WASTE STREAM 9G105 Reactor LLW

SITE Trawsfynydd

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m³
Future arisings -	1.4.2019 - 31.3.2028.....	~291.7 m³
Total future arisings:		291.7 m³
Total waste volume:		291.7 m³

Comment on volumes: The rate of arising of this stream will not be uniform over the period of Care and Maintenance Preparations.

Uncertainty factors on volumes:

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

WASTE SOURCE Preparations for Safestore construction and removal of non-reactor plant.

PHYSICAL CHARACTERISTICS

General description: Metal, plastics, rubber, rubble and glass. Contaminated sludges and HEPA filters are also likely to arise with this waste stream. Lightly contaminated or activated items not suitable for supercompaction and too large for 200 litre drums will be disposed of in half height ISO containers.

Physical components (%wt): Current composition is typically: metal, plastic, wood, organics, asbestos. This breakdown is likely to change as decommissioning progresses.

Sealed sources: -

Bulk density (t/m³): 0.4

Comment on density: WCH mass divided by volume

CHEMICAL COMPOSITION

General description and components (%wt): Metal (86%), plastics (7%), wood (4%), organics (1%), asbestos (2%)

Chemical state: Neutral

Chemical form of radionuclides:
H-3: Most tritium is expected to be present as water but some may be in the form of other inorganic compounds or as organic compounds.
C-14: Chemical form of carbon 14 has not been determined but may be graphite.
Cl-36: The chemical form of chlorine 36 has not been determined.
Se-79: The selenium content is insignificant.
Tc-99: The technetium content is insignificant.
Ra: Radium isotope content is insignificant.
Th: The thorium content is insignificant.
U: Uranium isotope content is insignificant.
Np: The neptunium content is insignificant.
Pu: Chemical form of plutonium isotope has not been determined but may be plutonium oxides.

Metals and alloys (%wt): Not assessed.

Stainless steel.....	4.2	Deplanted stainless steel including 0.6% chromium and 0.4% nickel
Other ferrous metals.....	76.0	Deplanted steel (36.4) and Deplanted ferrous metals (39.6)
Iron.....		
Aluminium.....	3.2	Deplanted aluminium/alloy
Beryllium.....		
Cobalt.....		

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	Copper.....		
	Lead.....	2.6	Deplanted lead
	Magnox/Magnesium.....		
	Nickel.....		
	Titanium.....		
	Uranium.....		
	Zinc.....		
	Zircaloy/Zirconium.....		
	Other metals.....	NE	"Other" metals might be present in trace quantities.
Organics (%wt):	The waste contains non-halogenated plastic as polythene.		
	Total cellulosics.....	4.0	
	Paper, cotton.....		
	Wood.....	4.0	
	Halogenated plastics		
	Total non-halogenated plastics.....	7.0	
	Condensation polymers.....	0	
	Others.....	7.0	Soft secondary waste
	Organic ion exchange materials....		
	Total rubber.....	0	
	Halogenated rubber		
	Non-halogenated rubber.....		
	Hydrocarbons.....	1.0	
	Oil or grease	1.0	Waste lubricating oil
	Fuel.....		
	Asphalt/Tarmac (cont.coal tar)...		
	Asphalt/Tarmac (no coal tar).....		
	Bitumen.....		
	Others.....		
	Other organics.....		
Other materials (%wt):	-		
	Inorganic ion exchange materials.		
	Inorganic sludges and flocs.....		
	Soil.....		
	Brick/Stone/Rubble.....		
	Cementitious material.....		
	Sand.....		
	Glass/Ceramics.....		
	Graphite.....		
	Desiccants/Catalysts.....		
	Asbestos.....	~2.0	
	Non/low friable.....	~1.0	Asbestos contaminated material - Asbestos contaminated wastes from this wastestream are most

			commonly chrysotile from textured coatings and amosite from old pipework lagging and gasket seals. Crocidolite asbestos is known to be present in some of the wastes covered by this waste stream, namely deplanted insulation boards and lagging materials.
	Moderately friable.....	~1.0	Asbestos contaminated material - Asbestos contaminated wastes from this wastestream are most commonly chrysotile from textured coatings and amosite from old pipework lagging and gasket seals. Crocidolite asbestos is known to be present in some of the wastes covered by this waste stream, namely deplanted insulation boards and lagging materials.
	Highly friable.....	0	
	Free aqueous liquids.....		
	Free non-aqueous liquids.....		
	Powder/Ash.....		
Inorganic anions (%wt):	Fluoride present in trace quantities. Other anions are aluminates and silicates associated with the encapsulated sludge.		
	Fluoride.....	TR	
	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:	Asbestos may be present in thermal insulation. Quantities will be dependent on decommissioning strategies.		
	Combustible metals.....		
	Low flash point liquids.....		
	Explosive materials.....		
	Phosphorus.....		
	Hydrides.....		
	Biological etc. materials.....		
	Biodegradable materials.....		
	Putrescible wastes.....		
	Non-putrescible wastes.....		
	Corrosive materials.....		
	Pyrophoric materials.....		
	Generating toxic gases.....		

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Reacting with water.....	P	1.85m2
Active particles.....		
Soluble solids as bulk chemical compounds.....		

Hazardous substances / non hazardous pollutants: It is possible that there may be low level activated asbestos. The quantity arising will be dependent upon decommissioning strategy. Lead and asbestos may be present.

Acrylamide.....

Benzene.....

Chlorinated solvents.....

Formaldehyde.....

Organometallics.....

Phenol.....

Styrene.....

Tri-butyl phosphate.....

Other organophosphates.....

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

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TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	On-site	3.0
Supercompaction (HFC)	Off-site	3.0
Incineration	Off-site	10.0
Solidification		
Decontamination		
Metal treatment	Off-site	6.0
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		81.0

Comment on planned treatments: 74% of the stream is expected to be disposed of as VLLW to landfill

Disposal Routes:

Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository	10.0
Expected to be consigned to a Landfill Facility	74.0
Expected to be consigned to an On-Site Disposal Facility	
Expected to be consigned to an Incineration Facility	10.0
Expected to be consigned to a Metal Treatment Facility	6.0
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 m³	Number of packages
1/3 Height IP-1 ISO			
2/3 Height IP-2 ISO			
1/2 Height WAMAC IP-2 ISO	~3.0	43.2	< 1
1/2 Height IP-2 Disposal/Re-usable ISO	~7.0	10	3
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: Data have been presented as though the waste will be in dedicated containers. It is likely that this waste will be placed in containers with other LLW. 43.2m3 loading volume is calculated based on the fact that you can low force compact two times the normal volume of waste into a 200 litre/0.2m3 drum (400 litres/0.4m3), you can then fit 36 drums (14.4m3) into a ½ height ISO, each drum can be super-compacted to a 1/3 of its original volume so therefore we

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can get 3 x the amount of un-compacted drums into the final disposal container (43.2m3).

Waste Planned for Disposal at the LLW Repository:

Container voidage:	Significant inaccessible voidage is not expected.
Waste Characterisation Form (WCH):	The waste meets the LLWR's Waste Acceptance Criteria (WAC). The waste has a current WCH.
Waste consigned for disposal to LLWR in year of generation:	Yes. The waste is expected to be consigned for disposal in the year of generation.
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:	The major source of activity is activation products.
Uncertainty:	The values quoted are derived from available measurements and are indicative of the activities to be expected.
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:	Activity data taken from WCH - 1MXN-3TRA-0-WCH-0-3869 and decayed for 2 years for RWI 2019.
Other information:	-

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3			7.95E-05	C C 1	Gd 153				8
Be 10				8	Ho 163				8
C 14			3.59E-05	C C 1	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			3.69E-05	C C 1	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			3.13E-06	C C 1	Pb 210				8
Co 60			7.22E-06	C C 1	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			1.21E-05	C C 1	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			5.21E-06	C C 1	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			3.21E-07	C C 1	Th 234				8
Mo 93				8	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99				8	U 232				8
Ru 106			2.49E-09	C C 1	U 233				8
Pd 107				8	U 234				8
Ag 108m			4.11E-08	C C 1	U 235				8
Ag 110m				8	U 236				8
Cd 109				8	U 238				8
Cd 113m				8	Np 237				8
Sn 119m				8	Pu 236				8
Sn 121m				8	Pu 238			1.39E-07	C C 1
Sn 123				8	Pu 239			1.76E-07	C C 1
Sn 126				8	Pu 240			2.3E-07	C C 1
Sb 125				8	Pu 241			3.77E-06	C C 1
Sb 126				8	Pu 242				8
Te 125m				8	Am 241			7.91E-07	C C 1
Te 127m				8	Am 242m				8
I 129				8	Am 243				8
Cs 134			4.95E-09	C C 1	Cm 242				8
Cs 135				8	Cm 243			1.67E-09	C C 1
Cs 137			5.63E-06	C C 1	Cm 244			2.96E-08	C C 1
Ba 133			3.95E-08	C C 1	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			7.13E-09	C C 1	Cf 251				8
Sm 147				8	Cf 252				8
Sm 151				8	Other a				
Eu 152			2.83E-08	C C 1	Other b/g				
Eu 154			7.49E-08	C C 1	**Total a**	**0**		**1.37E-06**	**C C 1**
Eu 155			2.37E-09	C C 1	**Total b/g**	**0**		**1.90E-04**	**C C 1**

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