WASTE STREAM 5C306 DIDO Reactor Decommissioning ILW

SITE	Harwell
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	ILW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m³
Future arisings -	1.4.2024 - 31.3.2025.....	60.0 m³
Total future arisings:		60.0 m³
Total waste volume:		60.0 m³

Comment on volumes:	Volumes updated for 2016 RWI to reflect SMART Inventory review			
Uncertainty factors on volumes:	Stock (upper):	x	Arisings (upper)	x 1.2
	Stock (lower):	x	Arisings (lower)	x 0.8

WASTE SOURCE Decommissioning of a 26MW(T) reactor in steel containment building with heavy water moderator.

PHYSICAL CHARACTERISTICS

General description:	Graphite reflector, steel tanks and pipework, iron-shot concrete and cadmium sheet. Large items will be broken down during decommissioning.
Physical components (%vol):	Graphite reflector (32%), top shield plug (7%), reactor aluminium tanks RATS (1%), reflector steel tank (3%), annular shield (7%) and concrete biological shield (50%).
Sealed sources:	-
Bulk density (t/m³):	3.1
Comment on density:	Estimated density for material types

CHEMICAL COMPOSITION

General description and components (%wt):	The waste will be dominated by the biological shield. Barytes concrete (54% including steel), other steel (6%), graphite (16%), aluminium (4%), iron shot concrete (19%), cast iron (1%) and cadmium (~0.1%)
Chemical state:	Neutral
Chemical form of radionuclides:	H-3: Tritium is present as an activation product in the graphite and concrete. C-14: C-14 is present as an activation product in the graphite. Cl-36: Cl-36 activation product in the graphite and concrete
Metals and alloys (%wt):	Metal is present in a large range of thicknesses.

Stainless steel.....	~6.0	
Other ferrous metals.....		
Iron.....	~1.0	Cast iron
Aluminium.....	~4.0	
Beryllium.....		
Cobalt.....		
Copper.....		
Lead.....	NE	
Magnox/Magnesium.....	0	
Nickel.....		
Titanium.....		
Uranium.....		
Zinc.....		
Zircaloy/Zirconium.....	0	

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	Other metals.....		
Organics (%wt):	-		
	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	
	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):	-		
	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs.....	0	
	Soil.....	0	
	Brick/Stone/Rubble.....	0	
	Cementitious material.....	~73.0	Barytes concrete (54% including steel), iron shot concrete (19%),
	Sand.....		
	Glass/Ceramics.....	0	
	Graphite.....	16.0	
	Desiccants/Catalysts.....		
	Asbestos.....	NE	
	Non/low friable.....		
	Moderately friable.....		
	Highly friable.....		
	Free aqueous liquids.....	0	
	Free non-aqueous liquids.....	0	
	Powder/Ash.....	0	
Inorganic anions (%wt):	-		

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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: Asbestos may be present.

Combustible metals	*0
Low flash point liquids	*0
Explosive materials	*0
Phosphorus	*0
Hydrides	*0
Biological etc. materials	*0
Biodegradable materials	
Putrescible wastes	*0
Non-putrescible wastes	
Corrosive materials	*0
Pyrophoric materials	*0
Generating toxic gases	*0
Reacting with water	*0
Active particles	
Soluble solids as bulk chemical compounds	

Hazardous substances / non hazardous pollutants: Cadmium (< 1%).

Acrylamide	
Benzene	
Chlorinated solvents	
Formaldehyde	
Organometallics	
Phenol	
Styrene	
Tri-butyl phosphate	
Other organophosphates	
Vinyl chloride	
Arsenic	
Barium	
Boron	

Cadmium..... ~0.10

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

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids……

Other organic complexants.....

Total complexing agents.....

PACKAGING AND CONDITIONING

Conditioning method: The waste will be packaged into 6m3 boxes and placed in long-term storage in the Harwell ILW Store

Plant Name: Dido ILW Processing Plant

Location: Harwell

Plant startup date: 2024

Total capacity (m³/y incoming waste): -

Target start date for packaging this stream: 2024

Throughput for this stream (m³/y incoming waste): -

Other information: -

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m³)	Payload (m³)	Number of packages
6m³ concrete box (SD)	100.0	2.06	5.8	30

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Likely container type comment:	-
Range in container waste volume:	Average waste volume will be ~2 m3, but could range from 0.7 to 2.8 m3.
Other information on containers:	The components of Dido have different activities and densities which effects the number of packages required. The aluminium tanks, steel tank and top shield plug are restricted by activity and the graphite, annular shield and concrete bio-shield by volume or weight.
Likely conditioning matrix:	Pulverised Fly Ash / Ordinary Portland Cement
Other information:	-
Conditioned density (t/m³):	~2.6
Conditioned density comment:	-
Other information on conditioning:	-
Opportunities for alternative disposal routing:	

Treatment	Stream volume (%)	Comment
-	-	-

RADIOACTIVITY

Source:	Activated reactor structure and components. Co-60 from irradiated steel.
Uncertainty:	Expected that waste will comprise primarily of beta/gamma emitting radionuclides. Alpha emitting radionuclides may be present but they are expected to be in small quantities.
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:	-
Other information:	-

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3			1.16E-01	C C 2	Gd 153				8
Be 10				8	Ho 163				8
C 14			3.85E-03	C C 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			1.68E-04	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				8	Pt 193				8
Mn 53				8	Tl 204				8
Mn 54				8	Pb 205				8
Fe 55			1.16E-02	C C 2	Pb 210				8
Co 60			1.85E-01	C C 2	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			1.19E+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				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			7.4E-04	C C 2	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			4.3E-03	C C 2	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			4.01E-06	C C 2	Other a				
Eu 152			4.96E-03	C C 2	Other b/g				
Eu 154			9.53E-04	C C 2	**Total a**	**0**		**0**	
Eu 155				8	**Total b/g**	**0**		**1.52E+00**	**C C 2**

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