

WASTE STREAM	5G01	Miscellaneous Reactor Hardware ILW
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SITE Winfrith

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE ILW; SPD2

WASTE VOLUMES

	Reported
Stocks: At 1.4.2019.....	0.8 m ³
Total future arisings:	0 m ³
Total waste volume:	0.8 m ³

Comment on volumes: Volumes based on assessment (ILW/LLW) of individual items.

Uncertainty factors on volumes:

Stock (upper):	x 1.2	Arisings (upper)	x
Stock (lower):	x 0.8	Arisings (lower)	x

WASTE SOURCE The waste consists of miscellaneous activated materials from SGHWR.

PHYSICAL CHARACTERISTICS

General description: Redundant components from operations that have been stored in SGHWR since operations ceased. The majority of components are stored in the mortuary holes pending retrieval. Components are primarily metallic and include Nimonic 90 springs, hanger bar couplings, hanger bar springs, various pressure tube sections, rigs and shield plugs. Maximum diameter of any item is approximately 150mm.

Physical components (%wt): Mild Steel (59.16%),Others (39.78%), Nimonic-90 (1.06%).

Sealed sources: -

Bulk density (t/m³): 1

Comment on density: The mean bulk density is based on 2004 RWI gross envelope material calculations. It should be noted that an updated waste estimate since has given a total mass of 6011.00 kg and a corresponding net material volume of 0.82 m³ (based on material density). This gives a mean waste material density of 7.31 te/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Mild Steel (59.16%),Others (39.78%), Nimonic-90 (1.06%).

Chemical state: Neutral

Chemical form of radionuclides: H-3: Tritium isotope present as trace element in the activated materials.
 C-14: Carbon-14 isotope present as trace element in the activated materials.
 Cl-36: Chlorine-36 isotope present as trace element in the activated materials.
 Se-79: Selenium-79 isotope present as trace element in the activated materials.
 Tc-99: Technetium-99 isotope present as trace element in the activated materials.
 I-129: Iodine-129 isotope present as trace element in the activated materials.
 Ra: Radium isotopes present as trace elements in the activated materials.
 Th: Thorium isotopes present as trace elements in the activated materials.
 U: Uranium isotopes present as trace elements in the activated materials.
 Np: Neptunium isotopes present as trace elements in the activated materials.
 Pu: Plutonium isotopes present as trace elements in the activated materials.

Metals and alloys (%wt): ~12 cm diameter tubes maximum 1 m long.Seal plugs ~ 12 x 12 cm section.

Stainless steel.....	0
Other ferrous metals.....	59.2
Iron.....	
Aluminium.....	NE
Beryllium.....	0
Cobalt.....	
Copper.....	0
Lead.....	0

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Magnox/Magnesium.....	TR	
Nickel.....	1.1	Nimonic-90
Titanium.....		
Uranium.....	TR	
Zinc.....	0	
Zircaloy/Zirconium.....	P	
Other metals.....	39.8	Other metals not specified, it is likely that a proportion will be Zircalloy.

Organics (%wt):

There may be a small amount of halogenated plastics present in the waste.		
Total cellulosics.....	0	
Paper, cotton.....	0	
Wood.....	0	
Halogenated plastics	TR	PVC used as wrapping.
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.....	0	
Non/low friable.....		
Moderately friable.....		
Highly friable.....		

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	Free aqueous liquids.....	0
	Free non-aqueous liquids.....	0
	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:	-	
	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.....	

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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: No pretreatment requirement has been established. The flattening of tubes and pipes would no longer be undertaken. Mild steel pipes will be sectioned and loaded into waste packages using specially designed furniture. Non-stainless steel wastes will be volume reduced. Waste to be sent to Harwell for processing into 500 litre drums and storage in the ISF.

Plant Name: -
 Location: Harwell
 Plant startup date: 2018
 Total capacity (m³/y incoming waste): -
 Target start date for packaging this stream: 2018
 Throughput for this stream (m³/y incoming waste): -
 Other information: -

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Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	500 l drum	100.0	0.41	0.47	2

Likely container type comment: The decommissioning of the SGHWR will be carried out in campaigns based on waste source and material type.

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, but this comprises of waste from both 5G01 and 5G302.

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: An average value for all waste packages is given above. The conditioned density is expected to vary with packaging campaign, between 2.0 to 6.3.

Other information on conditioning: The packaging plant will be inside the SGHWR building.

Opportunities for alternative disposal routing:

Treatment	Stream volume (%)	Comment
-	-	-

RADIOACTIVITY

Source: Activation products from reactor structural components.

Uncertainty: The activity is an estimated value only.

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: A reactor activation modelling study was carried out based on a 3-D Monte Carlo neutron transport code to determine energy dependent neutron flux spectra, and on the EASY/FISPACT neutron activation code. Dose rate measurements were also carried out on waste items.

Other information: -

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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	4.44E-02	BB 2			Gd 153		8		
Be 10	1.06E-07	BB 2			Ho 163	5.34E-08	BB 2		
C 14	4.49E-03	BB 2			Ho 166m	7.21E-06	BB 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171	3.11E-09	BB 2		
Cl 36	6.56E-07	BB 2			Lu 174		8		
Ar 39	1.58E-04	BB 2			Lu 176		8		
Ar 42		8			Hf 178n	1.41E-05	BB 2		
K 40	1.04E-08	BB 2			Hf 182		8		
Ca 41	2.45E-05	BB 2			Pt 193	2.86E-06	BB 2		
Mn 53		8			Tl 204	8.84E-05	BB 2		
Mn 54		8			Pb 205		8		
Fe 55	1.64E-02	BB 2			Pb 210		8		
Co 60	3.49E+01	BB 2			Bi 208		8		
Ni 59	1.87E-01	BB 2			Bi 210m		8		
Ni 63	1.71E+01	BB 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	1.54E-08	BB 2			Ra 225	1.10E-09	BB 2		
Kr 81	2.54E-08	BB 2			Ra 226		8		
Kr 85	9.89E-06	BB 2			Ra 228	2.64E-08	BB 2		
Rb 87	2.1E-07	BB 2			Ac 227		8		
Sr 90		8			Th 227		8		
Zr 93	2.63E-07	BB 2			Th 228	2.64E-08	BB 2		
Nb 91	1.75E-08	BB 2			Th 229	1.10E-09	BB 2		
Nb 92		8			Th 230		8		
Nb 93m	1.83E-04	BB 2			Th 232	2.64E-08	BB 2		
Nb 94	3.07E-05	BB 2			Th 234	1.07E-07	BB 2		
Mo 93	1.07E-05	BB 2			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	1.81E-06	BB 2			U 232		8		
Ru 106		8			U 233	2.15E-07	BB 2		
Pd 107		8			U 234	1.06E-07	BB 2		
Ag 108m	1.18E-05	BB 2			U 235	4.92E-09	BB 2		
Ag 110m		8			U 236		8		
Cd 109		8			U 238	1.07E-07	BB 2		
Cd 113m	4.43E-05	BB 2			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m	3.61E-06	BB 2			Pu 238		8		
Sn 123		8			Pu 239	3.8E-06	BB 2		
Sn 126		8			Pu 240	2.15E-08	BB 2		
Sb 125	5.51E-07	BB 2			Pu 241	3.96E-09	BB 2		
Sb 126		8			Pu 242		8		
Te 125m	1.38E-07	BB 2			Am 241		8		
Te 127m		8			Am 242m		8		
I 129		8			Am 243		8		
Cs 134	2.09E-07	BB 2			Cm 242		8		
Cs 135		8			Cm 243		8		
Cs 137	2.84E-07	BB 2			Cm 244		8		
Ba 133	9.28E-05	BB 2			Cm 245		8		
La 137	3.08E-09	BB 2			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145	1.33E-07	BB 2			Cf 250		8		
Pm 147	4.36E-09	BB 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	2.41E-05	BB 2			Other a				
Eu 152	3.70E-03	BB 2			Other b/g				
Eu 154	1.75E-04	BB 2			Total a	4.31E-06	BB 2	0	
Eu 155	4.77E-07	BB 2			Total b/g	5.23E+01	BB 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