

WASTE STREAM	5G301	SGHWR Decommissioning LLW
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SITE Winfrith
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Magnox Limited
WASTE TYPE LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m ³
Future arisings -	1.4.2019 - 31.3.2023.....	~4994.7 m ³
Total future arisings:		4994.7 m ³
Total waste volume:		4994.7 m ³
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 Decommissioning of Steam-Generating Heavy Water Reactor

PHYSICAL CHARACTERISTICS

General description: Waste comprising mostly redundant plant items and building structures; some change barrier and care & maintenance wastes. Large items of dismantled plant will be placed directly into half height ISO containers. Large tanks will be size reduced. Concrete expected mostly to be scabblings.

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: -

Bulk density (t/m³): 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%), Asbestos (4%), other (10%) including sludge residue (heels) (5%).

Chemical state: -

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		
Stainless steel.....	~9.8	Pipework, plate work
Other ferrous metals.....	~27.8	Other ferrous alloys = 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.....	~0.90	Shielding and contaminant in grout / rubber
Magnox/Magnesium.....	<0.90	
Nickel.....	~1.8	Contaminant in grout / rubber
Titanium.....	TR	As a metal additive

WASTE STREAM

5G301

SGHWR Decommissioning LLW

	Uranium.....		
	Zinc.....	~0.01	As a metal additive
	Zircaloy/Zirconium.....	0	
	Other metals.....	~7.8	Other metals include platinum and tin
Organics (%wt):	The waste contains wood, plastics and rubber.		
	Total cellulosics.....	~1.0	
	Paper, cotton.....	~0.10	
	Wood.....	~0.90	
	Halogenated plastics	~1.0	Halogenated plastics - PVC.
	Total non-halogenated plastics.....	~1.0	
	Condensation polymers.....	~0.90	
	Others.....	~0.10	including 0.01% vinyl chloride (un-polymerised)
	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):	-		
	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.....	~4.0	
	Non/low friable.....	0	
	Moderately friable.....	~2.0	Lagging and cladding, mostly chrysotile
	Highly friable.....	~2.0	Lagging and cladding, mostly chrysotile
	Free aqueous liquids.....	0	
	Free non-aqueous liquids.....	0	

WASTE STREAM

5G301

SGHWR Decommissioning LLW

	Powder/Ash.....	NE	
Inorganic anions (%wt):	Anions will only be present as chemical constituents of concrete and soil		
	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.		
	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	
	Reacting with water.....	NE	
	Active particles.....		
	Soluble solids as bulk chemical compounds.....		
Hazardous substances / non hazardous pollutants:	Asbestos present in some areas. ~4% of total weight.		
	Acrylamide.....		
	Benzene.....		
	Chlorinated solvents.....		
	Formaldehyde.....		
	Organometallics.....		
	Phenol.....		
	Styrene.....		
	Tri-butyl phosphate.....		
	Other organophosphates.....		
	Vinyl chloride.....		
	Arsenic.....	TR	Contaminant in grout / rubber

WASTE STREAM

5G301

SGHWR Decommissioning LLW

Barium.....		
Boron.....	TR	Contaminant in grout / rubber
Cadmium.....	TR	Contaminant in grout / rubber
Caesium.....		
Selenium.....		
Chromium.....	~2.7	As a metal additive
Molybdenum.....		
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.....		
Complexing agents (%wt):	No	
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		
Total complexing agents.....	0	

TREATMENT, PACKAGING AND DISPOSAL

Planned on-site / off-site treatment(s):

Treatment	On-site / Off site	Stream volume %
Low force compaction	Off-site	~16.0
Supercompaction (HFC)		
Incineration		
Solidification		
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None		~84.0

Comment on planned treatments:

it is expected that 53% of this stream will be disposed of as VLLW to landfill

WASTE STREAM**5G301****SGHWR Decommissioning LLW****Disposal Routes:**

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

Upcoming (2019/20-2021/22) Waste Routing (if expected to change from above):

Disposal Route	Stream volume %		
	2019/20	2020/21	2021/22
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 Packaging for Disposal:

Container	Stream volume %	Waste loading m ³	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	~31.0	~10	155
2m box (no shielding)			
4m box (no shielding)			
Other			

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.

WCF will require updating to cover some of the waste types arising in the later decommissioning period.

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

Potential for the waste to contain discrete items: -

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 seven individual SGHWR fingerprints. Rad data based on WCH: 1MXN-2WIN-0-WCH-0-4318 decayed by two years to 2019
Other information:	-

WASTE STREAM

5G301

SGHWR Decommissioning LLW

Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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			4.01E-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			4.14E-06	CC 2	Pb 210				8
Co 60			4.53E-05	CC 2	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			1.20E-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			1.29E-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		2.73E-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			7.87E-08	CC 2	Pu 241		5.07E-06	CC 2	8
Sb 126				8	Pu 242		1.17E-09	CC 2	8
Te 125m			1.97E-08	CC 2	Am 241		7.39E-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		2.97E-09	CC 2	8
Cs 137			6.13E-05	CC 2	Cm 244		1.2E-07	CC 2	8
Ba 133			2.32E-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			6.2E-08	CC 2	Other b/g				8
Eu 154			5.73E-08	CC 2	Total a	0	1.58E-06	CC 2	8
Eu 155			1.98E-09	CC 2	Total b/g	0	3.03E-04	CC 2	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