WASTE STREAM 2D148 HVVLLW from Final Decommissioning

SITE	Sellafield
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Sellafield Limited
WASTE TYPE	VLLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m³
Future arisings -	1.4.2019 - 31.3.2023.....	0 m³
	1.4.2023 - 31.3.2025.....	1830.8 m³
	1.4.2025 - 31.3.2030.....	16225.5 m³
	1.4.2030 - 31.3.2040.....	118882.9 m³
	1.4.2040 - 31.3.2050.....	283398.4 m³
	1.4.2050 - 31.3.2060.....	205274.2 m³
	1.4.2060 - 31.3.2070.....	217792.4 m³
	1.4.2070 - 31.3.2080.....	306455.1 m³
	1.4.2080 - 31.3.2090.....	226318.6 m³
	1.4.2090 - 31.3.2100.....	343754.8 m³
	1.4.2100 - 31.3.2110.....	556376.7 m³
	1.4.2110 - 31.3.2120.....	418665.1 m³
	1.4.2120 - 31.3.2121.....	6811.6 m³
Total future arisings:		2701786.3 m³
Total waste volume:		2701786.3 m³

Comment on volumes: Arisings are in line with current decommissioning programmes and strategy. Waste within this stream is generated from a number of decommissioning projects which will commence at a future date. As a result of this, although characterisation of current waste volumes and fingerprints has been carried out, there is a large uncertainty in the potential arisings. The ACCELS project refined the likely lower and upper bounds to be 1 million and 4 million cubic metres. It should be noted that our current best estimate, based on limited decommissioning experience, is that approximately 70% of this material may be exempt. Note the given levels of uncertainty apply to the total volume. The uncertainty associated with the arisings within a specific time period are significantly greater.

Uncertainty factors on volumes:				
	Stock (upper):	x	Arisings (upper)	x 1.45
	Stock (lower):	x	Arisings (lower)	x 0.35

WASTE SOURCE Demolition of reprocessing and associated plants, waste storage and treatment plants and site services facilities.

PHYSICAL CHARACTERISTICS

General description: Building structural materials. Most items size reduced in-situ. Some large items may be present.

Physical components (%wt): The physical components of the waste are concrete (75%), brick (15%), metals (5%), wood (1.5%), asbestos (1%), calcium silicate (1%), soil and stone (1% combined), coke (0.5%).

Sealed sources: -

Bulk density (t/m³): 1

Comment on density: -

CHEMICAL COMPOSITION

General description and components (%wt): The physical components of the waste are concrete (75%), brick (15%), metals (5%), wood (1.5%), asbestos (1%), calcium silicate (1%), soil and stone (1% combined), coke (0.5%).

Chemical state: Neutral

Chemical form of radionuclides: -

Metals and alloys (%wt): -

	Stainless steel	NE	
	Other ferrous metals	NE	
	Iron		
	Aluminium	NE	
	Beryllium		
	Cobalt	NE	
	Copper	NE	
	Lead	NE	
	Magnox/Magnesium	NE	
	Nickel	NE	
	Titanium		
	Uranium		
	Zinc	NE	
	Zircaloy/Zirconium	NE	
	Other metals	~5.0	The composition of the metal waste has not been estimated.
Organics (%wt):	The other organics are comprised entirely of coke. -		
	Total cellulosics	~1.5	
	Paper, cotton		
	Wood	~1.5	
	Halogenated plastics		
	Total non-halogenated plastics		
	Condensation polymers		
	Others		
	Organic ion exchange materials		
	Total rubber		
	Halogenated rubber		
	Non-halogenated rubber		
	Hydrocarbons		
	Oil or grease		
	Fuel		
	Asphalt/Tarmac (cont.coal tar)		
	Asphalt/Tarmac (no coal tar)		
	Bitumen		
	Others		
	Other organics	~0.50	Coke
Other materials (%wt):	The composition of the materials is 75% concrete, 15% brick and 1% soil and stone (combined), 1% asbestos, 1% calcium silicate.		
	Inorganic ion exchange materials.		
	Inorganic sludges and flocs		
	Soil	~0.50	
	Brick/Stone/Rubble	~15.5	
	Cementitious material	~75.0	
	Sand		

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	Glass/Ceramics.....		
	Graphite.....		
	Desiccants/Catalysts.....		
	Asbestos.....	~1.0	
	Non/low friable.....		
	Moderately friable.....		
	Highly friable.....		
	Free aqueous liquids.....	0	
	Free non-aqueous liquids.....	0	
	Powder/Ash.....	1.0	Cacium silicate may not be as loose powder
Inorganic anions (%wt):	Inorganic anions are not expected to be present.		
	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:	-		
	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.....		
	Corrosive materials.....	0	
	Pyrophoric materials.....	0	
	Generating toxic gases.....	0	
	Reacting with water.....	0	
	Active particles.....		
	Soluble solids as bulk chemical compounds.....		
Hazardous substances / non hazardous pollutants:	-		
	Acrylamide.....		
	Benzene.....		

Chlorinated solvents.....
Formaldehyde.....
Organometallics.....
Phenol.....
Styrene.....
Tri-butyl phosphate.....
Other organophosphates.....
Vinyl chloride.....
Arsenic.....
Barium.....
Boron.....
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.....

Complexing agents (%wt):

EDTA.....
DPTA.....
NTA.....
Polycarboxylic acids……
Other organic complexants..... Not present.
Total complexing agents..... 0

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction		
Supercompaction (HFC)		
Incineration		
Solidification		
Decontamination		
Metal treatment		5.0
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		~95.0

Comment on planned treatments: Based on our current decommissioning experience, it is estimated that around 70% of this waste may be classified as "out of scope" if handled in a suitable manner. However at this time a bulk material "out of scope" waste route has not been consistently agreed for this type of material.

Disposal Routes:

Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository	
Expected to be consigned to a Landfill Facility	~95.0
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	~5.0
Expected to be consigned as Out of Scope	
Expected to be recycled / reused	
Disposal route not known	

Upcoming (2019/20-2021/22) Waste Routing (if expected to change from above):

Disposal Route	Stream volume %		
	2019/20	2020/21	2021/22
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			

Waste Packaging for Disposal: (Not applicable to this waste stream)

Container	Stream volume %	Waste loading m^3	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			

Other information: Waste is anticipated to be disposed of to specialised near surface disposal such as CLESA type facilities.

Waste Planned for Disposal at the LLW Repository: (Not applicable to this waste stream)

Container voidage: -

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Waste Characterisation Form (WCH):	-
Waste consigned for disposal to LLWR in year of generation:	-
Potential for the waste to contain discrete items:	-

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:	The main sources of activity are actinides and fission products.
Uncertainty:	Waste within this waste stream is generated from a number of decommissioning projects which will commence at a future date. The uncertainties quoted for each nuclide represent both the uncertainty in quantification without detailed sampling and the likely variation of nuclide in different building consigned wastes under this waste stream. It is exceptionally unlikely that all the waste included in this waste stream will have the same variation in nuclide fingerprint. Also activity levels will depend on degree of decontamination achieved.
Definition of total alpha and total beta/gamma:	Totals shown on table of radionuclide activities are the sums of the listed alpha or beta/gamma emitting radionuclides plus 'other alpha' or 'other beta/gamma'.
Measurement of radioactivities:	Characterisation data review 2D148 HVVLW stream from final decommissioning.
Other information:	Co57, Co58, Zr95 and Nb95 may be present, though not in significant concentrations.

WASTE STREAM 2D148 HVVLLW from Final Decommissioning

Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3			9.13E-07	C D 2	Gd 153				
Be 10					Ho 163				
C 14			2.33E-08	C D 2	Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36			1.28E-08	C D 2	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54			1.13E-09	C D 2	Pb 205				
Fe 55			2.09E-07	C D 2	Pb 210				
Co 60			1.62E-08	C D 2	Bi 208				
Ni 59					Bi 210m				
Ni 63			2.89E-08	C D 2	Po 210				
Zn 65				5	Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226			3.10E-08	C D 2
Kr 85				8	Ra 228				
Rb 87					Ac 227				
Sr 90			6.72E-07	C D 2	Th 227				
Zr 93					Th 228			5.09E-09	C D 2
Nb 91					Th 229				8
Nb 92					Th 230			5.36E-09	C D 2
Nb 93m					Th 232			4.08E-09	C D 2
Nb 94					Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99			7.97E-08	C D 2	U 232			2.58E-09	C D 2
Ru 106			1.52E-08	C D 2	U 233			1.20E-07	C D 2
Pd 107					U 234			6.91E-07	C D 2
Ag 108m					U 235			1.24E-07	C D 2
Ag 110m				5	U 236			6.44E-08	C D 2
Cd 109					U 238			8.24E-07	C D 2
Cd 113m					Np 237			2.75E-08	C D 2
Sn 119m					Pu 236				
Sn 121m					Pu 238			1.80E-08	C D 2
Sn 123					Pu 239			5.21E-08	C D 2
Sn 126					Pu 240			5.96E-08	C D 2
Sb 125			4.36E-09	C D 2	Pu 241			3.32E-07	C D 2
Sb 126					Pu 242			1.30E-09	C D 2
Te 125m					Am 241			5.52E-08	C D 2
Te 127m					Am 242m				
I 129			2.37E-08	C D 2	Am 243				
Cs 134			3.88E-09	C D 2	Cm 242			6.15E-10	C D 2
Cs 135					Cm 243				5
Cs 137			3.70E-07	C D 2	Cm 244			3.23E-09	C D 2
Ba 133					Cm 245			7.59E-08	C D 2
La 137					Cm 246			6.98E-09	C D 2
La 138					Cm 248				
Ce 144			1.86E-08	C D 2	Cf 249				
Pm 145					Cf 250				
Pm 147			2.89E-08	C D 2	Cf 251				
Sm 147					Cf 252				
Sm 151			2.54E-10	C D 2	Other a				
Eu 152				5	Other b/g				5
Eu 154			9.10E-10	C D 2	**Total a**	**0**		**2.17E-06**	**C D 2**
Eu 155			2.50E-09	C D 2	**Total b/g**	**0**		**2.76E-06**	**C D 2**

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