

WASTE STREAM	5B310	Materials Test Reactor ILW
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SITE Dounreay

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Dounreay Site Restoration Limited

WASTE TYPE ILW

Is the waste subject to Scottish Policy: Yes

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	0 m ³
Future arisings -	1.4.2022 - 31.3.2023.....	4.9 m ³
	1.4.2023 - 31.3.2024.....	3.6 m ³
Total future arisings:		8.5 m ³
Total waste volume:		8.5 m ³

Comment on volumes: Arisings revised in line with Plant Waste Inventory walk round exercise.

Uncertainty factors on volumes:	Stock (upper):	x	Arisings (upper)	x 1.2
	Stock (lower):	x	Arisings (lower)	x 0.8

WASTE SOURCE Reactor decommissioning.

PHYSICAL CHARACTERISTICS

General description: Solid decommissioning waste from Materials Test Reactor internals and biological shields. There may be several items that may require special consideration either for weight or size reasons.

Physical components (%vol): Aluminium (3.17%), Graphite (80.31%), Mild Steel (16.52%),

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 0.65

Comment on density: No consignor's records for ILW. Therefore, use LLW (5B309).

CHEMICAL COMPOSITION

General description and components (%wt): Aluminium (2.57%), Graphite (56.85%), Mild Steel (40.57%),

Chemical state: Neutral

Chemical form of radionuclides:
H-3: Possibly present.
C-14: Possibly present.
Cl-36: Not known to be present.
Se-79: Possibly present.
Tc-99: Possibly present.
I-129: Not known to be present.
Ra: Not known to be present.
Th: Not known to be present.
U: Not known to be present.
Np: Not known to be present.
Pu: Not known to be present.

Metals and alloys (%wt): Mostly bulk metals, proportions not specified.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....			
Other ferrous metals.....	40.6		
Iron.....			
Aluminium.....	2.6		
Beryllium.....	0		
Cobalt.....	NE		

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Copper.....	NE
Lead.....	P
Magnox/Magnesium.....	NE
Nickel.....	NE
Titanium.....	
Uranium.....	NE
Zinc.....	NE
Zircaloy/Zirconium.....	NE
Other metals.....	Not specified.

Organics (%wt): Cellulose, plastics and rubber may be present in trace quantities. Not specified.

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

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.....	0		
Cementitious material.....	0		
Sand.....			
Glass/Ceramics.....			
Graphite.....	56.9		
Desiccants/Catalysts.....			

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Asbestos.....	TR
Non/low friable.....	
Moderately friable.....	
Highly friable.....	
Free aqueous liquids.....	0
Free non-aqueous liquids.....	0
Powder/Ash.....	0

Inorganic anions (%wt): About 3% inorganic anions present.

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

Materials of interest for waste acceptance criteria: Possibly asbestos.

	(%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.....	0	
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: Lead is present. Trace quantities of asbestos may be found.

	(%wt)	Type(s) and comment
Acrylamide.....		

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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): No

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

Potential for the waste to contain discrete items: Yes. Durable engineered steel structures. Cut graphite blocks

PACKAGING AND CONDITIONING

Conditioning method: Waste is to be packaged into 6m3 concrete box or HHISO depending on activity. The 6m3 concrete box will be filled and grouted at source. At the time required by

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mobile grouting plant. The Tritiated waste (Aluminium Tanks) will be decay stored and eventually sent for off site Treatment

Plant Name: Temporary Conditioning Plant

Location: Dounreay

Plant startup date: 2022

Total capacity (m³/y incoming waste): 5.0

Target start date for packaging this stream: 2022

Throughput for this stream (m³/y incoming waste): 5.0

Other information: Plant still to be designed and packages yet to be fully confirmed. Plant will be designed to handle required throughput.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	6m ³ concrete box (SD)	97.0	3.78	5.76	3
	Other(HHISO for decay storage of Tritiated metal (Aluminium Tank) - displacement volume = 19.5m ³)	3.0	3.9	19.5	< 1

Likely container type comment: The waste will be packaged in a 6m³ concrete box (SD), or for tritiated waste, will be decay stored until being sent for Off site Metal Treatment

Range in container waste volume: Not established

Other information on containers: The intent would be to use an IP2 rated HHISO as it may need to be used to transport the RAT off site.

Likely conditioning matrix: Cement

Other information: Cement for Concrete Boxes. The RAT will not be grouted in the HHISO

Conditioned density (t/m³): ~2.5

Conditioned density comment: The density is likely to be around 2 - 3 t/m³.

Other information on conditioning: -

Opportunities for alternative disposal routing: -

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Disposal at a Near Surface / Near Site Disposal Facility	Metal treatment	3.0	-	High	An Options Study has shown that decay storage of bulk aluminium waste from this stream for future recycling represents BPM

RADIOACTIVITY

Source: The main sources of activity are activated and contaminated equipment/structures.

Uncertainty: Within a factor of three.

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: The activity has been taken from package data from the DMTR ILoC.

Other information: Specific Activity uses UKRWI 2019 data decayed to 2022

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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			6.33E-02	CC 2	Gd 153				
Be 10					Ho 163				
C 14			6.53E-03	CC 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					Pb 205				
Fe 55			2.22E-04	CC 2	Pb 210				
Co 60			3.33E-02	CC 2	Bi 208				
Ni 59					Bi 210m				
Ni 63			1.03E+00	CC 2	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				
Tc 99					U 232				
Ru 106					U 233				
Pd 107					U 234				
Ag 108m					U 235				
Ag 110m					U 236				
Cd 109					U 238				
Cd 113m			2.30E-05	CC 2	Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238				
Sn 123					Pu 239				
Sn 126					Pu 240				
Sb 125					Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241				
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137			1.15E-05	CC 2	Cm 244				
Ba 133			4.01E-06	CC 2	Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a				
Eu 152			2.74E-05	CC 2	Other b/g				
Eu 154			8.17E-05	CC 2	Total a	0		0	
Eu 155			1.92E-06	CC 2	Total b/g	0		1.13E+00	BB 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