WASTE STREAM 6C33/C NDS Contact Handled ILW

SITE	Harwell
SITE OWNER	Minor Waste Producers
WASTE CUSTODIAN	Minor Waste Producers
WASTE TYPE	ILW

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2019.....	4.2 m^3	5.1 m^3
Total future arisings:		0 m^3	0 m^3
Total waste volume:		4.2 m^3	5.1 m^3
Number of waste packages in stock:	At 1.4.2019.....	9 package(s)	

Comment on volumes: This waste has now been encapsulated in to 9 x 500 litre drums. This waste stream covers the large NDS sources at Harwell, including RIPPLE sources 1 to 10, the teletherapy sources and the blood irradiator. Volume updated for 2019 RWI to be consistent with FLoC and package loading.

Uncertainty factors on volumes:

Stock (upper):	x 1.1	Arisings (upper)	x
Stock (lower):	x 0.9	Arisings (lower)	x

WASTE SOURCE RIPPLE (Radio Isotope Powered Prolonged Life Equipment) generators numbers I-X. These were 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) generators numbers I-X. These were 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 tungsten alloy, mild steel, stainless steel, lead, aluminium, brass, copper, bismuth telluride, polyurethane foam, wood, concrete and Strontium titanate. 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. Waste loaded into 500 litre drums did not contain DU and therefore were directly grouted.

Physical components (%wt): Cement/grout encapsulate 50%; Tungsten Alloy 12.5%; Mild Steel 20.3%; Stainless Steel 0.02%; Lead 10.9%; Aluminium 0.47%; Brass 3.1%; Copper 1.1%; Bismuth telluride 0.02%; Foam 0.08%; Wood 0.52%; Polyurethane foam 0.78%; Strontium titanate 0.16%.

Sealed sources: -

Bulk density (t/m^3): ~1.75

Comment on density: Conditioned waste density

CHEMICAL COMPOSITION

General description and components (%wt): Cement/grout encapsulate 50%; Tungsten Alloy 12.5%; Mild Steel 20.3%; Stainless Steel 0.02%; Lead 10.9%; Aluminium 0.47%; Brass 3.1%; Copper 1.1%; Bismuth telluride 0.02%; Foam 0.08%; Wood 0.52%; Polyurethane foam 0.78%; Strontium titanate 0.16%.

Chemical state: Alkali

Chemical form of radionuclides: -

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

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	Stainless steel	0.02	
	Other ferrous metals	20.3	Mild steel
	Iron		
	Aluminium	0.47	
	Beryllium		
	Cobalt		
	Copper	4.2	3.1% as brass
	Lead	10.9	
	Magnox/Magnesium		
	Nickel		
	Titanium		
	Uranium		
	Zinc		
	Zircaloy/Zirconium		
	Other metals	12.7	Other metals = 12.67% and comprise of 12.5% Tungsten Alloy; 0.16% Strontium titanate and 0.02% Bismuth telluride
Organics (%wt):	-		
	Total cellulosics	0.52	
	Paper, cotton		
	Wood	0.52	
	Halogenated plastics	0.78	PVC wrapping
	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	0.08	Polyurethane foam
Other materials (%wt):	-		
	Inorganic ion exchange materials		
	Inorganic sludges and flocs		
	Soil		
	Brick/Stone/Rubble		
	Cementitious material	50.0	

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	Sand.....	
	Glass/Ceramics.....	
	Graphite.....	
	Desiccants/Catalysts.....	
	Asbestos.....	
	Non/low friable.....	
	Moderately friable.....	
	Highly friable.....	
	Free aqueous liquids.....	
	Free non-aqueous liquids.....	
	Powder/Ash.....	
Inorganic anions (%wt):	Carbonate has been used to stabilise reactive metals. Other chemicals may be present in trace quantities but are not expected- hence recorded as zero.	
	Fluoride.....	0
	Chloride.....	
	Iodide.....	0
	Cyanide.....	0
	Carbonate.....	P
	Nitrate.....	0
	Nitrite.....	0
	Phosphate.....	0
	Sulphate.....	TR
	Sulphide.....	0
Materials of interest for waste acceptance criteria:	-	
	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.....	TR
	Active particles.....	
	Soluble solids as bulk chemical compounds.....	

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Hazardous substances / non hazardous pollutants: The waste contains traces of solvents and pharmaceutical compounds

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): No
EDTA.....
DPTA.....
NTA.....
Polycarboxylic acids……
Other organic complexants.....
Total complexing agents..... 0

PACKAGING AND CONDITIONING

Container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
500 l drum (basket for waste)	~100.0	~0.47	0.47	9

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Container type comment:	The physical geometry of the items in the 500 litre drums did not lend themselves for loading of more than one unit per drums and hence the low loading volume per drum.
Range in container waste volume:	Waste loaded into 500 litre drums did not contain DU and therefore were directly grouted. The physical geometry of the items in the 500 litre drums did not lend themselves for loading of more than one unit per drums and hence the low loading volume per drum.
Other information on containers:	Stainless Steel 316L
Conditioned density (t/m^3):	1.75
Conditioned density comment:	The density is assumed to be consistent with that stated in the FLoC submission.
Other information on conditioning:	-

RADIOACTIVITY

Source:	Sealed sources inside units
Uncertainty:	Data taken from FLoC and Waste Product Specification. It should be noted that whilst this waste stream has been encapsulated the specific activity of the waste remains the same as it was pre-encapsulation. This is due to the fact that the radioactivity is contained in the sealed source and does not become distributed throughout the grout.
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:	Data taken from FLoC and Waste Product Specification. It should be noted that whilst this waste stream has been encapsulated the specific activity of the waste remains the same as it was pre-encapsulation. This is due to the fact that the radioactivity is contained in the sealed source and does not become distributed throughout the grout formulation i.e. it is not homogenously mixed into the grout.
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		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	9.84E+00	B B 2			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	9.77E+01	B B 2			Th 227		8		
Zr 93		8			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230	8.28E-09	B B 2		
Nb 93m		8			Th 232		8		
Nb 94		8			Th 234	2.69E-04	B B 2		
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	1.5E-04	B B 2		
Ag 108m		8			U 235	7.13E-06	B B 2		
Ag 110m		8			U 236		8		
Cd 109		8			U 238	2.69E-04	B B 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	4.96E+00	B B 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			Other a				
Eu 152		8			Other b/g				
Eu 154		8			**Total a**	**4.26E-04**	**B B 2**	**0**	
Eu 155		8			**Total b/g**	**1.13E+02**	**B B 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