

<b>WASTE STREAM</b>	<b>5G301</b>	<b>SGHWR Decommissioning LLW</b>
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**SITE** Winfrith  
**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.....	0 m <sup>3</sup>
Future arisings -	1.4.2022 - 31.3.2034.....	~4261.4 m <sup>3</sup>
Total future arisings:		4261.4 m <sup>3</sup>
Total waste volume:		4261.4 m <sup>3</sup>
Comment on volumes:	Volume of arising updated to reflect SMART Inventory. Volume updated for 2016 RWI to reflect SMART Inventory review.	
Uncertainty factors on volumes:	Stock (upper): x	Arisings (upper) x 1.5
	Stock (lower): x	Arisings (lower) x 0.5

**WASTE SOURCE** The waste consists of all arisings from the SGHWR reactor decommissioning.

**PHYSICAL CHARACTERISTICS**

**General description:** The waste is primarily formed of metallics wastes, concrete, grout, soft wastes such as PPE and asbestos. Waste arising from the SGHWR Primary containment operations is asbestos contaminated, or asbestos in form. The waste detailed in this characterisation form originates from the SGHWR reactor only, and excludes any waste from other facilities or legacy projects (detailed under 5G308).

**Physical components (%vol):** Reactor building structures and items of plant including turbines, condensers, deaerators, refuelling machine, primary circulators, lead shielding and care & maintenance waste. Percentage breakdown not available.

**Sealed sources:** The waste does not contain sealed sources.

**Bulk density (t/m<sup>3</sup>):** 0.79

**Comment on density:** Mass divided by volume from WCH

**CHEMICAL COMPOSITION**

**General description and components (%wt):** Metals (59%), Rubble (23%), Plastic/Rubber (3%), Wood (1%), biodegradable (non-putrescibles) (2%), others (12%) including sludge residue (heels) and asbestos.

**Chemical state:** Neutral

**Chemical form of radionuclides:** H-3: Tritium due to activation of concrete.  
C-14: Carbon 14 due to activation of concrete and metals.

**Metals and alloys (%wt):** The raw waste contains many varied large items, and a range of metal thicknesses.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~9.8	Pipework, plate work	
Other ferrous metals.....	~27.8	Mild steel (Pipework, hand rails, grating, plate, RSJ's)	
Iron.....	~8.6	Pipework, hand rails, grating, plate, RSJ's	
Aluminium.....	~0.30	Electrical boxes and vent work	
Beryllium.....	TR	Contaminant in grout / rubber	
Cobalt.....	TR	As a metal additive	
Copper.....	~0.14	Associated with electrical systems	
Lead.....	~0.91	Shielding and contaminant in grout / rubber	

<b>WASTE STREAM</b>	<b>5G301</b>	<b>SGHWR Decommissioning LLW</b>
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Magnox/Magnesium.....	0	
Nickel.....	~1.8	Contaminant in grout / rubber
Titanium.....	TR	As a metal additive
Uranium.....		
Zinc.....	~0.01	As a metal additive
Zircaloy/Zirconium.....	0	
Other metals.....	~6.5	Not quantified in WCH

Organics (%wt):                      The waste contains wood, plastics and rubber.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	~1.0		
Paper, cotton.....	~0		
Wood.....	~1.0		
Halogenated plastics .....	~1.0	Halogenated plastics - PVC. Soft waste PPE	
Total non-halogenated plastics.....	~0.97		
Condensation polymers.....	~0.97	Soft waste PPE	
Others.....	P	including 0.01% vinyl chloride (unpolymerised)	
Organic ion exchange materials....	0		
Total rubber.....	~1.0		
Halogenated rubber .....	~1.0		
Non-halogenated rubber.....	NE		
Hydrocarbons.....			
Oil or grease .....			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	0		

Other materials (%wt):                      -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	~5.0		
Soil.....			
Brick/Stone/Rubble.....	~23.0		
Cementitious material.....			
Sand.....			
Glass/Ceramics.....	~1.4	Man Made Mineral Fibre bulk lagging	
Graphite.....	0		
Desiccants/Catalysts.....			
Asbestos.....	~4.2	Asbestos includes bulk friable	

<b>WASTE STREAM</b>	<b>5G301</b>	<b>SGHWR Decommissioning LLW</b>
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		chrysotile from lagging boxes. Asbestos also present in cladding and as a contaminant on soft wastes for incineration.
Non/low friable.....	0	
Moderately friable.....	~2.1	Lagging and cladding, Asbestos includes bulk friable chrysotile from lagging boxes. Asbestos also present in cladding and as a contaminant on soft wastes for incineration.
Highly friable.....	~2.1	Lagging and cladding. Asbestos includes bulk friable chrysotile from lagging boxes. Asbestos also present in cladding and as a contaminant on soft wastes for incineration.
Free aqueous liquids.....	0	
Free non-aqueous liquids.....	0	
Powder/Ash.....	NE	

Inorganic anions (%wt):      Anions will only be present as chemical constituents of concrete and soil.

	(%wt)	Type(s) and comment
Fluoride.....	NE	
Chloride.....	NE	
Iodide.....	NE	
Cyanide.....	NE	
Carbonate.....	P	
Nitrate.....	NE	
Nitrite.....	NE	
Phosphate.....	~0.01	Contaminant in grout / rubber
Sulphate.....	NE	
Sulphide.....	NE	

Materials of interest for waste acceptance criteria:      Concrete scabbling will generate some powders. Some lead may be included, approximately 15 tonnes assuming ~10% of the total has surface contamination.

	(%wt)	Type(s) and comment
Combustible metals.....	NE	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	TR	Contaminant in grout
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	~2.0	
Putrescible wastes.....	0	
Non-putrescible wastes.....	~2.0	
Corrosive materials.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	

<b>WASTE STREAM</b>	<b>5G301</b>	<b>SGHWR Decommissioning LLW</b>
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Reacting with water.....

Higher activity particles.....

Soluble solids as bulk chemical compounds.....

Hazardous substances / non hazardous pollutants: Asbestos present in some areas. ~4% of total weight. Carbon (0.02%), Manganese (0.9%), Silicon (0.12%), Sulphur (0.01%), Nitrogen (0.02%), Trace amounts of phosphorus and TPH (C8-C35) - All present as contaminants in grout.

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....		
Other organophosphates.....		
Vinyl chloride.....		
Arsenic.....	TR	Contaminant in grout / rubber
Barium.....		
Boron.....	TR	Contaminant in grout / rubber
Boron (in Boral).....		
Boron (non-Boral).....		
Cadmium.....	TR	Contaminant in grout / rubber
Caesium.....		
Selenium.....		
Chromium.....	~2.7	As a metal additive
Molybdenum.....	~0.45	Contaminant in grout / rubber
Thallium.....		
Tin.....		
Vanadium.....		
Mercury compounds.....		
Others.....		
Electronic Electrical Equipment (EEE)		
EEE Type 1.....	P	8 off Disused operational waste such as computers, electrical control units for reactor operational control, switches.
EEE Type 2.....	P	10 off plant items
EEE Type 3.....	P	50 off disused equipment (i.e. saws, drills, wire cutters, PAT test equipment) from decommissioning
EEE Type 4.....		
EEE Type 5.....		

**WASTE STREAM 5G301 SGHWR Decommissioning LLW**

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: Not yet determined. In & of itself not a DI; waste stream may include DIs (notably any stainless steel components). Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed Dis.

**TREATMENT, PACKAGING AND DISPOSAL**

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	Off-site	~16.0           ~84.0

Comment on planned treatments: it is expected that 53% of this stream will be disposed of as VLLW to landfill

**Disposal Routes:**

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	~31.0	0.79
Expected to be consigned to a Landfill Facility	~53.0	0.79
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	~16.0	0.40
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		

Classification codes for waste expected to be consigned to a landfill facility: 17 04 07, 17 05 03\*/04, 17 06 03\*, 17 06 01\*, 13 02 08\*, 16 03 03\*/04

**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			

**WASTE STREAM      5G301      SGHWR Decommissioning LLW**

**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:**

Container	Stream volume %	Waste loading m <sup>3</sup>	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	~31.0	~10	133

Other information:      -

**Waste Planned for Disposal at the LLW Repository:**

Container voidage:      Voidage will be <10%

Waste Characterisation Form (WCH):      The waste meets the LLWR's Waste Acceptance Criteria (WAC).  
The waste has a current WCH.  
Inventory information is consistent with the current WCH.

Waste consigned for disposal to LLWR in year of generation:      Yes.

**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:      Activation of core components (where not ILW). Contamination of primary circuit components with corrosion products. Miscellaneous contamination.

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:      Sampling and analysis campaign, used to create multiple individual SGHWR fingerprints with a weighted average applied to inform the WCH. Rad data in the RWI is based on WCH: 1MXN-2WIN-0-WCH-0-4318 V4 decayed by 5 years to 2022.

Other information:      -

**WASTE STREAM 5G301 SGHWR Decommissioning LLW**

Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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			3.39E-05	CC 2	Gd 153				8
Be 10				8	Ho 163				8
C 14			1.34E-05	CC 2	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			1.94E-06	CC 2	Pb 210				8
Co 60			3.05E-05	CC 2	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			1.17E-04	CC 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			1.2E-05	CC 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			4.81E-08	CC 2	Th 234		1.03E-08	CC 2	8
Mo 93				8	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99			3.04E-09	CC 2	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234		1.4E-08	CC 2	8
Ag 108m				8	U 235				8
Ag 110m				8	U 236				8
Cd 109				8	U 238		1.03E-08	CC 2	8
Cd 113m				8	Np 237				8
Sn 119m				8	Pu 236				8
Sn 121m				8	Pu 238		2.66E-07	CC 2	8
Sn 123				8	Pu 239		2.26E-07	CC 2	8
Sn 126				8	Pu 240		1.97E-07	CC 2	8
Sb 125			3.69E-08	CC 2	Pu 241		4.39E-06	CC 2	8
Sb 126				8	Pu 242		1.17E-09	CC 2	8
Te 125m			9.25E-09	CC 2	Am 241		7.58E-07	CC 2	8
Te 127m				8	Am 242m				8
I 129			3.12E-09	CC 2	Am 243				8
Cs 134				8	Cm 242				8
Cs 135				8	Cm 243		2.77E-09	CC 2	8
Cs 137			5.72E-05	CC 2	Cm 244		1.07E-07	CC 2	8
Ba 133			1.91E-09	CC 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				8	Other a				8
Eu 152			5.31E-08	CC 2	Other b/g				8
Eu 154			4.5E-08	CC 2	<b>Total a</b>	<b>0</b>	<b>1.58E-06</b>	<b>CC 2</b>	8
Eu 155			1.29E-09	CC 2	<b>Total b/g</b>	<b>0</b>	<b>2.71E-04</b>	<b>CC 2</b>	8

**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