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EVOLUTION OF PACKAGES FOR STORAGE, TRANSPORT AND DISPOSAL OF INTERMEDIATE LEVEL WASTE IN THE UK

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Abstract

The paper describes the evolution of designs of containers for the long term storage, transport and disposal of ILW in the UK destined for the UK Geological Disposal Facility (GDF).

The system for higher activity wastes (Type B and certain LSA wastes) uses thin walled stainless steel drum or box shaped containers to carry the ILW that require a Type B overpack for transport. The system for lower activity levels (LSA/SCO) is based on the use of large self-shielded containers that are approved as IP-2 transport packages. To meet containment and shielding requirements under accident conditions at the GDF, the ILW within both types of containers has to be immobilised (eg by grouting); the containers alone are not sufficiently robust to meet these requirements.

For the lower activity ILW (LSA) the evolution of the designs is described from 1st generation concrete boxes (WAGR boxes), through the 2nd generation stainless steel concrete lined boxes (GDF specified waste packages) to the 3rd generation DCIC containers.

A key issue in the design of shielded ILW containers is that they must be suitable for storage for up to 150 years before transport and emplacement in the GDF. This presents challenges in meeting transport and disposal requirements after such periods which are discussed.

The paper credits the introduction of DCIC containers to GNS, Siempelkamp and BAM in Germany where DCIC containers have been developed to meet disposal requirements in Germany: these containers have recently been introduced in the UK for Magnox ILW.

DCIC containers are inherently robust and can be designed to meet GDF accident conditions without undue reliance on the form of contents. This has the potential benefit for limiting or even avoiding conditioning of waste (potentially avoiding grouting) and providing a package that can be stored in a simple store, rather than a complex shielded store.

The paper indicates how the use of robust self-shielded DCIC containers for ILW has potential for use for Type B ILW and how these Type B packages can be shipped either directly as Type B packages, or within an overpack to meet transport requirements.

Introduction

This paper looks at the UK strategy and options for packaging Intermediate Level Waste (ILW) [1]. The UK strategy for ILW is to retrieve, condition and package the ILW and keep the packages in storage facilities until they can be emplaced in the UK Geological Disposal Facility (GDF), or long-term management in near-surface facilities for wastes in Scotland.

Intermediate Level Waste is radioactive waste with radioactivity levels exceeding the upper boundaries for Low Level Waste (LLW) but which do not require heating to be taken into account in the design of storage or disposal facilities. ILW is generated from a number of activities such as:

- decommissioning
- spent fuel reprocessing
- research facilities
- reactor operation
- historical waste storage practices

The chemical and physical form of ILW ranges from large solid waste items that are chemically inert, to wet sludges which could be chemically reactive and heavily contaminated. Depending on the distribution of activity in the waste material and the uniformity of activity distribution, the ILW is likely to be classified as either Low Specific Activity Material (LSA) or Surface Contaminated Objects (SCO). ILW in the form of LSA or SCO requires Industrial packaging. Where the requirements for LSA and SCO cannot be met, Type B packaging is required. Type A packages are not considered practical as a disposable package as they limit contents to A_1 or A_2 activity levels dependent on form of contents. For specific contents they may have a function but these are not discussed in this paper.

The Radioactive Waste Management Directorate (RWMD) of the Nuclear Decommissioning Authority (NDA), which is responsible for establishing the GDF, has identified requirements for the development and assessment of packaging processes to ensure that packaged waste is compatible with the GDF. The general requirements placed on ILW packages for disposal in the GDF are embodied in the Generic Waste Package Specification (GWPS) [2].The current Generic Waste Package Specification (GWPS) calls for a target total container lifetime of 500 years, based on extended periods of up to 150 years of surface storage after which the waste packages are expected to be handled and transported to the GDF.

Within the GDF environment, the waste package must be capable of limiting the release of the contents when subject to accident conditions specified for the GDF that include exposure to a hydrocarbon fire and being dropped onto a hard unyielding surface in a worst impact attitude [3].

A limited range of standard waste containers which are suitable for packaging the variety of wastes expected to arise within the UK and that meet GDF requirements has been specified at a detailed level by RWMD [2] in a number of Waste Package Specifications.

For packaging low dispersible materials such as LSA or SCO items in industrial packages various options have evolved over the last 30 years. The 1st generation of these packages was reinforced concrete boxes (6 Cubic Metre Boxes) with immobilsed contents; the waste package (container and wasteform) provided both shielding and containment under normal conditions of transport and under accident conditions in the GDF. The 2nd generation was designed for a wider range of contents; these were stainless steel boxes having concrete shielding lining the inside walls of the stainless steel container; again performance requirements were reliant on both container and waste form. The 3rd generation of IP-2 ILW packages is constructed in Ductile Cast Iron (DCI); these designs evolved initially to reduce reliance on the wasteform's contribution to the waste package performance. These 3rd generation designs also offer other benefits as the DCI is a more efficient shield material.

1st Generation IP-2 ILW Packages – Concrete Boxes

Until recently, ILW (that meets the requirements of LSA or SCO) has been packaged for disposal in concrete shielded containers (i.e. the WAGR box). The WAGR box (now known as the 6 Cubic Metre Box, see Figure 1) was designed over 20 years ago as an IP-2 transport package for packaging wastes arising from the pilot project to decommission the Windscale Advanced Gas-cooled Reactor (WAGR); the bulk of these wastes were in the form of activated components.

These 1st generation ILW disposal package designs for LSA and SCO were constructed mainly of concrete which provides shielding with mild steel reinforcing (rebar) to strengthen the structure and to provide the integrity of the load path for lifting and tie-down; higher density concretes with thicknesses up to 450mm have been used to provided for greater shielding for some contents.

With concrete waste packages and for some contents there are technical difficulties to be overcome. For more mobile radionuclides, especially for caesium-137, there is a risk that the radionuclides could migrate through the concrete shielding to the surface of the container causing the surface contamination limits to exceed those specified for transport (Paragraph [508] of the IAEA Transport Regulations [4]). Package external radiation levels may also increase as the shielding afforded to the gamma rays from migrating radionuclides decreases: there is a possibility that as migration progresses the package surface radiation levels may exceed the prescribed levels (Paragraphs [526] to [528] of the IAEA Transport Regulations).

Furthermore, there is a risk, if the environment is not controlled, of deterioration of the waste package from chloride induced corrosion of the rebar; this could compromise the package performance over an extended storage period. When rebar corrodes, the oxidation products (rust) expand, cracking the concrete and unbonding the rebar from the concrete. The durability of the concrete is subject to a number of destructive processes such as carbonation and chlorination of the concrete. Carbonation is a chemical reaction between carbon dioxide in the air with calcium hydroxide and hydrated calcium silicate in the concrete. This makes the pore water more acidic, thus lowering the pH, leading to depassivation of the rebars.

Chlorides, including sodium chloride, can, if present in sufficiently high concentration, promote the corrosion of embedded rebar.

Radionuclide migration could be engineered out by introducing a metal containment vessel to the inside surface of the concrete container and corrosion resistant (e.g. stainless steel) rebar could be used in place of traditional mild steel rebar. The addition of these features may significantly increase the production cost of these concrete containers, hence detracting from the initial low cost. However, for certain controls imposed on the storage environment and conditions, choice of construction materials and adequate quality control of manufacturing processes, these concrete boxes may provide a cost effective solution for some wasteforms.

Figure 1: 6 Cubic Metre Box

To ensure that the packages remain in an as packaged condition for prolonged periods of up to 150 years, it is necessary for the storage conditions to be controlled and monitored. Even if stored under controlled conditions, questions may still arise after prolonged storage, as to how the integrity of the load path consisting of steel work (particularly if mild steel) embedded in concrete is assured, and how package performance and containment requirements to meet GDF and future transport requirements can be demonstrated.

2nd Generation IP-2 ILW Packages – thin walled metal boxes with integral concrete shielding

These 2nd generation designs of IP-2 waste packages were introduced by RWMD as an improvement on concrete boxes. Two modular designs were developed: a 2m Box Waste Package (Figure 2) and a 4m Box Waste Package (Figure 3).

These boxes are essentially a continuously welded, gas leak tight, construction of stainless steel (nominally 6mm thickness) using ‘freight container’ fabrication techniques. A concrete liner is cast-in providing shielding and can have thickness from 100mm to 300mm; the shielding could be thicker but this would severely reduce the volume available for contents. The design of the 2m Box Waste Package and 4m Box Waste Package, as with the 1st generation concrete designs, requires that after the waste has been emplaced the container is in-filled with grout, and when this grout is set, that a concrete shield lid of the same thickness as the walls and base is cast in place. The requirement for grouting the waste depends on the form of the waste, but as the shield lid has to be cast in, the design intent is that the shield lid is cast on top of the grouted contents.

Figure 2: 2m Box Waste Package

Figure 3: 4m Box Waste Package

To date, only prototypes of these packages have been made. The use of a stainless steel fabricated 'skin' would ensure that any migration of radionuclides would not lead to an increase in contamination levels on the surface of the package, however as the stainless steel affords little radiation shielding does rates may still rise. The other advantage of this 2nd generation design is that the load path for lifting and tie-down is transmitted through a stainless steel frame that is accessible and visible for inspection and testing. The stainless fabrication affords better corrosion resistance than mild steel although the storage environment would need to be controlled to minimise potential environmental contaminants that may have an influence on corrosion. These transport packages also include a stainless steel transport lid that fits over the concrete shield lid. This transport lid has testable seals so containment performance can be demonstrated at any time after packaging waste. The transport lid seals can also be replaced if they do not pass the leak test; removing the transport lid will not expose operators to any increase in dose over that which the operators will see at the sides as the shield lid remains in place.

The cost of fabrication these 2nd generation designs is expected to be higher than with the first generation designs due to the stainless steel container that is fabricated and into which the concrete liners are cast. However, they do overcome some of the technical difficulties that could be experienced if using an all concrete waste package.

Unshielded ILW Packages for Type B contents

ILW that does not meet the requirements of LSA or SCO for transport in an Industrial Package has to be transported in a Type B transport package. In the UK the waste containers for this type of ILW are currently manufactured in stainless steel and afford no (or little) shielding. In these containers the waste is immobilised usually with cement and the waste packages are designated to be transported to the GDF in a reusable Type B transport package.

The principle unshielded stainless steel containers are the 500 litre Drum Waste Package (Figure 4), the 3 cubic metre Box Waste Package (Figure 5) and the 3 cubic metre Drum

Waste Package (Figure 6). The containers are typically manufactured from stainless steel which provides insignificant radiation shielding and therefore remote handling of the unshielded waste package is required to provide radiological protection. These packages are destined to be transported through the public domain in reusable shielded transport containers that provide both containment and shielding. These reusable transport containers are designed as Type B transport packages under the IAEA Transport Regulations and are specifically designed for the various unshielded waste packages.

Figure 4: 500 litre drums

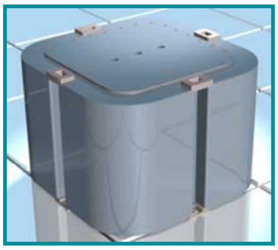

Figure 5: 3 cubic metre Box Waste Package

Figure 6: 3 cubic metre Drum Waste Package

Encapsulation of waste in these containers usually occurs in purpose built heavily shielded facilities with remote handling. Operations may involve sorting and segregation of the waste, preparing the waste for emplacement in a suitable container (this may include batching, volume reduction, placing in baskets) and mixing the waste with a suitable immobilising material before, during or after waste is transferred to the container. In some instances, a separate process maybe required to cap the solidified waste matrix in the container.

This process of immobilising waste is common for packaging of ILW in Industrial Packages (shielded waste packages) and in unshielded waste packages; the immobilisation of the waste creates a robust wasteform that allows the waste package to meet GDF accident conditions.

Waste encapsulation facilities can be costly to build, maintain, operate, clean-up and finally decommission. Such facilities can take a significant amount of time to implement from concept to actual operations; in addition to design and construction timescales, regulatory ‘due process’ (e.g. planning, safety approvals) needs to be accounted for in planning such facilities. Unshielded waste packages must be stored in a heavily shielded facility to ensure that dose rates from the building meet regulatory requirements (these are typically much more onerous than those allowed for under the IAEA Transport Regulations). Such shielded stores can be very costly to build, operate and maintain. Finally, any package inspection is likely to require remote equipment to access them and to provide any information on their condition.

To build, commission and operate such facilities (waste processing and encapsulation plant, and shielded stores) from concept through to actual operations can take many years and can present significant life-time costs.

ILW Packages – Robust Shielded Containers

Historically, in the UK, immobilisation of wastes, in either thin walled stainless steel containers or concrete containers, was seen as the only process that would allow waste packages to meet disposability requirements, particularly with respect to meeting the GDF performance requirements for impact and thermal accidents.

Although the immobilisation of waste is generally seen as best practice, disposability requirements in the UK do not explicitly require such an approach to the conditioning of waste and it is recognized that waste packages containing certain wastes may meet most or all of the requirements of disposability [2] without immobilisation depending on the physical or chemical form of the waste and/or the radionuclide inventory.

In 2006 Magnox, working with the NDA, examined methodologies for accelerating its programme for decommissioning its fleet of Magnox reactors which had reached the end of life. Magnox examined a number of novel solutions for dealing with waste streams included solutions existing in overseas facilities. This concluded with Magnox introducing the concept of Robust Shielded Containers (RSC) for the long term storage and eventual disposal of ILW. These RSCs were Ductile Cast Iron Containers (DCICs) which had been developed in Germany as ILW storage, transport and disposal containers by GNS (the package designer and Design Authority), Siempelkamp (the manufacturer) and BAM (the governmental technical authority). In these RSCs, the waste can be stored without requiring a shielded building and the waste does not need to be encapsulated (although it may require conditioning). The containers consisted of two types: a cuboidal DCIC (an IP-2 transport package) and a cylindrical DCIC (an IP-2 in its own right and Type B when fitted with impact and thermal limiters on the top and base). The use of RSCs supplied by GNS and other commercial companies to Magnox is expected to achieve substantial cost savings and programme acceleration.

The RSCs are seen as 3rd generation designs as they are a step forward from the 1st generation concrete boxes and the 2nd generation stainless steel boxes with integral concrete shielding. The main advantages of these 3rd generation RSCs over earlier generation designs are:

- The waste container itself meets the performance requirements for storage, transport and disposability. Figure 7 (taken from RWMD document [5]) illustrates the relative contribution of the waste container and wasteform to meeting overall waste package performance requirements. The two extremes are a robust waste form and a robust waste container, either of which can provide for the waste package performance; Figure 7 illustrates a ‘sliding scale’ between these two extremes and how each of these two elements can proportionately contribute to overall waste package performance.

- As the waste form is only required to provide a limited contribution to meeting the package performance requirements the need to encapsulate waste as an integral part of waste packaging operations is reduced. The design of some RSCs (e.g. Croft Safstores) does not preclude the possibility of encapsulating the waste at some later stage if this is deemed appropriate for other reasons (e.g. to reduce voidage).

- The need for heavily shielded stores for the waste packages diminishes where the RSCs meets the shielding requirements.

- Reducing and potentially removing the need for waste encapsulation plant that is integral to waste packaging operations and reducing the need for heavily shielded stores offers the potential benefit of significant cost savings of both up front capital expenditure but also in reduced lifetime costs.

- A DCIC package is more efficient for waste packing as iron is a better shield material than concrete and so for a fixed dimension package, the DCIC package has a greater internal volume for the waste.

- The DCIC wall thickness, as a minimum, is tens of mm thick and can be up to several hundred mm in thickness. Such thicknesses will ensure that no migration of radioactive materials will occur through the walls ensuring that both surface contamination levels and radiation levels remain within regulatory requirements.

- The load path for lifting and tie-down is an integral part of the container body of the DCICs; the body is made from a single complete casting and lifting and tie down features are machined into this casting. The container integrity is assessed by various NDT methods (e.g. magnetic particle, ultrasonics) and the same techniques can be used to examine DCIC during and after prolonged storage.

- The corrosion of DCIC is predictable and allowances are built into some DCICs (e.g. Croft Safstores) to allow for general corrosion losses. As above, the container integrity can be checked by non-destructive testing techniques.

- In common with the 2nd generation designs that are transport packages, some DCICs (e.g. Croft Safstores) also feature unique lid arrangements and durable seal surfaces to allow seals to be tested and replaced if required, and that ensure that doses to operators remain ALARP.

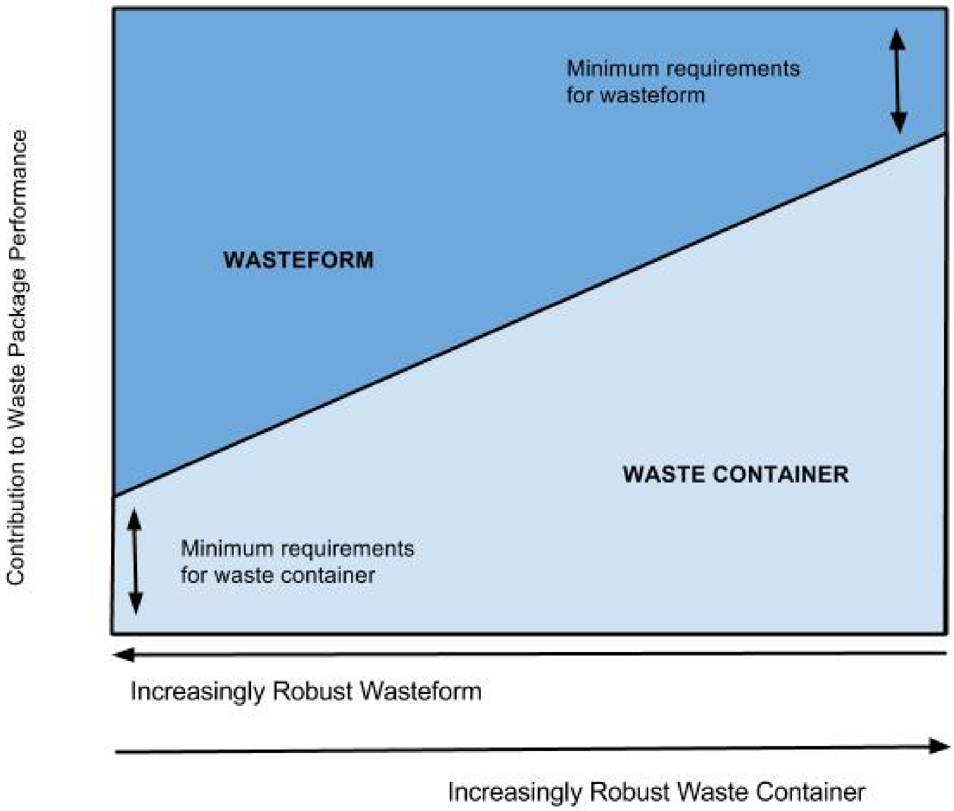

Figure 7: Relative contribution of the waste container and wasteform to waste package performance

Advantages of DCIC as a packaging material

For a fixed external volume of waste package, as the shielding thickness is increased (for either concrete or ductile cast iron) the cavity is reduced. As DCI is a more efficient shield material than concrete, for the same shielding effect, the cavity of a DCI shielded container will be considerably larger than the equivalent concrete shielded container.

For comparison purposes, a container of $11m^3$ external volume is compared with ductile cast iron shielding and concrete shielding which gives the same shielding effect, for various shielding thickness. The internal cavity volume, which will be available for waste materials, is compared to the external package volume. This gives a measure as to the packing efficiency of the waste package. This comparison is shown in Figure 8. The shield thickness for concrete is presented for iron equivalent where, for example, 150mm concrete shielding is plotted, which is equivalent to 50mm iron (over the energy range for gamma rays of interest); cavity dimensions are based on the actual concrete and ductile cast iron thicknesses.

As shown in Figure 8, the use of DCI offers a much higher packing efficiency than the use of concrete of equivalent shielding for a waste package of the same external dimension.

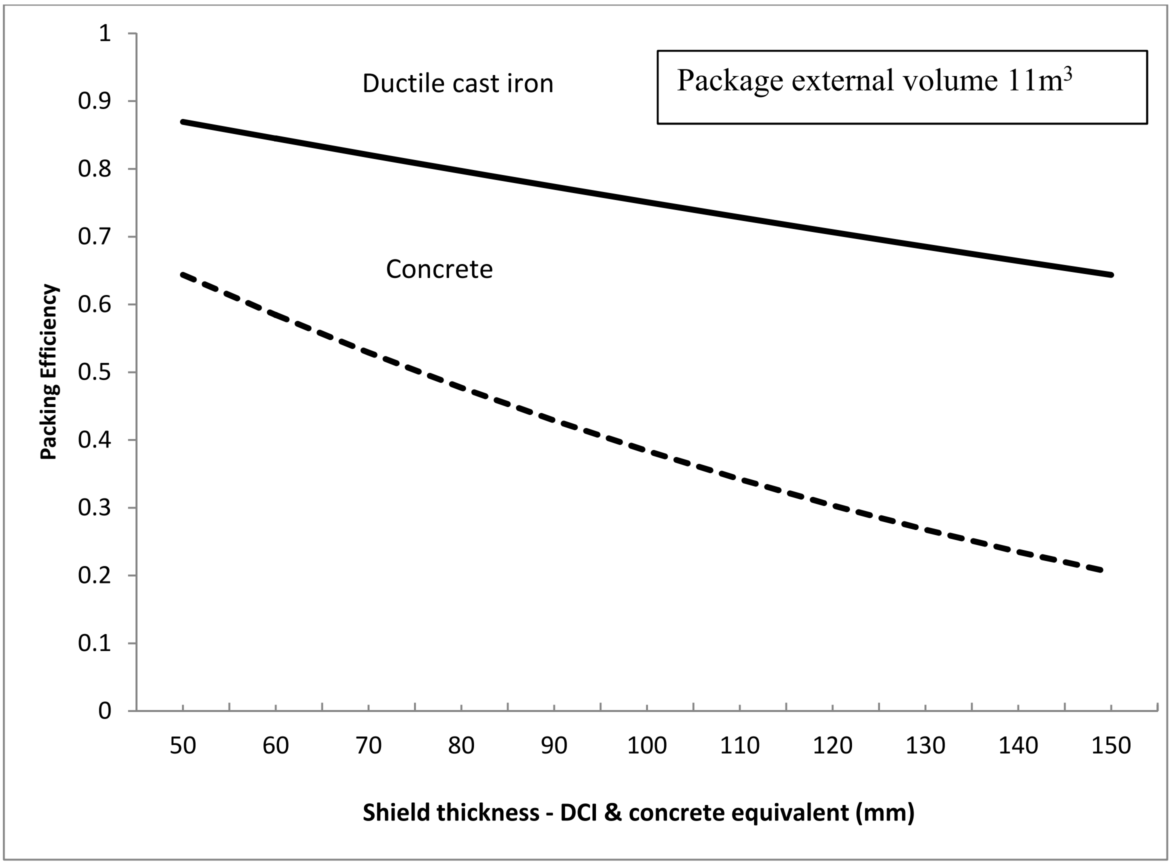

Figure 8: Comparison of waste efficiency for concrete and DCI for fixed external volume of 11m^3

The practical implications of using waste packages with these two shielding materials are considered for waste containers of the same external volume of 11m^3; comparing the Croft 2m Safstore with the RWMD 2m ILW box and 6 cubic metre box. Assuming 450mm concrete shielding is required the effective cavity is about 2.2m^3. The thickness for ductile cast iron required to give the same shielding efficiency is 150mm; this gives a cavity size of around 6.9m^3. This means that to pack the same waste volume a ratio of ~3 x concrete shielded containers is required to every 1 x DCIC. That is ~3 x number of RWMD 2m boxes or 6 cubic metre boxes compared to one 2m Safstore.

The consequence of this for various shielding thicknesses for a fixed external volume of 11m^3 is shown in Figure 9 which gives for various shield thicknesses, the ratio of the number of containers needed with concrete shielding compared to containers with ductile cast iron of equivalent shielding to accommodate the same equivalent waste volume. In Figure 9, the shield thickness is for ductile cast iron, and concrete thickness is converted to a ductile cast iron equivalent (e.g. 150mm concrete is plotted as 50mm ductile cast iron). The waste volume that can be accommodated is based on the cavity volume which is calculated assuming actual material thicknesses (e.g. 450mm concrete and 150mm ductile cast iron).

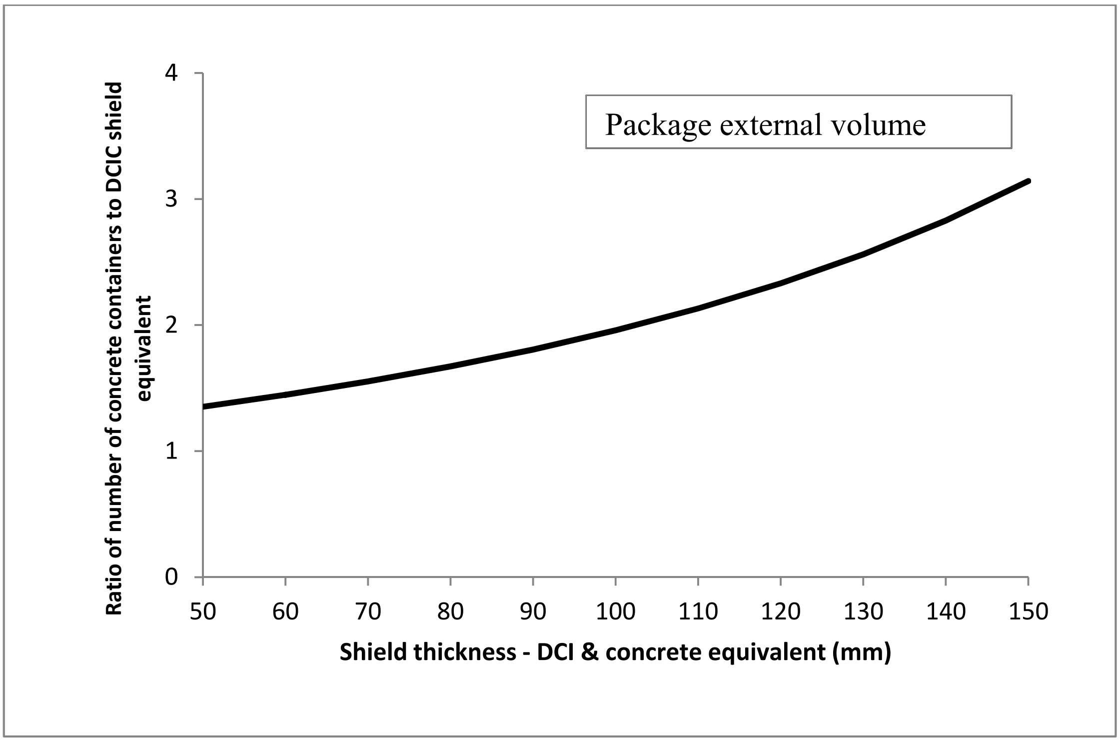

Figure 9: Ratio of concrete shield containers to DCIC (same external dimensions of 11m^3) with equivalent shielding

In considering the economics of packaging waste, the following factors should be taken into account:

- The total number of boxes required for the volume of waste under consideration, bearing in mind that for the same volume more concrete shielded boxes will be required compared to DCI (~3 x concrete containers with 450mm shield wall compared to 1 x DCIC with 150mm shield wall).
- The resources, hence cost, for processing, packaging and storing additional waste packages bearing in mind that more concrete shielded boxes are likely to be needed compared to DCI; in the example cited above ~3 x more packaging operations are required compared to the DCIC equivalent.
- The cost of transporting additional waste packages, for the example cited above ~3 x the transport operations will be required compared to DCI shielding equivalent.
- The plant and equipment, hence cost, of a grout plant to infill the box, plus the plant and operations to also cast on the lid. Although this might be the same grout plant two separate operations may be required.
- The type of waste material that can be placed in concrete packages considering the technical issues that may need to be address to meet transport and disposability issues following prolonged storage; this may limit certain waste materials and/or require design changes to the waste package to accommodate (this may then require revalidation for transport and disposal)

Economies of scale

The cavity sizes of the Croft 2m Safstore and 4m Safstore are presented in Figure 10 as a function of shield wall thickness (which is the cast thickness of the container); sizes of these two DCICs is given in Table 1.

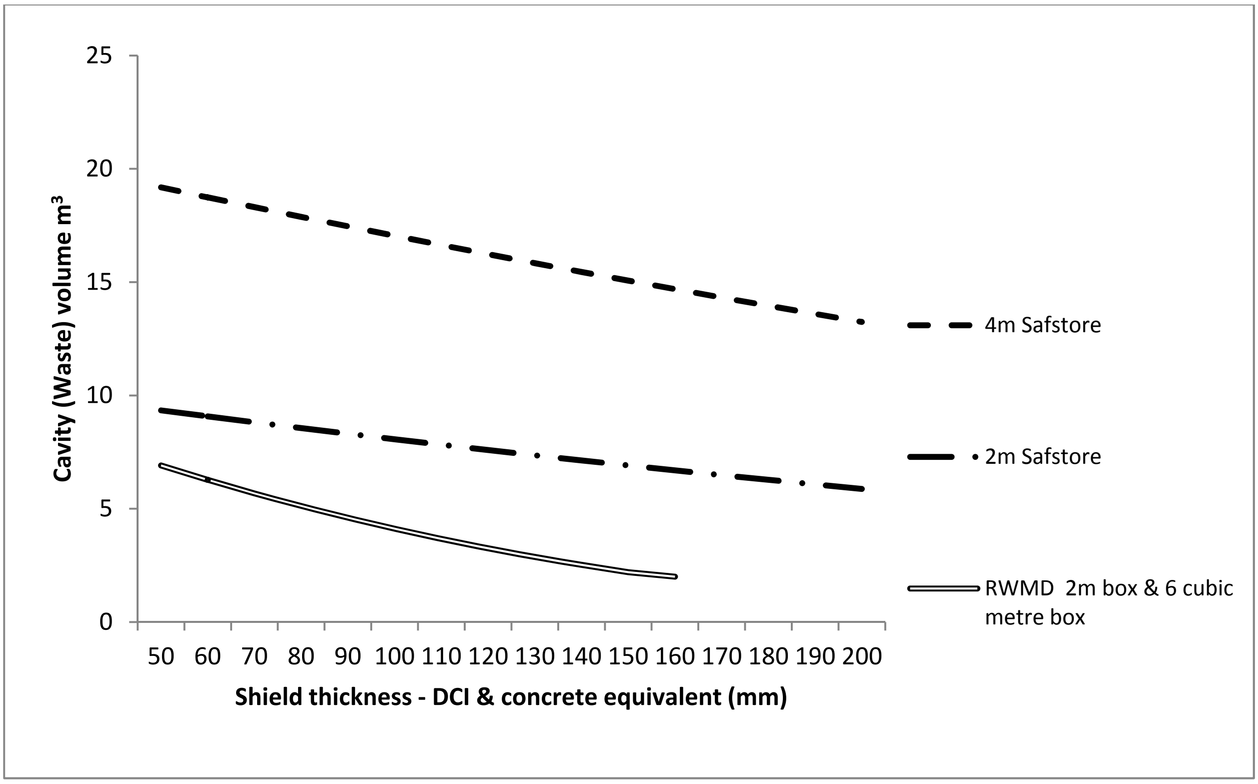

Figure 10: Cavity (Waste) volume verses shield thickness for Croft Safstores (DCIC) and concrete shielded boxes

Also presented in Figure 10 is the same plot for the RWMD 2m box and the 6 cubic metre box as a function of equivalent DCI wall thickness. As can be seen, the 2m Safstore has the same external volume as the RWMD 2m box and the 6 cubic metre box, but presents a much larger cavity for accommodating waste over the complete range of shield thicknesses. Also as demonstrated previously, as the shield thickness increases, the 2m Safstore becomes a more efficient waste package. This trend is more pronounced for the 4m Safstore.

A volume of waste of 1000m^3 is considered, by way of an example, to look at the number of containers needed to package this amount of waste; the package numbers are shown in Figure 11 (excluding any adjustments for packing fractions or voidage).

Figure 11 shows a number of key trends:

- Significantly more waste packages will be needed using concrete shielding than with ductile cast iron shielding for the equivalent sized box.

- The larger capacity containers present the most efficient packaging option in terms of the number of containers required; for example in going from 50mm of DCI shielding to 150mm DCI shielding the number of 2m Safstores increases by about 50% whereas for the 4m Safstore the increase is about 30% for the same volume of waste. Compared to the 2m Safstore, the number of concrete boxes of same external volume increases by a factor of 300% over the same equivalent shielding range.

The larger capacity containers offer the opportunity to reduce the amount of waste processing by allowing larger items to be packaged. This presents an opportunity of reducing exposure times to operators if they are directly involved with size reduction operations ensuring that dose commitments are ALARP. There is also anecdotal evidence to suggest that the largest possible aperture is also favoured as this minimises the amount of size reduction needed to fit waste through the box aperture.

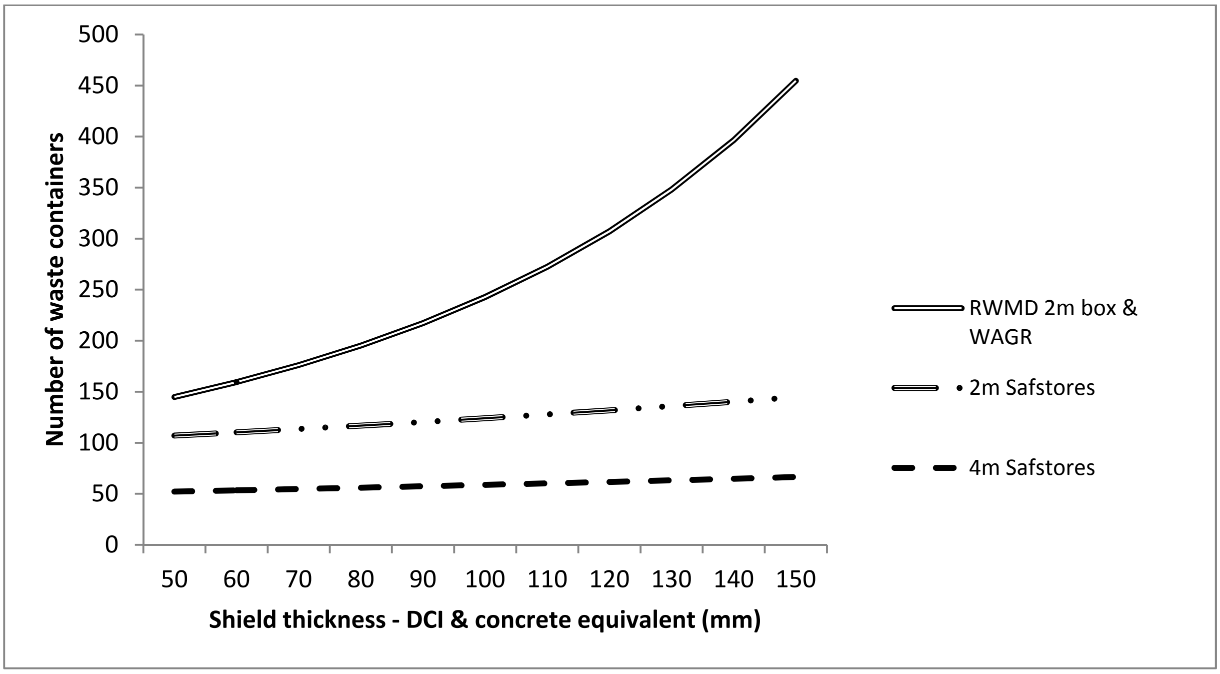

Figure 11: Number of waste container for 1000m^3 of waste

Usage of Robust Shielded Containers

By reducing the need for complex waste packaging plant and heavily shielded stores, the use of RSCs offers waste packagers the opportunity to achieve hazard reduction much more quickly and more economically than using the more traditional approaches to packaging wastes.

Whilst Magnox selection of DCICs meets its needs, an analysis of the wider international nuclear industry suggested a range of sizes and thickness would be appropriate.

Table 1: Members of Croft range of Safstores

Croft DCIC Design	**External dimensions** L x W x H Or (L x Φ) metres	**Waste Capacities m³**	**Shielding (DCIC) Typical mm**	**Mass (empty) tonne**	**Equivalent RWMD specification packages (thin stainless steel with concrete lining)**
IP-2 for LSA/SCO material					
2m Safstore *	1.967 x 2.438 x 2.2	9.3 to 6.9	50 to 150	11 to 29	2m ILW box waste package
4m Safstore	4.013 x 2.438 x 2.2	19.1 to 15.0		17 to 49	4m ILW box waste package
IP-2 for LSA/SCO material / Type B materials (requires overpack for transport as a Type B)					
500 litre Safstore	1.975 x Φ1.43	2.0 to 0.7	100 to 300	9 to 19	(to fit 500litre RWMD drum 800mm Φ x 1200mm height)
200 litre Safstore	1.575 x Φ1.22	1.4 to 0.3		6 to 12	(to fit industry standard 200litre drum)

**There is a 1/2ht version of this Safstore at 1.1m height*

Croft recognised that the wide range of waste streams that could arise from decommissioning activities both in the UK and internationally fitted with a more versatile range of RSCs, and the development of novel engineering solutions to facilitate storage, transport and disposability of these containers.

Consequently, Croft has developed a range of RSCs in DCI: these are called Safstores. The Croft Safstores offer solutions for waste management from interim storage through to final disposal. The Safstores can provide a safer interim solution for storage of legacy radioactive waste rather than leaving in-situ pending resolution on final disposal options. Wastes can be stored safely until waste processing facilities come on-stream should further processing be deemed appropriate, although final disposal in the Safstores could prove a viable option (conceptual stage acceptance has been received from RWMD for a number of designs).

The more significant RSCs in DCI developed by Croft are given in Table 1. These meet both requirements for transport [4] and disposability requirements (required by RWMD, NDA). In addition Croft also develops bespoke solutions to meet specific customer needs.

The typical design features of a Croft IP-2 Safstore intended for LSA or SCO material are shown in Figure 12. This shows a double lid arrangement: a shield lid of the same thickness as the container body, and an outer transport lid with replaceable verifiable seal system. Figure 12 also shows the design as it was developed and the subsequent manufacture. Croft has a patent pending in relation to its Safstore design features.

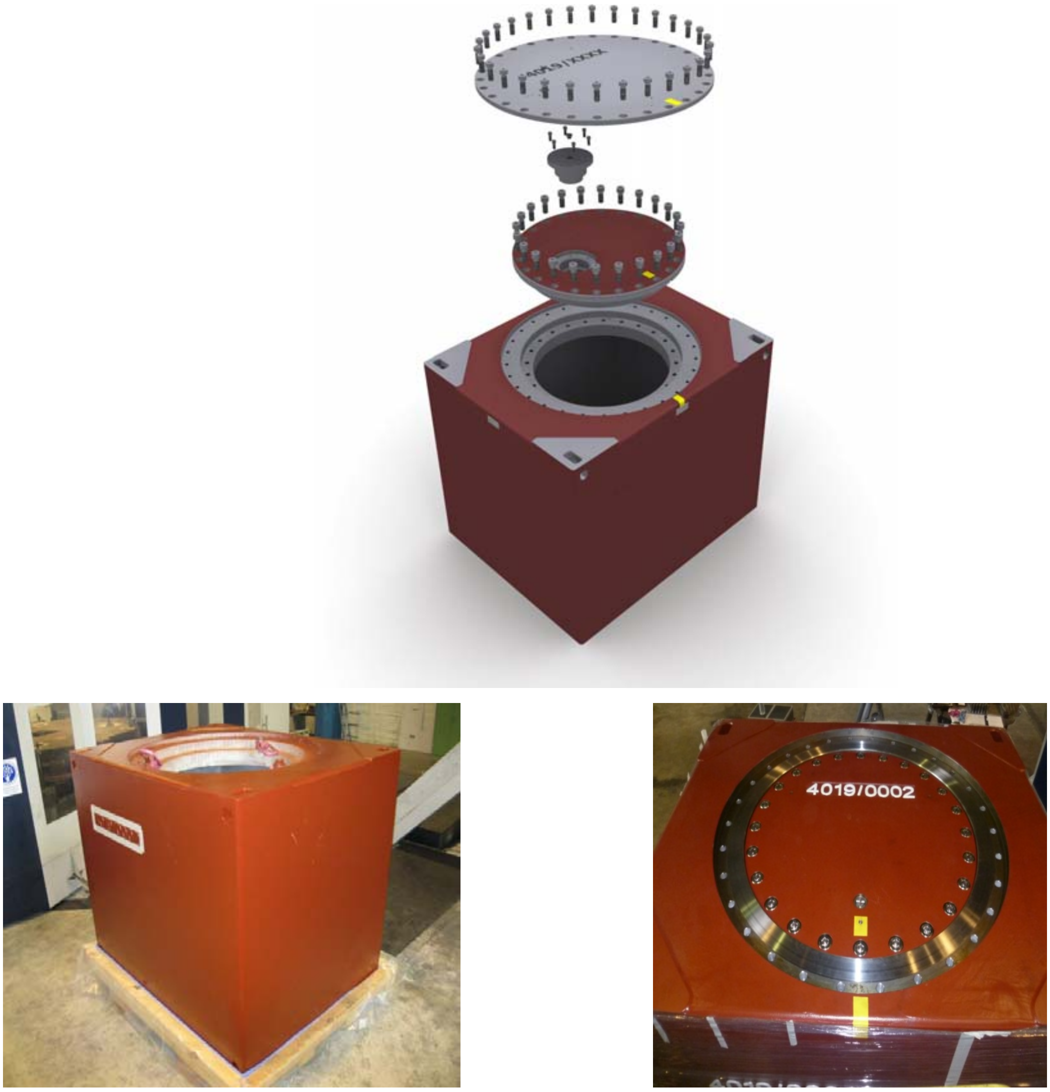

Figure 12: Typical Croft IP-2 Safstore (with circular opening)

Conclusion

Whereas historically, in the UK immobilisation of wastes was seen as the only process that would allow waste packages to meet disposability requirements, it has been found that the use of RSCs obviates the need for the same degree of immobilisation and also offers other benefits.

Reducing the need for encapsulation plant integral to waste packaging operations and, for traditional unshielded waste packages, removing the need for heavily shielded stores, offers the opportunity to site operators to accelerate hazard reduction, decommissioning, and site clean-up with significant efficiency improvement and significant cost saving.

DCI as a material for RSCs offers benefits over early generations of shielded containers through mitigating issues of migration of radionuclides through the concrete, whilst providing more efficient shielding (more space for waste) thus allowing for reduced numbers of containers for a given amount of waste to be packaged.

Croft has developed a range of RSCs constructed in DCI (called Safstores), that are suitable for a variety of wasteforms. The Safstore range provides waste packagers with the flexibility to choose cavity size and shielding, and to maximize packaging efficiencies to meet weight limits whilst offering safe solutions for interim storage, transport and eventual disposal of ILW.

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