WASTE STREAM 5G302 SGHWR Decommissioning ILW

SITE Winfrith

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE ILW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m³
Future arisings -	1.4.2021 - 31.3.2023.....	40.0 m³
Total future arisings:		40.0 m³
Total waste volume:		40.0 m³

Comment on volumes: Volume 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 Reactor decommissioning.

PHYSICAL CHARACTERISTICS

General description: Miscellaneous reactor hardware. Consists of tubular and plate components. Most items are large and will require size reduction.

Physical components (%vol): Upper Neutron Shield Tank 11.3%, Upper auxillary neutron shield tank 1.5%, Calandria 7.3%, Lower auxillary neutron shield tank 0.5%, Lower neutron shield tank 11.2%, Radial shield tank 32.6%, Hangar bars 5.6%, Boiling channels 19.6%, Other Potential ILW 10.5%

Sealed sources: -

Bulk density (t/m³): ~7.4

Comment on density: Average estimated from total mass/total volume in 2012 iLoC. The waste density is expected to vary, between 7.9 to 2.7 t/m3.

CHEMICAL COMPOSITION

General description and components (%wt): Inconel X750 0.02%, 410 Iron 1.6%, Zircaloy-2 3.1%, Al/Mg alloy 2.6%, Stainless Steel 20.7%, Mild Steel 72.0%

Chemical state: -

Chemical form of radionuclides:
H-3: Present as activated material component
C-14: Present as activated material component
Cl-36: Present as activated material component
Se-79: Present as activated material component
Tc-99: Present as activated material component
I-129: Present as activated material component
Ra: Present as activated material component
Th: Present as activated material component
U: Present as activated material component
Np: Present as activated material component
Pu: Present as activated material component

Metals and alloys (%wt): Upper Neutron Shield 2" and 3/4" thick plates.Calandria 1.5" and 3/4" thick plate.Radial Neutron Shield 1" thick plate.

Stainless steel.....	20.7	
Other ferrous metals.....	72.0	Mild Steel 72.0%
Iron.....	1.6	410 Iron 1.6%
Aluminium.....	NE	
Beryllium.....	0	
Cobalt.....		
Copper.....	NE	
Lead.....	NE	
Magnox/Magnesium.....	0	

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	Nickel	<0.02	Inconel X750 0.02%
	Titanium		
	Uranium	TR	
	Zinc	P	
	Zircaloy/Zirconium	3.1	Zircaloy-2 3.1%,
	Other metals	2.6	Al/Mg Alloy 2.6%
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	0	
	Sand		
	Glass/Ceramics	0	
	Graphite	0	
	Desiccants/Catalysts		
	Asbestos	TR	
	Non/low friable		
	Moderately friable		
	Highly friable		
	Free aqueous liquids	0	
	Free non-aqueous liquids	0	

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Powder/Ash..... 0

Inorganic anions (%wt): -

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: It is anticipated that Powder/Fines will be produced from decommissioning operations. An estimate has been carried out into the quantities of fines which may be produced from various cutting techniques. The estimates range from 0.15 m3 to 0.35 m3. The fines will be collected in 10-litre sacrificial cans and encapsulated using vinyl ester styrene in the segmentation cell.There may be trace levels of asbestos in the area. A specialist contractor will remove the asbestos, which is expected to be disposed as LLW.

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: None expected

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

Conditioning method:	The waste will be packaged into 6m3 boxes (High Density) and encapsulated with cement prior to transfer to the Harwell ILW Store.
Plant Name:	SGHWR ILW Processing Plant
Location:	Winfrith
Plant startup date:	-
Total capacity (m^3/y incoming waste):	-
Target start date for packaging this stream:	-
Throughput for this stream (m^3/y incoming waste):	-
Other information:	-

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Likely container type:

Container	Waste packaged (%vol)	Waste loading (m³)	Payload (m³)	Number of packages
6m³ concrete box (HD)	100.0	~0.455	5.8	88

Likely container type comment:	The decommissioning of the SGHWR will be carried out in campaigns based on waste source and material type. Internal furniture has been designed to house waste items.
Range in container waste volume:	The volume of raw waste per package will vary with campaign. It is expected to be in the range 0.11 to 2.42 m3.
Other information on containers:	Payload volume quoted above is the wasteform volume.
Likely conditioning matrix:	Pulverised Fly Ash / Ordinary Portland Cement
Other information:	3:1 PFA/OPC at a 0.42 w/s ratio
Conditioned density (t/m³):	~2.6
Conditioned density comment:	Conditioned density is expected to vary with packaging campaign, between 2.0 to 6.3.
Other information on conditioning:	Size reduction will produce fines from the cutting process. It is proposed that these fines will be immobilised by polymer encapsulation of the fines with vinyl ester styrene in 10 litre cans. These cans will be placed into the 6m3 boxes and grouted.
Opportunities for alternative disposal routing:	

Treatment	Stream volume (%)	Comment
-	-	-

RADIOACTIVITY

Source:	Activation of materials of construction and heavy water coolant. Fuel and fission product contamination of primary circuit.
Uncertainty:	The main source of uncertainty in the activation modelling is the elemental uncertainties in the material compositions. The uncertainties relate to the trace elements present within the material used to manufacture the SGHWR components. Wherever possible specific compositions and trace element data was used for each component.There is also uncertainty in the inventory from the flux modelling. However, the uncertainty presented by the flux modelling is regarded to be much less than that presented by the elemental uncertainties.
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:	Activation modelling based on a 3-D Monte Carlo neutron transport code to determine energy dependent neutron flux spectra, and also an EASY/FISPACT neutron activation code was used. Swab samples of the primary circuitry also concluded that contamination by fission products was negligible.
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			1.02E+01	B B 2	Gd 153				8
Be 10			2.21E-05	B B 2	Ho 163			6.42E-07	B B 2
C 14			2E-01	B B 2	Ho 166m			3.47E-04	B B 2
Na 22				8	Tm 170				8
Al 26				8	Tm 171			1.29E-04	B B 2
Cl 36			2.1E-03	B B 2	Lu 174			9.37E-07	B B 2
Ar 39			2.16E-03	B B 2	Lu 176				8
Ar 42			5.36E-06	B B 2	Hf 178n			1.73E-02	B B 2
K 40			5.1E-08	B B 2	Hf 182			1.21E-06	B B 2
Ca 41			6.77E-04	B B 2	Pt 193			1.56E-02	B B 2
Mn 53				8	Tl 204			1.24E-01	B B 2
Mn 54			4.88E-07	B B 2	Pb 205			7.06E-08	B B 2
Fe 55			6.08E+00	B B 2	Pb 210			5.54E-08	B B 2
Co 60			1.64E+01	B B 2	Bi 208			3.11E-09	B B 2
Ni 59			1.31E-01	B B 2	Bi 210m			3.98E-08	B B 2
Ni 63			1.5E+01	B B 2	Po 210			5.62E-08	B B 2
Zn 65			1.11E-08	B B 2	Ra 223			3.23E-07	B B 2
Se 79			6.58E-06	B B 2	Ra 225			5.64E-06	B B 2
Kr 81			1.15E-03	B B 2	Ra 226			6.25E-09	B B 2
Kr 85			5.76E-02	B B 2	Ra 228			4.8E-07	B B 2
Rb 87			4.38E-07	B B 2	Ac 227			3.24E-07	B B 2
Sr 90			4.21E-05	B B 2	Th 227			3.19E-07	B B 2
Zr 93			2.29E-02	B B 2	Th 228			4.71E-04	B B 2
Nb 91			2.56E-06	B B 2	Th 229			5.64E-06	B B 2
Nb 92				8	Th 230			4.96E-07	B B 2
Nb 93m			1.13E+00	B B 2	Th 232			4.89E-07	B B 2
Nb 94			5.83E-02	B B 2	Th 234			1.79E-07	B B 2
Mo 93			1.16E-03	B B 2	Pa 231			6.71E-07	B B 2
Tc 97			1.78E-09	B B 2	Pa 233			1.49E-06	B B 2
Tc 99			1.94E-04	B B 2	U 232			5.22E-04	B B 2
Ru 106				8	U 233			1.22E-03	B B 2
Pd 107			3.27E-08	B B 2	U 234			4.38E-04	B B 2
Ag 108m			5.93E-04	B B 2	U 235			4.04E-08	B B 2
Ag 110m				8	U 236			1.64E-06	B B 2
Cd 109			7.63E-06	B B 2	U 238			1.79E-07	B B 2
Cd 113m			2.66E-04	B B 2	Np 237			1.49E-06	B B 2
Sn 119m			3.92E-07	B B 2	Pu 236				8
Sn 121m			8.18E-02	B B 2	Pu 238			1.61E-02	B B 2
Sn 123				8	Pu 239			6.84E-05	B B 2
Sn 126			1.74E-08	B B 2	Pu 240			1.13E-04	B B 2
Sb 125			3.48E-01	B B 2	Pu 241			7.39E-03	B B 2
Sb 126			2.44E-09	B B 2	Pu 242			1.89E-06	B B 2
Te 125m			8.72E-02	B B 2	Am 241			4.15E-04	B B 2
Te 127m				8	Am 242m			7.65E-07	B B 2
I 129			4.63E-09	B B 2	Am 243			2.42E-05	B B 2
Cs 134			2.94E-01	B B 2	Cm 242			6.26E-07	B B 2
Cs 135			1.02E-03	B B 2	Cm 243			3.65E-06	B B 2
Cs 137			1.65E-02	B B 2	Cm 244			1.39E-02	B B 2
Ba 133			6.44E-02	B B 2	Cm 245			1.78E-06	B B 2
La 137			1.12E-04	B B 2	Cm 246			9.05E-06	B B 2
La 138				8	Cm 248			2.04E-09	B B 2
Ce 144				8	Cf 249			1.83E-08	B B 2
Pm 145			2.77E-05	B B 2	Cf 250			1.4E-07	B B 2
Pm 147			4.49E-05	B B 2	Cf 251			1.53E-09	B B 2
Sm 147				8	Cf 252				8
Sm 151			4.13E-04	B B 2	Other a				
Eu 152			2.64E-02	B B 2	Other b/g			1.21E-06	B B 2
Eu 154			1.12E-02	B B 2	**Total a**	**0**		**3.33E-02**	**B B 2**
Eu 155			6.97E-04	B B 2	**Total b/g**	**0**		**5.04E+01**	**B B 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