

WASTE STREAM	6N101	Decommissioning Near Beam
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SITE Rutherford Appleton Laboratory

SITE OWNER UK Research and Innovation

WASTE CUSTODIAN UK Research and Innovation

WASTE TYPE ILW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025	= 0		
Future arisings:	1.4.2045 - 31.3.2058	~ 26.0		
Total future arisings:		26.0		
Total waste volume:		26.0		

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

Comment on arising rates: Currently no detailed plan for decommissioning but waste shall arise during 2045-2058.

Additional information on quantities: Volumes are estimated from current ISIS machine envelope and on the assumption that 5% of machine will be ILW. This fraction is based on current arisings but is uncertain.

Uncertainty factors on volumes: Stock (upper): x - Arisings (upper): x 2.00
Stock (lower): x - Arisings (lower): x 0.50

WASTE SOURCE Decommissioning of the ISIS neutron spallation activation from areas close to the target and the high-energy proton beam.

PHYSICAL CHARACTERISTICS

General description: Mixed highly activated metal components. Mostly structural steel components. Very small contribution of graphite from intermediate targets used for muon production. These are a separately stored sub-wastestream.

Changes since waste generated: Metallic solids

Bulk density (t/m³): ~ 7.8

Comment on density: Theoretical density, packaged density will be significantly lower.

CHEMICAL COMPOSITION

General description and components (%wt): Mostly steel and ferrous metals.

Chemical state: Neutral

Sheet metal proportion / thickness: 100% present as bulk items, dimensions in each dimension range from a few centimeters to a few meters.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	~ 81.0	304	
Other ferrous metals.....	~ 14.0	-	
Iron.....	= 0	-	
Aluminium.....	~ 0.50	5083	
Beryllium.....	= 0	-	
Cobalt.....	= 0	-	
Copper.....	~ 4.0	-	
Lead.....	= 0	-	
Magnox/Magnesium.....	= 0	-	
Nickel.....	= 0	-	
Titanium.....	= 0	-	
Uranium.....	= 0	-	
Zinc.....	= 0	-	
Zircaloy/Zirconium.....	= 0	-	
Other metals.....	~ 0.50	Phosphor bronze	

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...	= 0.01	-	
Halogenated rubber...	= 0	-	
Non-halogenated rubber...	= 0.01	EPDM rubber seals & Silicon-rubber seals	
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...	~~ 0.50	ceramic insulators	
Graphite...	< 0.01	-	
Desiccants/Catalysts...	= 0	-	
Asbestos...	TR	-	
Non/low friable...	TR	-	
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).....	= 0	-
Cadmium.....	~~ 0.01	-
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	~ 15.0
Decay storage	On-site	~ 50.0
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	On-site	~ 50.0

Comments on planned treatments:

Treatment fractions are educated guesses. Decay storage is for diversion to LLW disposal. Other physical treatment is expected to be size reduction by cutting. Estimate that ~50% of waste can be decayed stored to diversion. Total adds up to more than 100% and multiple treatments are expected.

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 (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
	Not yet determined	50.0	-	-	-	-

Range in container waste loading:

Other information on packaging and conditioning: Base line is for some waste to be interim stored on site and disposed to GDF. The package type is currently unknown.

Conditioned density (t/m³): -
Conditioned density comment: -

Management Routes:

Disposal Route	Stream volume %	Raw density t/m³	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	~ 50.0		
Expected to be consigned to a Near Surface Disposal Facility			
Expected to be consigned to the LLW Repository	~ 20.0	~ 1.0	2050
Expected to be consigned to a Landfill Facility	~ 30.0	~ 1.0	2060
Expected to be disposed On-Site			
Expected to be managed by In-Situ Disposal			
Expected to be consigned to an Incineration Facility			
Expected to be consigned to a Metal Treatment Facility			
Expected to be Out of Scope			
Expected to be recycled / reused			
Disposal route not known			

Classification codes for waste expected to be consigned to a landfill facility: 17 04 05, 17 04 07

Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
GDF	NSDF	~ 50.0	AMBER	We don't currently know basis for NSD, this is our guess.

RADIOACTIVITY

Source: Activation

Uncertainty: Uncertainty arises due to a range of possible activation identified by activation calculations and there is ongoing work to improve estimates.

Measurement of radioactivities: Activity concentration of a subset of the wastes measured and taken to be representative of total waste stream. Co-60 measured through dose rate measurements and initial activity then calculated. Other nuclides modelled and inferred through the Co-60 assessment based on dose rate.

Chemical form of radionuclides: H-3: produced within metals
C-14: produced within metals
Cl-36: -
Se-79: -
Tc-99: -
I-129: -
Ra: -
Th: -
U: -
Np: -
Pu: -

WASTE STREAM 6N101 Decommissioning Near Beam									
Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code		Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3			= 4.96E-01	D B 2	Gd 153				8
Be 10				4	Ho 163				4
C 14				6	Ho 166m				4
Na 22				8	Tm 170				4
Al 26				4	Tm 171				4
Cl 36				4	Lu 174				4
Ar 39				4	Lu 176				4
Ar 42				4	Hf 178n				4
K 40				4	Hf 182				4
Ca 41				4	Pt 193				4
Mn 53				4	Ti 204				4
Mn 54			= 3.18E+00	D C 2	Pb 205				4
Fe 55			= 7.39E+00	D C 2	Pb 210				4
Co 60			= 6.54E-01	A A 2	Bi 208				4
Ni 59				4	Bi 210m				4
Ni 63			= 4.54E-02	D C 2	Po 210				4
Zn 65			= 4.77E-01	D C 2	Ra 223				4
Se 79				4	Ra 225				4
Kr 81				4	Ra 226				4
Kr 85				4	Ra 228				4
Rb 87				4	Ac 227				4
Sr 90				4	Th 227				4
Zr 93				4	Th 228				4
Nb 91				4	Th 229				4
Nb 92				4	Th 230				4
Nb 93m				4	Th 232				4
Nb 94				4	Th 234				4
Mo 93				4	Pa 231				4
Tc 97				4	Pa 233				4
Tc 99				4	U 232				4
Ru 106				4	U 233				4
Pd 107				4	U 234				4
Ag 108m				8	U 235				4
Ag 110m				8	U 236				4
Cd 109				4	U 238				4
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				4	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	Unsp a				8
Eu 152				4	Unsp b/g			= 9.56E+00	D C 2
Eu 154				4	Total a	0	*	0	*
Eu 155				4	Total b/g	0	*	2.18E+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