

**WASTE STREAM****6N102 Decommissioning Bulk Steel****SITE** Rutherford Appleton Laboratory**SITE OWNER** Minor Waste Producers**WASTE CUSTODIAN** Minor Waste Producers**WASTE TYPE** ILW

Is the waste subject to Scottish Policy: No

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2022.....	0 m <sup>3</sup>
Future arisings -	1.4.2037 - 31.3.2050.....	~~4200.0 m <sup>3</sup>
Total future arisings:		4200.0 m <sup>3</sup>
Total waste volume:		4200.0 m <sup>3</sup>
Comment on volumes:	Estimated volume calculated for current shielding volume Nominal uncertainty to account for dimensional errors	
Uncertainty factors on volumes:	Stock (upper): x	Arisings (upper) x 1.25
	Stock (lower): x	Arisings (lower) x 0.75

**WASTE SOURCE** Steel support structures/shielding from the decommissioning of the ISIS neutron source.**PHYSICAL CHARACTERISTICS**

General description: Activated steel  
 Physical components (%wt): mild steel (100%)  
 Sealed sources: The waste does not contain sealed sources.  
 Bulk density (t/m<sup>3</sup>): 7.8  
 Comment on density: Based on the density of steel.

**CHEMICAL COMPOSITION**

General description and components (%wt): -  
 Chemical state: Neutral  
 Chemical form of radionuclides: H-3: Bound within the steel  
 C-14: Bound within the steel  
 Metals and alloys (%wt): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	~100.0		
Iron.....	0		
Aluminium.....	0		
Beryllium.....	0		
Cobalt.....	0		
Copper.....	0		
Lead.....	0		
Magnox/Magnesium.....	0		
Nickel.....	0		
Titanium.....	0		
Uranium.....	0		
Zinc.....	0		

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Zircaloy/Zirconium.....	0		
Other metals.....	0		
Organics (%wt):	-		
	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	0		
Paper, cotton.....	0		
Wood.....	0		
Halogenated plastics .....	0		
Total non-halogenated plastics.....	0		
Condensation polymers.....	0		
Others.....	0		
Organic ion exchange materials....	0		
Total rubber.....	0		
Halogenated rubber .....	0		
Non-halogenated rubber.....	0		
Hydrocarbons.....	0		
Oil or grease .....	0		
Fuel.....	0		
Asphalt/Tarmac (cont.coal tar)...	0		
Asphalt/Tarmac (no coal tar)....	0		
Bitumen.....	0		
Others.....	0		
Other organics.....	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.....	0		
Cementitious material.....	0		
Sand.....	0		
Glass/Ceramics.....	0		
Graphite.....	0		
Desiccants/Catalysts.....	0		
Asbestos.....	0		
Non/low friable.....	0		
Moderately friable.....	0		
Highly friable.....	0		
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

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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.....	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.....	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	

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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
Vanadium.....	0
Mercury compounds.....	0
Others.....	0
Electronic Electrical Equipment (EEE)	
EEE Type 1.....	0
EEE Type 2.....	0
EEE Type 3.....	0
EEE Type 4.....	0
EEE Type 5.....	0

Complexing agents (%wt):      No

(%wt)      Type(s) and comment

EDTA.....
DPTA.....
NTA.....
Polycarboxylic acids.....
Other organic complexants.....
Total complexing agents.....

Potential for the waste to contain discrete items:      Yes. Steel is a resistant material.

**TREATMENT, PACKAGING AND DISPOSAL**

**Waste that is currently ILW:**      Decay Storage Not yet assessed

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

Treatment	On-site / Off site	Stream volume %	
Low force compaction	On-site	~95.0	
Supercompaction (HFC)			
Incineration			
Solidification			
Decontamination			
Metal treatment			
Size reduction			
Decay storage			
Recycling / reuse			~5.0
Other / various			
None			

Comment on planned treatments:

Decay storage will divert majority of waste away from ILW disposal. Anticipate ~5% will not be divertable to LLW by decay storage.

**Disposal Routes:**

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	~5.0	~7.8
Expected to be consigned to a Landfill Facility	~20.0	~7.8
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	~70.0	~7.8
Expected to be recycled / reused		
Disposal route not known	~5.0	~7.8

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			

**Opportunities for alternative disposal routing:** -

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

**Waste Packaging for Disposal:**

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Container	Stream volume %	Waste loading m <sup>3</sup>	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			

Other information: -

**Waste Planned for Disposal at the LLW Repository:**

Container voidage: -

-

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: Neutron activation.

Uncertainty: No characterisation has yet been undertaken so the nuclide list is based on a generic mild steel fingerprint with the data collected from other mild steel components from ISIS.

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: Derived from operational steel wastes as not yet been characterised. The activity is calculated on the assumption that the inner monolith (~15% by volume) is similar to current shutter wastes and remaining bulk shielding (~85% by volume) is similar to current bulk metal arrisings. The reported activity is the weighted sum of these two sources

Other information: -

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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			~3.14E-04	CC 2	Gd 153				4
Be 10				4	Ho 163				4
C 14				6	Ho 166m				4
Na 22				5	Tm 170				4
Al 26				5	Tm 171				4
Cl 36				4	Lu 174				4
Ar 39				4	Lu 176				4
Ar 42				4	Hf 178n				4
K 40				5	Hf 182				4
Ca 41				4	Pt 193				4
Mn 53				4	Tl 204				4
Mn 54			~1.76E-02	CC 2	Pb 205				4
Fe 55			~1.52E-01	CC 2	Pb 210				5
Co 60			~4.96E-03	CC 2	Bi 208				4
Ni 59				4	Bi 210m				5
Ni 63				6	Po 210				5
Zn 65				4	Ra 223				4
Se 79				4	Ra 225				5
Kr 81				4	Ra 226				5
Kr 85				4	Ra 228				5
Rb 87				4	Ac 227				5
Sr 90				4	Th 227				4
Zr 93				4	Th 228				5
Nb 91				4	Th 229				4
Nb 92				4	Th 230				5
Nb 93m				4	Th 232				5
Nb 94				4	Th 234				5
Mo 93				4	Pa 231				5
Tc 97				4	Pa 233				4
Tc 99				4	U 232				4
Ru 106				4	U 233				4
Pd 107				4	U 234				5
Ag 108m				4	U 235				5
Ag 110m				4	U 236				4
Cd 109				4	U 238				5
Cd 113m				4	Np 237				4
Sn 119m				4	Pu 236				4
Sn 121m				4	Pu 238				4
Sn 123				4	Pu 239				4
Sn 126				4	Pu 240				4
Sb 125				4	Pu 241				4
Sb 126				4	Pu 242				4
Te 125m				4	Am 241				4
Te 127m				4	Am 242m				4
I 129				4	Am 243				4
Cs 134				6	Cm 242				4
Cs 135				4	Cm 243				4
Cs 137				4	Cm 244				4
Ba 133				4	Cm 245				4
La 137				4	Cm 246				4
La 138				4	Cm 248				4
Ce 144				4	Cf 249				4
Pm 145				4	Cf 250				4
Pm 147				4	Cf 251				4
Sm 147				4	Cf 252				4
Sm 151				4	Other a				4
Eu 152				6	Other b/g				4
Eu 154				6	<b>Total a</b>	<b>0</b>		<b>0</b>	<b>4</b>
Eu 155				6	<b>Total b/g</b>	<b>0</b>		<b>~1.75E-01</b>	<b>CC 2</b>

**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