WASTE STREAM 2X25 Disposal of LLW from Fuel Handling Plant

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

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	0 m³
Future arisings -	1.4.2022 - 31.3.2023.....	146.0 m³
	1.4.2023 - 31.3.2024.....	167.5 m³
	1.4.2024 - 31.3.2025.....	167.5 m³
	1.4.2025 - 31.3.2026.....	146.0 m³
	1.4.2026 - 31.3.2027.....	146.0 m³
	1.4.2027 - 31.3.2028.....	146.0 m³
	1.4.2028 - 31.3.2029.....	146.0 m³
	1.4.2029 - 31.3.2030.....	146.0 m³
	1.4.2030 - 31.3.2031.....	146.0 m³
	1.4.2031 - 31.3.2032.....	146.0 m³
	1.4.2032 - 31.3.2033.....	146.0 m³
	1.4.2033 - 31.3.2034.....	146.0 m³
	1.4.2034 - 31.3.2035.....	146.0 m³
	1.4.2035 - 31.3.2036.....	146.0 m³
	1.4.2036 - 31.3.2037.....	146.0 m³
	1.4.2037 - 31.3.2038.....	146.0 m³
	1.4.2038 - 31.3.2039.....	146.0 m³
	1.4.2039 - 31.3.2040.....	146.0 m³
	1.4.2040 - 31.3.2041.....	146.0 m³
	1.4.2041 - 31.3.2042.....	146.0 m³
	1.4.2042 - 31.3.2043.....	146.0 m³
	1.4.2043 - 31.3.2044.....	146.0 m³
Total future arisings:		3254.6 m³
Total waste volume:		3254.6 m³

Comment on volumes:	Arisings are sourced from REM_TP_0116A and are based on the latest five-year forecasts from the Waste Forecasting database. The overall timescale for waste arising are informed by the Sellafield Site Master Timeline. Uncertainty information is notional.			
Uncertainty factors on volumes:	Stock (upper):	x	Arisings (upper)	x 1.5
	Stock (lower):	x	Arisings (lower)	x 0.5
WASTE SOURCE	The waste arises as a result of routine operations and maintenance within the Fuel Handling Plant (including the pond and decanners).			

PHYSICAL CHARACTERISTICS

General description:	The waste will be predominately secondary wastes and metallic waste (associated with maintenance and redundant plant items) The waste has not undergone any changes since it was generated.
Physical components (%wt):	Metals (35%), Concrete/Rubble (4.8%), Wood (3%), Rubber (3%), Halogenated Plastics (17%), Non-Halogenated Plastics (17%), Hydrocarbons (0.4%), Other Organics (18%), Asbestos (0.2%) and Other (1.6%).
Sealed sources:	The waste does not contain sealed sources.
Bulk density (t/m³):	0.250
Comment on density:	The total Bulk density is derived from REM_TP_0116A and is based on the five-year forecast from the Waste Forecasting database.

CHEMICAL COMPOSITION

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General description and components (%wt): Metals (35%), Concrete/Rubble (4.8%), Wood (3%), Rubber (3%), Halogenated Plastics (17%), Non-Halogenated Plastics (17%), Hydrocarbons (0.4%), Other Organics (18%), Asbestos (0.2%) and Other (1.6%).

Chemical state: Alkali

Chemical form of radionuclides: -

Metals and alloys (%wt): Material thickness not specified

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	13.4		
Other ferrous metals	13.3		
Iron	6.7		
Aluminium	0.39		
Beryllium	0		
Cobalt	0		
Copper	0.05		
Lead	0.90		
Magnox/Magnesium	0		
Nickel	0		
Titanium	0		
Uranium	0		
Zinc	0.22		
Zircaloy/Zirconium	0		
Other metals	0		

Organics (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	3.0		
Paper, cotton	0		
Wood	3.0		
Halogenated plastics	17.0		
Total non-halogenated plastics	17.0		
Condensation polymers			
Others			
Organic ion exchange materials	0		
Total rubber	3.0		
Halogenated rubber			
Non-halogenated rubber			
Hydrocarbons	0.45		
Oil or grease	0.45		
Fuel	0		
Asphalt/Tarmac (cont.coal tar)	0		
Asphalt/Tarmac (no coal tar)	0		
Bitumen	0		
Others	0		

Other organics	18.0

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	4.8		
Cementitious material	0		
Sand	0		
Glass/Ceramics	1.5		
Graphite	0		
Desiccants/Catalysts	0		
Asbestos	0.24		
Non/low friable	0.12		
Moderately friable	0.09		
Highly friable	0.02		
Free aqueous liquids	0		
Free non-aqueous liquids	0		
Powder/Ash	0		

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	18.0	

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Putrescible wastes.....	1.0
Non-putrescible wastes.....	17.0
Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0.62
Higher activity particles.....	0
Soluble solids as bulk chemical compounds.....	0

Hazardous substances / non hazardous pollutants: -

	(%wt)	Type(s) and comment
Acrylamide.....	0	
Benzene.....	0	
Chlorinated solvents.....	0	
Formaldehyde.....	0	
Organometallics.....	0	
Phenol.....	0	
Styrene.....	0	
Tri-butyl phosphate.....	0	
Other organophosphates.....	0	
Vinyl chloride.....	0	
Arsenic.....	0	
Barium.....	0	
Boron.....	0	
Boron (in Boral).....	0	
Boron (non-Boral).....	0	
Cadmium.....	0	
Caesium.....	0	
Selenium.....	0	
Chromium.....	0	
Molybdenum.....	0	
Thallium.....	0	
Tin.....	0.11	
Vanadium.....	0	
Mercury compounds.....	0	
Others.....	0	
Electronic Electrical Equipment (EEE)		
EEE Type 1.....		220 items in 5 years.
EEE Type 2.....		90 items in 5 years.
EEE Type 3.....		20 items in 5 years.
EEE Type 4.....		10 items in 5 years.

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EEE Type 5..... 10 items in 5 years.

Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA.....	<0.01	
DPTA.....	0	
NTA.....	0	
Polycarboxylic acids…….	0	
Other organic complexants.....	0	
Total complexing agents.....	<0.01	

Potential for the waste to contain discrete items: Yes. Pumps, motors, hand tools

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction		
Supercompaction (HFC)	On-site	17.6
Incineration	Off-site	73.3
Solidification		
Decontamination		
Metal treatment	Off-site	7.1
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		2.0

Comment on planned treatments: All high force compaction takes place in WAMAC. For Inventory purposes, it is assumed that supercompaction will continue after the closure of WAMAC in 2028. Waste not requiring treatment is mostly 'out of scope' metal and direct disposal to LLWR.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	17.9	0.15
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	73.3	0.14
Expected to be consigned to a Metal Treatment Facility	7.1	1.4
Expected to be consigned as Out of Scope	1.8	1.4
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):

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Disposal Route	Stream volume %		
	2022/23	2023/24	2024/25
Expected to be consigned to the LLW Repository	18.1	15.9	15.9
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	73.1	75.2	75.2
Expected to be consigned to a Metal Treatment Facility	7.0	7.3	7.3
Expected to be consigned as Out of Scope	1.8	1.7	1.7
Expected to be recycled / reused			
Disposal route not known			

Opportunities for alternative disposal routing: No

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	17.6	59.28	10
1/2 Height IP-2 Disposal/Re-usable ISO	0.28	10	< 1
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: -

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 has a current WCH.
Differences exist between Inventory information and current WCH.
Materials and radioactivity data have been taken from the current WCH, but data on waste volumes and waste routes are based on the Waste Forecasting database as this information is more recent.

Waste consigned for disposal to LLWR in year of generation: Yes.

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 activity arises from the irradiated Magnox and AGR fuels handled at the facility. The waste becomes contaminated as a result of routine operations.

Uncertainty: The uncertainty associated with the fingerprinting analysis is likely to be low, however the

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	volumes and total activity information (and possibly some other assumptions) are likely to be more notional and thus more uncertain.
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:	Specific activity data is based on data in the corresponding WCH, which in turn maps an estimated total activity to an analytically derived radionuclide fingerprint.
Other information:	The radionuclides have been taken from REM_TP_0116A and are based on the current WCH (LLWR Ref: 1S-1S-0-WCH-0-4561 Version 6).

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3			1.65E-06	C C 2	Gd 153				
Be 10					Ho 163				
C 14			6.59E-07	C C 2	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			6.59E-07	C C 2	Pb 205				
Fe 55			2.66E-06	C C 2	Pb 210				
Co 60			1.25E-06	C C 2	Bi 208				
Ni 59					Bi 210m				
Ni 63			1.69E-06	C C 2	Po 210				
Zn 65			2.20E-08	C C 2	Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90			3.25E-05	C C 2	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			2.20E-08	C C 2	U 232				
Ru 106			1.34E-06	C C 2	U 233				
Pd 107					U 234			1.10E-07	C C 2
Ag 108m					U 235			4.72E-09	C C 2
Ag 110m					U 236			3.14E-09	C C 2
Cd 109					U 238			1.10E-07	C C 2
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238			1.19E-06	C C 2
Sn 123					Pu 239			1.14E-06	C C 2
Sn 126					Pu 240			1.14E-06	C C 2
Sb 125			5.49E-07	C C 2	Pu 241			8.24E-05	C C 2
Sb 126					Pu 242				
Te 125m					Am 241			3.19E-06	C C 2
Te 127m					Am 242m				
I 129					Am 243				
Cs 134			3.01E-06	C C 2	Cm 242			4.39E-08	C C 2
Cs 135					Cm 243				
Cs 137			7.05E-05	C C 2	Cm 244			2.20E-07	C C 2
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144			9.23E-07	C C 2	Cf 249				
Pm 145					Cf 250				
Pm 147			9.56E-06	C C 2	Cf 251				
Sm 147					Cf 252				
Sm 151			1.23E-06	C C 2	Other a				
Eu 152					Other b/g			4.39E-08	C C 2
Eu 154			1.10E-06	C C 2	**Total a**	**0**		**7.15E-06**	**C C 2**
Eu 155			7.91E-07	C C 2	**Total b/g**	**0**		**2.13E-04**	**C C 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