WASTE STREAM 9G105 Reactor LLW

SITE	Trawsfynydd
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	LLW
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	0 m^3
Future arisings -	1.4.2022 - 31.3.2028.....	~215.7 m^3
Total future arisings:		215.7 m^3
Total waste volume:		215.7 m^3

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 This waste stream captures decommissioning activities and wastes arising in the Reactor Buildings.

PHYSICAL CHARACTERISTICS

General description: The waste consists of predominantly activated metals and concrete from decommissioned plant and structures and associated secondary wastes. Items include concrete blocks and cores ,drums, brickwork, rubble, doors, soft waste, PPE, a mild steel BROKK chassis with a total mass of 900kg has been size reduced to item weighing no more than 25kg , sheeting, pipework, girders, ducting, lead shielding and general deplanted equipment/components including valves, pumps, pipework ,cooling oil, 70 no of vacuum bags (close weave glass fibre bags weighing 115g when empty and averaging 8kg of dust from operational plant processing. Waste comprises decommissioned plant, structural materials and secondary wastes. Some organic liquid (oils) may be present.

Physical components (%wt): Current composition is typically: Metal (10%), concrete / rubble (76%), Biodegradable- non putrescibles (1%), plastics (7%), wood (2%), organics (1%), asbestos (~1%). This breakdown is likely to change as decommissioning progresses.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m^3): 1.18

Comment on density: WCH mass divided by volume

CHEMICAL COMPOSITION

General description and components (%wt): Metal (10%), concrete / rubble (76%), Biodegradable- non putrescibles (1%), plastics (7%), wood (2%), organics (1%), asbestos (~1%)

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.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	0.32	Deplanted equipment drum lining, sheeting, ducting, valves & pipework	
Other ferrous metals	9.1	Deplanted equipment drum lining, sheeting,valves& pipework	
Iron			
Aluminium	0.16	Deplanted equipment sheeting, ducting, valves and pipework	
Beryllium			
Cobalt			
Copper			
Lead	0.36	Shielding blocks, sheets & small amounts of lead from paint dust (77kg paint dust containing typically less than 0.8kg (1%) of 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.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	2.0		
Paper, cotton			
Wood	2.0		
Halogenated plastics	4.9	Pipework, valves, pumps,ducting and plastic sheeting	
Total non-halogenated plastics	1.6		
Condensation polymers	0		
Others	1.6	Soft Waste, Visqueen, takki rags, PPE, sample pots,	
Organic ion exchange materials			
Total rubber	1.0		
Halogenated rubber	~0.50		
Non-halogenated rubber	~0.50		
Hydrocarbons	1.0		
Oil or grease	~1.0	0.99% cooling oil and 0.05% white mineral oil	
Fuel			
Asphalt/Tarmac (cont.coal tar)			
Asphalt/Tarmac (no coal tar)			
Bitumen			
Others			
Other organics	~1.0		

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Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..			
Inorganic sludges and flocs.....			
Soil.....			
Brick/Stone/Rubble.....			
Cementitious material.....	76.0		
Sand.....			
Glass/Ceramics.....			
Graphite.....			
Desiccants/Catalysts.....			
Asbestos.....	~0.90		
Non/low friable.....	~0.45	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.....	~0.45	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.....	0.52	0.42% concrete dust, 0.08% plaster dust, 0.02% magnesium oxide	

Inorganic anions (%wt): Fluoride present in trace quantities. Other anions are aluminates and silicates associated with the encapsulated sludge.

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	(%wt)	Type(s) and comment
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 contaminated gratings and asbestos contaminated soft secondary waste arisings.

	(%wt)	Type(s) and comment
Combustible metals.....		
Low flash point liquids.....		
Explosive materials.....		
Phosphorus.....		
Hydrides.....		
Biological etc. materials.....		
Biodegradable materials.....	1.0	
Putrescible wastes.....		
Non-putrescible wastes.....	1.0	
Corrosive materials.....		
Pyrophoric materials.....		
Generating toxic gases.....		
Reacting with water.....	P	20m2
Higher activity 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.

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....		
Other organophosphates.....		

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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.....	

Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids…….		
Other organic complexants.....	0.05	Decon-90
Total complexing agents.....	0.05	

Potential for the waste to contain discrete items: Not yet determined. Large Concrete Items (LCIs) may be DIs; drummed (ungrouted)/"rubbleised" wastes assumed NOT DIs.Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs; Stainless items assumed DIs

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	On-site	0.27
Supercompaction (HFC)	Off-site	0.27
Incineration	Off-site	36.3
Solidification		
Decontamination		
Metal treatment	Off-site	2.1
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		61.4

Comment on planned treatments: 55.97% of the stream is expected to be disposed of as VLLW to landfill

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	5.7	1.2
Expected to be consigned to a Landfill Facility	56.0	1.2
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	36.3	0.40
Expected to be consigned to a Metal Treatment Facility	2.1	1.4
Expected to be consigned as Out of Scope		
Expected to be recycled / reused		
Disposal route not known		

Classification codes for waste expected to be consigned to a landfill facility: 17 04 05, 17 04 07, 17 02 03, 17 06 01*

Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):

Disposal Route	Stream volume %		
	2022/23	2023/24	2024/25
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			

Opportunities for alternative disposal routing: -

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

Waste Packaging for Disposal:

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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	~0.27	43.2	< 1
1/2 Height IP-2 Disposal/Re-usable ISO	~5.4	10	2
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 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.
Inventory information is consistent with the current WCH.

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

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-0-4739 V3 and decayed for 1 year for RWI 2022.

Other information: -

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3			1.45E-05	C C 2	Gd 153				8
Be 10				8	Ho 163				8
C 14			7.64E-06	C C 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			9.93E-08	C C 2	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			3.17E-07	C C 2	Pb 210				8
Co 60			9.77E-07	C C 2	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			2.35E-06	C C 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			1.79E-08	C C 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			2.2E-09	C C 2	Th 234				8
Mo 93				8	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99				8	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			9.68E-09	C C 2	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				8
Sn 123				8	Pu 239				8
Sn 126				8	Pu 240				8
Sb 125				8	Pu 241			7.88E-09	C C 2
Sb 126				8	Pu 242				8
Te 125m				8	Am 241			2.21E-09	C C 2
Te 127m				8	Am 242m				8
I 129				8	Am 243				8
Cs 134				8	Cm 242				8
Cs 135				8	Cm 243				8
Cs 137			1.86E-08	C C 2	Cm 244				8
Ba 133			6.9E-09	C C 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				
Eu 152			5.65E-09	C C 2	Other b/g				
Eu 154			1.26E-08	C C 2	**Total a**	**0**		**2.21E-09**	**C C 1**
Eu 155				8	**Total b/g**	**0**		**2.60E-05**	**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