

WASTE STREAM	2A308	Final Dismantling & Site Clearance: Misc Metals & Materials (Reactor and Non-Reactor) LLW
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SITE Calder Hall
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 m ³
Future arisings -	1.4.2022 - 31.3.2023.....	0 m ³
	1.4.2023 - 31.3.2024.....	0 m ³
	1.4.2024 - 31.3.2025.....	0 m ³
	1.4.2025 - 31.3.2107.....	0 m ³
	1.4.2107 - 31.3.2111.....	~721.0 m ³
Total future arisings:		721.0 m ³
Total waste volume:		721.0 m ³

Comment on volumes: For inventory purposes the arisings are assumed to arise at a uniform rate. Final Dismantling & Site Clearance is assumed to commence in 2104, with reactor dismantling commencing in 2107, and lasting for ten years. Volumes and radioactivity have been calculated for 100 years after reactor shutdown, i.e. 2103, but the volume in this stream would not change for decommissioning in 2107.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 5.0
 Stock (lower): x Arisings (lower) x 0.2

WASTE SOURCE A variety of materials from active plant dismantling.

PHYSICAL CHARACTERISTICS

General description: A variety of materials including metals and insulation materials.
 Physical components (%vol): Temporary active drains, vacuum clean and washdown items, Magnox and zirconium from reactor components.
 Sealed sources: The waste does not contain sealed sources.
 Bulk density (t/m³): 1
 Comment on density: The density is of the waste as prepared for packaging.

CHEMICAL COMPOSITION

General description and components (%wt): A variety of materials including metals and insulation materials.
 Chemical state: Neutral
 Chemical form of radionuclides: H-3: The tritium content is insignificant.
 C-14: The chemical form of carbon 14 has not been assessed but may be graphite.
 Cl-36: The chemical form of chlorine has not yet been determined.
 Se-79: The selenium content is insignificant.
 Tc-99: The technetium content is insignificant.
 I-129: The iodine content is insignificant.
 Ra: The radium content is insignificant.
 Th: The thorium content is insignificant.
 U: The uranium content is insignificant.
 Np: The neptunium content is insignificant.
 Pu: The plutonium content is insignificant.
 Metals and alloys (%wt): Items will have been cut for packaging but an assessment of the item dimensions has not been made.

WASTE STREAM	2A308	Final Dismantling & Site Clearance: Misc Metals & Materials (Reactor and Non-Reactor) LLW
---------------------	--------------	--

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	0		
Iron.....			
Aluminium.....	NE		
Beryllium.....	NE		
Cobalt.....	NE		
Copper.....	NE		
Lead.....	NE		
Magnox/Magnesium.....	<0.10		
Nickel.....	NE		
Titanium.....			
Uranium.....	NE		
Zinc.....	NE		
Zircaloy/Zirconium.....	<0.10		
Other metals.....	NE	Other metals have not been assessed.	

Organics (%wt): None expected. Halogenated rubbers are not expected. Halogenated plastics have not been assessed.

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

Other materials (%wt): Some graphite dust may be associated with reactor materials.

WASTE STREAM

2A308

Final Dismantling & Site Clearance: Misc Metals & Materials (Reactor and Non-Reactor) LLW

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

Inorganic anions (%wt): Not fully assessed.

	(%wt)	Type(s) and comment
Fluoride.....	NE	
Chloride.....	NE	
Iodide.....	NE	
Cyanide.....	0	
Carbonate.....	NE	
Nitrate.....	NE	
Nitrite.....	NE	
Phosphate.....	NE	
Sulphate.....	NE	
Sulphide.....	NE	

Materials of interest for waste acceptance criteria: The presence or absence of asbestos has yet to be confirmed.

	(%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.....		

WASTE STREAM	2A308	Final Dismantling & Site Clearance: Misc Metals & Materials (Reactor and Non-Reactor) LLW
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Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Higher activity particles.....	
Soluble solids as bulk chemical compounds.....	

Hazardous substances / non hazardous pollutants: -

	(%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.....		

WASTE STREAM

2A308

Final Dismantling & Site Clearance: Misc Metals & Materials (Reactor and Non-Reactor) LLW

Complexing agents (%wt): Not yet determined

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

Potential for the waste to contain discrete items: Yes. Partial fabrications.

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	Off-site	80.0
Supercompaction (HFC)		
Incineration		
Solidification		
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None		20.0

Comment on planned treatments:

It has been assumed for the 2022 UK RWI that 80% of the metallic waste will be treated by the supply chain and will subsequently be 'out of scope'. The remaining 20% is assumed to be consigned to LLWR for disposal as non-compactable LLW.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	20.0	1.0
Expected to be consigned to a Landfill Facility		
Expected to be consigned to an On-Site Disposal Facility	80.0	1.0
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		

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			

WASTE STREAM**2A308****Final Dismantling & Site Clearance: Misc Metals & Materials (Reactor and Non-Reactor) LLW****Opportunities for alternative disposal routing:** Not yet determined

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 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	20.0	10	15

Other information: -

Waste Planned for Disposal at the LLW Repository:

Container voidage: -

Waste Characterisation Form (WCH): It is not yet determined if the waste meets LLWR's Waste Acceptance Criteria (WAC).

Waste consigned for disposal to LLWR in year of generation: Not yet determined.

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: Activation of the materials and impurities. There may be some contamination.

Uncertainty: Only very approximate estimates have been made of the total specific activities. The activities quoted are those at the time of Final Dismantling & Site Clearance.

Definition of total alpha and total beta/gamma: All alpha emitters activities are insignificant and the total is therefore given as <1E-9 TBq/m³. An estimate of total beta/gamma activity is provided, individual nuclide activities have not been quantified.

Measurement of radioactivities: The specific activities have been estimated using a neutron activation calculation using available material specifications. The major source of uncertainty is the impurity levels.

Other information: There may be some contamination by Cs137. The activities quoted are those at 100 years after reactor shutdown, i.e. in 2103.

WASTE STREAM

2A308

Final Dismantling & Site Clearance: Misc Metals & Materials (Reactor and Non-Reactor) LLW

Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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				8	Gd 153				8
Be 10				8	Ho 163				8
C 14				8	Ho 166m				8
Na 22					Tm 170				8
Al 26			2.00E-07	CC 2	Tm 171				8
Cl 36			5.00E-06	CC 2	Lu 174				8
Ar 39				8	Lu 176				8
Ar 42				8	Hf 178n				8
K 40				8	Hf 182				8
Ca 41			1.00E-05	CC 2	Pt 193				8
Mn 53				8	Tl 204				8
Mn 54				8	Pb 205				8
Fe 55				8	Pb 210				8
Co 60			4.00E-07	CC 2	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			7.00E-09	CC 8	Po 210				8
Zn 65				8	Ra 223				8
Se 79				8	Ra 225				8
Kr 81				8	Ra 226				8
Kr 85				8	Ra 228				8
Rb 87				8	Ac 227				8
Sr 90				8	Th 227				8
Zr 93				8	Th 228				8
Nb 91				8	Th 229				8
Nb 92				8	Th 230				8
Nb 93m				8	Th 232				8
Nb 94				8	Th 234				8
Mo 93				8	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99				8	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m				8	U 235				8
Ag 110m				8	U 236				8
Cd 109				8	U 238				8
Cd 113m				8	Np 237				8
Sn 119m				8	Pu 236				8
Sn 121m				8	Pu 238				8
Sn 123				8	Pu 239				8
Sn 126				8	Pu 240				8
Sb 125				8	Pu 241				8
Sb 126				8	Pu 242				8
Te 125m				8	Am 241				8
Te 127m				8	Am 242m				8
I 129				8	Am 243				8
Cs 134				8	Cm 242				8
Cs 135				8	Cm 243				8
Cs 137				6	Cm 244				8
Ba 133				8	Cm 245				8
La 137				8	Cm 246				8
La 138				8	Cm 248				8
Ce 144				8	Cf 249				8
Pm 145				8	Cf 250				8
Pm 147				8	Cf 251				8
Sm 147				8	Cf 252				8
Sm 151				8	Other a				8
Eu 152				8	Other b/g				8
Eu 154				8	Total a	0	<1.00E-09	C 3	
Eu 155				8	Total b/g	0	2.00E-05	CC 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