

WASTE STREAM	9A312	Miscellaneous Metal (Reactor) ILW
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SITE Berkeley

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE ILW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025	= 0		
Future arisings:	1.4.2060 - 31.3.2079	52.0		
Total future arisings:		52.0		
Total waste volume:		52.0		

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

Comment on arising rates: For inventory purposes waste arisings are assumed to occur at a uniform rate over 20 years

Additional information on quantities: Reactor Dismantling and Site Clearance is assumed to commence in 2060 and last for 20 years. The volumes and radioactivity have been calculated for 72 years after reactor shutdown i.e. 2060

Uncertainty factors on volumes: Stock (upper): x - Arisings (upper): x 1.20
Stock (lower): x - Arisings (lower): x 0.80

WASTE SOURCE A variety of miscellaneous metallic wastes resulting from reactor dismantling.

PHYSICAL CHARACTERISTICS

General description: Reactor components including channel sleeves, control rods, tie rods, zirconium pins, CGO thermocouples, core thermocouples and thermocouple ducts. Waste can be packaged in standard ILW containers.

Changes since waste generated: -

Bulk density (t/m³): ~ 1.4

Comment on density: The density is of the waste as cut for packaging.

CHEMICAL COMPOSITION

General description and components (%wt): Boron steel (10%wt), Magnox alloy (~60% wt), zirconium (~6%), NiloK steel (~24%wt), alume1 (<0.1% wt) and chromel (<0.1%wt).

Chemical state: Neutral

Sheet metal proportion / thickness: All of the waste will have been cut to fit a standard 4m ILW container.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 0	-	
Other ferrous metals.....	~ 34.0	All of the waste included in this waste stream is from a wide range of miscellaneous metals	
Iron.....	-	-	
Aluminium.....	= 0	-	
Beryllium.....	TR	-	
Cobalt.....	-	-	
Copper.....	= 0	-	
Lead.....	= 0	-	
Magnox/Magnesium.....	~ 60.0	-	
Nickel.....	-	-	
Titanium.....	-	-	
Uranium.....	-	-	
Zinc.....	= 0	-	
Zircaloy/Zirconium.....	~ 6.0	-	
Other metals.....	TR	Chromel and alume1 are present at <0.1% wt.	

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.....		-	
Oil or grease.....		-	
Fuel.....		-	
Asphalt/Tarmac (cont.coal tar).....		-	
Asphalt/Tarmac (no coal tar).....		-	
Bitumen.....		-	
Others.....		-	
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.....		-	
Glass/Ceramics.....	= 0	-	
Graphite.....	TR	-	
Desiccants/Catalysts.....		-	
Asbestos.....	= 0	-	
Non/low friable.....		-	
Moderately friable.....		-	
Highly friable.....		-	
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.....	TR	-
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.....	~ 60.0	-
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.....		-
Corrosive materials.....	= 0	-
Pyrophoric materials.....	= 0	-
Generating toxic gases.....	= 0	-
Reacting with water.....	~ 60.0	-
Higher activity particles.....		-
Soluble solids as bulk chemical compounds.....		-

Hazardous substances / non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....	0	-
Benzene.....		-
Chlorinated solvents.....		-
Formaldehyde.....		-
Organometallics.....		-
Phenol.....		-
Styrene.....		-
Tri-butyl phosphate.....		-
Other organophosphates.....		-
Vinyl chloride.....		-
Arsenic.....		-
Barium.....		-
Boron.....		-
Boron (in Boral).....		-
Boron (non-Boral).....		-
Cadmium.....		-
Caesium.....		-
Selenium.....		-
Chromium.....		-
Molybdenum.....		-
Thallium.....		-
Tin.....		-
Vanadium.....		-
Mercury compounds.....		-
Others.....		-

Complexing agents (%wt):

Yes		
	(%wt)	Type(s) and comment
EDTA.....	TR	-
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 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	100.0

Comments on planned treatments:

-

Conditioning method:

It is currently intended that these wastes will be grouted. The waste is not expected to be supercompacted. It will be placed in baskets in the waste packages followed by encapsulation with BFS/OPC.

Conditioning plants:

Plant Name	Location
RDC Encap BRK	Berkeley

Likely conditioning matrix:

Unknown

Further information on the conditioning matrix:

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Waste Packaging:

Likely container type:	Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
	4 m box (300 mm concrete shielding)	100.0	6.9	8.1	8	-

Range in container waste loading: Not yet determined.

Other information on packaging and conditioning: The waste will be in baskets placed in the waste packages. Baskets of different reactor dismantling and site clearance ILW may be in the same waste package. As encapsulation is now intended, the matrix is likely to be BFS/OPC and the density of the conditioned waste product will be about 3 t/m³.

Conditioned density (t/m³): ~ 3.0
 Conditioned density comment: The conditioned waste density assumes the waste will be encapsulated.

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)	100.0		
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			
Expected to be consigned to a Near Surface Disposal Facility			
Expected to be consigned to the LLW Repository			
Expected to be consigned to a Landfill Facility			
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:

Opportunities for alternative disposal routing: No

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
-	-	-	-	-

RADIOACTIVITY

Source: Activation of the metals and impurities.

Uncertainty: The values quoted were derived by calculation from available material specifications and are indicative of the activities that are expected. The major source of uncertainty is the impurity levels.

Measurement of radioactivities: The specific activities were estimated from neutron activation calculations of the materials and the expected impurities. The activities quoted are those at 72 years after reactor shutdown, i.e. in 2060.

Chemical form of radionuclides: H-3: -
 C-14: The carbon 14 is incorporated in the metal. There may also be some contamination as graphite.
 Cl-36: The chlorine 36 is incorporated in the metal.
 Se-79: -
 Tc-99: -
 I-129: -
 Ra: -
 Th: -
 U: -
 Np: -
 Pu: -

WASTE STREAM 9A312 Miscellaneous Metal (Reactor) ILW									
Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	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				8	Gd 153				8
Be 10				8	Ho 163				8
C 14			2.20E-02	C C 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26			3.91E-07	C C 2	Tm 171				8
Cl 36			1.09E-03	C C 2	Lu 174				8
Ar 39				8	Lu 176				8
Ar 42				8	Hf 178n				8
K 40				8	Hf 182				8
Ca 41			7.10E-05	C C 2	Pt 193				8
Mn 53				8	Ti 204			3.71E-09	C C 2
Mn 54				8	Pb 205				8
Fe 55			8.18E-08	C C 2	Pb 210				8
Co 60			9.62E-02	C C 2	Bi 208				8
Ni 59			8.08E-02	C C 2	Bi 210m				8
Ni 63			6.14E+00	C C 2	Po 210				8
Zn 65				8	Ra 223				8
Se 79				8	Ra 225				8
Kr 81				8	Ra 226				8
Kr 85				8	Ra 228				8
Rb 87				8	Ac 227				8
Sr 90				8	Th 227				8
Zr 93				8	Th 228				8
Nb 91				8	Th 229				8
Nb 92			4.93E-09	C C 2	Th 230				8
Nb 93m				8	Th 232				8
Nb 94			8.06E-03	C C 2	Th 234				8
Mo 93			3.51E-04	C C 2	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99			6.86E-05	C C 2	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			7.71E-06	C C 2	U 235				8
Ag 110m				8	U 236				8
Cd 109				8	U 238				8
Cd 113m				8	Np 237				8
Sn 119m				8	Pu 236				8
Sn 121m			2.55E-03	C C 2	Pu 238				8
Sn 123				8	Pu 239				8
Sn 126				8	Pu 240				8
Sb 125				8	Pu 241				8
Sb 126				8	Pu 242				8
Te 125m				8	Am 241				8
Te 127m				8	Am 242m				8
I 129				8	Am 243				8
Cs 134				8	Cm 242				8
Cs 135				8	Cm 243				8
Cs 137				8	Cm 244				8
Ba 133				8	Cm 245				8
La 137				8	Cm 246				8
La 138				8	Cm 248				8
Ce 144				8	Cf 249				8
Pm 145				8	Cf 250				8
Pm 147				8	Cf 251				8
Sm 147				8	Cf 252				8
Sm 151				8	Unsp a				
Eu 152			2.73E-03	C C 2	Unsp b/g				
Eu 154			3.17E-04	C C 2	Total a	0	*	0	*
Eu 155			2.70E-06	C C 2	Total b/g	0	*	6.35E+00	*

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