WASTE STREAM 2F17 Excellox Flasks

SITE	Sellafield
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Sellafield Limited
WASTE TYPE	LLW; SPD1
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022......................	1223.4 m³
Total future arisings:		0 m³
Total waste volume:		1223.4 m³

Comment on volumes: The total number of Excellox flasks identified is 84. The flasks are presently stored both dry inside buildings and outdoors with covers on at Sellafield. They are currently considered to be redundant and unlicensible. The volume declared is the volume of the flasks, however, it is planned to decontaminate and recycle the metal. If this is successful only small amounts of residues will arise for disposal. A study is currently being carried out to consider options for decommissioning the PNTL (Japanese owned flasks on the Sellafield site) which may influence the overall decommissioning strategy for the Excellox flasks.

Uncertainty factors on volumes:

Stock (upper):	x 1.5	Arisings (upper)	x
Stock (lower):	x 0.5	Arisings (lower)	x

WASTE SOURCE Fuel flasks, used in the transport of spent LWR fuel from Japanese reactor sites to Sellafield.

PHYSICAL CHARACTERISTICS

General description: These are steel containers internally contaminated with traces of activation and fission products from spent fuel. These containers are nominally empty and were previously used for the transport of spent LWR fuel. They comprise cylindrical Excellox flasks and they are painted with CEGB System 6 epoxy paint. Flasks weigh between 38.5 and 83.1 tonnes each. The waste is not anticipated to undergo any changes since it was generated. The flasks are presently stored both dry inside buildings and outdoors with covers on at Sellafield. Flasks sometimes undergo chemical decontamination as part of routine maintenance.

Physical components (%vol): Spent fuel transport flasks (100%). Flask surfaces are painted with CEGB System 6 epoxy paint (~0.1% wt) and there is a rubber viton seal (<0.01% wt).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 3.68

Comment on density: The density ranges from 2.21 to 4.77 te/m³. The weighted average density is 3.68 te/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Ferritic steel (52%), lead (43%) and stainless steel (5%). The majority of the flasks are painted with CEGB System 6 epoxy paint.

Chemical state: Neutral

Chemical form of radionuclides:
H-3: Unknown if present.
C-14: The chemical form of Carbon has not been determined.
Se-79: Unknown if present.
Tc-99: The chemical form of Technetium has not been determined.
Ra: Unknown if present.
Th: Unknown if present.
U: The chemical form of Uranium has not been determined.
Np: The chemical form of Neptunium has not been determined.
Pu: The chemical form of Plutonium has not been determined.

Metals and alloys (%wt): 100% bulk metal as fabrications or lead castings. Ferritic steel is typically 100 mm and 200 mm thick. Stainless steel is typically 15 mm thick. The lead is in rings up to 1245 & 1320 mm OD, 839 & 890 mm ID and 180 mm thickness.Early flasks are to the standards - body plate (BS1501-grade 224/400B/LT50), forging (BS1503 - grade 224/430E/LT50), stainless steel (BS1501-304-S12 & BS970-304-S12 max 0.03% carbon). Later flasks are to standards - mild steel (BS1501(1980)24/400E/LT50), lead (BS3909/2), stainless steel

(BS1501-304-S12). Nickel and niobium are present in stainless steel and carbon steel in alloying proportions.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	5.0	BS1501-304-S12, BS970-304-S12, BS1501-304-S12.	
Other ferrous metals	52.0	BS1501-grade 224/400B/LT50, BS1503 - grade 224/430E/LT50, BS1501(1980)24/400E/LT50.	
Iron			
Aluminium			
Beryllium			
Cobalt	0		
Copper			
Lead	43.0	BS3909/2.	
Magnox/Magnesium	0		
Nickel			
Titanium			
Uranium			
Zinc	0		
Zircaloy/Zirconium	0		
Other metals	0		

Organics (%wt): Viton "O" ring seals between flask lid and flask body, and around valves, are made of Viton B rubber, stainless steel & asbestos, or silicone. Most flasks are coated with CEGB System 6 epoxy based. Viton B (fluorinated) present in trace quantity in the form of gasket seals. Silicone sealants used in the past could be halogenated as well.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	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	TR		
Halogenated rubber	TR		
Non-halogenated rubber	0		
Hydrocarbons			
Oil or grease			
Fuel			
Asphalt/Tarmac (cont.coal tar)			
Asphalt/Tarmac (no coal tar)			
Bitumen			
Others			
Other organics	TR		

Other materials (%wt): Graphite is reported a being present in some seals used on these flasks.

	(%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............................			
Graphite..	TR		
Desiccants/Catalysts....................			
Asbestos......................................	TR		
Non/low friable........................			
Moderately friable....................			
Highly friable...........................			
Free aqueous liquids....................	0		
Free non-aqueous liquids.............	0		
Powder/Ash..................................	0		

Inorganic anions (%wt): Inorganic anions are not expected to be present.

	(%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: Viton seals contain fluorcarbons which can be release at high temperatures. No other materials likely to pose non-radiological hazard have been identified.

Asbestos is present in some of the gasket seals on some flasks.

	(%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.................	
Reacting with water......................	0
Higher activity particles................	
Soluble solids as bulk chemical compounds..................................	

Hazardous substances / non hazardous pollutants: There are trace amounts of cadmium on bolts in the form of plating. The total quantity of lead in this waste stream is approximately 2,500 tonnes.

	(%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...		
Electronic Electrical Equipment (EEE)		
EEE Type 1...............................		
EEE Type 2...............................		
EEE Type 3...............................		
EEE Type 4...............................		
EEE Type 5...............................		

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Complexing agents (%wt): No

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

Potential for the waste to contain discrete items: Yes. Waste itself could be a discrete item.

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction		
Supercompaction (HFC)		
Incineration		
Solidification		
Decontamination		
Metal treatment		100.0
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		

Comment on planned treatments: Treatment will be via size reduction and decontamination, with an anticipated maximum of 5% of the flask assumed to then be disposed of to the LLWR as LLW. The remainder is anticipated to be free release scrap.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	5.0	3.7
Expected to be consigned to a Landfill Facility		
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility		
Expected to be consigned to a Metal Treatment Facility	95.0	3.7
Expected to be consigned as Out of Scope		
Expected to be recycled / reused		
Disposal route not known		

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

Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):

Disposal Route	Stream volume %		
	2022/23	2023/24	2024/25
Expected to be consigned to the LLW Repository			
Expected to be consigned to a Landfill Facility			
Expected to be consigned to an On-Site Disposal Facility			
Expected to be consigned to an Incineration Facility			
Expected to be consigned to a Metal Treatment Facility			
Expected to be consigned as Out of Scope			
Expected to be recycled / reused			
Disposal route not known			

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Opportunities for alternative disposal routing: -

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

Waste Packaging for Disposal:

Container	Stream volume %	Waste loading m³	Number of packages
1/3 Height IP-1 ISO 2/3 Height IP-2 ISO 1/2 Height WAMAC IP-2 ISO 1/2 Height IP-2 Disposal/Re-usable ISO 2m box (no shielding) 4m box (no shielding) Other	5.0	10	7

Other information: After size reduction and dismantling only an anticipated maximum of 5% of the flask is assumed to then be disposed of to the LLWR as LLW. The remainder is anticipated to be free release scrap.

Waste Planned for Disposal at the LLW Repository:

Container voidage: -

Waste Characterisation Form (WCH): The waste meets the LLWR's Waste Acceptance Criteria (WAC). The waste does not have a current WCH.

A WCH will be raised nearer the time of disposal.

Waste consigned for disposal to LLWR in year of generation: No. The waste will be disposed of when the flasks are prepared for disposal. This is dependent upon work load and NDA strategy.

Non-Containerised Waste for In-Vault Grouting: (Not applicable to this waste stream)

Stream volume (%): -

Waste stream variation: -

Bounding cuboidal volume:

Inaccessible voidage: -

Other information: -

RADIOACTIVITY

Source: Fission and activation product contamination with some actinides possibly present.

Uncertainty: -

Definition of total alpha and total beta/gamma: Where totals are shown on the table of radionuclide activities they are the sums of the listed alpha or beta/gamma emitting radionuclides plus 'other alpha' or 'other beta/gamma'.

Measurement of radioactivities: -

Other information: -

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3					Gd 153				
Be 10					Ho 163				
C 14					Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36					Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54					Pb 205				
Fe 55					Pb 210				
Co 60					Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210				
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90					Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232				
Nb 94					Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106					U 233				
Pd 107					U 234				
Ag 108m					U 235				
Ag 110m					U 236				
Cd 109					U 238				
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238				
Sn 123					Pu 239				
Sn 126					Pu 240				
Sb 125					Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241				
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137					Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a				
Eu 152					Other b/g				
Eu 154					**Total a**			**0**	
Eu 155					**Total b/g**	**<3.00E-02**		**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 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