

**WASTE PACKAGE SPECIFICATION AND  
GUIDANCE DOCUMENTATION**

**WPS/600: Lifting Grab for 500 litre Drum  
Waste Package: Description and Design  
Guidelines**

**March 2008  
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## WASTE PACKAGE SPECIFICATION AND GUIDANCE DOCUMENTATION

### LIFTING GRAB FOR 500 LITRE DRUM WASTE PACKAGE: DESCRIPTION AND DESIGN GUIDELINES

This document forms part of a suite of documents prepared and issued by the Radioactive Waste Management Directorate (RWMD) of the Nuclear Decommissioning Authority (NDA).

The Waste Package Specification and Guidance Documentation (WPSGD) provide specifications and guidance for waste packages, containing Intermediate Level Waste and certain Low Level Wastes, which meet the transport and disposability requirements of geological disposal in the UK. They are based on, and are compatible with, the Generic Waste Package Specification (GWPS).

The WPSGD are intended to provide a 'user-level' interpretation of the GWPS to assist Site License Companies (SLCs) in the early development of plans and strategies for the management of radioactive wastes. To aid in the interpretation of the criteria defined by the WPSGD, and in their application to proposals for the packaging of wastes, SLCs are advised to contact RWMD at an early stage.

The WPSGD will be subject to periodic enhancement and revision. SLCs are therefore advised to contact RWMD to confirm that they are in possession of the latest version of any documentation used.

#### WPSGD DOCUMENT NUMBER WPS/600 - VERSION HISTORY

VERSION	DATE	COMMENTS
WPS/600/01	December 2005	Aligns with GWPS (Nirex Report N/104) as published June 2005
WPS/600/02	March 2008	Responsibility for the WPSGD passed to the NDA RWMD. Aligns with Issue 2 of GWPS (Nirex Report N/104) as published March 2007.

This document has been compiled on the basis of information obtained by Nirex and latterly by the NDA. The document was verified in accordance with arrangements established by the NDA that meet the requirements of ISO 9001. The document has been fully verified and approved for publication by the NDA.



## 1 INTRODUCTION

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

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

The primary document which defines the packaging standards and specifications for Intermediate Level Waste (ILW), and certain Low Level Wastes (LLW) not suitable for disposal in other LLW facilities is the Generic Waste Package Specification (GWPS) [1]. The GWPS is supported by the Waste Package Specification and Guidance Documentation (WPSGD) which comprises a suite of documentation primarily aimed at waste packagers, its intention being to present the generic packaging standards and specifications at the user level. The WPSGD also includes explanatory material and guidance that users will find helpful when it comes to application of the specification to practical packaging projects. For further information on the extent and the role of the WPSGD, reference should be made to the *Introduction to the Waste Package Specification and Guidance Documentation, WPS/100*<sup>1</sup>.

In order to facilitate the safe and efficient packaging, transport and disposal of ILW, RWMD has defined a limited range of standard containers and has issued specifications for the standard waste packages that are manufactured using these containers. These specifications define the dimensions, lifting, handling and other key features of the containers as well as minimum performance requirements for the complete waste package.

The purpose of this document is to supplement the specification for one such standard, the 500 litre Drum waste package, by providing the design basis information for the lifting grab intended to handle such waste packages in a GDF. The information defines the interface between the 500 litre Drum waste package and the lifting grab mechanism.

In most circumstances, during interim surface storage, transport and operations in a GDF, 500 litre Drum waste packages are handled in groups of four waste packages in stillages<sup>2</sup>. A need may also arise to handle 500 litre Drum waste packages individually, and to ensure that such handling is safe and efficient it is important that all such waste packages are capable of being handled in the same manner using the same design of equipment. This requirement has led to the inclusion in *Specification for 500 litre Drum Waste Package, WPS/300* of a specification for the shape of the lifting feature for the

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<sup>1</sup> Specific references to individual documents within the WPSGD are made in this document in *italic script*, followed by the relevant WPS number.

<sup>2</sup> A description of the lifting frame used with such stillages can be found in *Lifting Frame for Stillage and corner lifting variant of 3 cubic metre Box Waste Package: Description and Design Guidelines, WPS/604*.

waste package. This specification has been derived from a number of design basis assumptions regarding the concepts which will be adopted for the handling equipment. These may impact on the design of the waste containers and are therefore set down in this document to ensure compliance by designers of both waste containers and handling equipment.

This document is not therefore a full specification for the lifting grab for the 500 litre Drum waste package and is limited to a consideration of those areas which have an impact on the specification of that waste package (i.e. *WPS/300*).

## **2 GENERAL DESCRIPTION OF THE LIFTING GRAB**

### **2.1 Function of the Grab**

The function of the lifting grab is to ensure that individual 500 litre Drum waste packages can be handled in a safe manner by an overhead crane or a similar handling device.

### **2.2 Design Assumptions**

The following are the assumptions regarding the design of the grab which have been made in the derivation of *Specification for 500 litre Drum Waste Package, WPS/300*. These assumptions will be relevant to both designers of waste packages and of waste package handling equipment.

The grab will be designed to handle standard 500 litre Drum waste packages as defined in *WPS/300*. Specifically, the key parameters of such waste packages are:

- overall dimensions within a cylindrical envelope of diameter 800mm and height 1200mm (Figure 1);
- a standardised lifting feature (Figure 2) consisting of the body flange to which the lid is attached, and;
- a gross mass not exceeding 2,000kg.

The grab will be capable of lifting a 500 litre Drum waste package from a stillage containing four such waste packages (Figure 3) and located within a Shielded Waste Transport Container (SWTC) [2].

The grab will be designed to handle 500 litre Drum waste packages by means of three claws which will engage the underside of the lifting feature and thereby allow lifting.

RWMD has developed a design concept for a lifting grab [3] the basic features of which are shown in Figure 4. The main features of this design are three claws attached to a lifting arm structure which houses systems to control the attachment of the grab to the waste package. The claws will be capable of radial movement to enable the claws to close onto, and retract from, the waste package lifting feature.

In operation, the grab will be lowered with claws in the fully open position onto the lid of the waste package such that the three feet on the underside of the grab make contact with the lid. In this position a clearance will exist between the lower face of the drum lifting flange and the load bearing surfaces of each of the three grab claws.



The claws will then be closed to contact the waste package lifting feature and the grab will be lifted slowly by an overhead crane (or similar) until the claws contact the underside of the lifting feature; the package will then be lifted.

The grab design will include control mechanisms to ensure that the grab does not apply severe snatch lifting loads to the waste package during the above sequence of operations.

The grab will be designed in accordance with BS 2573 [4] which specifies the classification, stress calculations and design criteria for crane structures. The group classification, as defined in BS 2573, is assumed to be 'A4' with a class of utilisation 'U5' (frequent use) which in turn implies a state of loading 'Q1' (light loading). A snatch load factor of 2 will be assumed in the design.

Measures will be incorporated in the design of the grab to minimise the risk of inadvertent release or other mishandling of waste packages. These are likely to include:

- limit and/or probe switches and appropriate warnings to indicate the status of the claws;
- interlocks to detect the presence of a load and prevent unlocking of the claws when laden;
- a 'slack rope' interlock to indicate when the grab has been lowered on to the waste package.

In the event of failure of the grab whilst attached to a waste package, measures will be provided to allow the package to be lowered in a controlled manner and disengaged from the waste package by remote means.

The design of the grab shall be such as to minimise the risk of releasing the waste package in the event of a collision of the grab and waste package with a stationary object.

### **3 KEY INTERFACING INFORMATION**

The grab interfaces with the waste package at four points in the operating cycle:

- i) when the grab is lowered on to the waste package lid;
- ii) when the claws are closed to contact the circumference of the lifting feature;
- iii) when the grab is lifted to the point where the claws contact the underside of the lifting feature;
- iv) when the waste package is lifted.

To allow the grab to be lowered onto the waste package lid, it is essential that the top surface of the lid of all 500 litre Drum waste packages are provided with a clear annular space, as specified in Section 3.6 of *WPS/300*.

It is assumed that the grab design will include feet fitted with location sensors to indicate to the operator when the grab has been correctly positioned on the waste package lid.

**WPS/600/02**  
**March 2008**

It is not intended that the lifting feature is held radially by the lifting grab. The control mechanisms to be included in the grab design will provide a system for ensuring that only a limited load (typically 100N) will be applied to the lifting feature flange when the claws are closed. This operation therefore places no special requirements on the lifting feature.

To enable the claws to close fully there are a number of key dimensional requirements that the design of the waste package and lifting feature must satisfy. Based on anticipated claw dimensions these requirements, illustrated in Figure 32 are that:

- the thickness of the lifting feature flange does not exceed 55mm;
- the diameter of the feature flange is between 750mm and 800mm, and;
- the outside diameter of the waste package is at least 20mm less than the outside diameter of the lifting feature flange, to a point at least 35mm below the lower face of the flange and to at least 90mm below the upper surface of the waste package lid.

The grab assembly will be designed so that it will not damage any part of the waste package when engaging or disengaging the claws. The claws will be operated at creep speed when raised to contact the underside of the lifting flange. Sensors located in the claws indicate when contact has been made, thereby ensuring that shock loads are not applied to the lifting flange during this process. This operation therefore imposes no special requirements on the waste package design.

Figure 1 500 litre Drum Waste Package

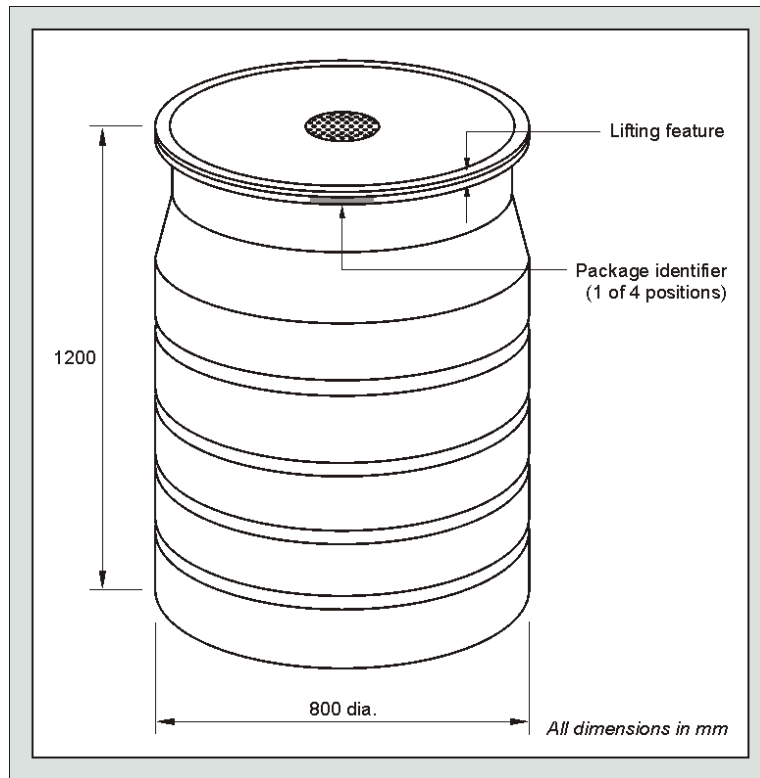


Figure 2 500 litre Drum Waste Package Lifting Feature

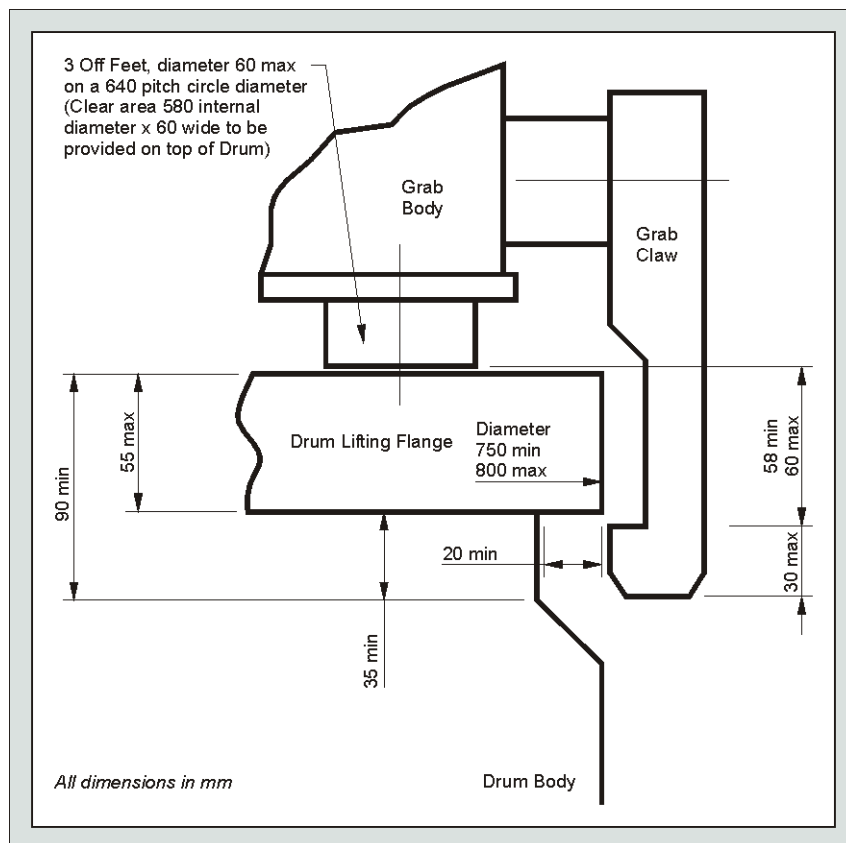


Figure 3 500 litre Drum Waste Packages in Stillage

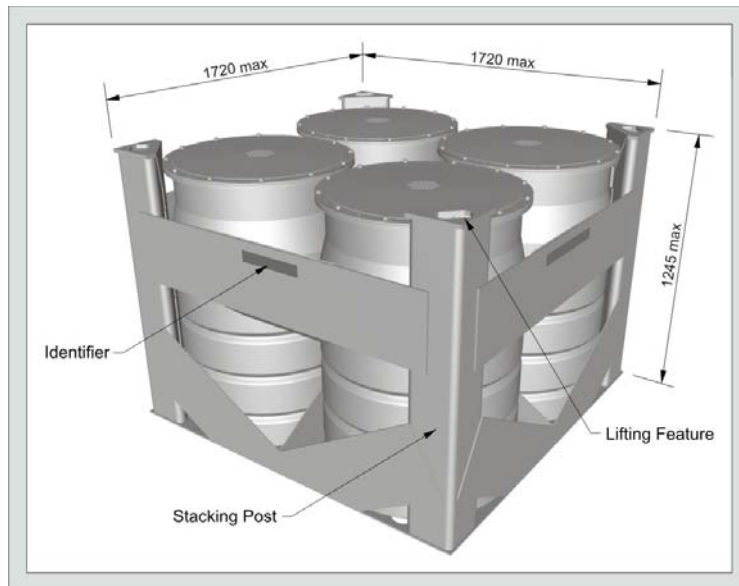
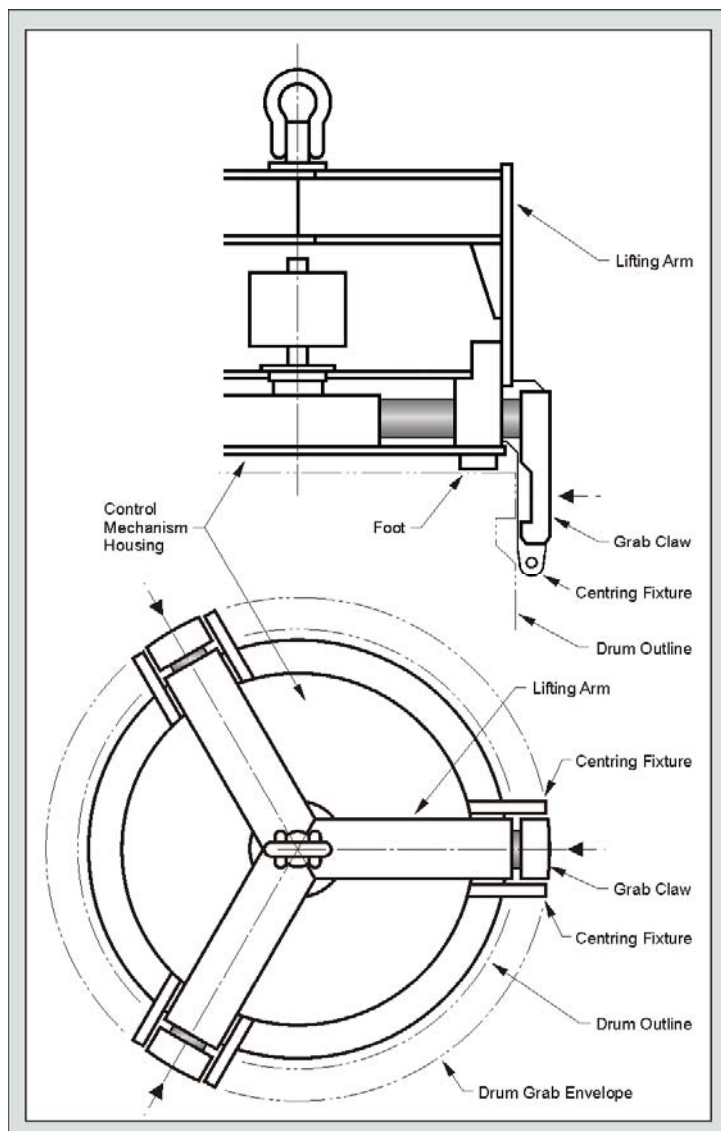


Figure 4 500 litre Drum Waste Package Grab Design Concept



## 4 REFERENCES

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- 1 Nirex, *Generic Waste Package Specification*, Nirex Report N/104 Issue 2, 2007.
- 2 Nirex, *Information on Reusable Transport Containers for ILW*, Nirex Report No. N/066, 2003.
- 3 Gravatom Projects Ltd, *The design of a 500 litre Drum Lifting Grab for UK Nirex Ltd*, Nirex Report No. 55, 1989.
- 4 British Standards Institution, *British Standard Rules for the Design of Cranes, Part 1. Specification for classification, stress calculations and design criteria for structures*, BS 2573: Part 1: 1983.





