SITE Windscale

SITE OWNER **Nuclear Decommissioning Authority**

WASTE CUSTODIAN Sellafield Limited

LLW **WASTE TYPE**

Is the waste subject to

Scottish Policy:

Nο

WASTE VOLUMES

Reported At 1.4.2022..... Stocks: $0.5 \, m^3$ Future arisings -1.4.2022 - 31.3.2023...... $0 \, \text{m}^3$ 1.4.2023 - 31.3.2024...... $0 \, \text{m}^3$ 1.4.2024 - 31.3.2025...... $0 \, \text{m}^3$ 1.4.2025 - 31.3.2027...... $0 \, \text{m}^3$ 1.4.2027 - 31.3.2053...... ~2444.5 m³ Total future arisings: 2444.5 m³ Total waste volume: 2445.0 m³

Comment on volumes: Waste arisings are due to the decommissioning of several facilities and hence are not

constant. The volume may change significantly according to decommissioning,

decontamination and segregation techniques applied.

Uncertainty factors on Arisings (upper) Stock (upper): x 1.5 x 1.5 volumes: Stock (lower): x 0.5 Arisings (lower) x 0.5

WASTE SOURCE Decommissioning waste from redundant facilities. These include PIE facilities, Redundant

Flasks, and Packaging plant.

PHYSICAL CHARACTERISTICS

General description: Concrete, lead shielding bricks, pipework and redundant plant with small amounts of

cellulosic and plastic material. No large items have been identified.

Physical components (%vol): Sufficient data is not available to characterise waste.

Sealed sources:

Bulk density (t/m3): ~1.97

Comment on density: The density varies depending on waste characteristics however, approx. 80% of the waste

is concrete (~1.8t/m³) with the remainder being largely steel with smaller quantities of lead.

CHEMICAL COMPOSITION

General description and components (%wt):

Steel (19%), lead (1%), concrete (80%).

Chemical state: Alkali

Chemical form of

H-3: As gas or tritiated water trapped within concrete matrix.

radionuclides:

Metals and alloys (%wt): Insufficient data at present.

> (%wt) % of total C14 Type(s) / Grade(s) with proportions

activity

Stainless steel..... Other ferrous metals..... ~19.0 Iron..... Aluminium...... 0 Beryllium..... Cobalt..... Copper...... 0 Lead......<1.0

	Magnox/Magnesium	0		
	Nickel	0		
	Titanium			
	Uranium	Р		
	Zinc	0		
	Zircaloy/Zirconium	0		
	Other metals	<1.0	Other metals include tungsten at	
• • • • • •		~() 4 !!	<1% by weight.	
Organics (%			llose, in the form of Sisal Kraft Paper and enated plastics - PVC. Halogenated rubbe	
		(%wt)	Type(s) and comment	% of total C14
	Total cellulosics	<1.0		activity
	Paper, cotton	<1.0		
	Wood	<1.0		
	Halogenated plastics	<1.0		
	Total non-halogenated plastics	<1.0		
	Condensation polymers	NE		
	Others	NE		
	Organic ion exchange materials	0		
	Total rubber	Р		
	Halogenated rubber	Р		
	Non-halogenated rubber	Р		
	Hydrocarbons			
	Oil or grease			
	Fuel			
	Asphalt/Tarmac (cont.coal tar)			
	Asphalt/Tarmac (no coal tar)			
	Bitumen			
	Others			
	Other organics	0		
Other materi	als (%wt): Any sludges found, 6	e.g. in pipe	s, will be immobilised.	
		(%wt)	Type(s) and comment	% of total C14 activity
	Inorganic ion exchange materials	0		
	Inorganic sludges and flocs	TR		
	Soil	0		
	Brick/Stone/Rubble	0		
	Cementitious material	80.0		
	Sand			
	Glass/Ceramics	0		
	Graphite	0		
	Desiccants/Catalysts			
	Asbestos	NE		

	Non/low friable		
	Moderately friable		
	Highly friable		
	Free aqueous liquids	NE	
	Free non-aqueous liquids	NE	
	Powder/Ash	0	
Inorganic ar	nions (%wt): Inorganic anions pr	esent as c	onstituents of concrete.
		(%wt)	Type(s) and comment
	Fluoride	NE	
	Chloride	NE	
	lodide	NE	
	Cyanide	NE	
	Carbonate	Р	
	Nitrate	NE	
	Nitrite	NE	
	Phosphate	NE	
	Sulphate	NE	
	Sulphide	NE	
Materials of waste accep	interest for Hazardous materia otance criteria:	ls are not e	expected to be present, but requires confirmation.
		(%wt)	Type(s) and comment
	Combustible metals		
	Low flash point liquids	0	
	Explosive materials	0	
	Phosphorus	0	
	Hydrides	0	
	Biological etc. materials	0	
	Biodegradable materials	NE	
	Putrescible wastes	0	
	Non-putrescible wastes	NE	
	Corrosive materials	0	
	Pyrophoric materials	0	
	Generating toxic gases	0	
	Reacting with water		
	Higher activity particles	NE	
	Soluble solids as bulk chemical compounds	NE	
	substances / Only bulk metals, sous pollutants:	uch as lead	d, expected to be present.
		(%wt)	Type(s) and comment
	Acrylamide	•	
	Benzene	NE	

Chlorinated solvents		
Formaldehyde		
Organometallics		
Phenol	NE	
Styrene		
Tri-butyl phosphate	NE	
Other organophosphates		
Vinyl chloride	NE	
Arsenic	NE	
Barium		
Boron	NE	
Boron (in Boral)		
Boron (non-Boral)		
Cadmium	NE	
Caesium		
Selenium	NE	
Chromium	NE	
Molybdenum	NE	
Thallium		
Tin	NE	
Vanadium	NE	
Mercury compounds		
Others	NE	
Electronic Electrical Equipment (EEE)		
EEE Type 1		
EEE Type 2		
EEE Type 3		
EEE Type 4		
EEE Type 5		
Complexing agents (%wt): Not yet determined		
	(%wt)	Type(s) and comment
EDTA		
DPTA		
NTA		
Polycarboxylic acids		
Other organic complexants	NE	Complexing agents are not expected to be present.
Total complexing agents	NE	

Potential for the waste to contain discrete items:

Yes. Potential for tools and steel fabrications to be present in this waste stream.

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		<20.0
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		80.0

Comment on planned treatments:

This is dependant upon the origin of the waste and characterisation that will be carried out upon decommissioning. Disposal routes will depend upon the results obtained through characterisation. Based on current experience we have assumed the treatment methods set out in the table for the purposes of the 2022 UK Inventory.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	80.0	1.2
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	<20.0	1.4
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 %			
Disposal Noute			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				

Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Disposal at LLWR	Authorised landfill	NE	2027	Medium	There may some waste suitable for recategorising as VLLW or Out of Scope but this will depend on characterisation and demolition techniques.

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	80.0	~10	196

Other information: The use of half height ISO containers will be considered for the denser items

e.g. lead/steel in order to achieve an acceptable packing efficiency balanced

against container weight limits.

Waste Planned for Disposal at the LLW Repository:

Container voidage: Inaccessible voidage will be <10%.

Waste Characterisation

The waste meets the LLWR's Waste Acceptance Criteria (WAC).

Form (WCH): The waste does not have a current WCH.

Waste consigned for disposal to LLWR in year of generation:

Yes.

Non-Containerised Waste for In-Vault Grouting:

Stream volume (%):

Waste stream variation: There is no existing waste stream variation for this waste

Bounding cuboidal volume:

Inaccessible voidage: -

Other information: -

RADIOACTIVITY

Source: Overall the waste contains contributions from activated products, e.g Co60, fission

products, e.g Cs137 and U and Pu isotopes.

Uncertainty: More detailed information will be available upon characterisation.

Definition of total alpha and total beta/gamma:

Activity data based on activity data of waste stream 2A306.

Measurement of Concrete coring has been undertaken in some areas, in other cases significant

radioactivities: contamination is known but not yet fully characterised e.g. drains, cell/cave internals & roof

areas.

Other information:

Nuclide Waste at 1,4,2022 Bands and Code Future arisings Bands and Code Nuclide Waste at 1,4,2022 Bands and Code Future arising H 3 Be 10 Gd 153 Ho 163 Ho 166m Ho 166m Ho 166m Tm 170 Al 26 Tm 170 Al 26 Tm 171 Lu 174 Lu 174 Lu 176 Hf 178n Hf 182 Pt 193 Ti 204 Pb 205 Pb 210 Bi 208 Bi 210m Pb 210 Bi 208 Bi 210m Pb 210 Bi 208 Bi 210m Pb 210 Bi 223 Bi 2223 Bi 2223 Bi 2226 Bi	
Be 10 C 14 Na 22 Al 26 Cl 36 Ar 39 Ar 42 K 40 Ca 41 Mn 53 Mn 54 Fe 55 Co 60 Al 36 Al 37 Be 210 Be 20 Be 210 Be 20	3 Code
C 14 Na 22 Al 26 C 136 Ar 39 Ar 42 K 40 Ca 41 Mn 53 Mn 53 Mn 54 Fe 55 Co 60 Bi 208 Ni 59 Ni 63 Zn 65 Se 79 Kr 81 Kr 85 Rb 87 Sr 90 Zr 93 Nb 91 Nb 92 Nb 93 Nb 93 Nb 94 Mb 93 Tc 97 Hb 166 Tm 170 Tm 171 Lu 174 Lu 176 Hf 178n Hf 182 Pt 193 Tl 204 Pb 205 Pe 205 Pb 210 Co 60 Bi 208 Bi 210m Po 210 Ra 223 Ra 225 Ra 226 Ra 228 Rb 87 Th 227 Th 227 Th 228 Th 230 Th 230 Th 232 Th 230 Th 232 Th 234 Mo 93 Tc 97	
C 14 Na 22 Al 26 C 136 Ar 39 Ar 42 K 40 Ca 41 Mn 53 Mn 53 Mn 54 Fe 55 Co 60 Bi 208 Ni 59 Ni 63 Zn 65 Se 79 Kr 81 Kr 85 Rb 87 Sr 90 Zr 93 Nb 91 Nb 92 Nb 93 Nb 93 Nb 94 Mb 93 Tc 97 Hb 166 Tm 170 Tm 171 Lu 174 Lu 176 Hf 178n Hf 182 Pt 193 Tl 204 Pb 205 Pe 205 Pb 210 Co 60 Bi 208 Bi 210m Po 210 Ra 223 Ra 225 Ra 226 Ra 228 Rb 87 Th 227 Th 227 Th 228 Th 230 Th 230 Th 232 Th 230 Th 232 Th 234 Mo 93 Tc 97	
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Ar 42 K 40 Hf 178n Ca 41 Hf 182 Pt 193 Mn 53 Tl 204 Pb 205 Mn 54 Pb 205 Pb 210 Fe 55 Pb 210 Pb 210 Co 60 6 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 Th 231 Tc 97 Pa 233	
K 40 Hf 182 Ca 41 Pt 193 Mn 53 Tl 204 Mn 54 Pb 205 Fe 55 Pb 210 Co 60 6 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 230 Nb 92 Th 230 Nb 93m Th 232 Nb 94 Th 234 Mo 93 Pa 231 Tc 97	
Ca 41 Pt 193 Mn 53 Tl 204 Mn 54 Pb 205 Fe 55 Pb 210 Co 60 6 Ni 59 Bi 208 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	
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Fe 55 Co 60 Ni 59 Ni 63 Zn 65 Se 79 Kr 81 Kr 85 Rb 87 Sr 90 Zr 93 Nb 91 Nb 92 Nb 93 Nb 93 Tc 97 Pb 210 Bi 208 Bi 208 Bi 210m Po 210 Ra 223 Ra 225 Ra 226 Ra 228 Rb 227 Th 227 Th 227 Th 228 Th 230 Th 232 Th 234 Pa 231 Pa 233	
Co 60 6 6 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 Pa 231 Mo 93 Pa 231 Tc 97 Pa 233	
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	
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	
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	
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	
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	
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	
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	
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	
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	
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	
Nb 91 Th 229 Nb 92 Th 230 Nb 93m Th 232 Nb 94 Th 234 Mo 93 Pa 231 Tc 97 Pa 233	
Nb 92 Th 230 Nb 93m Th 232 Nb 94 Th 234 Mo 93 Pa 231 Tc 97 Pa 233	
Nb 93m Th 232 Nb 94 Th 234 Mo 93 Pa 231 Tc 97 Pa 233	
Nb 94 Th 234 Mo 93 Pa 231 Tc 97 Pa 233	
Mo 93 Tc 97 Pa 231 Pa 233	
Tc 97 Pa 233	
Tc 99 U 232	
Ru 106 6 U 233	
Pd 107 U 234	
Ag 108m U 235 6	6
Ag 110m U 236	
Cd 109 U 238 6	6
Cd 113m Np 237	
Sn 119m Pu 236	
Sn 121m Pu 238	
Sn 123 Pu 239 6	6
Sn 126 Pu 240 6	6
Sb 125 Pu 241 6	6
Sb 126 Pu 242 6	6
Te 125m Am 241 6	6
Te 127m Am 242m	J
1 129 Am 243	
Cs 134 6 6 Cm 242	
Cs 135	
Cs 137 6 6 Cm 244	
Ba 133 Cm 245	
La 137 Cm 246	
La 138 Cm 248	
Ce 144 6 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 6 6 Total a NE N	E
Eu 155 Total b/g NE N	
Rands (Unper and Lower)	_

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

- Measured activity
 Derived activity (best estimate)
 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