

<b>WASTE STREAM</b>	<b>9G110</b>	<b>Reactor LLW</b>
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**SITE** Trawsfynydd

**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Magnox Limited

**WASTE TYPE** LLW

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	0 m <sup>3</sup>
Future arisings -	1.4.2029 - 31.3.2074.....	90.0 m <sup>3</sup>
Total future arisings:		90.0 m <sup>3</sup>
Total waste volume:		90.0 m <sup>3</sup>

Comment on volumes: Arisings are assumed to be approximately 2m<sup>3</sup> per year for each of the 45 years of Care & Maintenance. Care & Maintenance is assumed to start in 2029 after Care & Maintenance Preparation has been completed.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 1.2  
 Stock (lower): x Arisings (lower) x 0.8

**WASTE SOURCE** Wastes arising from general reactor area during Care and Maintenance.

**PHYSICAL CHARACTERISTICS**

General description: Mixed plastic sheeting and protective clothing. There are no large items expected.

Physical components (%vol): Plastic, cloth and steel drums.

Sealed sources: -

Bulk density (t/m<sup>3</sup>): ~0.4

Comment on density: The density is likely to lie between 0.3 and 1.0 t/m<sup>3</sup>.

**CHEMICAL COMPOSITION**

General description and components (%wt): The waste comprises various plastics, cloth and steel drums. Percentage breakdown of components not assessed.

Chemical state: Neutral

Chemical form of radionuclides: H-3: Tritium is present as surface contamination of waste by tritiated liquor.  
 C-14: Contamination in the form of graphite dust.  
 Cl-36: Chlorine 36 may be present as a contaminant of graphite dust..  
 Se-79: The selenium content is insignificant.  
 Tc-99: The technetium content is insignificant.  
 Ra: The radium isotope content is insignificant.  
 Th: The thorium content is insignificant.  
 U: The chemical form of uranium isotopes has not been determined but may be uranium oxides.  
 Np: The neptunium content is insignificant.  
 Pu: The chemical form of plutonium isotopes has not been determined but may be as plutonium oxides.

Metals and alloys (%wt): Bulk and sheet metal are not expected to be present in significant quantities and have not been assessed.

Stainless steel.....	NE
Other ferrous metals.....	~25.0
Iron.....	
Aluminium.....	NE
Beryllium.....	
Cobalt.....	
Copper.....	NE
Lead.....	NE
Magnox/Magnesium.....	NE

**WASTE STREAM****9G110 Reactor LLW**

	Nickel.....	
	Titanium.....	
	Uranium.....	
	Zinc.....	TR
	Zircaloy/Zirconium.....	NE
	Other metals.....	NE
Organics (%wt):	A wide variety of materials may be present. The presence or absence of halogenated plastics and rubbers remains to be confirmed.	
	Total cellulosics.....	~55.0
	Paper, cotton.....	~55.0
	Wood.....	NE
	Halogenated plastics .....	~10.0
	Total non-halogenated plastics.....	NE
	Condensation polymers.....	NE
	Others.....	NE
	Organic ion exchange materials....	0
	Total rubber.....	~10.0
	Halogenated rubber .....	~10.0
	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.....	NE
	Graphite.....	0
	Desiccants/Catalysts.....	
	Asbestos.....	0
	Non/low friable.....	
	Moderately friable.....	
	Highly friable.....	
	Free aqueous liquids.....	0
	Free non-aqueous liquids.....	0

**WASTE STREAM****9G110 Reactor LLW**

	Powder/Ash.....	0
Inorganic anions (%wt):	None expected.	
	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:	No materials likely to pose a fire or other non-radiological hazard have been identified.	
	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.....	
	Vinyl chloride.....	
	Arsenic.....	

**WASTE STREAM****9G110 Reactor LLW**

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

**TREATMENT, PACKAGING AND DISPOSAL**

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

Treatment	On-site / Off site	Stream volume %
Low force compaction Supercompaction (HFC) Incineration Solidification Decontamination Metal treatment Size reduction Decay storage Recycling / reuse Other / various None	Off-Site	100.0

Comment on planned treatments:

-

**WASTE STREAM****9G110 Reactor LLW****Disposal Routes:**

Disposal Route	Stream volume %
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	100.0

**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 m <sup>3</sup>	Number of packages
1/3 Height IP-1 ISO 2/3 Height IP-2 ISO 1/2 Height WAMAC IP-2 ISO 1/2 Height IP-2 Disposal/Re-usable ISO 2m box (no shielding) 4m box (no shielding) Other	100.0	21.6	5

**Other information:**

21.6m<sup>3</sup> loading volume is calculated based on the fact that you can fit 36 off (200 litre/0.2m<sup>3</sup>) drums (7.2m<sup>3</sup>) 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 (21.6m<sup>3</sup>)

**Waste Planned for Disposal at the LLW Repository:**

Container voidage: -

Waste Characterisation Form (WCH):

The waste meets the LLWR's Waste Acceptance Criteria (WAC).  
The waste does not have a current WCH.

Waste consigned for disposal to LLWR in year of generation:

No. The timing of consignment of waste for disposal cannot be determined at present. Disposal to LLWR at the start of Care & Maintenance is expected, later disposal route to be established.

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:

**WASTE STREAM****9G110****Reactor LLW**

Inaccessible voidage: -

Other information: -

**RADIOACTIVITY**

Source: Activation and contamination of materials.

Uncertainty: Only approximate estimates have been made of the specific activities.

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: The specific activities have been estimated from the activity of stream 9G105 decayed to 2029.

Other information: Activity estimates are shown in the table.

**WASTE STREAM 9G110 Reactor LLW**

Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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		8	4.73E-05	C D 2	Gd 153		8		8
Be 10		8		8	Ho 163		8		8
C 14		8	7E-06	C D 2	Ho 166m		8		8
Na 22		8		8	Tm 170		8		8
Al 26		8		8	Tm 171		8		8
Cl 36		8	4E-06	C D 2	Lu 174		8		8
Ar 39		8		8	Lu 176		8		8
Ar 42		8		8	Hf 178n		8		8
K 40		8		8	Hf 182		8		8
Ca 41		8		8	Pt 193		8		8
Mn 53		8		8	Tl 204		8		8
Mn 54		8		8	Pb 205		8		8
Fe 55		8	1.55E-06	C C 2	Pb 210		8		8
Co 60		8	1.75E-06	C C 2	Bi 208		8		8
Ni 59		8		8	Bi 210m		8		8
Ni 63		8	5.96E-06	C D 2	Po 210		8		8
Zn 65		8		8	Ra 223		8		8
Se 79		8		8	Ra 225		8		8
Kr 81		8		8	Ra 226		8		8
Kr 85		8		8	Ra 228		8		8
Rb 87		8		8	Ac 227		8		8
Sr 90		8	2.93E-06	C C 2	Th 227		8		8
Zr 93		8		8	Th 228		8		8
Nb 91		8		8	Th 229		8		8
Nb 92		8		8	Th 230		8		8
Nb 93m		8		6	Th 232		8		8
Nb 94		8	1E-06	C D 2	Th 234		8	1E-09	C C 2
Mo 93		8		8	Pa 231		8		8
Tc 97		8		8	Pa 233		8		8
Tc 99		8		8	U 232		8		8
Ru 106		8		8	U 233		8		8
Pd 107		8		8	U 234		8		8
Ag 108m		8	9.98E-09	C D 2	U 235		8		8
Ag 110m		8		8	U 236		8		8
Cd 109		8		8	U 238		8	1E-09	C C 2
Cd 113m		8		8	Np 237		8		8
Sn 119m		8		8	Pu 236		8		8
Sn 121m		8		8	Pu 238		8	4.96E-07	C C 2
Sn 123		8		8	Pu 239		8	5E-07	C C 2
Sn 126		8		8	Pu 240		8	6E-07	C C 2
Sb 125		8		8	Pu 241		8	9.53E-06	C C 2
Sb 126		8		8	Pu 242		8		8
Te 125m		8		8	Am 241		8	2.01E-06	C C 2
Te 127m		8		8	Am 242m		8		8
I 129		8		8	Am 243		8		8
Cs 134		8		8	Cm 242		8		8
Cs 135		8		8	Cm 243		8	1.95E-09	C C 2
Cs 137		8	2.93E-06	C C 2	Cm 244		8	4.81E-08	C C 2
Ba 133		8	2.81E-09	C C 2	Cm 245		8		8
La 137		8		8	Cm 246		8		8
La 138		8		8	Cm 248		8		8
Ce 144		8		8	Cf 249		8		8
Pm 145		8		8	Cf 250		8		8
Pm 147		8	1.54E-08	C C 2	Cf 251		8		8
Sm 147		8		8	Cf 252		8		8
Sm 151		8		8	Other a				
Eu 152		8	9.5E-09	C C 2	Other b/g				
Eu 154		8	9.23E-08	C C 2	<b>Total a</b>	<b>0</b>	<b>3.66E-06</b>	<b>C C 2</b>	
Eu 155		8		8	<b>Total b/g</b>	<b>0</b>	<b>8.41E-05</b>	<b>C C 2</b>	

**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