WASTE STREAM	5G302	SGHWR Decommissioning ILW

SITE Winfrith

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE ILW

WASTE VOLUMES

		Reported (m^3)
Stocks:	At 1.4.2025	= 0
Future arisings:	1.4.2026 - 31.3.2038	= 40.0
Total future arisings:		**40.0**
Total waste volume:		**40.0**

OR

Conditioned (m^3)	Packaged (m^3)

Number of waste packages in stock: At 1.4.2025…… - packages

Comment on arising rates: -

Additional information on quantities: Volume updated for 2016 RWI to reflect SMART Inventory review

Uncertainty factors on volumes:
Stock (upper): x - Arisings (upper): x 1.20
Stock (lower): x - Arisings (lower): x 0.80

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.

Changes since waste generated: -

Bulk density (t/m³): ~ 7.4

Comment on density: 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: -

Sheet metal proportion / thickness: Upper Neutron Shield 2" and 3/4" thick plates.
Calandria 1.5" and 3/4" thick plate.
Radial Neutron Shield 1" thick plate.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
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	-	
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):

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

	(%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	TR	-	
Non/low friable		-	
Moderately friable		-	
Highly friable		-	
Free aqueous liquids	= 0	-	
Free non-aqueous liquids	= 0	-	
Powder/Ash	= 0	-	

COMPONENTS OF MATERIALS, WASTE PROPERTIES, MATERIALS NOT CONTRIBUTING TO MASS

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		-
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: -

	(%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		-

Complexing agents (%wt): No

	(%wt)	Type(s) and comment
EDTA		-
DPTA		-
NTA		-
Polycarboxylic acids		-
Other organic complexants		-
Total complexing agents	= 0	-

Physical components:

	Number	Type(s) and comment
Sources		-
Electronic & Electrical Equipment (EEE)		-
EEE Type 1		-
EEE Type 2		-
EEE Type 3		-
EEE Type 4		-
EEE Type 5		-

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off-site	Stream volume %
Size reduction		
Decay storage		
Low force compaction		
Supercompaction (HFC)		
Incineration		
Drying/dewatering/liquid separation		
Tie down/fixatives/strippable coating/painting application		
Decontamination		
Metal treatment		
Recycling / reuse		
Thermal treatment, including vitrification		
Encapsulation	On-site	100.0
Polymer encapsulation		
Other physical treatment		
Other chemical treatment		
Containerisation		
Treatment not yet determined		
None		

Comments on planned treatments: -

Conditioning method: The waste will be packaged into 6m3 boxes (High Density) and encapsulated with cement.

Conditioning plants:

Plant Name	Location
WIN encapsulation station	Winfrith

Likely conditioning matrix: Unknown

Further information on the conditioning matrix: 3:1 PFA/OPC at a 0.42 w/s ratio.

Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m^3)	Payload (m^3)	Number of packages	Estimated start date for packaging
6 m^3 concrete box (HD)	100.0	0.46	5.8	88	-

Range in container waste loading: 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 packaging and 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.

Conditioned density (t/m^3): ~ 2.6
Conditioned density comment: Conditioned density is expected to vary with packaging campaign, between 2.0 to 6.3.

Management Routes:

Disposal Route	Stream volume %	Raw density t/m^3	Start date
Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland)			
Expected to be Non-NSD HAW managed under Scottish Government's policy			
Expected to be disposed to LLW Vaults NRS Dounreay			
Expected to be consigned to the Geological Disposal Facility	100.0		
Expected to be consigned to a Near Surface Disposal Facility			
Expected to be consigned to the LLW Repository			
Expected to be consigned to a Landfill Facility			
Expected to be disposed On-Site			
Expected to be managed by In-Situ Disposal			
Expected to be consigned to an Incineration Facility			
Expected to be consigned to a Metal Treatment Facility			
Expected to be Out of Scope			
Expected to be recycled / reused			
Disposal route not known			

Classification codes for waste expected to be consigned to a landfill facility:

Opportunities for alternative disposal routing: No

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	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.

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.

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

WASTE STREAM **5G302** **SGHWR Decommissioning ILW**

Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3			7.72E+00	B B 2	Gd 153				8
Be 10			2.21E-05	B B 2	Ho 163			6.42E-07	B B 2
C 14			2.00E-01	B B 2	Ho 166m			3.46E-04	B B 2
Na 22				8	Tm 170				8
Al 26				8	Tm 171			2.13E-05	B B 2
Cl 36			2.10E-03	B B 2	Lu 174			3.54E-07	B B 2
Ar 39			2.13E-03	B B 2	Lu 176				8
Ar 42			4.83E-06	B B 2	Hf 178n			1.55E-02	B B 2
K 40			5.10E-08	B B 2	Hf 182			1.21E-06	B B 2
Ca 41			6.77E-04	B B 2	Pt 193			1.46E-02	B B 2
Mn 53				8	Tl 204			4.98E-02	B B 2
Mn 54			8.49E-09	B B 2	Pb 205			7.06E-08	B B 2
Fe 55			1.71E+00	B B 2	Pb 210			4.85E-08	B B 2
Co 60			8.53E+00	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			1.45E+01	B B 2	Po 210			4.89E-08	B B 2
Zn 65				8	Ra 223			3.74E-07	B B 2
Se 79			6.58E-06	B B 2	Ra 225			6.21E-06	B B 2
Kr 81			1.15E-03	B B 2	Ra 226			7.33E-09	B B 2
Kr 85			4.17E-02	B B 2	Ra 228			4.85E-07	B B 2
Rb 87			4.38E-07	B B 2	Ac 227			3.76E-07	B B 2
Sr 90			3.74E-05	B B 2	Th 227			3.70E-07	B B 2
Zr 93			2.29E-02	B B 2	Th 228			5.00E-04	B B 2
Nb 91			2.55E-06	B B 2	Th 229			6.22E-06	B B 2
Nb 92				8	Th 230			5.16E-07	B B 2
Nb 93m			9.14E-01	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			4.97E-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			5.88E-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			4.95E-07	B B 2	U 238			1.79E-07	B B 2
Cd 113m			2.06E-04	B B 2	Np 237			1.49E-06	B B 2
Sn 119m			5.23E-09	B B 2	Pu 236				8
Sn 121m			7.68E-02	B B 2	Pu 238			1.55E-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			1.19E-04	B B 2
Sb 125			9.91E-02	B B 2	Pu 241			5.81E-03	B B 2
Sb 126			2.44E-09	B B 2	Pu 242			1.89E-06	B B 2
Te 125m			2.48E-02	B B 2	Am 241			4.64E-04	B B 2
Te 127m				8	Am 242m			7.46E-07	B B 2
I 129			4.63E-09	B B 2	Am 243			2.42E-05	B B 2
Cs 134			5.49E-02	B B 2	Cm 242			6.16E-07	B B 2
Cs 135			1.02E-03	B B 2	Cm 243			3.25E-06	B B 2
Cs 137			1.48E-02	B B 2	Cm 244			1.15E-02	B B 2
Ba 133			4.64E-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			1.82E-08	B B 2
Pm 145			2.28E-05	B B 2	Cf 250			1.07E-07	B B 2
Pm 147			1.20E-05	B B 2	Cf 251			1.53E-09	B B 2
Sm 147				8	Cf 252				8
Sm 151			3.98E-04	B B 2	Unsp a				
Eu 152			2.05E-02	B B 2	Unsp b/g			1.21E-06	
Eu 154			7.48E-03	B B 2	**Total a**		**0** *	**3.04E-02**	*
Eu 155			3.41E-04	B B 2	**Total b/g**		**0** *	**3.43E+01**	*

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 the 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
* Total calculated from the 114 declared radionuclides