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Transport Permissioning (SVC4349309)

**Amendment of Certificate of Approval GB/5122/B(U)F-96 (Rev. 0) for the ES-3100
Package to Extend the Permitted Content
(Multilateral Approval of the USA Competent Authority Certification -
USA/9315/B(U)F-96 Rev. 11)**

Project Assessment Report ONR-SDFW-PAR-17-012
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EXECUTIVE SUMMARY

Amendment of Certificate of Approval GB/5122/B(U)F-96 (Rev. 0) for the ES-3100 Package to Extend the Permitted Content

This report summarises the basis of the regulatory decision by the Office for Nuclear Regulation (ONR) as the Great Britain (GB) Competent Authority (CA) for Class 7 (radioactive material) dangerous goods, to issue a revised Certificate of Approval (CoA) to allow continued use of the GB/5122/B(U)F-96 transport package (known as the ES-3100 package) in the United Kingdom (UK).

Permission Requested

Consolidated Nuclear Security, llc (CNS) has requested an amendment to the GB CA approval of the GB/5122/B(U)F-96 package, for transport by road, rail, sea and air within the UK. This request is made under the United Nations Economic Commission for Europe (UNECE) modal regulations ADR 2017 and RID 2017 for the transport of dangerous goods by road and rail, the International Maritime Dangerous Goods Code (IMDG) 2014 (or IMDG 2017) and the International Civil Aviation Organisation's Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO TI) 2017-2018 Edition.

Background

CNS submitted an approval request to ONR for use in the UK of United States of America (USA) package design USA/9315/B(U)F-96 (known as ES-3100), to transport fissile material overseas in support of strategic threat reduction programmes. ONR has previously approved the transport of this package in the UK under CoA GB/5122/B(U)F-96 (Rev. 0). This CoA permitted carriage of a sub-set of contents allowed by the USA CA certificate USA/9315/B(U)F-96 (Rev. 10), namely Highly Enriched Uranium (HEU) oxide or Broken HEU metal alloy or UO₂-Mg research reactor fuel elements and components. The USA CA has recently issued a new Competent Authority Certification (CAC), USA/9315/B(U)F-96 (Rev. 11), therefore CNS applied for an amendment to the current UK approval and requested the inclusion of additional contents of HEU metal or alloy turnings, fines or powders.

Assessment and inspection work carried out by ONR in consideration of this request

ONR carried out a programme of work in consideration of this request which involved assessment of the applicant's safety case, its claims, arguments, supporting documentation and evidence, with particular attention given to the new content (HEU metal or alloy turnings, fines or powders). The assessment focused on key package safety functional areas of criticality, engineering and shielding of the package, its use and any issues that have arisen since the previous CoA was granted.

No inspection work was conducted explicitly in support of this application. Regulatory confidence is drawn from recent inspection history of the UK based dutyholder (the package consignor), approval from the originating CA, and written correspondence from the applicant to establish specific details relevant to this application.

Matters arising from ONR's work

ONR identified supplementary controls for use of the package in the UK, required to bound technical assessment uncertainties associated with aspects of the package design and ensure regulatory expectations are met. These include: restricting the maximum mass of ²³⁵U per package, restricting water and other moderating materials for certain contents; restricting the maximum package criticality safety index, restricting the use of certain materials used as

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seals; restricting the maximum activity when transporting by air and time constraints once the package is sealed to allow for hydrogen generation inside the package.

Conclusions

Subject to the imposition of supplementary controls, the package design is judged to be safe and meet relevant regulatory requirements.

Recommendation

It is recommended that the application is approved under GB certificate GB/5122/B(U)F-96 (Rev. 1) which includes supplementary controls as conditions of approval.

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LIST OF ABBREVIATIONS

ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
CA	Competent Authority
CAC	Competent Authority Certification
CDG	The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations
CNS	Consolidated Nuclear Security, llc
CoA	Certificate of Approval
CSI	Criticality Safety Index
DCI	Deputy Chief Inspector
DOT	(US) Department of Transportation
DOE	(US) Department of Energy
EPDM	Ethylene Propylene Diene Monomer
GB	Great Britain
HEU	Highly Enriched Uranium
HOW2	(Office for Nuclear Regulation) Business Management System
IAEA	The International Atomic Energy Agency
ICAO TI	International Civil Aviation Organisation Technical Instructions for the Safe Transport of Dangerous Goods
IMDG	International Maritime Dangerous Goods Code
ONR	Office for Nuclear Regulation
PAR	Project Assessment Report
RID	Regulations concerning the International Carriage of Dangerous Goods by Rail
SARP	Safety Analysis Report for Packaging
SI	Superintending Inspector
SDFW	Sellafield, Decommissioning, Fuel and Waste
SSG	(IAEA) Specific Safety Guide
SSR	(IAEA) Specific Safety Requirements
TIE	Transport Inspection and Enforcement
UK	United Kingdom
UNECE	United Nations Economic Commission for Europe
US	United States
USA	United States of America
Y-12	Y-12 National Security Complex
σ	Standard Deviation

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Figure 1: ES-3100 Package Illustration

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1 PERMISSION REQUESTED

1. The Applicant, Consolidated Nuclear Security, llc (CNS) have requested an amendment to the Great Britain (GB) Competent Authority (CA) approval of the GB/5122/B(U)F-96 package, known as the ES-3100 package, for transport by road, rail, sea and air within the United Kingdom (UK) [1]. The ES-3100 package is shown in Figure 1.

2 BACKGROUND

2. There are certain transport package designs carrying Class 7 (radioactive material) dangerous goods that require CA approval. For example, all packages containing fissile material (that are not classed as fissile excepted) require multilateral approval, i.e. approval by the relevant competent authority of the country of origin of the design, and also, where the consignment is to be transported through or into any other country, approval by the competent authority of that country.
3. The Office for Nuclear Regulation (ONR) is the GB CA for the civil inland surface transport of Class 7 (radioactive material) dangerous goods. This statutory duty is given to ONR through The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations (CDG) [2]. ONR also acts on behalf of other civilian UK CAs in cases where CA approval of a package design is required; namely:
 - The Competent Authority of the United Kingdom of Great Britain and Northern Ireland in respect of sea transport, being the Secretary of State for Transport including the Maritime and Coastguard Agency;
 - The Competent Authority of the United Kingdom of Great Britain and Northern Ireland in respect of air transport, being the Civil Aviation Authority; and
 - The Competent Authority of Northern Ireland in respect of road transport, being the Department of Agriculture, Environment and Rural Affairs - Northern Ireland.
4. The Y-12 National Security Complex (Y-12) operated by CNS is the design agency for the ES-3100 Type B(U)F transport package for fissile radioactive material. Y-12 is working with a UK based duty-holder to transport certain materials using the ES-3100 package.
5. The ES-3100 package has been approved for use in the United States (US) by the relevant US CA (US Department of Transportation (DOT)) under Competent Authority Certification (CAC) USA/9315/B(U)F-96 (Rev. 10) [3]. This package is currently approved for transport in the UK under a certificate of approval (CoA), GB/5122/B(U)F-96 (Rev. 0) [4], which permits a sub-set of contents defined in US DOT CAC, USA/9315/B(U)F-96 (Rev. 10) [3]. Both of these US and UK approvals were based on the Safety Analysis Report for Packaging (SARP), SP-PKG-801940-A001 Rev. 1, dated 3 September 2015 [5].
6. Some material that needs to be transported using the ES-3100 package is not covered by the permitted contents in the US DOT CAC USA/9315/B(U)F-96 (Rev. 10) [3]. The material in question is classified as “Highly Enriched Uranium (HEU) metal or alloy turnings, fines, or powders”. This category is currently limited to $\leq 80\%$ enrichment on the US certificate, but the specific material for transport is in the 93% enrichment range, thus necessitating an amendment to the US DOT CAC. CNS submitted a revised SARP, SP-PKG-801940-A001 Rev. 2, dated 8 September 2016 [6] to the US CA (US DOT), who subsequently issued a revised CAC, USA/9315/B(U)F-96 Rev. 11 [7] which increase the maximum permitted enrichment of “HEU metal or alloy turnings,

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- finer, or powders” from 80% to 100%. The new US DOT CAC, USA/9315/B(U)F-96 Rev. 11 [7], expires on 30 September 2020.
7. The Applicant, CNS have written to ONR to request an amendment to the current UK approval, GB/5122/B(U)F-96 (Rev. 0) [4], to permit material that falls into the category “HEU metal or alloy turnings, fines, or powders”, but with an enrichment of $\leq 100\%$ [1]. As this request concerns transport in the UK by road, rail, sea and air the following provisions of the associated modal regulations demand multilateral approval of fissile packages:
 - **Road** - 6.4.22.4 of the European Agreement Concerning the International Carriage of Dangerous Goods by Road, ADR [8];
 - **Rail** - 6.4.22.4 of the Regulations concerning the International Carriage of Dangerous Goods by Rail, RID [9];
 - **Sea** - 6.4.22.4 of the International Maritime Dangerous Goods Code, IMDG [10];
 - **Air** - 7.21.4 of the International Civil Aviation Organisation’s Technical Instructions for the Safe Transport of Dangerous Goods by Air, ICAO TI [11].
 8. In addition, provision 6.4.22.8 of both ADR and RID [8, 9] require that package designs granted unilateral approval by countries outside the European Agreements (ADR and RID) also need approval by the CA of a country ‘Contracting Party’ to the European Agreements. This country would be the first one reached by a consignment utilising the approved design.
 9. The above modal regulations are based on the International Atomic Energy Agency (IAEA) Regulations for the Safe Transport of Radioactive Material, currently SSR-6 (2012 Edition) supported by advisory material in SSG-26 [12].
 10. From a UK approval perspective, ONR have never approved “HEU metal or alloy turnings, fines, or powders” for any enrichment. The previous approvals were for:
 - HEU oxide (UO_2 , UO_3 , U_3O_8 , $\text{U}_3\text{O}_8\text{-Al}$, $\text{UO}_2\text{-Mg}$, $\text{UO}_2\text{-ZrO}_2$) - First approved in the UK on 21 June 2013 via UK validation USA/9315/B(U)F-96(1) [13];
 - Broken HEU metal alloy - First approved in the UK on 1 March 2016 via UK CoA GB/5122/B(U)F-96 (Rev. 0) [4];
 - Research reactor fuel elements and components ($\text{UO}_2\text{-Mg}$) – First approved in the UK on 1 March 2016 via UK CoA GB/5122/B(U)F-96 (Rev. 0) [4].
 11. The proposed modification to the existing UK approval only affects the contents, the packaging design is unaffected.
 12. Containment of the radioactive contents is achieved through a system comprising the containment vessel body, the sealing lid, and the inner O-Ring.
 13. External radiation levels are controlled predominantly through restriction of the contents to mainly alpha emitting material, however some gamma- and neutron-emitting isotopes are permitted. These have been shown to meet the external dose rate criteria.
 14. Criticality is prevented through control of permitted contents and the presence of neutron absorbing material (Cat-277). It is necessary to apply supplementary controls to limit (a) the quantity of moderating material present for certain contents, and (b) the maximum mass of ^{235}U present.

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15. Damage caused by heat is prevented through a maximum permitted heat load from the content of 5 W. Under thermal accident conditions, the integrity of the seals (the most vulnerable component of the package to heat) has been proven through testing.
16. This package is intended to facilitate transfer of nuclear materials from the UK in support of global threat reduction strategies. UK approval of the package design is required to enable delivery of these strategies.

3 ASSESSMENT AND INSPECTION WORK CARRIED OUT BY ONR IN CONSIDERATION OF THIS REQUEST

17. This current application has been considered in accordance with ONR's assessment processes [14]. ONR carried out a detailed programme of work [15 – 21] that involved the assessment of the applicant's transport safety case, supporting documentation and evidence, and the mechanisms for its implementation via the relevant management systems.
18. The package design under assessment is a Type B(U)F which was designed in the USA. CA approval for use in the UK is required for this package as:
 - It is classed as a fissile package which requires multilateral approval in accordance with provision 6.4.22.4 of ADR [8], 6.4.22.4 of RID [9], 6.4.22.4 of IMDG [10] and 7.21.4 of ICAO TI [11] (which are based on para 802 and Annex I of SSR-6 [12]);
 - The USA is not a 'Contracting Party' to the European Agreements (ADR and RID [8, 9], and therefore requires approval by the CA of a country 'Contracting Party' to the European Agreements in accordance with provision 6.4.22.8 of both ADR and RID [8, 9].
19. In relation to multilateral approvals, para 840.1 of SSG-26 [12] states 'Competent authorities, other than that of the country of origin, have the option of either performing a separate safety assessment and evaluation or making use of the assessment already made by the original competent authority, thus limiting the scope and extent of their own assessment'. Cognisance has been taken that the assessment has already been approved by the US CA (US DOT) with their assessment findings documented Docket Nos. 17-05-9315 & 17-31-9315 [22 & 23]. Additional confidence is gained from the fact that the package is not novel or complex and the design has been approved recently (March 2016) by ONR for similar content types ("Broken HEU metal alloy") to that proposed in the modification ("HEU metal or alloy turnings, fines, or powders"). The approval given in March 2016 included a detailed programme of work which subjected the safety case to a high level of scrutiny [24].
20. Therefore, an assessment approach was adopted which focused mainly on the criticality analysis and any engineering/ administrative aspects which influence the criticality assessment, as well as changes since the last approval, any findings and outcomes from previous ONR assessments and any issues that have arisen since the previous CoA was granted.
21. The ONR assessment involved four topic areas that are potentially significant in terms of transport safety: criticality, shielding, engineering and management systems. The key findings and conclusions of the assessment areas are summarised below.

3.1 CRITICALITY ASSESSMENT

22. The ONR criticality assessment [18] focused on the new package contents requested for approval, on the basis that the original contents justification has been accepted by

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ONR during the previous approval. Consideration was also given to regulatory issues that have been identified since the current approval was granted in 2016, most notably the effect of temperature on criticality safety.

23. The assessment of the criticality case conducted by ONR supporting the previous approvals given in June 2013 and March 2016 identified significant shortcomings which could justify rejection of the application. These same shortcomings remain for the present application. However, by using an approach that is consistent with the previous approvals, ONR have identified supplementary controls for use of the package in the UK, required to bound technical assessment uncertainties associated with aspects of the package design and ensure regulatory expectations are met. These include: restricting the maximum mass of ^{235}U per package, restricting water and other moderating materials for certain contents and restricting the maximum package criticality safety index.
24. It was concluded that subject to the imposition of those supplementary controls for use of the package within the UK, the claims, arguments and evidence laid down within the safety case documentation demonstrate that the criticality safety requirements of SSR-6 (Ref. 14) have been met in the areas sampled.

3.2 SHIELDING ASSESSMENT

25. The ONR shielding assessment [19] found that the SARP [5] contained a comprehensive shielding assessment and that the proposed change in content to include HEU metal or alloy turnings, fines, or powders for any enrichment will not affect the original shielding analysis in the SARP, which considered the worst case material at enrichments of up to 100%. Some clarification was sought with regard to the proportion of ^{232}U assumed in reprocessed uranium, as this dominates the dose rate. ONR is satisfied that this is adequately controlled through the permitted contents approved for the package.

3.3 ENGINEERING ASSESSMENT

26. The ONR engineering assessment [20], focussed primarily on those aspects of the SARP that have the potential to be affected by the additional content type and their engineering implications. As this is a modification most of the arguments and evidence presented in the SARP have been previously assessed by ONR. It was considered a proportionate approach not to further review these aspects in detail. It was concluded that there are no issues that suggest the proposed changes to the package safety case, enabling the shipment of HEU metal or alloy turnings, fines or powders with up to 100% enrichment has changed the mechanical capabilities of the package as previously approved.

3.4 SAFETY CASE REQUIREMENTS ASSESSMENT

27. The ONR safety case requirements assessment [21] assessed the management system arrangements for implementation of the requirements of the transport package safety case. ONR focussed on the UK based duty-holder and established ongoing confidence in its capability to implement the requirements of the safety case and certificate of approval. The assessment is supported by recent transport inspections of UK based duty-holder that examined both general and specific management arrangements in the context of other high profile radioactive material transport operations (discussed in [21]). Based on the outcome of these regulatory activities, the consignor's arrangements in respect of provision 1.7.3 of ADR [8] (and equivalent provisions in other modal texts) were considered adequate for the purposes of transporting radioactive material. No concerns were identified by ONR from these

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assessment and inspection activities that could detrimentally impact safe use of the ES-3100 package. Ongoing compliance with the requirements of the certificate of approval is examined through routine interactions with the consignor.

4 MATTERS ARISING FROM ONR'S WORK

28. For this assessment effort has been concentrated on those aspects of the safety case that differs from the previously approved submissions.
29. The US DOT CAC refers to the US Department of Energy (DOE) Certificate of Compliance (CoC), USA/9315/B(U)F-96 (DOE). The US DOE CoC originally sent to ONR was USA/9315/B(U)F-96(DOE) Rev. 11, which increased the allowable enrichment for the material category "HEU metal or alloy turnings, fines, or powders" to 100% for ground transport. However, Rev. 11 of the CoC did not increase the enrichment of this material category to 100% for air transport. This was communicated to the applicant, who confirmed that this was an error. Thus, the CoC was updated to USA/9315/B(U)F-96(DOE) Rev. 12 [7] to increase the allowable enrichment from 80% to 100% for the material category "HEU metal or alloy turnings, fines, or powders", for air transport.
30. As part of the assessment process in support of previous UK approvals, e.g. that carried out in 2016 [24], a number of deficiencies were identified in the transport safety case. In order to fully address technical uncertainties associated with some areas of assessment (relating to criticality and engineering), additional restrictions (supplementary controls) were identified to ensure the required safety standard is achieved. These supplementary controls were previously captured on the GB CoA, GB/5122/B(U)F-96 (Rev. 0) [4].
31. As part of ONR's work on the present modification, it was confirmed that these additional restrictions remain adequate and are suitably extended to cover the new content requested as part of the proposed modification, i.e. "HEU metal or alloy turnings, fines, or powders", up to 100% enrichment. The findings of this review are documented in the safety case requirements assessment [21], and are summarised briefly below:
 - For "Broken HEU metal or alloy" and "HEU metal or alloy turnings, fines or powders", the maximum mass of ^{235}U per package is 7.0 kg for any mode of transport;
 - For "Broken HEU metal or alloy" and "HEU metal or alloy turnings, fines or powders", no water is permitted to be present with new content "HEU metal or alloy turnings, fines or powders";
 - For "Broken HEU metal or alloy" and "HEU metal or alloy turnings, fines or powders", the maximum Criticality Safety Index (CSI) is 0.8;
 - Hydrogenous packing materials in the containment vessel are limited to 500 g per package and must have a hydrogen density no greater than 0.1315 g/cm^3 at 20°C ;
 - Further to the above, for contents "Broken HEU metal or alloy" and "HEU metal or alloy turnings, fines, or powders", packaging material must have a hydrogen density no greater than water;
 - For content "UO₂-Mg research reactor fuel elements and components", the moisture content in the oxide must not exceed 3 weight percent water.
 - Specify that the use of Viton O-rings is not permitted as they cannot be substantiated to a temperature of -40°C as required by the regulations. The alternative ethylene propylene diene monomer (EPDM) O-rings must be used.
 - As already captured in the previous UK approval, GB/5122/B(U)F-96 (Rev. 0) [4]:

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- Restrict the maximum activity of the content to 3000A₂ when transported by air.
 - Include time constraint that ensures the period of time between loading and unloading the package with uranium oxide content does not exceed 12 months (to allow for hydrogen generation inside the package and prevent an explosive atmosphere evolving).
 - Clarification required that for content “HEU oxide”, the allowance for 500 g of hydrogenous packing material is in addition to the permitted 3% moisture content
32. These supplementary controls are incorporated into a GB CoA, GB/5122/B(U)F-96 (Rev. 1) [25].
33. The applicant/ UK consignor has been made aware and has accepted these additional restrictions. As stated in section 3.4, the consigners management system arrangements are considered adequate and there is no reason to believe compliance will not be achieved. An intervention at the UK duty-holder is scheduled for August 2017, which will include inspection of their management arrangements for the ES-3100 package. Specific intelligence arising from this permissioning assessment has been communicated to Transport Inspection and Enforcement [26] and has subsequently been added to ONR’s Class 7 Transport Nuclear Sector Compliance Map [27] to ensure appropriate follow-up.

5 CONCLUSIONS

34. This report presents the findings and basis of ONR’s regulatory decision following our assessment of the GB/5122/B(U)F-96 package, known as the ES-3100 package (identified as USA/9315/B(U)F-96 in the US).
35. ONR is satisfied with the claims, arguments and evidence presented within the original submission supported by subsequent correspondence / evidence provided in response to our assessment findings. This conclusion and the associated regulatory decision to issue an approval for use of the package in the UK, is subject to imposition of supplementary controls that bound technical uncertainties related to moderators, fissile mass, sealing materials, and hydrogen generation.

6 RECOMMENDATIONS

36. This project assessment report recommends that the USA/9315/B(U)F-96 (ES-3100) package design is approved for use in the UK by road, rail, sea and air by issue of a GB CoA, GB/5122/B(U)F-96 (Rev. 1), which includes additional supplementary controls as discussed above.

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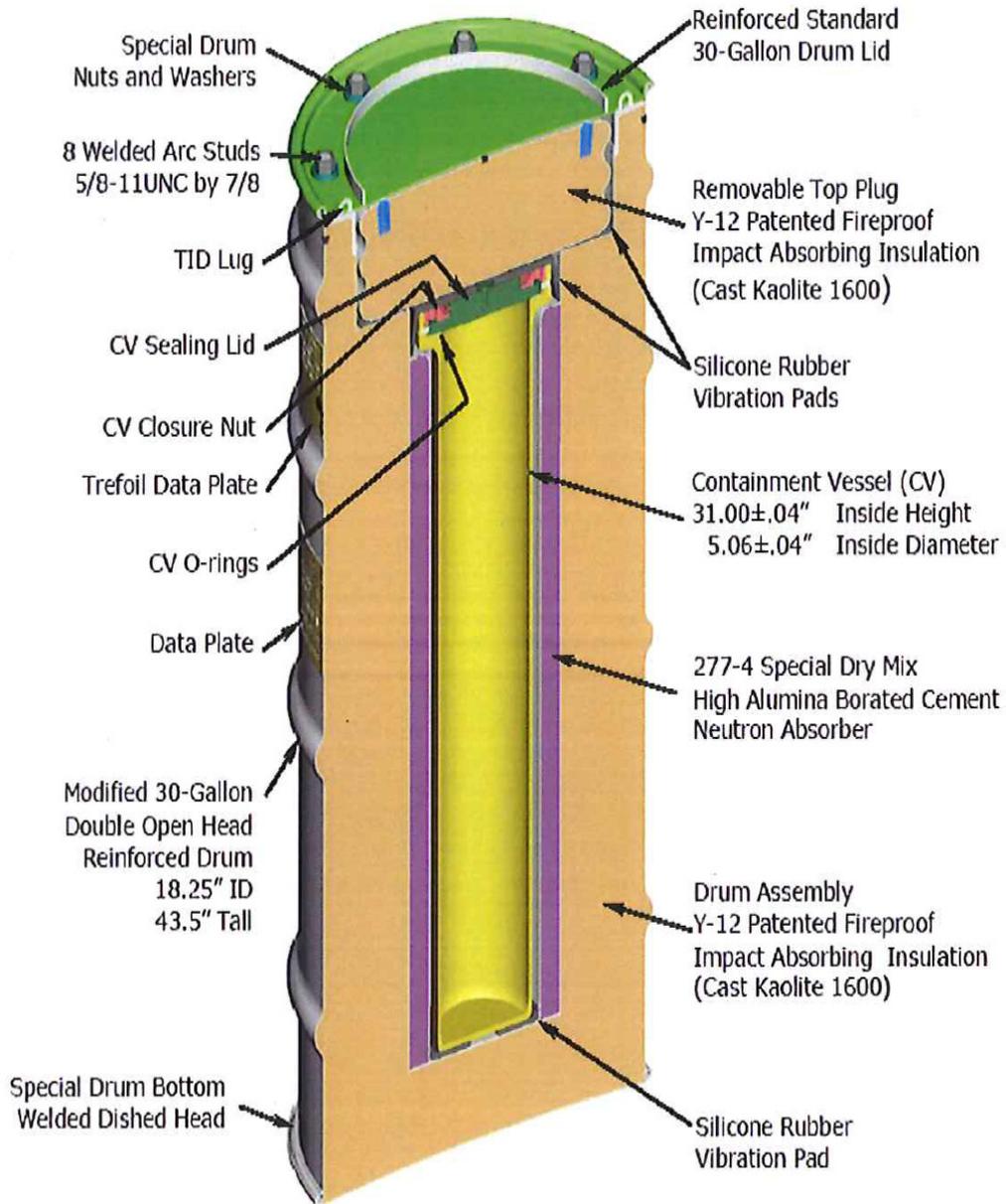
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Figure 1
ES-3100 Package Illustration



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