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Standardising the Transport of (Very) Low Level Waste in the UK

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Abstract #390

LLW Repository Ltd is the UK's primary Low Level Waste (LLW) repository since the 1940s and has been subjected to many strategic changes over its 70 yeaof operation. Latest UK radioactive waste forecasting figures reveal that the UK's primary LLW repository is being filled at an unsustainable rate. This is primarily due to poor segregation of low activity wastes at the location of origin.

Modern waste management studies have indicated that the best environmental options are when possible; to recycle LLW and to entirely divert Very low Level Waste (VLLW) to authorised landfill disposal sites. In most waste recycling scenarios the final concentrated residues return to the UK as untreatable LLW for final storage in the concrete vaults. The LLW Repository Ltd manages the design of all the IP-2 ISO container designs that are accepted at the repository for final disposal, offering safe and cost effective transport solutions. This approach essentially standardises LLW packaging and transport systems across the UK.

In the case of VLLW diversion to non-nuclear licensed landfill sites many variants of package designs are accepted. In practice the UK has seen an array of different package designs being used all with differing levels of package integrity, different loading, handling, tie down requirements.

This paper briefly describes LLW Repository Ltd approach to both managing OECD aspects of VLLW waste diversion and standardising the transport of VLLW. It features the development of the new IP-1 (IP-2) TC11 package design for the transport of VLLW. The TC11 is an IAEA compliant multi-modal Soft Sided Package Transport system that is adaptable and designed ready to be uprated to IP-2 for LLW transport upon demand. The paper details the TC11 prototype tests and functional trials (over and above IAEA requirements) on the inners and the outer frame.

Finally the paper will explain to the reader why and how the LLW Repository Ltd has taken a UK lead in the management of VLLW and is able to provide nuclear liability insurance protection for the transport and disposal of VLLW to authorised landfill sites.

INTRODUCTION

The Low Level Waste Repository (LLWR) is located near the village of Drigg in Cumbria, and is the UK's primary Low Level Waste disposal facility. The facility is managed and operated on behalf of the Nuclear Decommissioning Authority (NDA) by UKNWM and the nuclear site license company is the LLW Repository Ltd. The volumetric capacity at the UK facility is limited and current Waste inventory forecasts indicate that a potential capacity gap of 3.5 million m^3 exists between the maximum capacity of the LLWR site and the volume of waste currently identified for disposal. The current focus of the LLWR is to prevent disposal capacity being used up at the facility by waste types which lend themselves to alternative treatment and/or disposition routes.

Proposed alternatives include offering, supercompaction, metallic and combustible waste treatment services and diversion of (V)LLW to alternative routes. The aim is to ensure that only appropriate wastes, which require an engineered barrier for environmental or personnel protection, are consigned to the concrete lined vaults at the LLWR. The establishment of these alternative waste treatment routes is expected to extend the operational life of the current LLWR to support the UK's nuclear decommissioning strategy. Application of the waste hierarchy (avoid, reduce, re-use and re-cycle) in this way ensures that the aims of the UK Government's Policy for the long term management of solid low level waste in the United Kingdom are achieved.

Package Design IP-1(2)/TC11 described in this paper is primarily designed to transport (V)LLW for waste diversion to authorised commercial hazardous waste land fill sites, whilst retaining the capability to transport conditioned LLW for use as profile material in the construction projects, such as the LLW Repository Site final cap.

1 - LLW REPOSITORY OPERATIONAL STRATEGY

The objectives of the LLW Repository Ltd operational strategy is to implement and offer a fully integrated waste management operation, providing a full service across the broad spectrum of waste management activities in support of UK waste consignor initiatives. A UK Nuclear Industry LLW Management Plan has been developed to sit alongside the strategy which, provides detail on a number of tactical solutions required to implement the significant opportunities presented by the proposed strategy including the design, testing and supply of a new range of packages to transport LLW to support all LLW routes. LLWR in its role as National (V)LLW 'integrator' has a key role in the implementation of the strategy. In order to facilitate implementation of the waste hierarchy, LLWR has been developing a suite of new package designs to provide alternative options and flexibility for waste producers, whilst meeting the NDA's main Transport and Logistics Strategy principle of optimising rail over road.

2 - UK LLW AND RELATED IAEA TRANSPORT CATEGORIES

About 94% (about 4.4 million cubic metres) of radioactive waste falls into the LLW category. Of this volume, 4 million cubic metres are from the dismantling and demolition of nuclear facilities. About 6% (290,000 cubic metres) of radioactive waste is in the ILW category, and less than 0.1% (1,000 cubic metres) is in the HLW category.

Low Level Wastes (LLW) is defined as wastes having a radioactive content not exceeding 4 GBq (gigabecquerels) per tonne of alpha, or 12 GBq per tonne of beta/gamma activity. Very Low Level Waste (V)LLW is a sub-category of LLW that comprises:

- Low Volume (V)LLW (LV-LLW) - wastes that can be safely disposed of to an unspecified destination with municipal, commercial or industrial waste, each 0.1 cubic metre of material containing less than 400kBq (kilobecquerels) of total activity, or single items containing less than 40kBq of total activity. There are additional limits for carbon-14 and tritium in wastes containing these radionuclides.

- High Volume (V)LLW - bulk disposals (HV-LLW) – wastes with maximum concentrations of 4MBq (megabecquerels) per tonne of total activity that can be disposed of to specific permitted and authorized landfill sites. There is an additional limit for tritium bearing wastes.

The principal difference between the two LLW categories is the need for controls on the total volumes of HV-LLW being deposited at any one particular landfill site. LV-LLW is generated principally by the "small users", while most HV-LLW is produced at nuclear licensed sites [1].

Experience has shown that most (V)LLW falls within the scope of the UK's statutory instrument for invoking the safe transport of radioactive material by road:"The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations" [2]. This UK statutory instrument essentially implements the requirements of ADR 2013 . LLW & LLW activity limit constraints align to the transport categories of TS-R-1 [3] either Low Specific Activity LSA-II, LSA-I (majority) or Excepted Packages. The bounding package type required to be able to transport all forms of (V)LLW is an Industrial Package Type 2 (IP-2).

It must be noted that if multiple package designs and transport methods are considered for the transport of (V)LLW, a low percentage of (V)LLW may be transportable as either excepted packages or as un-packaged LSA-I or SCO-I. These options are not discussed in this paper as Excepted package designs are only sufficient for a small percentage of the (V)LLW transports and un-packaged waste transports require careful preparation; for example; prevention of cross contamination, contents specific waste loading plans, exclusive use transport methods etc. In summary, these options do not offer any standardisation, safety or multi-modal benefits and in the opinion of the author these methods of transporting radioactive waste should be the exception.

3 - EXISTING UK PACKAGES TO TRANSPORT (V)LLW

3.1 LLW for Disposal at the LLW Repository Site

LLWR waste acceptance criteria (for disposal) restricts waste producers to using the LLW Repository Ltd specially designed IP-2 ISO containers. LLW Repository operates a fleet of nine height driven design variants of these top opening containers. In summary, the LLW is placed in the IP-2 ISO Containers at waste producers sites and then transported to the LLW Repository Site. The containers are then subjected to voidage filling operations using a cement based grout, before they are finally transferred to the engineered concrete lined vaults for disposal.

To ensure the integrity and longevity of the concrete vaults is maintained, all existing IP-2 ISO container variants are fabricated from weldable structural carbon steel. Retention of contents within the containers is provided by the totally sealed welded construction of the body and lid. The integrity of the package containment system is ensured by a manufacturing container body leak tightness test prior to painting and additionally where designs incorporate twin lid seals, an isolation pressure fall leak test to the lid seal interspace. The packages are intended to be completely loaded with waste optimising packing efficiency, reducing voidage and preventing any free movement of contents within the package cavity during normal conditions of transport. These containers were not designed to be emptied once loaded with un-treatable (V)LLW.

3.2 (V)LLW for disposal at Authorised Land Fill Sites

There are various designs of packages used to transport (V)LLW to authorised hazardous waste land fill sites, the most common being off the shelf drums of varying integrity and capacity and Soft Sided Packages (SSPs) from various suppliers of differing designs used in various ways, with the only common factor of being restricted to one mode of transport (road). UK experience from the use of SSPs loaded and unloaded via pallets directly to flat bed trailers is raising safety concerns and has caused a small number of near miss events at these specific land fill sites. No standardised packaging system has ever been introduced in the UK to specifically transport and dispose of HV-LLW for waste diversion.

3.3 (V)LLW for disposal as construction profile infill

It is planned to cap the LLW Repository site vaults (1- 16) progressively over time in order to maximise containment of the LLW disposed of since 1959 and up until 2080. The cap is designed to keep infiltration as low as possible for as long as possible; minimise leachate quantities at all stages of the life of the facility; minimise the rate of degradation of waste due to effects of waters and provide optimal physical barrier against natural processes and human intrusion. The cap requires 720,000m^3 of infill, of which a large proportion will be provided by excavated materials, from construction of future vaults at the site. However there is a calculated shortfall of approx. 230,000m^3. Studies have been produced that demonstrate it is feasible for a proportion of this in fill construction to be replaced with conditioned (V)LLW (restricted to contaminated soil and rubble), subject to activity restrictions. The conditioned (V)LLW is known as Profiling Fill. There is currently no UK packaging system for the bulk transfer of contaminated rubble and soil that can be emptied on receipt for safe emplacement of profiling fill. It must be noted that at the time of writing this paper, this approach remains at feasibility stage and no formal proposal has been presented to the authorities for the use of (V)LLW as profile infill.

The remaining sections of this paper describes how LLWR has approached standardising (packaging and transport) logistics for the movement of (V)LLW to either; authorised commercial hazardous waste land fill sites or to the LLW Repository Site for use in the vault capping construction project.

4 – DEMONSTRATING IAEA COMPLIANCE FOR (V)LLW PACKAGES

As explained above a high proportion of (V)LLW will meet the IAEA regulatory requirements if packed in Excepted or IP-1 Packages. In the spirit of the IAEA graded approach, Excepted and IP-1 packages are merely required to satisfy the criteria for routine conditions of transport (RCT). RCT does not invoke any IAEA regulatory performance testing and for this reason rarely are Excepted or IP-1 package designs supplied with a self assessment package approval certificates that references an applicable package design safety report. The consignor is still required to demonstrate that the Excepted or the IP-1 package design, complies with the basic safety criterion as listed in TS-R-1 Paragraph 606 – 616 prior to using the packaging. Attention must be drawn specifically to paragraphs 606, 612 & 615 and the fact that quite often off the shelf (bulk supplied) packagings intended for use as Excepted or IP-1 packages, often raise a challenge to the consignor being able to provide evidence that these minimum IAEA provisions are satisfied, due to the level of data supplied with these packagings as often the design intent of these packages was never for use as an IAEA compliant package.

> *606. The package shall be so designed in relation to its mass, volume and shape that it can be easily and safely transported. In addition, the package shall be so designed that it can be properly secured in or on the conveyance during transport.*
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> *612. The package shall be capable of withstanding the effects of any acceleration, vibration or vibration resonance which may arise under routine conditions of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole. In particular, nuts, bolts and other securing devices shall be so designed as to prevent them from becoming loose or being released* unintentionally, even after repeated use.
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> *615. The design of the package shall take into account ambient temperatures and pressures that are likely to be encountered in routine conditions of transport.*

Whereas IP-2 package designs are required to meet the higher IAEA graded criteria of Normal Conditions of Transport (NCT), which invokes the start of the IAEA performance tests. IP-2 package designs typically have a Package Design Safety Report (PDSR) and manufacturing life time quality record pack. Together these key documents demonstrate to the consignor that compliance has been achieved.

5 – (V)LLW DIVERSION - TRANSPORT CHALLENGES

5.1 Package acceptance (handling and disposing) at authorised UK Land Fill Sites

Authorised commercial hazardous waste land fill site operators currently do not impose any package design acceptance criteria. All UK permitted (authorised) land fill sites acceptance criterion is based on the ability/capability of the facility to safely handle (conventionally) the package designs when unloading from the conveyance and subsequent on site transports for disposing the waste into the near surface disposal trenches. Unlike established UK nuclear licensed sites, land fill sites have limited infrastructure, limited lifting capability and only fit for purpose access and egress systems to their shallow burial trenches. Typically these land fill sites will not have any overhead crane capability and will operate fork lift trucks, rough terrain telescopic handlers and tipper trucks/trailers. They commonly utilise an unloading area for large goods vehicle deliveries (road only) and then on site rough terrain mobilisation transport systems. To ensure these (V)LLW diversion routes remain a cost effective sustainable option, it is important that any package type introduced for disposal at these permitted (authorised) land fill sites can be safely operated using their existing systems, without any need for any large investments to procure infrastructure or equipment.

5.2 Package acceptance (handling and disposing) at the LLW Repository Ltd site.

LLWR site utilises a range of IP-2 ISO container variants for LLW disposal and has all the infrastructure and equipment to handle containers weighing up to 42te. Any new system offered to the site, would need to take into consideration and utilise current package handling systems to ensure the success and sustainability of using (V)LLW as profile fill.

5.3 UK Waste producers

UK waste producers seek a solution that is capable of transporting LSA-I & LSA-II waste that is compatible with existing loading and handling infrastructure as used for traditional LLW management. Any system must also minimise the need for investment. Additionally any new system must be able to be transported by rail for optimised logistics campaigns, with minimum impact on existing waste management practices.

5.4 Nuclear Civil Liability Transfer for LLW (Nuclear Matter)

In the UK approximately 98% of LLW is generated from the UK's nuclear energy programme. The Nuclear Decommissioning Authority (NDA), a non-departmental public body owns 19 of the UK's nuclear sites and all the associated civil nuclear liabilities and assets. The issue is the nuclear civil liability transfer. The current interpretation of the Paris/Brussels Convention [4] is that the for material defined as Nuclear Matter (UK interpretation: all wastes that originate from the nuclear fuel cycle are deemed to be nuclear matter) the licensed nuclear operator where the waste originated from remains liable for the waste until the waste is accepted by another licensed nuclear operator. LLWR site is a nuclear licensed site, and typically takes risk, title and ownership of the (V)LLW upon collection or receipt at the LLWR site, subject to certain conditions. The UK permitted (authorised) land fill sites are not nuclear licensed operators and as such all consignors of waste to these land fill sites theoretically remain liable for the waste during transport and disposal indefinitely.

5.5 Disposal (Single use) Package economics

The cost of single use packaging for the nuclear waste sector is a major factor in successful implementation. The major risk to avoid is an over engineered and overpriced packaging solution. An attempted national implementation of such a system would have a detrimental effect. UK waste producers need a solution that is compatible with existing systems and accepted by all the permitted (authorised) land fill sites and is cost effective on a £/m^3 basis.

6 – DEVELOPING THE IP-1(2)-TC11 PACKAGE SYSTEM

At PATRAM 2010 LLW Repository Ltd presented a concept design for introducing the US designed Soft Sided Packages (SSP) to the UK [5]. Since 2010 LLWR has developed the concept into a prototype.

The TC11 SSP delivery system comprises of an inner and an outer. The outer primarily functions as the delivery system for SSPs (the inners). The outer is an open frame design and performs as the payload restraint system. The lateral and longitudinal restraint of the SSP are provided by the internal walls of the TC11 loading bays, and internal baffles. The payload vertical restrain is provided by the integral load bearing cargo net fixed to the frame with captive ratchet-operated lashing straps. The TC11 outer also functions as the conveyance tie down interface and provides the package stacking capability using ISO twist locks. Both payload restraint and conveyance restraint systems meet all required accelerations for road, rail and sea transport modes [6]. The inner, 'the SSP' forms the containment system for the (V)LLW, including water resistance for the package system. The TC11 inner and the TC11 outer form the "TC11 Package Design".

6.1 TC11 inner (SSP) testing and trials

Taking into account that no standard SSP system has ever been offered, LLW Repository Ltd carried out international research to identify what designs of SSP on a large scale were in operations using similar infrastructure and equipment that UK waste producers are using today for LLW. The key parameters of the research focused on a low cost SSP system that was compatible. The research unfortunately did not identify existing systems that satisfied all requirements. The decision to design a prototype SSP delivery systems that was able to be transported by road, rail and sea modes was taken.

A key phase of this project involved the re-assurance testing of the US designed SSP system (variant supplied by PACTEC Inc). The aim was to ensure the SSP was both safe to handle and was able to demonstrate that no loss or dispersal of contents would occur during routine conditions of transport. The key test that gave LLW Repository Ltd confidence that the TC11 package system could be successful was the containment test. This test was performed in the US and consisted of subjecting the SSP to a vibration table test with an associated pressure flow test with a tracer dust to detect release of any fine particulate dust during the test. The RCT test profile was based on 1000 driving hours, with typical pressure differentials and temperature increases equating to a volume increase of 7%. This specific test on the SSP, which was successful, was presented as a technical paper at PATRAM 2010 [7].

Post manufacture and structural testing of the TC11 outer, the TC11 prototype package system was trialed using readily available off the shelf sizes of SSP (2 x 2.2m^3 SSPs were used per TC11 bay) to contain the payload.. The SSP were loaded with LLW simulant while positioned inside the supplied (by PACTEC Inc) Loading Frame. The simulant comprised of a heterogeneous 4:1 mix of sand and rubble. The SSP Loading Frame worked very well and the SSP was loaded using mechanical shovels from a height of up to 1.8m, without any damaging impacts to the SSP base and flexible side walls. The SSP containment system was easily closed safely using the zip ties fitted to the SSP. The closure system relied on two separate systems to form the containment system. However it was noted that without the two closure systems the containment system would have been unsatisfactory as there was a visible leak path where the 2 x zip ties met each other on the same zip line.

The suppliers (PACTEC Inc) SSP Lifting Frame was utilised for lifting the SSPs. The Lifting Frame, consisting of 10 equally spaced lifting hooks to attach the SSP lifting loops. The fitting of the SSP to the lifting frame involved manual access around the lifting Frame. The middle hook at the rear of the Lifting frame (as seen in figure 1), required manual access to the underneath of the forks to attach the SSP lifting loop:this operation was questioned as a potential unsafe practice. When lifted the SSP did retain its shape when retracted from the loading frame and was consequently successfully re-mounted into the TC11 bay. It must be noted that for large scale operations a remote detaching Lifting Frames are available from the US suppliers PACTEC Inc.

Figure 1 - SSP being lowered in to TC11 middle bay using the Lifting Frame

6.2 Analysis and development of the TC11 inner

LLWR has carefully analysed all learning from the trials and all learning passed by the US users of the SSPs. The design of the TC11 inner has been adapted to take into account stakeholder technical requirements and enhance operational safety, which should assist national implementation of the TC11 system. The TC11 inner is a specially adapted variant of the commonly available SSP design, comprising the same containment system design to ensure the SSP meets test criteria as referred to in section 7. It will be offered in two size variants. The smaller size variant (4 x SSP to each TC11 bay) will have a payload capacity of 1.18te. It will be manufactured from a single layer and incorporate a closable (water resistant) internal duffle (via zip tie), to prevent cross-contamination from loading operations using mechanical loaders. The SSP will incorporates sock type lifting tubes around the lifting loops, to facilitate lifting with minimal man access to only the side of the fork lift truck (FLT) using ‘large bag’ fork tine adapters. It will incorporate a zip closure system that forms a seal at one end of the system and be designed to rest on a rubber type buffer to ensure no leak paths arise around the end of the single zip key.

The large variant SSP is an identical variant of the small variant, with the exception of retaining the requirement to use a Lifting Frame to spread the loads during lifting. The longitudinal axis middle lifting loop will be eliminated to remove the requirement for man access to the rear of the SSP during attaching and detaching of the lifting loops.

6.3 TC11 outer testing and trials

The TC11 outer is manufactured from stainless steel and is fabricated with three payload bays each of which can accommodate a large SSPs (4.5m^3), with a gross laden weight of 5te each. . The outer is based on a 20 foot ISO container and was successfully subjected to the ISO 1496/1 regime of tests. Experience shared by US users of SSP’s transported in cuboid containers revealed that the contents physically compact in the SSP’s during transport and can if loaded into a parallel sided container become vacuum locked. The bays of the TC11 outer were shaped to avoid this effect.

6.4 Analysis and development of the TC11 outer

LLWR has carefully analysed all learning from the TC11 outer prototype trial and stakeholder engagement. LLWR has now taken the initiative to modify the prototype TC11 outer to incorporate a removable internal baffle fitted to each of the three payload bays. This facilitates the transport of twelve smaller SSPs in each TC11, each with a gross weight of up to 1.18te. This will allow the TC11 to maintain its payload of approximately 15te of (V)LLW, contained within 12 x 1.18te SSPs of HV-LLW, meeting the permitted (authorised) land fill sites and waste producer requirements. The TC11 outer has retained its capability to transport a payload of three 4.5te SSPs for the bulk transport of (V)LLW, e.g conditioned (V)LLW used as profile fill for construction projects.

7 – NUCLEAR CIVIL LIABILITY TRANSFER OF HV-LLW

A solution to the challenge earlier described in this paper, of multiple nuclear licensed sites shipping HV-LLW to permitted (authorised) land fill sites and remaining attached indefinitely to the nuclear civil liability for their HV-LLW, has been sought. The management of all NDA’s HV-LLW to the permitted (authorised) land fill sites is being carried out by the NDA’s lead waste integrating site, the LLW Repository Ltd under contract. Using this approach the HV-LLW risk, title and ownership is transferred at the point of collection (as the nuclear material is under relevant carriage) from the consigning nuclear site to the LLW Repository nuclear site and the nuclear civil liability associated with the transport and disposal of the HV-LLW is attached to the LLW Repository Ltd nuclear licensed site.

8 - OPTIMISING THE DESIGN OF THE TC11

In the event that the LLW Repository Ltd receives authorisation to proceed with the use of (V)LLW as vault capping profile fill, or any other UK nuclear site construction project receives similar authorisation to use (V)LLW as aggregate; or the activity limits increase at the existing or future permitted (authorised) land fill sites. The TC11 may then be expected to transport higher activity (V)LLW, which may therefore require IP-2.

For the TC11 systems to meet IP-2 (TS-R-1 paragraph 622), the design will additionally need to demonstrate compliance to the IAEA normal conditions of transport performance test criterion: the impact test and the stacking test. The stacking test for the TC11 system has already been proven during its IP-1 certification via the ISO testing and satisfies this IAEA requirement (TS-R-1 paragraph 723). The outstanding performance test is the impact test (TS-R-1 paragraph 722). The regulatory requirement of this impact test is that the container must demonstrate no loss of contents during or post the impact test (above an accepted standardized leakage rate).

8.1 TC11 Impact Test Strategy

To enable self assessment licensing of the TC11 system to IP-2 status the TC11 system will be initially subjected to finite element analysis to predict the stresses and deformation of a 0.9m drop. The TC11 has a maximum allowable weight of 15 Te, and will in this use be packed to maximize contents in the SSPs. It is not anticipated that any part loaded SSPs will be transported in the TC11 system. Therefore, the drop height will be calculated based on the TC11 being loaded with a minimum load of only one TC11 bay fully loaded (approx 6te including tare weight of the TC11 outer), and loaded with three large SSPs (maximum 15te gross). This equated to a worst-case scenario drop height of 0.9m (TS-R-1 table 14).

As previously accepted by the UK Competent Authority for a package with an identical footprint, the TC11 will be assumed to drop due to the failure of two or more lifting points, leading to an impact on either edge, a corner or flat onto the base.

The rationale behind this approach is as follows;

- If only one corner lifting point fails then it will be considered that the container would not impact onto the ground.
- If two lifting points on a common edge fail then an impact onto that edge would occur.
- If two diagonally opposite lifting points failed then, depending on the location of the center of gravity, the container would either remain stable or rotate slowly about the diagonal.

Therefore the assessment will assume three lifting points failing, the TC11 then drops onto a corner and secondly all four lifting points fail (or the central lifting point fails) and the TC11 then drops flat onto its base. Note - Secondary slap-down impacts will not be considered due to the predicted low energies involved.

As mentioned above, the TC11 system uses the SSP as the containment system and relies on the TC11 frame for structural integrity. This combination is believed to provide some resistance to the impact energy transfer. The energy is assumed to be absorbed by the structure, without gross deformation or fabrication failure. The energy is not expected to directly pass to the independent "floating" containment system that is the SSP, resulting in the TC11 system being able to demonstrate compliance as an IP-2 Package. If the FEA demonstrates this theory, a reasoned argument will be presented to exempt the TC11 from being subjected to a full size drop test.

CONCLUSION

In conclusion, within the UK the HV-LLW waste diversion routes are an accessible option to UK waste producers. The main outstanding challenge to the optimisation of these (V)LLW diversion routes is logistics. Rising to this challenge, the TC11 prototype was designed and found to pose many problems for both waste producers and the current permitted (authorised) land fill site operators. The learning from the continued development journey of the TC11 SSP delivery system has potentially resulted in a solution meeting all stakeholder technical requirements, for the safe implementation of the Soft Sided Package. The TC11 SSP delivery system can be transported by road, rail or sea and has two configuration options to adapt for small volume HV-LLW diversion and bulk transfer of (V)LLW for larger construction projects. The TC11 system demonstrates all requirements for an IP-1 package, with clear prospect to achieve IP-2

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