

WASTE STREAM	5C319	Ripple Crates
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SITE Harwell
SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE LLW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	20.2 m ³
Total future arisings:		0 m ³
Total waste volume:		20.2 m ³

Comment on volumes: -

Uncertainty factors on volumes:	Stock (upper):	x 1.05	Arisings (upper)	x
	Stock (lower):	x 0.8	Arisings (lower)	x

WASTE SOURCE The waste stream consist of the equipment used to produce Sr-90 titanate sources for the RIPPLE (Radio Isotope Powered Prolonged Life Equipment) generators.

PHYSICAL CHARACTERISTICS

General description: 9 wooden crates and 1 metal tank containing the disassembled plant that was used to produce the RIPPLE sources during the late 60's and early 70's at Harwell. The disassembled plant is contaminated with strontium titanate.

Physical components (%vol): Steel, plastic, wood and ceramic

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.65

Comment on density: Based on recorded masses and volumes of outer containers.

CHEMICAL COMPOSITION

General description and components (%wt): ~95% metal, 5% other

Chemical state: -

Chemical form of radionuclides: -

Metals and alloys (%wt): Metal is typically around 3mm thick

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~95.0	The identity of steels/other alloys is not known.	
Other ferrous metals.....	P		
Iron.....			
Aluminium.....	P		
Beryllium.....			
Cobalt.....			
Copper.....	TR		
Lead.....			
Magnox/Magnesium.....	TR		
Nickel.....			
Titanium.....			
Uranium.....			

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Zinc.....	TR	
Zircaloy/Zirconium.....	TR	
Other metals.....		Metal proportions unknown. Probably most is steel

Organics (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	~1.0		
Paper, cotton.....			
Wood.....	~1.0		
Halogenated plastics	~3.0		
Total non-halogenated plastics.....	NE		
Condensation polymers.....	NE		
Others.....	NE		
Organic ion exchange materials....			
Total rubber.....	TR		
Halogenated rubber	NE		
Non-halogenated rubber.....	NE		
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	TR		

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.....	0		
Desiccants/Catalysts.....			
Asbestos.....			
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....			
Free non-aqueous liquids.....			

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Powder/Ash.....

Inorganic anions (%wt): -

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

Materials of interest for waste acceptance criteria: -

	(%wt)	Type(s) and comment
Combustible metals.....		
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: none expected

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		

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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.....
 Electronic Electrical Equipment (EEE)
 EEE Type 1.....
 EEE Type 2.....
 EEE Type 3.....
 EEE Type 4.....
 EEE Type 5.....

Complexing agents (%wt): No

(%wt) Type(s) and comment

EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants.....
 Total complexing agents..... 0

Potential for the waste to contain discrete items: Yes. All Stainless items assumed DIs

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction Supercompaction (HFC) Incineration Solidification Decontamination Metal treatment Size reduction Decay storage Recycling / reuse Other / various None		100.0

Comment on planned treatments:

-

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be consigned to an On-Site Disposal Facility Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be consigned as Out of Scope Expected to be recycled / reused Disposal route not known	100.0	0.65

Classification codes for waste expected to be consigned to a landfill facility:

-

Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):

Disposal Route	Stream volume %		
	2022/23	2023/24	2024/25
Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be consigned to an On-Site Disposal Facility Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be consigned as Out of Scope Expected to be recycled / reused Disposal route not known			

Opportunities for alternative disposal routing:

-

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

Waste Packaging for Disposal:

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Container	Stream volume %	Waste loading m ³	Number of packages
1/3 Height IP-1 ISO 2/3 Height IP-2 ISO 1/2 Height WAMAC IP-2 ISO 1/2 Height IP-2 Disposal/Re-usable ISO 2m box (no shielding) 4m box (no shielding) Other	100.0	10	3

Other information: LLWR have not yet accepted the case to dispose the RIPPLE crates at the repository. At the point when the crates are transferred to LLWR they would presumably be packaged within ISO containers.

Waste Planned for Disposal at the LLW Repository:

Container voidage: -
Waste Characterisation Form (WCH): -
Waste consigned for disposal to LLWR in year of generation: -

Non-Containerised Waste for In-Vault Grouting: (Not applicable to this waste stream)

Stream volume (%): -
Waste stream variation: -
Bounding cuboidal volume:
Inaccessible voidage: -
Other information: -

RADIOACTIVITY

Source: Sr-90 only
Uncertainty: -
Definition of total alpha and total beta/gamma: Where totals are shown on the table of radionuclide activities they are the sums of the listed alpha or beta/gamma emitting radionuclides plus 'other alpha' or 'other beta/gamma'.
Measurement of radioactivities: Legacy inventory noted at the point when the crates were transferred for storage in the early 70's.
Other information: -

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2022	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		8			Bi 208		8		
Ni 59		8			Bi 210m		8		
Ni 63		8			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	9.86E-03	BB 2			Th 227		8		
Zr 93		8			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m		8			Th 232		8		
Nb 94		8			Th 234		8		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99		8			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234		8		
Ag 108m		8			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		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			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			Other a				
Eu 152		8			Other b/g				
Eu 154		8			Total a	0			0
Eu 155		8			Total b/g	9.86E-03	BB 2		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 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