedial action(s) taken following inspection or abnormal occurrence | C8.1 C8.2 | Implicit | To be managed under non-compliance arrangements |
| 13 | Criticality Safety | Criticality Compliance Assurance Documentation (CCAD) and appropriate criticality safety cases | A2.5 B2 | Explicit | Covers both CCAD and any package-specific CSA |
| | | Declaration of compliance or non-compliance with the CCAD | C2.4 | Explicit | |
| | | Verification of compliance or non-compliance with the CCAD | C4.2 | Implicit | Re-structuring of records is based on demonstrating compliance. |
| | | Details of any non-compliance of the waste package with the CCAD | C8.1 | Explicit | |
| | | Details of remedial action taken to establish as compliant a waste package that had been found non-compliant with the CCAD | C8.2 | Explicit | |
| 14 | Administrative Information | Waste owner contact | C9.2 | Implicit | Potential to review whether these should be continued in current form |
| | | Waste owner authorisation and agreement for transfer of waste package for disposal. | C9.3 | Explicit | |
| 15 | Transport | Consignment documentation covering transport of the waste package | C9.3 | Explicit | Potential to review whether this should be continued in current form |
| 16 | International Safeguards | Safeguards category (Safeguarded, Non-safeguarded or Exempt). | C9.1 | Explicit | Fields are too detailed and specific (may be out-dated). Specific requirements need to be reviewed (but probably not included in the requirements). |
| | | Material Balance Area (MBA) code of facility hosting waste. | | | |
| | | Waste item identifier | | | |
| | | Batch code | | | |
| | | Key Measurement Point (KMP) code of installation | | | |
| | | Measurement basis | | | |
| | | Element category (Pu, HEU, LEU, NatU, DU or Th) | | | |

| Original Requirements (WPS/400/02) | | Revised Specification | | Comments | |
|------------------------------------|--|---------------------------|---------|----------|--|
| Category | Field | Category/ Field | Linkage | | |
| | Material form code | | | | |
| | Material container code | | | | |
| | Material state code | | | | |
| | Element weight. | | | | |
| | Fissile isotope code (U235, U233 or U235 + U233) | | | | |
| | Fissile isotope weight | | | | |
| | Obligation code | | | | |
| | Date and time of all movements of the item and relevant MBAs | | | | |
| 17 | Hazardous Wastes (if applicable) | Consignment documentation | C9.3 | Implicit | Potential to review whether this should be continued in current form |



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