

WASTE STREAM	6C31/C	NDS Contact Handled ILW
--------------	--------	-------------------------

SITE Harwell

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE ILW

WASTE VOLUMES

Stocks:

Future arisings:

Total future arisings:

Total waste volume:

	Reported (m ³)
At 1.4.2025	

OR

Conditioned (m ³)	Packaged (m ³)
= 10.8	13.1
	0.0
	0.0
0.0	0.0
10.8	13.1

Number of waste packages in stock: At 1.4.2025..... 4 packages

Comment on arising rates: This waste has now been encapsulated in to 4 x 3m3 boxes.

Additional information on quantities: This waste stream covers the large NDS sources at Harwell, including RIPPLE source 10, the teletherapy sources and the blood irradiator.

Uncertainty factors on volumes: Stock (upper): x 1.00 Arisings (upper): x -
Stock (lower): x 1.00 Arisings (lower): x -

WASTE SOURCE RIPPLE (Radio Isotope Powered Prolonged Life Equipment) generator number X. This was used for the production of Sr90 titanate sources to power navigation buoy lights and radio-direction equipment. Large teletherapy sources and blood irradiator used in the medical sector and collected by the National Disposal Service and latterly Safeguard International

PHYSICAL CHARACTERISTICS

General description: RIPPLE (Radio Isotope Powered Prolonged Life Equipment) generator number X. This was used for the production of Sr90m titanate sources to power navigation buoy lights and radio-direction equipment. Large teletherapy sources and blood irradiator used in the medical sector and collected by the National Disposal Service and latterly Safeguard International. Contains DU, tungsten alloy, mild steel, stainless steel, lead, aluminium, brass, copper, bismuth telluride, polyurethane foam, wood, concrete and Strontium titanate

Changes since waste generated: The waste has been encapsulated using 3:1 PFA/OPC grout with a water/solid ratio of 0.42. Internal overpacks and sacrificial harnesses were used to contain the waste. Due the potential for DU metal reacting with grout, internal overpacks have been used in the 3m3 boxes to provide an expansion gap between the waste and grout.

Bulk density (t/m³): ~ 2.4

Comment on density: Aligned to conditioned waste density.

CHEMICAL COMPOSITION

General description and components (%wt): The material composition was not available for any of the other waste sources in the boxes except for the RIPPLE X source. The following percentages are for this source.
Cement/grout encapsulate 77.7%; Dep U 13.19%; Mild Steel 2.52%; Lead 5.35%; Copper 0.97%; Bismuth telluride 0.14%; Strontium titanate 0.11%; Hastelloy 'C' / Deloro 'C' 0.03%

Chemical state: Alkali

Sheet metal proportion / thickness: Metal is present in a large range of thicknesses.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity	
Stainless steel.....	= 2.5	-		
Other ferrous metals.....		Mild steel		
Iron.....		-		
Aluminium.....		-		
Beryllium.....		-		
Cobalt.....	= 0.97			
Copper.....				
Lead.....	= 5.4			
Magnox/Magnesium.....				
Nickel.....	= 13.2	depleted uranium		
Titanium.....				
Uranium.....				
Zinc.....				
Zircaloy/Zirconium.....	= 0.25	Other metals = 0.25% and comprise of 0.11% Strontium titanate and 0.14% Bismuth telluride		
Other metals.....				

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	0	-	
Paper, cotton.....		-	
Wood.....		-	
Halogenated plastics.....		-	
Total non-halogenated plastics.....	0	-	
Condensation polymers.....		-	
Others.....		-	
Organic ion exchange materials.....	= 0	-	
Total rubber.....	0	-	
Halogenated rubber.....		-	
Non-halogenated rubber.....		-	
Hydrocarbons.....		-	
Oil or grease.....		-	
Fuel.....		-	
Asphalt/Tarmac (cont.coal tar).....		-	
Asphalt/Tarmac (no coal tar).....		-	
Bitumen.....		-	
Others.....		-	
Other organics.....		-	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity	
Inorganic ion exchange materials.....	= 77.7	-		
Inorganic sludges and flocs.....		-		
Soil.....		-		
Brick/Stone/Rubble.....		-		
Cementitious material.....		-		
Sand.....		-		
Glass/Ceramics.....		-		
Graphite.....	0			
Desiccants/Catalysts.....				
Asbestos.....				
Non/low friable.....				
Moderately friable.....				
Highly friable.....				
Free aqueous liquids.....				
Free non-aqueous liquids.....				
Powder/Ash.....				

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

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
Fluoride.....	= 0	
Chloride.....		
Iodide.....	= 0	
Cyanide.....		
Carbonate.....	= 0	
Nitrate.....		
Nitrite.....	= 0	
Phosphate.....		
Sulphate.....	= 0	
Sulphide.....		

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals.....	0	-
Low flash point liquids.....		-
Explosive materials.....		-
Phosphorus.....		-
Hydrides.....		-
Biological etc. materials.....		-
Biodegradable materials.....		-
Putrescible wastes.....		-
Non-putrescible wastes.....		-
Corrosive materials.....		-
Pyrophoric materials.....		-
Generating toxic gases.....		-
Reacting with water.....		-
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.....	= 0.03	Hastelloy 'C' / Deloro 'C'

Complexing agents (%wt):

	(%wt)	Type(s) and comment
EDTA.....	= 0	-
DPTA.....		-
NTA.....		-
Polycarboxylic acids.....		-
Other organic complexants.....		-
Total complexing agents.....		-

Physical components:

	Number	Type(s) and comment
Sources.....		RIPPLE (Radio Isotope Powered Prolonged Life Equipment) generator number X. Large teletherapy sources and blood irradiator used in the medical sector.
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		

Comments on planned treatments:

-

Conditioning method:

The waste has been packaged and encapsulated into 4 x 3m3 boxes. The waste has been encapsulated using 3:1 PFA/OPC grout with a water/solid ratio of 0.42. Internal overpacks and sacrificial harnesses were used to contain the waste. Due the potential for DU metal reacting with grout, internal overpacks have been used in the 3m3 boxes to provide an expansion gap between the waste and grout.

Conditioning plants:

Plant Name	Location

Likely conditioning matrix:

-

Further information on the conditioning matrix:

3:1 PFA:OPC w/s 0.42.

Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
3 m³ box (side lifting)	100.0	2.7	2.7	4	-

Range in container waste loading:

Internal overpacks and sacrificial harnesses were used to contain the waste. Due the potential for DU metal reacting with grout, internal overpacks have been used in the 3m3 boxes to provide an expansion gap between the waste and grout. 3m3 Box 1 contains 3 overpacks; 3m3 Box 2 contains 3 overpacks; 3m3 Box 3 contains 4 overpacks; 3m3 Box 4 contains 3 overpacks. As a result the loading and payload volumes will not be consistent.

Other information on packaging and conditioning:

-

Conditioned density (t/m³):

= 2.4

Conditioned density comment:

The density is assumed to be consistent with that stated in the FLoC submission.

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: Sealed sources inside units - some of which also contain DU.

Uncertainty: It should be noted that whilst this waste stream has been encapsulated, the activity distribution will not be homogeneous throughout the package as the data suggests. This is due to the fact that the radioactivity is contained in the sealed sources and does not become distributed throughout the grout formulation i.e. it is not homogenously mixed into the grout.

Measurement of radioactivities: -

Chemical form of radionuclides: H-3: -
C-14: -
Cl-36: -
Se-79: -
Tc-99: -
I-129: -
Ra: -
Th: -
U: Depleted uranium shielding
Np: -
Pu: -

WASTE STREAM		6C31/C		NDS Contact Handled 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		8			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36		8			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40		8			Hf 182		8		
Ca 41		8			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55		8			Pb 210		8		
Co 60	1.07E+00	C C	2		Bi 208		8		
Ni 59		8			Bi 210m		8		
Ni 63		8			Po 210		8		
Zn 65		8			Ra 223	2.65E-09	C C	2	
Se 79		8			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85		8			Ra 228		8		
Rb 87		8			Ac 227	2.70E-09	C C	2	
Sr 90	1.17E+02	C C	2		Th 227	2.63E-09	C C	2	
Zr 93		8			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230	1.27E-07	C C	2	
Nb 93m		8			Th 232		8		
Nb 94		8			Th 234	1.77E-03	C C	2	
Mo 93		8			Pa 231	1.40E-08	C C	2	
Tc 97		8			Pa 233		8		
Tc 99		8			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	9.93E-04	C C	2	
Ag 108m		8			U 235	4.70E-05	C C	2	
Ag 110m		8			U 236		8		
Cd 109		8			U 238	1.77E-03	C C	2	
Cd 113m		8			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m		8			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	8.20E+00	C C	2		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		8			Unsp b/g				
Eu 154		8			Total a	2.81E-03	*	0	*
Eu 155		8			Total b/g	1.26E+02	*	0	*

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