WASTE STREAM	6N04	Near Beam Metallic

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	~ 9.2
Future arisings:	1.4.2025 - 31.3.2026	0.9
	1.4.2026 - 31.3.2027	0.9
	1.4.2027 - 31.3.2028	0.9
	1.4.2028 - 31.3.2045	15.0
Total future arisings:		**17.6**
Total waste volume:		**26.8**

OR

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

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

Comment on arising rates: Arising rates taken from average of arisings.

Additional information on quantities: Volumes are from weights and densities so the true, unprocessed and unpackaged volumes will be considerably higher. These wastes remain uncharacterised by measurement as many are difficult to access due to dose rates associated with the wastes. The data reported are from modelling.

Uncertainty factors on volumes: Stock (upper): x 1.50 Arisings (upper): x 1.50
Stock (lower): x 0.50 Arisings (lower): x 0.50

WASTE SOURCE ISIS neutron spallation activaton 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/m^3): ~ 7.8

Comment on density: Mostly steel.

CHEMICAL COMPOSITION

General description and components (%wt): -

Chemical state: Neutral

Sheet metal proportion / thickness: -

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel……	~ 75.5	304	
Other ferrous metals……	~ 20.0	unknown	
Iron……	= 0	-	
Aluminium……	~~ 2.0	5083	
Beryllium……	= 0	-	
Cobalt……	= 0	-	
Copper……	~~ 2.0	-	
Lead……	= 0	-	
Magnox/Magnesium……	= 0	-	
Nickel……	P	-	
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 cellulosics	= 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		
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	On-site	~ 15.0
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 treatement 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: No conditioning expected

Conditioning plants:

Plant Name	Location

Likely conditioning matrix: None

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
MBGWS box	20.0	-	-	-	-
Not yet determined	30.0	-	-	-	-

Range in container waste loading: Waste volume is based on raw bulk density of 7.8t/m3. Assuming achivable loading of 2t/m3 MBGWS package loading is 0.88m3 per package (or 3.5 tonne).

Other information on packaging and conditioning: Baseline is for some waste to be transferred to MBGWS and some to be interim stored on site prior to disposal to GDF. Pakage type for this latter category is curently unknown.
The schedule of MBGWS transfer to GDF is unknown, we have used the allocated transfer data for RAL waste to GDF as placeholder.
The distrbution of waste managment routes are little more than guesses at this stage.

Conditioned density (t/m^3): ~ 2.0
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	~~ 50.0		
Expected to be consigned to a Near Surface Disposal Facility			
Expected to be consigned to the LLW Repository	~~ 20.0	~ 1.0	2030
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: Nuclides and their fractions taken from neutronics data and applied to a total activity of the stream taken from initial dose rate measurements, assumed to be Co-60.

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 **6N04** **Near Beam Metallic**

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	= 4.96E-01	D B 2	= 4.96E-01	D B 2	Gd 153		8		8
Be 10		4		4	Ho 163		4		4
C 14		6		6	Ho 166m		4		4
Na 22		8		8	Tm 170		4		4
Al 26		4		4	Tm 171		4		4
Cl 36		4		4	Lu 174		4		4
Ar 39		4		4	Lu 176		4		4
Ar 42		4		4	Hf 178n		4		4
K 40		4		4	Hf 182		4		4
Ca 41		4		4	Pt 193		4		4
Mn 53		4		4	Tl 204		4		4
Mn 54	= 3.18E+00	D C 2	= 3.18E+00	D C 2	Pb 205		4		4
Fe 55	= 7.39E+00	D C 2	= 7.39E+00	D C 2	Pb 210		4		4
Co 60	= 6.54E-01	A A 2	= 6.54E-01	A A 2	Bi 208		4		4
Ni 59		4		4	Bi 210m		4		4
Ni 63	= 4.54E-02	D C 2	= 4.54E-02	D C 2	Po 210		4		4
Zn 65	= 4.77E-01	D C 2	= 4.77E-01	D C 2	Ra 223		4		4
Se 79		4		4	Ra 225		4		4
Kr 81		4		4	Ra 226		4		4
Kr 85		4		4	Ra 228		4		4
Rb 87		4		4	Ac 227		4		4
Sr 90		4		4	Th 227		4		4
Zr 93		4		4	Th 228		4		4
Nb 91		4		4	Th 229		4		4
Nb 92		4		4	Th 230		4		4
Nb 93m		4		4	Th 232		4		4
Nb 94		4		4	Th 234		4		4
Mo 93		4		4	Pa 231		4		4
Tc 97		4		4	Pa 233		4		4
Tc 99		4		4	U 232		4		4
Ru 106		4		4	U 233		4		4
Pd 107		4		4	U 234		4		4
Ag 108m		8		8	U 235		4		4
Ag 110m		8		8	U 236		4		4
Cd 109		4		4	U 238		4		4
Cd 113m		4		4	Np 237		4		4
Sn 119m		4		4	Pu 236		4		4
Sn 121m		4		4	Pu 238		4		4
Sn 123		4		4	Pu 239		4		4
Sn 126		4		4	Pu 240		4		4
Sb 125		4		4	Pu 241		4		4
Sb 126		4		4	Pu 242		4		4
Te 125m		4		4	Am 241		4		4
Te 127m		4		4	Am 242m		4		4
I 129		4		4	Am 243		4		4
Cs 134		4		4	Cm 242		4		4
Cs 135		4		4	Cm 243		4		4
Cs 137		4		4	Cm 244		4		4
Ba 133		4		4	Cm 245		4		4
La 137		4		4	Cm 246		4		4
La 138		4		4	Cm 248		4		4
Ce 144		4		4	Cf 249		4		4
Pm 145		4		4	Cf 250		4		4
Pm 147		4		4	Cf 251		4		4
Sm 147		4		4	Cf 252		4		4
Sm 151		4		4	Unsp a		8		8
Eu 152		4		4	Unsp b/g	= 9.56E+00	D C 2	= 9.56E+00	D C 2
Eu 154		4		4	**Total a**	**0**	*	**0**	*
Eu 155		4		4	**Total b/g**	**2.18E+01**	*	**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