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

Trevor Tait
Senior Project Manager

Bob Vaughan
Founding Director

Croft Associates Ltd, Culham, Oxon, UK
Tel:- 0044 (0)1865 408640
E Mail:- Trevor.Tait@Croftltd.com

ABSTRACT

Designers of packages for Intermediate level waste (ILW), to be supplied for use within the United Kingdom (UK), recognise the need to meet the separate regulatory requirements pertaining to on site storage, transportation and final disposal.

These requirements emerge from the different regulatory regimes under which ILW packages must operate during their lifetime; from operations on nuclear licensed sites, through to transport in the public domain and ultimately final disposal in the UK Geological Disposal Facility (GDF).

The regulatory requirements for transportation are historically well defined and understood by package designers. This is, however, not necessarily the case with regards to the requirements for site handling, transportation and storage, which often vary due to the particular licence requirements of the individual Site Licence Company (SLC). Requirements for disposal exist for a number of generic package designs in the form of level 3 specifications.

It is clear that provision of a package design to meet all of the above regulatory requirements, which can be contradictory rather than complimentary, is a complex undertaking. In the optimum scenario, for all of the requirements to be satisfied they should be considered at the earliest stage of the product lifecycle, ideally at the point of commencing the design phase.

As an experienced provider of packaging solutions, Croft has optimised the design process to incorporate an initial phase of requirements capture to definitively map all of the varying requirements, and identify how each is met. This technique has proved most effective when all interested parties operate in an integrated manner. Utilising this methodology Croft has developed innovative design solutions to meet the assorted performance requirements; satisfying the needs of waste producers to package various types of ILW ranging from LSA and SCO materials, to Type B quantities of radioactive wastes.

This paper discusses the complex array of regulatory requirements, the potential packaging solutions which should be considered by the end user, and by the use of case studies, illustrates how Croft can optimise each design to meet the specific regulatory needs of a package.

INTRODUCTION

Intermediate Level Waste (ILW) arises from operational facilities and from decommissioning legacy plant and process. In the UK, ILW has activity levels that exceed those of Low Level Waste (that is with activity levels greater than 12 GBq/tonne of beta/gamma and 4GBq/tonne alpha) and thus is not suitable for disposal at the Low Level Waste Repository. ILW is destined for disposal at the Geological Disposal Facility (GDF), and as this is some years away from operations the waste has to be stored for potentially long periods (up to 150 years) before it can be transported for final disposal.

Packaging such wastes now, in suitable containers, ensures that such wastes can be maintained in a safer state than if left in situ. At the heart of this packaging process and that which will contribute towards the waste package's long term performance and safety, is the waste container.

The lifecycle of a waste package consists of a number of defined stages covering the waste packaging process where the waste is processed into a waste container, the subsequent interim storage period which follows from waste packaging pending availability of a disposal route (which could be up to 150 years), and transport to the disposal facility.

There may be additional stages as raw waste may be transported from site of arising to a separate licensed site for processing and packaging, and the waste package may then be transported to another centralised storage facility at a separate licensed site. The timescales for these different stages may vary by 10's if not 100's of years.

The operations carried out at the various stages of waste processing and packaging, storage and transport, must meet all appropriate regulations. These requirements emerge from the different regulatory regimes under which ILW packages must operate during their lifetime; from operations on nuclear licensed sites, through to transport in the public domain and ultimately final disposal at the GDF.

This paper sets out an optimised methodology, utilised by Croft to ensure that the customer receives an appropriate and fully substantiated container design which satisfies all the appropriate regulatory requirements, whilst providing the most economic solution for management of these wastes.

The success of the methodology is strongly dependent upon detailed and collaborative requirements capture performed at the initiation of the enquiry. These requirements, once agreed with the customer, are then distilled into a product specification which is subsequently utilised to select the most appropriate package design.

This paper describes the package design process outlined above, and illustrates the successful deployment of the process by way of a specific case study.

THE REGULATORY FRAMEWORK WITHIN THE UK

For transporting packages containing ILW in the public domain, these requirements are as defined by the International Atomic Energy Agency's regulations (Ref 1) (referred to hereafter as the IAEA Transport Regulations). These regulations, first published in 1961, are long established and well understood by those within the packaging industry associated with the transport requirements for radioactive materials (Class 7). Within the UK, satisfying the UK Competent Authority, (that is the Office for Nuclear Regulation *abbrev.* ONR), of compliance with the IAEA Transport Regulations is an essential pre-requisite for any package required for transportation in the public domain.

For transport, ILW is either generally classified as Low Specific Activity Material or Surface Contaminated objects (LSA or SCO). For those materials not meeting the IAEA Transport Regulations requirements for these materials; they would be further classified as requiring Type B transport packaging. The packaging standard for LSA or SCO is an Industrial Package (IP); the actual IP category (IP-1, IP-2, or IP-3) will depend on such factors as the form of material and specific activity (LSA-I, LSA-II or LSA-III), and surface contamination levels for SCO (SCO-I or SCO-II).

In the last decade the focus for ILW has increasingly been drawn to the issue of final disposability. In common with many other countries with a nuclear legacy, the UK plans for ultimate disposability of ILW packages presently remain in the planning stage. Specifications exist for "standard" packages accepted as suitable for disposal by the responsible body; in the UK this is Radioactive Waste Management Ltd (RWM). All packages, destined for disposal are required to be assessed and endorsed against these specification requirements by RWM as part of the Letter of Compliance (LoC); a process of acceptance for final disposal.

Furthermore, with regards to the packaging of ILW, the waste is the responsibility of one of the UK Site Licensed Companies (SLCs). In the packaging process the waste container will be held within a waste packaging facility where the waste is recovered from its source. Once the waste packaging process has been completed the waste package will either be stored locally, thus limiting site movement, or it may be transported elsewhere either on-site or off-site to an interim storage facility. There it will be stored for a period until the GDF becomes operational; UK SLCs are adopting a policy of storage in purpose built storage facilities. These waste processing and storage facilities will have their own site specific operational requirements to satisfy the site specific safety cases with regards to on-site storage and transport movements.

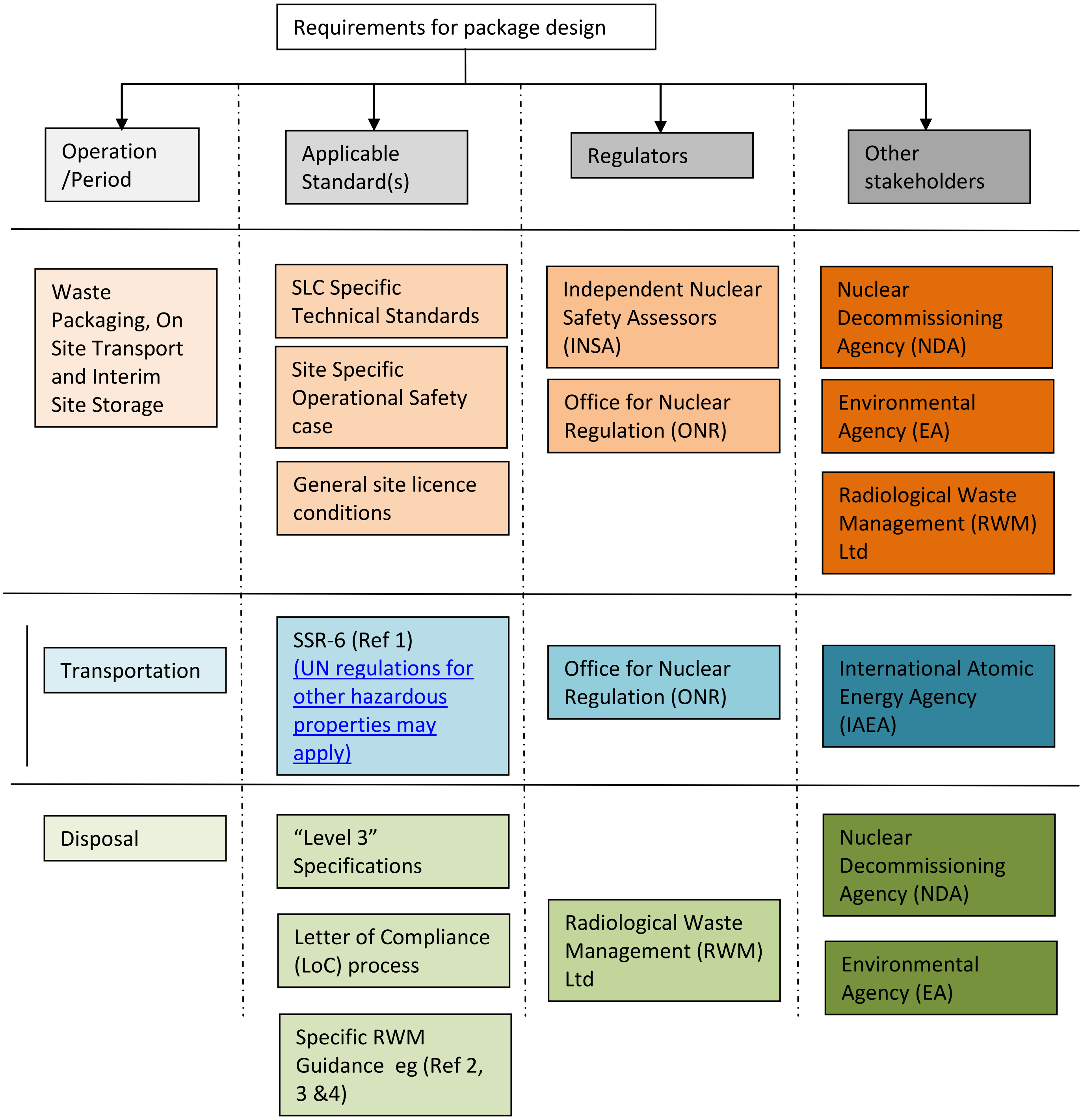
For waste packages which are transport packages and destined for final disposal, it can therefore be seen that a package designer within the UK must be fully cognisant of these separate sets of requirements applicable to a transportable and disposable package, along with the nuances of separate regulatory and approval bodies.

In addition to the requirements for transport and disposal, it can therefore be seen that site licence requirements constitute a further element of consideration for the package designer.

Figure 1 below provides a diagrammatic depiction of the regulatory framework within the UK as summarised above.

Thus it can be seen that a container designed solely for transport in the public domain in mind may not be directly suitable when considering these other requirements.

Figure 1 – Diagrammatic depiction of the regulatory framework within the UK



THE PACKAGE DESIGN PROCESS

As illustrated above, the regulatory framework within the UK is a complex one to navigate successfully for package designers. Customers, such as SLCs, may require packages suitable for a number of different operational phases: waste packaging, on-site transport, interim site storage, transportation and disposability. Alternatively customers may require a package that only meets a combination of these elements, for example, options to meet final disposability at a later point in the product lifecycle might be considered to allow 'regulatory approval' for preceding stages to commence more quickly to assist in accelerated hazard reduction. Furthermore, individual project affordability may dominate a customer's thinking, and therefore it may not be cost effective upon a given project to design and substantiate a generic package to meet all possible requirements.

In an ideal situation a package designer will have a detailed specification provided by the customer to clarify the operational requirements. In practice, even if a specification is available, it is commonly very high level and generic in order to allow differing options to be considered within the procurement exercise.

Of course it may be that a customer's requirements align exactly to the selection of an existing product supplied by the product designer or that is available from the supply chain, although considering the regulatory framework as presented above, this is increasingly unlikely. It is very common that customer requirements require additional functionality within an already existing product.

This presents the package designer with some difficulty of how to determine the optimum solution for each customer, and how to develop package designs suitable for timely provision within the UK regulatory framework.

Following consideration of this problem Croft determined that in order to provide appropriate packages in a timely fashion the following elements should ideally be in place.

- Customer Specification
- Detailed and collaborative Requirements Capture.
- Detailed product specification derived from the Requirements Capture.
- Mapping of requirements against available products.
- Where necessary, design optimisation to incorporate customer specific requirements.
- Substantiation of product

CUSTOMER SPECIFICTION

In order to approach the market it is common that the customer has performed an initial feasibility study, and may have commenced the initial elements of the safety case process such as Hazard Identification. This will often lead to the distillation of a set of high level requirements into a Specification. In some cases the customers experience is such that the specification is detailed and constrained around a particular solution, leading to a fully defined technical / functional specification. In this case the subsequent steps of the design process identified herein may be curtailed or even circumnavigated.

However, it is much more common that the customer's specification is at a high level, with minimal detail, in order not to preclude a selection of solutions as an outcome of the procurement process. This type of specification is often identified as a Procurement Specification, and in order to proceed, requires the detailed requirements to be captured in the process identified below.

REQUIREMENTS CAPTURE

Requirements Capture is a term often utilised for the process of capturing pertinent information before design commencement. Broadly there are three phases to the process:-

- Defining the problem and the business requirements,
- Determining and detailing the functions required to satisfy the problem,
- Documenting the results, critically including the substantiation required, within a requirements specification.

A fourth phase is commonly employed, whereby the requirements are reviewed against the finished design to ensure full compliance.

Requirements capture tools and processes are widely used, particularly in the field of systems engineering, where projects can be multifaceted, employ multiple parties, and have complex interface requirements.

Although designing a package is perhaps not of the complexity of some complex engineered systems, it can be seen by reference to Figure 1, that without some methodology to capture requirements it is likely that key requirements will be missed. This may increase the risks of delays in packaging waste which can significantly increase costs and can potentially make the regulatory environment much harder to navigate successfully.

It is not the intention of this paper to look at requirements capture methodologies and systems in detail, as they are well documented within many literature sources. Rather it is the intention to briefly illustrate below the process employed by Croft to ensure successful delivery of a fully compliant package.

The Croft technique is based upon the use of Functional Analysis, to determine the applicable functional and performance requirements. Ideally this is commenced at contract initiation, noting that the outcome may potentially point towards the use of a standard or existing design. It is therefore paramount that the exercise takes place before design or development of a product commences in earnest. As the design of the waste packaging plant can be heavily dependent on a specific package design it is important that this exercise is carried out early in project planning. If packaging plant design and building works progress without an agreed package design (agreed and approved by all relevant regulatory bodies), any non-compliances requiring alternation to plant design or build could lead to significant programme and cost overruns.

The optimum process usually commences immediately upon receipt of an enquiry. The nature of enquiries can be wide ranging, from detailed specifications through to simple statements based upon the perceived need of an existing product. In essence the process is similar for each enquiry and is ideally fully collaborative with the customer.

Through conversations, site visits and document review, requirements are captured and tabulated for ease of reference. Significant package design experience is required to successfully undertake the process as what is often most difficult to capture are those requirements that are not explicitly stated by the customer but implicit from other requirements. Check lists may be utilised as prompts, but are not relied upon as the process does require intuition and experience to obtain maximum benefit.

Requirements are carefully worded to ensure that they are:-

- Solution independent: Requirements should not specify the solution, what needs to be done rather than how it will be done.
- Complete: Requirements need to consider, unless otherwise specified by the customer, all relevant phases of the product lifecycle. Namely waste packaging process (retrieval, treatment etc), interim site storage, transportation and disposability.
- Clear: Clarity is essential in order to substantiate that a requirement has been met.
- Concise: Unnecessary / duplicated requirements should be removed.
- Testable: Quantitative limits should be indicated wherever possible. Testable requirements can be measured at the end of the design phase to substantiate that the design intent has been achieved.
- Traceable: Traceability of the requirement though the requirements capture spreadsheet, which is a live document throughout the design process, allows the final design substantiation to be reviewed and accepted by the customer.

As can be imagined, the requirements capture spreadsheet can become a weighty document. A sample capture spreadsheet is included within Table 1 below to give an illustration of the format and process.

Once the requirements have been successfully captured it is imperative that they are then reviewed with the customer prior to any decision upon the potential package solution. Following this review and customer acceptance the requirements are then utilised in the selection of the most appropriate packaging solution as described below. Note that the appropriateness of a particular solution should be substantiated against each requirement as part of the design review process before final commitment to a particular design.

Table 1 - Extract from Requirements Capture spreadsheet for typical Croft package design.

Req Id	Ref	Req Description	Compliance statement	evidence	status
125	Outline Spec	The ability to operate within the SWL of the facility equipment to mass limits for the EOTC, Bogie, product Hoist lift of container & contents (including any cover liquor) for lid lifting mechanism.	Standard Croft product masses are well within EOTC, Flask Bogie and container hoist SWL, assuming maximum mass of contents	Product data Sheet, GA	Fully compliant
126	Outline Spec	The ability to operate within the physical limits imposed by the envelope of the rail and road network for transport both on and off site.	Standard Croft product is within rail transportation limits	GA	Fully compliant
127	Outline Spec	The ability to operate within the physical limits imposed by the Export building.	Standard product is bounded with respect to dimensions and mass by site flask	GA	Fully compliant
128	Outline Spec	The ability to accommodate the 2 container variants, large & small	The standard product has been designed to handle the largest container	GA, Design Justification Report	Fully compliant
129	Outline Spec	The ability to allow remote operations, such as to raise and lower the containers within the cell	The standard product has been designed for receipt of the container from the container handling mast within the cell.	GA	Fully compliant
130	Outline Spec	The ability to allow bogie transport of the Croft Package within cell.	The standard Croft product is within the site flask envelope in terms of size and mass	GA	Fully compliant

PRODUCT SPECIFICATION

From the requirements capture exercise a set of conditions emerges: limits, parameters and features that cover such issues as:

<u>Contents</u>

- Inventory: radionuclides in the waste, activity levels (which will affect shielding requirements)
- Uniformity of contents and specific activity (for LSA compliance),
- Contamination levels (for SCO compliance),
- Nature of contents
- Presence of potentially reactive materials,
- Liquids, water content
- Waste loading arrangements (will waste be dropped in and present impact loads?).

Waste treatment & packaging & on-site transport

- Limits and constraints as imposed by the waste treatment and packaging plant and yield
- Dimensional constraints
- Weight limits on all lifting equipment available
- Clearances on lifting equipment and handling equipment
- Tolerances
- Potential contamination issues when packaging wastes
- Background radiation levels which might affect any manual operations
- Information on potential fault scenarios to determine integrity requirements from plant safety cases and hence
- Substantiation requirements for waste containers (e.g. Impact requirements, thermal load cases etc)
- Specific on site standards and requirements for transport packages

Other customer specific issues such as

- Flammable gas produced from waste products
- Interface with existing in cell handling equipment and processes.
- Customer specific paint finish
- Demonstrable robustness to customer specific impact performance requirements.

Radiological conditions

- Radiological zones and interfaces on SLC's with packaging plant, on-site transport limits and limits imposed by any interim storage facilities.
- Covering such issues as radiological conditions required of the waste package, e.g. external radiation levels at surface and at distances.

On-site transport

- On site performance requirements for impact and thermal accidents
- Containment requirements for normal and post accident conditions
- Surface contamination levels
- Radiation levels
- Types of finish required
- Load factors for lifting
- Allowable materials
- Lifting features
- Methods of transport

Interim storage

- Length of time to be stored
- Requirement for beyond storage period (transport to GDF, disposability)
- Containment criteria for store
- Type of storage environment and any potential contaminates (e.g. chlorides)
- Gas management
- Operational safety case requirements (impact and thermal accident faults)

<u>Off-site transport</u>

- Is the waste package the transport package
- Classification if a transport package
- Ability to verify against original design specification particularly if stored for extended periods

<u>Disposability</u>

- Ability to meet RWM Waste Package Specifications, e.g.
    - Weight limits
    - Dimensional limits
    - Handling features
    - Impact and thermal accidents
- Waste steam compatibility
    - Reactive metals
    - Mobile radionuclides

At this point of the design process the requirements are distilled into a product / design specification. This may not be necessary if the customer specification is of sufficient detail. It should be noted that the specification is not simply a reformatting of the requirements capture exercise, rather it should seek to emphasise the discreet requirements pertinent to mapping and packaging selection. In particular, the specification should ideally consolidate similar customer requirements into one actual design requirement. For instance, it may be that the site safety case requirements for on-site transportation bound the off-site transportation performance. Therefore in this scenario, to simplify the packaging mapping and selection, only the on-site requirements would be specified at this stage.

Apparent contradictory requirements can emerge; requirements for disposability and for meeting on-site safety cases can be more onerous than for meeting IAEA Transport regulation requirements.

MAPPING OF REQUIREMENTS

Following the distillation of the key requirements into a product / design specification, these most pertinent requirements are mapped against a broad range of container options. Comprehensive knowledge of the products available within the market is required at this stage in order to ensure all potential packaging solutions are examined.

Initially, particularly if a key requirement is disposability, it is sensible to begin the mapping exercise against the “standard” ILW designs presently assessed as suitable for the GDF by RWM.

Clearly, if the key requirements align with a “standard” package specification then the mapping process can be relatively simple, resulting in a clear packaging solution. Experience suggests that this is unlikely, and that in practice a number of alternative solutions may be identified which satisfy most, but perhaps not all, of the key requirements.

When the outcome presents multiple solutions it is usual to evaluate these, either qualitatively or quantitatively, within an optioneering exercise. A quantitative exercise has the advantage of applying a numerical, documented and structural approach, which makes the task of reviewing the decision much simpler. Indeed this is the preferred approach with regards to demonstration of regulatory compliance.

A qualitative approach is often employed where the selection choices are simpler and easier to evaluate. Whichever approach is undertaken it is vital that this mapping exercise to determine the final solution is performed collaboratively with the customer. The output of the exercise should be a solution that meets most, if not all, of the key requirements identified in the design specification. From experience, the identified solution is very likely to be a variation upon the standard designs requiring "design optimisation" to meet specific customer operational requirements. In a small number of situations the optioneering may conclude that a fully bespoke solution is required, and the product / design spec and output from the optioneering exercise can then be used to define the parameters for the design process.

DESIGN OPTIMISATION

At this stage of the process the identified packaging solution should be relatively mature. The key requirements will have been identified, and a packaging solution identified to meet these requirements. The packaging solution is typically dominated by a consolidated set of key requirements, namely:-

- Impact Performance
- Containment Performance
- Shielding performance
- Wasteform Evolution
- Container Evolution
- Mass constraints
- Geometry constraints

It can be seen that to satisfy the key requirements above the packaging solution will have identified the container material, geometry, wall thickness, mass limits, handling and tie-down and external / internal geometry. It is usual at this stage to consider compliance with customer specific requirements which are not within the standard package design, but readily configurable. It is important to ensure that these variations do not compromise package performance or existing licences for transport and disposability before incorporation into the design. It is typical to optimise a standard package to suit a customer's specific need pertaining to such items as:-

- Wall thickness
    - Optimising wall thickness is a common requirement to suit a particular customer requirement which will be largely driven by shielding thicknesses and structural issues. It is often advantageous in terms of mass / affordability and operability to minimise excessive wall thickness where not required to perform shielding function. With regards to containers of cast construction,

concrete or metal, this can relatively easily be accommodated by variations to the master pattern. Alternatively liners or shielding panels may be more appropriate to increase wall thickness of a standard package.

- Aperture Configuration
    - With regards to onsite operation, it may be beneficial for the customer to minimise additional processing, particularly with regards to size reduction of the wasteform. It can therefore be a requirement to optimise the aperture for loading, typically making the aperture larger and rectangular rather than circular. The affect upon impact performance and containment requires detailed consideration when making changes to the aperture of an already substantiated package.

- Lifting Features
    - With regards to transportation and disposability lifting features are relatively standardised for ILW packages. However, typically for site operating requirements, additional lifting features are often deemed necessary following the requirements capture exercise. This can lead to incorporation of such items as pintles, trunnions, or additional lifting attachments to allow lifting of the container, or maybe lifting the container lid with existing site operational equipment.

- Ventilation
    - Typically Croft would ensure ventilation is specified in all packages as part of the requirements capture process, indeed all Croft ILW packages have filtered ventilation as standard to mitigate against container pressurisation during long term storage and for disposal. However, due to the wasteform, and possibly container evolution, particularly over the timescales associated with interim storage and disposal, enhanced ventilation may be an optimisation requirement. In particular the evolution of some wasteforms can lead to hydrogen generation, requiring enhanced ventilation as part of a hydrogen management regime.

- Surface treatment.
    - It is common to incorporate a customer specific treatment, in particular with regards to external paint systems where many UK SLCs have defined site standards to ensure decontaminability. It may also be that the requirements dictate an internal coating / finish to mitigate against container evolution effects during interim storage and final disposal, with corrosion resistance being of particular concern considering the respective time frames of 150 years and 350 years respectively.

Many further design optimisations have been employed by Croft upon ILW Packaging solutions, for example;

- Double lid arrangement

    - The incorporation of two lids; a shield lid and a separate transport lid, this simplified the processing for verification of containment for transportation, recognising that this could be after as much as 150 years after interim site storage. Following the interim storage period the transport lid can be easily removed, the seal checked for performance and replaced if necessary before verification of leak tightness prior to transportation; the inner shield lid remains inplace and protects the operator from direct radiation; this ALARP approach minimises operator dose during remediation work on the transport lid seal system if this is required.

- Simple face to face sealing.
    - The lid seals are designed to act in a face to face rather than piston configuration. This greatly simplifies lid removal and attachment, again minimising operator dose uptake. It also makes the seals easy to install and replace minimising the operational maintenance required.

CASE STUDY – PACKAGING DESIGN FOR LEGACY UK ILW

Around 5 years ago, Croft Associates developed a standard range of robust self shielded containers in ductile cast iron to accommodate most ILW within the UK radioactive waste inventory (Ref 5). As a design basis such wastes are destined for disposal at the GDF following site storage of up to 150 years.

The initial design solution for LSA materials was for large volume containers based on the dimensions and handling feature of the RWM specification waste packages this offered advantages of compliance with RWM specifications which ensures compatibility for disposability; cLoCs were obtained for these designs. Design solutions were developed of increasing capacity as cost per m^3 of contained waste decrease as capacity increases.

All designs can be optimised as discussed above. Examples of optimised small cavity containers manufactured in ductile cast iron are shown diagrammatically in figure 2 below.

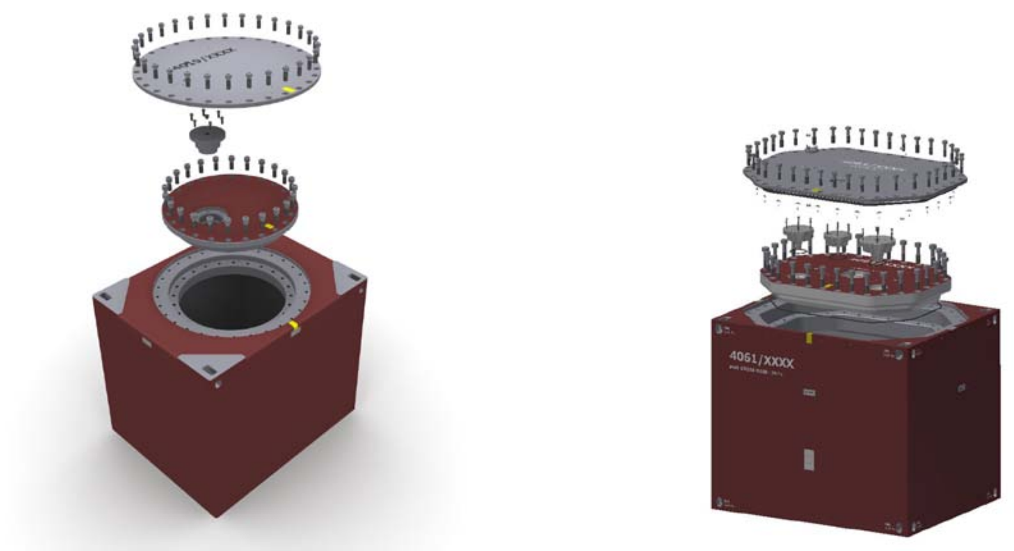


Figure 2 – Examples of a Robust Self Shielded Waste Containers Options

In looking at the specific needs of a SLC and when the requirements capture exercise was carried out a collaborative review was held with the customer, from which further customer specific requirements were identified. These were primarily identified to aid site operations, with the addition of an optional requirement to facilitate future transportation. The design solution was then optimised:-

- The design of the customer's waste loading facilities was mature, and the customer's preference was to maintain this design. A circular opening presented operational difficulties, and so a larger rectangular aperture was offered without prejudice to the impact, containment and shielding performance.

- The customer's preference was that the container should have the flexibility to interface with additional waste processing equipment as necessary, in particular to allow for waste drying in the container if deemed necessary. Additional process ports were duly accommodated within the inner shield lid, and the filters arranged so that these additional ports did not compromise vent performance.

- The containers were designed by Croft to enable potential future transportation as a type B package if the operational need should arise. Croft design's incorporated optional features to allow for the provision of future Type-B transportation, in particular a bespoke impact and thermal limiter.

- Larger capacity containers were offered to the customer as larger capacities offer a lower cost per m3 of container waste and also larger capacities require less operational effort to fit large items of waste. However, the smaller capacity containers were preferred to fit existing operational plant and processes.

The case study above illustrates the design process leading to delivery of a substantiated package design; namely by following a detailed requirements capture exercise, optimising an existing design to suit the specific customer requirements, and building upon existing substantiation to verify that requirements had been met to customer and regulator satisfaction.

The optimisation process is greatly enhanced when the respective responsible bodies (which exist within Croft) for design, licensing (conformance to IAEA Transport Regulations), disposability, manufacturing and quality, are present as an integrated team. Experience suggests that this cross-fertilisation within a single team allows for integrated solutions to be developed more efficiently.

SUMMARY

In summary, this paper has illustrated the increasingly complex nature of package design for storage, transport and disposal of ILW within the UK. The complexity is largely realised by the particular regulatory requirements of each regulatory body, and often how these are interpreted by SLCs within site specific safety cases.

In order to ensure a package meets the array of requirements, a process has been illustrated based upon the methodology employed by Croft Associates for packaging design. The process is initiated by a collaborative requirements capture exercise which helps to determine the exact requirements for package performance. These requirements, once agreed with the customer, are then evaluated initially against "standard" designs specified as suitable for disposal by RWM.

Once the type of container has been down selected, a cross check against each requirement is performed to ensure that performance can be substantiated. Croft experience is that at this point a degree of design optimisation may be required to suit a customer specific requirement.

As an experienced package designer, Croft solutions provide confidence with regards to the conformance of packagers to relevant regulatory requirements. Furthermore, having a long established Quality Management System, routinely audited by the UK regulator, assures that each and every package is delivered to the customer's satisfaction.

REFERENCES

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4 NDA, Generic Specification for waste packages containing low heat generating waste, NDA report NDA/RWMD/068, August 2012

5 The 2013 UK Radioactive Waste and materials Inventory published by NDA/DECC.