WASTE STREAM 5C318 Harwell Remote Handled ILW - WRATs

SITE Harwell

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE ILW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	17.9 m³
Total future arisings:		0 m³
Total waste volume:		17.9 m³

Comment on volumes: Waste retrieved under waste stream ID 5C30 that requires further treatment is included in the volume above. This waste stream represents ILW that has been retrieved from storage tubes under stream 5C30 and is now stored in 500 litre drums awaiting further work prior to grouting. These are known as Waste Requiring Additional Treatment (WRATs). The volume given is the volume of waste cans, not the outer 500 litre drums.

Uncertainty factors on volumes:

Stock (upper):	x 1.05	Arisings (upper)	x
Stock (lower):	x 0.95	Arisings (lower)	x

WASTE SOURCE Operational solid wastes from research reactors and active cells performing a wide variety of tasks, including fuel examination, source production and others. Redundant sources, notably Co60, Am/Be and Pu238. This waste represents legacy ILW in B462.

PHYSICAL CHARACTERISTICS

General description: Laboratory/ cell wastes, sources, cut-up experimental rigs, glassware and concrete. Most wastes in cans (max 50 litres). Some wastes (including liquids) have been cemented or encapsulated in polymer. Some solids have been subject to low-force compaction.

Physical components (%vol): Miscellaneous canned wastes (95%), bulk items (5%).

Sealed sources: The waste contains sealed sources.

Bulk density (t/m³): ~0.8

Comment on density: Estimate- mass data not available for many items.

CHEMICAL COMPOSITION

General description and components (%wt): Ferrous metal (>21%), other metals (<38%), plastics (<16%), cellulose(<12%) and others. Note that this does not include the steel containers, most of which are diverted to LLW.

Chemical state: Neutral

Chemical form of radionuclides: H-3: H3 is principally present as a metal activation product with some absorption from D2O/H3 gas.
C-14: C-14 is associated with labelled organic compounds and activation of metals.
Ra: Radium may be present in a variety of forms, principally oxide, nitrate and sulphate.
Th: Thorium is principally present as metal or oxide and in irradiated fuel.
U: Uranium may be present in a variety of forms, principally oxide, metal and fuel.
Pu: Plutonium may be present in a variety of forms, principally oxide and metal fuel.

Metals and alloys (%wt): Metal is present in a large range of thicknesses.

Stainless steel.....	P	
Other ferrous metals.....	~21.0	The identity of steels/other alloys is unknown.
Iron.....		
Aluminium.....	~33.0	
Beryllium.....	0	
Cobalt.....		
Copper.....	~0.40	
Lead.....	~0.60	
Magnox/Magnesium.....	TR	

	Nickel		
	Titanium		
	Uranium	<0.01	
	Zinc	TR	
	Zircaloy/Zirconium	~0.50	
	Other metals	~4.0	Other metals inlcude uranium, europium, cobalt, magnesium, tin, nickel and trace mercury.
Organics (%wt):	Complexing agents may be present at trace levels in a few packages (e.g. EDTA, citrate, TBP, oxalate etc.).		
	Total cellulosics	~12.0	
	Paper, cotton	~11.8	
	Wood	~0.20	
	Halogenated plastics	<13.0	PVC and PTFE
	Total non-halogenated plastics	<9.9	
	Condensation polymers	~0.40	
	Others	<9.5	
	Organic ion exchange materials	~0.03	
	Total rubber	<0.50	
	Halogenated rubber	<0.25	Neoprene and hypalon
	Non-halogenated rubber	<0.25	
	Hydrocarbons		
	Oil or grease		
	Fuel		
	Asphalt/Tarmac (cont.coal tar)		
	Asphalt/Tarmac (no coal tar)		
	Bitumen		
	Others		
	Other organics	<0.10	
Other materials (%wt):	Other inert inorganics present include vermiculite and Mor-dri (~.4%)		
	Inorganic ion exchange materials.	P	
	Inorganic sludges and flocs	0	
	Soil	0	
	Brick/Stone/Rubble	0	
	Cementitious material	~2.0	
	Sand		
	Glass/Ceramics	~1.5	
	Graphite	~0.10	
	Desiccants/Catalysts		
	Asbestos	~0.02	Exact data unavailable
	Non/low friable		
	Moderately friable		
	Highly friable		
	Free aqueous liquids	<0.01	

Free non-aqueous liquids	<0.01
Powder/Ash	P

Inorganic anions (%wt): Chlorides are present as eutectic powder.

Fluoride	<0.01
Chloride	<1.0
Iodide	<0.01
Cyanide	NE
Carbonate	<0.10
Nitrate	<0.10
Nitrite	<0.10
Phosphate	<0.10
Sulphate	<0.10
Sulphide	<0.10

Materials of interest for waste acceptance criteria: Combustible/ pyrophoric metals comprise finely divided metals, possibly reactive ones. Free liquids will be immobilised in cement before packaging. There are trace levels of asbestos present in the waste. Powders are present principally from degradation of plastics and corrosion of mild steel. Cans retrieved to date contain <<1% on average.

Combustible metals	<0.10
Low flash point liquids	<0.01
Explosive materials	<0.01
Phosphorus	<0.01
Hydrides	<0.01
Biological etc. materials	<0.01
Biodegradable materials	0.01
Putrescible wastes	<0.01
Non-putrescible wastes	
Corrosive materials	<0.01
Pyrophoric materials	<0.01
Generating toxic gases	<0.01
Reacting with water	<0.01
Active particles	
Soluble solids as bulk chemical compounds	

Hazardous substances / non hazardous pollutants: Cadmium (0.02vol%)and beryllium (0.003vol%) are present in massive form or part of other materials. Mercury/ mercuric compounds are present in <5 cans. Lead is thought only to be present as bulk metal, in which form it does not require consideration as special waste.

Acrylamide	
Benzene	
Chlorinated solvents	
Formaldehyde	
Organometallics	
Phenol	
Styrene	
Tri-butyl phosphate	

	Other organophosphates.....
	Vinyl chloride.....
	Arsenic.....
	Barium.....
	Boron.....
	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):	Yes
	EDTA.....
	DPTA.....
	NTA.....
	Polycarboxylic acids……
	Other organic complexants.....
	Total complexing agents..... TR

PACKAGING AND CONDITIONING

Conditioning method:	The waste is removed from its storage cans and treated prior to packaging into enhanced 500 litre drums. At this point it is reclassed as 5C52 and stored pending availability of the conditioning plant. A proportion of the waste stream, including the cans, may be reclassified as CHILW/ LLW and processed accordingly.
Plant Name:	Head End Cells (HEC)
Location:	Harwell
Plant startup date:	-
Total capacity (m^3/y incoming waste):	~24.0
Target start date for packaging this stream:	-
Throughput for this stream (m^3/y incoming waste):	~24.0
Other information:	Reference plans are to complete waste packaging by 2023, increasing throughput annually. See 5C52 for details of conditioning plant.

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Likely container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
500 l drum (pre-cast annular)	100.0	0.4	0.4	45

Likely container type comment:	The waste loading varies greatly according to the precise nature of the raw wastes. The above loading is the reference value for planning purposes. Drums packed to date have averaged ~0.4m3.
Range in container waste volume:	Significant variation in waste loading is expected, based upon the precise nature of the wastes being packaged at any time, and limits applying to their contents.
Other information on containers:	316L Stainless Steel with cement annulus.
Likely conditioning matrix:	Pulverised Fly Ash / Ordinary Portland Cement
Other information:	3:1 PFA:OPC w/s 0.42
Conditioned density (t/m^3):	~2.0
Conditioned density comment:	Density will vary according to nature of individual drum contents.
Other information on conditioning:	-
Opportunities for alternative disposal routing:	

Treatment	Stream volume (%)	Comment
-	-	-

RADIOACTIVITY

Source:	Activated and contaminated items from historic R&D activities on the Harwell site, including standard sources and fuel samples.
Uncertainty:	Activities have been calculated from records in the B462 waste database.
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:	Variety of techniques according to waste type/ source and time of consignment. Typically based on gamma dose measurements and/ or fuel/ item masses where appropriate.
Other information:	-

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	9.21E-01	C C 2			Gd 153	8.42E-04	B B 2		
Be 10		8			Ho 163		8		
C 14	3.53E-05	C C 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	4.25E-05	B B 2			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40	1.31E-05	B C 2			Hf 182		8		
Ca 41	3.84E-06	B B 2			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54	1.17E-08	C C 2			Pb 205		8		
Fe 55	2.18E-03	B B 2			Pb 210	9.93E-05	B C 2		
Co 60	8.43E+00	B B 2			Bi 208		8		
Ni 59	1.46E-02	B B 2			Bi 210m		8		
Ni 63	1.03E+00	B B 2			Po 210	1.01E-04	C C 2		
Zn 65		8			Ra 223	1.65E-02	C C 2		
Se 79		6			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85	6.47E-03	B B 2			Ra 228		8		
Rb 87		8			Ac 227	1.65E-02	C C 2		
Sr 90		8			Th 227	1.63E-02	C C 2		
Zr 93		8			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	2.87E-04	B B 2			Th 232		8		
Nb 94	3.57E-04	B B 2			Th 234		8		
Mo 93	9.2E-05	B C 2			Pa 231	2.87E-05	B C 2		
Tc 97		8			Pa 233	7.14E-06	C C 2		
Tc 99		8			U 232		8		
Ru 106		8			U 233		8		
Pd 107		6			U 234	1.05E-06	C C 2		
Ag 108m	6.09E-04	B B 2			U 235		8		
Ag 110m		8			U 236	1.3E-08	C C 2		
Cd 109	1.65E-07	B B 2			U 238		8		
Cd 113m	2.06E-02	B B 2			Np 237	7.15E-06	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	6.07E-02	C C 2		
Sn 123		8			Pu 239	1.1E-01	C C 2		
Sn 126		8			Pu 240	7.31E-02	C C 2		
Sb 125		8			Pu 241	2.39E+00	C C 2		
Sb 126		8			Pu 242	8.99E-05	C C 2		
Te 125m		8			Am 241	2.78E-01	C C 2		
Te 127m		8			Am 242m	3.02E-07	B C 2		
I 129	2.54E-06	B B 2			Am 243	1.82E-04	C C 2		
Cs 134	3.91E-05	B B 2			Cm 242	2.71E-07	C C 2		
Cs 135	4.25E-07	B C 2			Cm 243	1.26E-07	C C 2		
Cs 137	5.39E+00	B B 2			Cm 244	3.81E-02	C C 2		
Ba 133	1.18E-05	B B 2			Cm 245	3.25E-09	B C 2		
La 137		8			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144	1.09E-05	B B 2			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	2.83E-03	B B 2			Cf 251		8		
Sm 147		8			Cf 252	2.38E-07	C C 2		
Sm 151		8			Other a				
Eu 152	5.84E-01	B B 2			Other b/g				
Eu 154	<1.48E+00	C 3			**Total a**	**5.93E-01**	**C C 2**	**0**	
Eu 155	<4.78E-05	C 3			**Total b/g**	**2.03E+01**	**C C 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