WASTE STREAM 5G01 Miscellaneous Reactor Hardware ILW

SITE	Winfrith
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	ILW; SPD2
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	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. Stream comprises ten 10 litre cans containing nimonic springs (max 18 per can) and five 10 litre cans containing pencil loop sections. Waste stream may also include other hotspots and anything not suitable for a 6m3 box, so isn't limited to the above.

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

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m^3): 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.

WASTE STREAM 5G01 Miscellaneous Reactor Hardware ILW

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	0		
Other ferrous metals	59.2		
Iron			
Aluminium	NE		
Beryllium	0		
Cobalt			
Copper	0		
Lead	0		
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.

	(%wt)	Type(s) and comment	% of total C14 activity
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): -

WASTE STREAM 5G01 Miscellaneous Reactor Hardware ILW

	(%wt)	Type(s) and comment	% of total C14 activity
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.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): -

	(%wt)	Type(s) and comment
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: -

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	0	
Putrescible wastes.....	0	
Non-putrescible wastes.....		

WASTE STREAM 5G01 Miscellaneous Reactor Hardware ILW

Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Higher activity particles.....	
Soluble solids as bulk chemical compounds.....	

Hazardous substances / non hazardous pollutants: none expected

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....		
Other organophosphates.....		
Vinyl chloride.....		
Arsenic.....		
Barium.....		
Boron.....	0	
Boron (in Boral).....		
Boron (non-Boral).....		
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.....		

WASTE STREAM 5G01 Miscellaneous Reactor Hardware ILW

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: Yes. Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs; Stainless items assumed DIs (MAC also includes nimonics, known DIs)

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: -

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: -

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
500 l drum (pre-cast annular)	100.0	0.41	0.4	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 varying 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/m^3): ~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: -

WASTE STREAM 5G01 Miscellaneous Reactor Hardware ILW

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	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:	-

WASTE STREAM 5G01 Miscellaneous Reactor Hardware ILW

Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	3.75E-02	B B 2			Gd 153		8		
Be 10	1.06E-07	B B 2			Ho 163	5.34E-08	B B 2		
C 14	4.49E-03	B B 2			Ho 166m	7.20E-06	B B 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171	1.05E-09	B B 2		
Cl 36	6.56E-07	B B 2			Lu 174		8		
Ar 39	1.57E-04	B B 2			Lu 176		8		
Ar 42		8			Hf 178n	1.32E-05	B B 2		
K 40	1.04E-08	B B 2			Hf 182		8		
Ca 41	2.45E-05	B B 2			Pt 193	2.74E-06	B B 2		
Mn 53		8			Tl 204	5.11E-05	B B 2		
Mn 54		8			Pb 205		8		
Fe 55	7.65E-03	B B 2			Pb 210		8		
Co 60	2.35E+01	B B 2			Bi 208		8		
Ni 59	1.87E-01	B B 2			Bi 210m		8		
Ni 63	1.68E+01	B B 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	1.54E-08	B B 2			Ra 225	1.16E-09	B B 2		
Kr 81	2.54E-08	B B 2			Ra 226		8		
Kr 85	8.14E-06	B B 2			Ra 228	2.64E-08	B B 2		
Rb 87	2.1E-07	B B 2			Ac 227		8		
Sr 90		8			Th 227		8		
Zr 93	2.63E-07	B B 2			Th 228	2.64E-08	B B 2		
Nb 91	1.74E-08	B B 2			Th 229	1.16E-09	B B 2		
Nb 92		8			Th 230		8		
Nb 93m	1.62E-04	B B 2			Th 232	2.64E-08	B B 2		
Nb 94	3.07E-05	B B 2			Th 234	1.07E-07	B B 2		
Mo 93	1.07E-05	B B 2			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	1.81E-06	B B 2			U 232		8		
Ru 106		8			U 233	2.15E-07	B B 2		
Pd 107		8			U 234	1.06E-07	B B 2		
Ag 108m	1.18E-05	B B 2			U 235	4.92E-09	B B 2		
Ag 110m		8			U 236		8		
Cd 109		8			U 238	1.07E-07	B B 2		
Cd 113m	3.81E-05	B B 2			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m	3.48E-06	B B 2			Pu 238		8		
Sn 123		8			Pu 239	3.8E-06	B B 2		
Sn 126		8			Pu 240	2.15E-08	B B 2		
Sb 125	2.59E-07	B B 2			Pu 241	3.43E-09	B B 2		
Sb 126		8			Pu 242		8		
Te 125m	6.49E-08	B B 2			Am 241		8		
Te 127m		8			Am 242m		8		
I 129		8			Am 243		8		
Cs 134	7.62E-08	B B 2			Cm 242		8		
Cs 135		8			Cm 243		8		
Cs 137	2.65E-07	B B 2			Cm 244		8		
Ba 133	7.62E-05	B B 2			Cm 245		8		
La 137	3.08E-09	B B 2			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145	1.18E-07	B B 2			Cf 250		8		
Pm 147	1.97E-09	B B 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	2.36E-05	B B 2			Other a				
Eu 152	3.17E-03	B B 2			Other b/g				
Eu 154	1.38E-04	B B 2			**Total a**	**4.31E-06**	**B B 2**	**0**	
Eu 155	3.11E-07	B B 2			**Total b/g**	**4.06E+01**	**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