WASTE STREAM	6N06	Shutters

SITE Rutherford Appleton Laboratory

SITE OWNER UK Research and Innovation

WASTE CUSTODIAN UK Research and Innovation

WASTE TYPE ILW

WASTE VOLUMES

		Reported (m^3)
Stocks:	At 1.4.2025	~ 13.6
Future arisings:	1.4.2025 - 31.3.2026	0.6
	1.4.2026 - 31.3.2027	0.6
	1.4.2027 - 31.3.2028	0.6
	1.4.2028 - 31.3.2045	10.5
Total future arisings:		**12.4**
Total waste volume:		**26.0**

OR

Conditioned (m^3)	Packaged (m^3)

Number of waste packages in stock: At 1.4.2025…… - packages

Comment on arising rates: From 1996 to 2017, 14 waste shutters and beam-line plugs became waste as new beam-lines were opened or the internal collimation/beam-guides were changed to meet changing user requirements. It is hard to predict future arisings but it has been assumed that the rate of arisings will be similar to that experienced thus far. Also, there is a programme to upgrade various beamlines so the predicted arising until 2045 decommissioning date has been increased to account for this programme.

Additional information on quantities: Current holdings as at the report date is 15 shutter or beam-line plug sections and 6 shutter location pins. All items are not size reduced nor packaged and the shutters and plugs weigh between 1.5 te to 7 te each, with the steel pins weighing only 20-25kg each. The number of items is well known but the volume uncertainty comes from the assumptions made relating to the density of the iron and concrete shutters.

Uncertainty factors on volumes:

Stock (upper):	x 1.20	Arisings (upper):	x 1.20
Stock (lower):	x 0.80	Arisings (lower):	x 0.80

WASTE SOURCE ISIS neutron spallation source, these components shield users from the neutron beam as samples are changed or plug a gap in the shielding around the neutron source that can be removed to make a new beam-line.

PHYSICAL CHARACTERISTICS

General description: Large metal and concrete items with narrow face towards the neutrons and of 2 metres in length. It has a beam-guide in the centre that may contain glass and resin material. One face is routinely hit by neutrons when the beam is on and thus becomes highly activated and the other face is lightly activated if at all.

Changes since waste generated: Solid, dry metal and concrete items with beam-guide in centre that may contain glass and resin material.

Bulk density (t/m^3): ~ 7.8

Comment on density: Nominal density of steel used for inventory assessment

CHEMICAL COMPOSITION

General description and components (%wt): Mixture of steel and concrete and very small quantities of aluminum.

Chemical state: -

Sheet metal proportion / thickness: -

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel	5.0	-	
Other ferrous metals	~ 70.0	Grade unknown	
Iron	0	-	
Aluminium	TR	Small qauntities of aluminum within some collimators	
Beryllium	0	-	
Cobalt	0	-	
Copper	TR 0	-	
Lead	0	-	
Magnox/Magnesium	0	-	
Nickel	TR 0	some contain nickel supermirrors in glass beam guides	
Titanium	0	-	
Uranium	0	-	
Zinc	0	-	
Zircaloy/Zirconium	0	-	
Other metals	TR	Small qauntities of other metals within collimators and vacuum fittings	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	0	-	
Paper, cotton	0	-	
Wood	0	-	
Halogenated plastics	0	-	
Total non-halogenated plastics	< 1.0	Epoxy as part of beam collimators	
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	~ 25.0	Mixture of steel shot loaded concrete and concreat with steel structure	
Sand	0	-	
Glass/Ceramics	P	Some shutters contain glass beam guides	
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	-	

COMPONENTS OF MATERIALS, WASTE PROPERTIES, MATERIALS NOT CONTRIBUTING TO MASS

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	-
Other organophosphates	0	-
Vinyl chloride	0	-
Arsenic	0	-
Barium	0	-
Boron	0	-
Boron (in Boral)	0	-
Boron (non-Boral)	< 1.0	boric acid and B4C contained in beam collimators
Cadmium	0	-
Caesium	0	-
Selenium	0	-
Chromium	0	-
Molybdenum	0	-
Thallium	0	-
Tin	0	-
Vanadium	0	-
Mercury compounds	0	-
Others	0	-

Complexing agents (%wt): No

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

Physical components:

	Number	Type(s) and comment
Sources		-
Electronic & Electrical Equipment (EEE)		-
EEE Type 1		-
EEE Type 2		-
EEE Type 3		-
EEE Type 4		-
EEE Type 5		-

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off-site	Stream volume %
Size reduction	On-site	= 100.0
Decay storage	On-site	= 100.0
Low force compaction		
Supercompaction (HFC)		
Incineration		
Drying/dewatering/liquid separation		
Tie down/fixatives/strippable coating/painting application		
Decontamination		
Metal treatment		
Recycling / reuse		
Thermal treatment, including vitrification		
Encapsulation		
Polymer encapsulation		
Other physical treatment		
Other chemical treatment		
Containerisation		
Treatment not yet determined		
None		

Comments on planned treatments: Size reduction will be required due to activation being hetereogenous but no method of achieving this has been determined. Decay storage will enable diversion to LLW and OOS waste routes. Expectation is that only 10% will required GDF.

Conditioning method: -

Conditioning plants:

Plant Name	Location

Likely conditioning matrix: -

Further information on the conditioning matrix: -

Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m^3)	Payload (m^3)	Number of packages	Estimated start date for packaging
Not yet determined	10.0	-	-	-	-

Range in container waste loading:

Other information on packaging and conditioning: -

Conditioned density (t/m^3): -
Conditioned density comment: -

Management Routes:

Disposal Route	Stream volume %	Raw density t/m^3	Start date
Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland)			
Expected to be Non-NSD HAW managed under Scottish Government's policy			
Expected to be disposed to LLW Vaults NRS Dounreay			
Expected to be consigned to the Geological Disposal Facility	~ 10.0		2062
Expected to be consigned to a Near Surface Disposal Facility			
Expected to be consigned to the LLW Repository	~ 10.0	~ 1.0	2032
Expected to be consigned to a Landfill Facility	~ 49.0	~ 1.0	2032
Expected to be disposed On-Site			
Expected to be managed by In-Situ Disposal			
Expected to be consigned to an Incineration Facility	< 1.0	~ 1.0	2032
Expected to be consigned to a Metal Treatment Facility			
Expected to be Out of Scope	~ 30.0	~ 1.0	2062
Expected to be recycled / reused			
Disposal route not known			

Classification codes for waste expected to be consigned to a landfill facility: 17 01 01, 17 04 07, 17 04 05, 16 02 15*, 16 02 16

Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
GDF	Recycled / reused	~ 10.0	AMBER	There is the oportunity to reuse existing shutters following refit

RADIOACTIVITY

Source: Activation by neutrons

Uncertainty: The activity of the shutters has been calculated from measurement of the dose-rate at the highest spot and calculating the activity across the item as if it where homogeneously activated. This is acknowledged as an over-estimate but tends to caution for initial assessments. One lower activity shutter has been characterised to date and extrapolation from the pattern of the results has confirmed that the initial calculations are considerably high.

Measurement of radioactivities: Gamma-spectromery, dose rate measurements and analysis of drilled samples.

Chemical form of radionuclides:

H-3: Within steel/concrete matrix
C-14: -
Cl-36: -
Se-79: -
Tc-99: -
I-129: -
Ra: -
Th: -
U: -
Np: -
Pu: -

WASTE STREAM **6N06** **Shutters**

Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3	~ 1.67E-02	D D 2	~ 1.97E-02	D D 2	Gd 153				
Be 10					Ho 163				
C 14	~ 8.05E-05	D D 2	~ 8.05E-05	D D 2	Ho 166m				
Na 22	~ 1.38E-03	D D 2	~ 3.08E-03	D D 2	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	~ 4.79E-04	D D 2	~ 5.47E-03	D D 2	Pb 205				
Fe 55	~ 3.44E-01	D D 2	~ 7.49E-01	D D 2	Pb 210				
Co 60	~ 3.32E-02	D D 2	~ 4.93E-02	D D 2	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					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					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					Cm 244				
Ba 133					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					Unsp a				
Eu 152	~ 7.92E-03	D D 2	~ 9.24E-03	D D 2	Unsp b/g				
Eu 154					**Total a**	**0**	*	**0**	*
Eu 155					**Total b/g**	**4.04E-01**	*	**8.36E-01**	*

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 the 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
* Total calculated from the 114 declared radionuclides