

WASTE STREAM	2A07	Redundant Fuel Transport Flasks & Liners
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SITE Calder Hall

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Ltd

WASTE TYPE LLW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025	= 86.4		
Future arisings:				
Total future arisings:		0.0		
Total waste volume:		86.4		

Number of waste packages in stock: At 1.4.2025..... - packages

Comment on arising rates: Stocks consist of liners and redundant fuel transport flasks. The flasks have become redundant after the end of Calder Hall defuelling. However there is the possibility that a number of the flasks will be taken over by others (suitably qualified & licenced organisations) who will then be responsible for decommissioning and disposal of these flasks. This will affect the final volume associated to this waste stream and the rate at which these are decommissioned and disposed of.

Additional information on quantities: The total number of flask liners identified is 6. The total number of flasks identified is 6. The volume declared for disposal is the volume of the liners and the flasks without any size reduction, however this volume will only be taken up at the LLWR if the flasks are not broken up and recycled.

Uncertainty factors on volumes:

Stock (upper):	x 1.25	Arisings (upper):	x -
Stock (lower):	x 0.75	Arisings (lower):	x -

WASTE SOURCE Both liners and flasks used for the transport of irradiated Magnox fuel from Calder Hall reactors.

PHYSICAL CHARACTERISTICS

General description: These are ferritic steel containers internally contaminated with traces of activation and fission products from the spent fuel. The flask liners have a 200 mm thick lining of 4% antimonial lead encased by 10mm stainless steel. The lead should be uncontaminated. The liners weigh up to 16.5 te each. Actual disposal weight may be less. The flasks are painted with CEGB System 6 epoxy paint. The flasks weigh up to 41 t each. All flasks have handling trunnions fitted. This is the maximum all up weight of a flask assembly. Actual disposal weight may be less.

Changes since waste generated: The waste is not anticipated to undergo any changes since it was generated. Flasks sometimes undergo chemical decontamination as part of routine maintenance.

Bulk density (t/m³): ~ 4.0

Comment on density: The average density of 3.99 t/m³ refers to the mass of the components divided by the volume as stored prior to disposal. Density for the flask liners is 3.63 t/m³. Density for the transport flasks is 4.16 t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Flask liners are estimated to be 85% lead, 15% stainless steel by weight. Transport flask surfaces are painted with CEGB System 6 epoxy paint and there is a seal made of viton. The chemical components are stainless steel and ferrous based alloys (approx. 100%) possibly with nickel, vanadium, molybdenum, manganese, niobium and chromium in alloying proportions, Viton (<0.01%), and CEGB System 6 epoxy based paint (~0.1%). Small components will give traces of bronze, copper, aluminium, brass, lead and graphite (total <0.5%).

Chemical state: Neutral

Sheet metal proportion / thickness: Approximately 100% of waste is bulk metal in the form of flask liners and transport flasks. Flask liner casing and spacing formwork is in BS1501Part 3. Flask body material is a forging in BS 1503, ASTM/A350 with bolts and other fittings in stainless steel (unidentified). Nickel, niobium and molybdenum are present in alloying proportions in steels. Flask liner is stainless steel type MAT2A.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	~ 33.0	-	
Other ferrous metals.....	~ 43.0	-	
Iron.....		-	
Aluminium.....	TR	-	
Beryllium.....	= 0	-	
Cobalt.....	= 0	-	
Copper.....	TR	Copper and brass.	
Lead.....	~ 24.0	Lead/Antimony alloy (24:1 Pb/Sb).	
Magnox/Magnesium.....	TR	-	
Nickel.....	TR	-	
Titanium.....		-	
Uranium.....	P	-	
Zinc.....	= 0	-	
Zircaloy/Zirconium.....	= 0	-	
Other metals.....	= 0	-	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulotics.....	= 0	-	
Paper, cotton.....	= 0	-	
Wood.....	= 0	-	
Halogenated plastics.....	= 0	-	
Total non-halogenated plastics.....	= 0	-	
Condensation polymers.....	= 0	-	
Others.....	= 0	-	
Organic ion exchange materials.....	= 0	-	
Total rubber.....	< 0.01	-	
Halogenated rubber.....	< 0.01	Viton B.	
Non-halogenated rubber.....	= 0	-	
Hydrocarbons.....		-	
Oil or grease.....		-	
Fuel.....		-	
Asphalt/Tarmac (cont.coal tar).....		-	
Asphalt/Tarmac (no coal tar).....		-	
Bitumen.....		-	
Others.....		-	
Other organics.....	~ 0.10	CEGB System 6 Epoxy Paint.	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	= 0	-	
Inorganic sludges and flocs.....	= 0	-	
Soil.....	= 0	-	
Brick/Stone/Rubble.....	= 0	-	
Cementitious material.....	= 0	-	
Sand.....		-	
Glass/Ceramics.....	= 0	-	
Graphite.....	TR	-	
Desiccants/Catalysts.....		-	
Asbestos.....	= 0	-	
Non/low friable.....		-	
Moderately friable.....		-	
Highly friable.....		-	
Free aqueous liquids.....	= 0	-	
Free non-aqueous liquids.....	= 0	-	
Powder/Ash.....	= 0	-	

COMPONENTS OF MATERIALS, WASTE PROPERTIES, MATERIALS NOT CONTRIBUTING TO MASS

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
Fluoride.....	= 0	-
Chloride.....	= 0	-
Iodide.....	= 0	-
Cyanide.....	= 0	-
Carbonate.....	= 0	-
Nitrate.....	= 0	-
Nitrite.....	= 0	-
Phosphate.....	= 0	-
Sulphate.....	= 0	-
Sulphide.....	= 0	-

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals.....	= 0	-
Low flash point liquids.....	= 0	-
Explosive materials.....	= 0	-
Phosphorus.....	= 0	-
Hydrides.....	= 0	-
Biological etc. materials.....	= 0	-
Biodegradable materials.....	= 0	-
Putrescible wastes.....	= 0	-
Non-putrescible wastes.....	= 0	-
Corrosive materials.....	= 0	-
Pyrophoric materials.....	= 0	-
Generating toxic gases.....	= 0	-
Reacting with water.....	= 0	-
Higher activity particles.....		-
Soluble solids as bulk chemical compounds.....		-

Hazardous substances / non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....		-
Benzene.....		-
Chlorinated solvents.....		-
Formaldehyde.....		-
Organometallics.....		-
Phenol.....		-
Styrene.....		-
Tri-butyl phosphate.....		-
Other organophosphates.....		-
Vinyl chloride.....		-
Arsenic.....		-
Barium.....		-
Boron.....		-
Boron (in Boral).....		-
Boron (non-Boral).....		-
Cadmium.....		-
Caesium.....		-
Selenium.....		-
Chromium.....		-
Molybdenum.....		-
Thallium.....		-
Tin.....		-
Vanadium.....		-
Mercury compounds.....		-
Others.....		-

Complexing agents (%wt):

No		
	(%wt)	Type(s) and comment
EDTA.....		-
DPTA.....		-
NTA.....		-
Polycarboxylic acids.....		-
Other organic complexants.....		-
Total complexing agents.....	= 0	-

Physical components:

	Number	Type(s) and comment
Sources.....	= 0	-
Electronic & Electrical Equipment (EEE)		
EEE Type 1.....	= 0	-
EEE Type 2.....	= 0	-
EEE Type 3.....	= 0	-
EEE Type 4.....	= 0	-
EEE Type 5.....	= 0	-

TREATMENT, PACKAGING AND DISPOSAL

Planned on-site / off-site treatment(s):

Treatment	On-site / Off-site	Stream volume %
Size reduction	Off-site	~ 80.0
Decay storage		
Low force compaction		
Supercompaction (HFC)		
Incineration		
Drying/dewatering/liquid separation		
Tie down/fixatives/strippable coating/painting application		
Decontamination		
Metal treatment		
Recycling / reuse		
Thermal treatment, including vitrification		
Encapsulation		
Polymer encapsulation		
Other physical treatment		
Other chemical treatment		
Containerisation		
Treatment not yet determined		
None		~ 20.0

Comments on planned treatments:

It has been assumed for the 2025 UK RWI that 80% of the metallic waste will be treated by the supply chain and will subsequently be 'out of scope'. The remaining 20% is assumed to be consigned to LLWR for disposal as non-compactable LLW.

Conditioning method:

-

Conditioning plants:

Plant Name	Location

Likely conditioning matrix:

-

Further information on the conditioning matrix:

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Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
1/2 Height IP-2 Disposal/Re-usable ISO (TC01/TC02)	20.0	10.0	18.3	2	-

Range in container waste loading:

Other information on packaging and conditioning:

-

Conditioned density (t/m³):

-

Conditioned density comment:

-

Management Routes:

Disposal Route	Stream volume %	Raw density t/m³	Start date
Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland)	~ 20.0	= 4.0	
Expected to be Non-NSD HAW managed under Scottish Government's policy			
Expected to be disposed to LLW Vaults NRS Dounreay			
Expected to be consigned to the Geological Disposal Facility			
Expected to be consigned to a Near Surface Disposal Facility			
Expected to be consigned to the LLW Repository			
Expected to be consigned to a Landfill Facility	~ 80.0	= 4.0	
Expected to be disposed On-Site			
Expected to be managed by In-Situ Disposal			
Expected to be consigned to an Incineration Facility			
Expected to be consigned to a Metal Treatment Facility			
Expected to be Out of Scope			
Expected to be recycled / reused			
Disposal route not known			

Classification codes for waste expected to be consigned to a landfill facility:

Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
Metal treatment facility	Recycled / reused	~ 66.0	AMBER	Potential to reuse the Flask bodies for further waste management at Sellafield.

RADIOACTIVITY

Source: Contamination from Magnox fuel.

Uncertainty: The flask waste is expected to be LLW but levels of contamination have to be determined.

Measurement of radioactivities: The specific activity levels of the flasks have yet to be determined.

Chemical form of radionuclides:

- H-3: Tritium may be present as inorganic or organic compounds.
- C-14: The carbon 14 content is insignificant.
- Cl-36: The chlorine content is insignificant.
- Se-79: The selenium isotope content is insignificant.
- Tc-99: The technetium isotope content is insignificant.
- I-129: The iodine content is insignificant.
- Ra: The radium isotope content is insignificant.
- Th: The thorium isotope content is insignificant.
- U: The chemical form of uranium isotopes has not been determined but may be present as uranium oxides.
- Np: The neptunium isotope content is insignificant.
- Pu: The chemical form of plutonium isotopes has not been determined but may be present as plutonium oxides.

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code		Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3		6			Gd 153				
Be 10		8			Ho 163				
C 14		8			Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36		8			Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41		8			Pt 193				
Mn 53					Tl 204				
Mn 54		6			Pb 205				
Fe 55		6			Pb 210		6		
Co 60		6			Bi 208				
Ni 59		6			Bi 210m				
Ni 63		6			Po 210		6		
Zn 65		6			Ra 223				
Se 79		6			Ra 225		6		
Kr 81					Ra 226		6		
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90		6			Th 227				
Zr 93		6			Th 228				
Nb 91					Th 229		6		
Nb 92					Th 230		6		
Nb 93m		6			Th 232		8		
Nb 94		6			Th 234		6		
Mo 93		6			Pa 231		8		
Tc 97					Pa 233		6		
Tc 99		6			U 232				
Ru 106		6			U 233		6		
Pd 107		6			U 234		6		
Ag 108m		6			U 235		6		
Ag 110m					U 236		6		
Cd 109					U 238		6		
Cd 113m					Np 237		6		
Sn 119m					Pu 236				
Sn 121m		6			Pu 238		6		
Sn 123					Pu 239		6		
Sn 126		6			Pu 240		6		
Sb 125		6			Pu 241		6		
Sb 126					Pu 242		6		
Te 125m		6			Am 241		6		
Te 127m					Am 242m		6		
I 129		6			Am 243		6		
Cs 134		6			Cm 242		6		
Cs 135		6			Cm 243		6		
Cs 137		6			Cm 244		6		
Ba 133					Cm 245		8		
La 137					Cm 246		8		
La 138					Cm 248				
Ce 144		6			Cf 249				
Pm 145					Cf 250				
Pm 147		6			Cf 251				
Sm 147					Cf 252				
Sm 151		6			Unsp a		8		
Eu 152		6			Unsp b/g				
Eu 154		6			Total a	0	*	0	*
Eu 155		6			Total b/g	0	*	0	*

Bands (Upper and Lower)

A a factor of 1.5
B a factor of 3
C a factor of 10
D a factor of 100
E a factor of 1000

Note: Bands quantify uncertainty in the mean radioactivity.

Code

1 Measured activity
2 Derived activity (best estimate)
3 Derived activity (upper limit)
4 Not present
5 Present but not significant
6 Likely to be present but not assessed
7 Present in significant quantities but not determined
8 Not expected to be present in significant quantity
* Total calculated from the 114 declared radionuclides