SITE Sellafield

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Limited

WASTE TYPE VLLW

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	0 m³
	1.4.2023 - 31.3.2024	1.0 m ³
	1.4.2024 - 31.3.2025	1.0 m ³
	1.4.2025 - 31.3.2030	3121.5 m ³
	1.4.2030 - 31.3.2040	73119.7 m ³
	1.4.2040 - 31.3.2050	120490.5 m ³
	1.4.2050 - 31.3.2060	273663.0 m ³
	1.4.2060 - 31.3.2070	333727.8 m ³
	1.4.2070 - 31.3.2080	352630.6 m ³
	1.4.2080 - 31.3.2090	61298.1 m ³
	1.4.2090 - 31.3.2100	413204.7 m ³
	1.4.2100 - 31.3.2110	209014.1 m ³
	1.4.2110 - 31.3.2121	806549.3 m ³
Total future arisings:		2646821.3 m ³
Total waste volume:		2646821.3 m ³

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

Reported

with the arisings within a specific time period are significantly greater.

Uncertainty factors on

volumes:

Stock (upper): x Stock (lower): x Arisings (upper) x 1.45 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%).

te: Neutral			
m of - s:			
ılloys (%wt):			
	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	NE		activity
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.	
wt): The other organics a	are compr	sed entirely of coke	
	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	~1.5		a,
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	
	m of size illoys (%wt): - Stainless steel	m of - 5:	Illoys (%wt)

Other materials (%wt): The composition of the materials is 75% concrete, 15% brick and 1% soil and stone

(combined), 1% asbestos, 1% calcium silicate.

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials			acamy
Inorganic sludges and flocs			
Soil	~0.50		
Brick/Stone/Rubble	~15.5		
Cementitious material	~75.0		
Sand			
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 a	are not expe	ected to be present.	
	(%wt)	Type(s) and comment	
Fluoride	0		
Chloride	0		
lodide	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		
(Corrosive materials	0	
	Pyrophoric materials	0	
	Generating toxic gases	0	
	Reacting with water	0	
I	Higher activity particles		
	Soluble solids as bulk chemical compounds		
Hazardous sub non hazardous			
		(%wt)	Type(s) and comment
ı	Acrylamide		
1	Benzene		
(Chlorinated solvents		
	Formaldehyde		
(Organometallics		
1	Phenol		
;	Styrene		
	Tri-butyl phosphate		
	Other organophosphates		
,	Vinyl chloride		
	Arsenic		
I	Barium		
1	Boron		
	Boron (in Boral)		
	Boron (non-Boral)		
(Cadmium		
(Caesium		
:	Selenium		
(Chromium		
	Molybdenum		
	Thallium		
	Tin		
,	Vanadium		
	Mercury compounds		
(Others		
I	Electronic Electrical Equipment (EEE)		
	EEE Type 1		
	EEE Type 2		
	EEE Type 3		
	EEE Type 4		
	EEE Type 5		

	(%wt)	Type(s) and comment
EDTA		
DPTA		
NTA		
Polycarboxylic acids		

Total complexing agents...... 0

Potential for the waste to contain discrete items:

Complexing agents (%wt):

No.

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		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 %	Disposal density t/m3
Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility	~95.0	1.0
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	1.0
Expected to be consigned as Out of Scope Expected to be recycled / reused	0.0	1.0
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 Route	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				

Opportunities for alternative disposal routing:

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Authorised landfill	Out of scope	70.0	2023	Medium	This waste stream is not expected to be disposed at LLWR. The baseline route is assumed to be authorised landfill. There is potential for a significant proportion to be categorised as out of scope and this will be dependant upon the extent of contamination and demolition techniques deployed. There is potential for ~70% of this waste to be recategorised as out of scope but this is based on limited decommissioning experience. This will be better underpinned when facilities are characterised and broadfront decommissioning commences

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

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/Pausable ISO	Container	Stream volume %	Waste loading m ³	Number of packages
2m box (no shielding) 4m box (no shielding) Other	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 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: -

Waste Characterisation

Form (WCH):

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Waste consigned for disposal to LLWR in year of generation:

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.

Nuclide	Bands and Code
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 Ni 59 Ni 63 Zn 65 Se 79 Kr 81 Kr 85 Rb 87 Sr 90 Zr 93 Nb 91 Nb 92 Nb 93m Nb 94 Mb 92 Nb 93m Nb 94 Mo 93 Tc 97 Tc 99 Tc 99 Tc 99 Tc 99 Tr 97 Tc 99 Tr 97 Tc 99 Tr 98 Tr 97 Tr 99	
Cl 36	
Ar 39 Ar 42 K 40 Ca 41 Mn 53 Mn 54 Fe 55 Co 60 Ni 59 Ni 63 Zn 65 Se 79 Kr 81 Kr 85 Ra 828 Ra 226 Kr 85 Rb 87 Sr 90 Zr 93 Nb 91 Nb 92 Nb 93 Nb 94 Nb 93 Tc 97 Tc 99 Ru 106 Pd 107 Ag 108m Ag 108m Ag 108m Ag 128 Sn 1	
Ar 42 K 40 C a 41 Mn 53 Mn 54 Fe 55 C 0 60 Ni 59 Ni 63 Z n 65 Se 79 Kr 81 Kr 85 Rb 87 Sr 90 Z r 93 Nb 91 Nb 92 Nb 93 Nb 94 Mo 93 Tc 97 Tc 99 Ru 106 Pd 107 Ag 108m Ag 110m Cd 109 Cd 113m Sn 121m Sn 121m Sn 121m Sn 121m Sn 121m Sn 121m Sn 123 Sn 126 I 1.13E-09 C D 2 Ph 210 Pb 200 Pb 210 Pb 200 Pb 210 Pb 200 Bi 200 Bi 210m Bi 223 Bi 236 Bi 246-07 Bi 238 Bi 246-07 Bi 239 Bi 246-08 Bi 210m Bi 210m Bi 210m Bi 210m Bi 223 Bi 238 Bi 246-07 Bi 239 Bi 246-08 Bi 210m Bi 210m Bi 210m Bi 210m Bi 220m Bi 210m Bi 210m Bi 210m Bi 220m Bi 210m Bi 210m Bi 210m Bi 210m Bi 210m Bi 220m Bi 210m	
K 40	
Ca 41	
Mn 53 Mn 54	
Mn 54	
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Se 79 Rs 225 Ra 226 3.10E-08 0 Kr 81 Ra 226 3.10E-08 0 Rb 87 Ra 228 Ac 227 0 Sr 90 6.72E-07 CD 2 Th 227 0 Zr 93 Th 227 0 0 Nb 91 Th 228 5.09E-09 0 Nb 92 Th 230 5.36E-09 0 Nb 93m Th 232 4.08E-09 0 Nb 94 Th 234 4.08E-09 0 Mo 93 Th 234 7.97E-08 CD 2 U 232 2.58E-09 0 Ru 106 1.52E-08 CD 2 U 233 1.20E-07 0 Pd 107 U 234 0.91E-07 0 0 Ag 110m 5 U 236 0.44E-08 0 Cd 109 U 238 0.44E-08 0 Cd 113m Np 237 2.75E-08 0 Sn 121m Pu 238 1.80E-08 0 Sn 123 Pu 239 5.21E-08 5.96E-08	
Kr 81 Ra 226 3.10E-08 3.10E-08 6 Kr 85 Rb 87 6.72E-07 CD 2 Th 227 5.09E-09 C Sr 90 6.72E-07 CD 2 Th 227 5.09E-09 C J Nb 91 Th 228 5.09E-09 C Nb 92 Th 230 5.36E-09 C Nb 93m Th 232 4.08E-09 C Nb 94 Pa 231 Pa 231 C Mo 93 Tc 97 Pa 233 T T Tc 99 7.97E-08 CD 2 U 232 2.58E-09 C Ru 106 1.52E-08 CD 2 U 233 1.20E-07 C Pd 107 U 234 6.91E-07 C C C U 234 6.91E-07 C C Ag 110m 5 U 236 6.44E-08 C C U 236 6.44E-08 C C U 236 8.24E-07 C C U 236 8.24E-07 C C U 236 8.24E-07 C U 236 8.24E-07 C U 236 8.24E-07 U 236 <td></td>	
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	CD 2
La 138 Cm 248	
Ce 144 1.86E-08 CD 2 Cf 249	
Pm 145	
Pm 147 2.89E-08 CD 2 Cf 251	
Sm 147 Cf 252 Cf 252 Cm 151	
Sm 151 2.54E-10 CD 2 Other a	-
Eu 152 5 Other b/g Eu 154 9.10E-10 CD 2 Total a 0 2.17E-06 (5
	`D 0
Eu 155 2.50E-09 CD 2 Total b/g 0 2.76E-06 (CD 2 CD 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