

WASTE STREAM	9A105	Reactor LLW
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SITE Berkeley

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m ³
Future arisings -	1.4.2023 - 31.3.2074.....	102.0 m ³
Total future arisings:		102.0 m ³
Total waste volume:		102.0 m ³
Comment on volumes:	-	
Uncertainty factors on volumes:	Stock (upper): x	Arisings (upper) x 1.1
	Stock (lower): x	Arisings (lower) x 0.5

WASTE SOURCE Wastes from the general reactor area during the Care and Maintenance period.

PHYSICAL CHARACTERISTICS

General description: Principally mixed plastic sheeting and protective clothing, all in mild steel drums. Any large items will be cut to fit standard packages.

Physical components (%wt): Principally plastic and cloth (~75%wt), all in mild steel drums (~25 %wt).

Sealed sources: -

Bulk density (t/m³): ~0.4

Comment on density: The density estimate may be subject to revision.

CHEMICAL COMPOSITION

General description and components (%wt): The waste comprises principally various plastics and cloth, all in mild steel drums. Steel drum approximately 25%wt, percentage breakdown of other components not fully 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.
 Pu: The chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): Bulk and sheet metal are not expected to be present in significant quantities and have not been assessed. Mild steel drums containing the waste will arise at about 10 per year.

Stainless steel.....	0
Other ferrous metals.....	25.0
Iron.....	
Aluminium.....	0
Beryllium.....	0
Cobalt.....	
Copper.....	0
Lead.....	0
Magnox/Magnesium.....	0
Nickel.....	
Titanium.....	
Uranium.....	
Zinc.....	0
Zircaloy/Zirconium.....	0

WASTE STREAM**9A105 Reactor LLW**

"Other" metals have not been identified.

	Other metals.....	0
Organics (%wt):	-	
	Total cellulose.....	38.0
	Paper, cotton.....	38.0
	Wood.....	NE
	Halogenated plastics	~37.0
	Total non-halogenated plastics.....	0
	Condensation polymers.....	NE
	Others.....	NE
	Organic ion exchange materials....	0
	Total rubber.....	NE
	Halogenated rubber	NE
	Non-halogenated rubber.....	NE
	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
	Powder/Ash.....	0

Inorganic anions (%wt): -

WASTE STREAM**9A105 Reactor LLW**

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.....	
Barium.....	
Boron.....	

WASTE STREAM**9A105 Reactor LLW**

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):

EDTA.....
 DPTA.....
 NTA.....
 Polycarboxylic acids.....
 Other organic complexants.....
 Total complexing agents..... NE

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**9A105****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 ³	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:

21.6m³ loading volume is calculated based on the fact that you can fit 36 off (200 litre/0.2m³) drums (7.2m³) into a ½ height ISO, each drum can be super-compacted to a 1/3 of its original volume so therefore 3 x the amount of un-compacted drums will fit into the final disposal container (21.6m³).

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:

The timing of consignment of the 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**9A105****Reactor LLW**

Inaccessible voidage: -

Other information: -

RADIOACTIVITY

Source: Activation and contamination of materials.

Uncertainty: Activity values are current best estimates. Specific activity is a function of Station operating history. The values quoted are indicative of the activities that would 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: Radionuclide data was originally taken from the 2007 RWI for 9A920. This data has been decay adjusted to reflect the latest date for arisings.

Other information: Activity estimates are as shown in the table.

WASTE STREAM

9A105

Reactor LLW

Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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	1.02E-04	C C 2	Gd 153		8		8
Be 10		8		8	Ho 163		8		8
C 14		8	3E-05	C C 2	Ho 166m		8		8
Na 22		8		8	Tm 170		8		8
Al 26		8		8	Tm 171		8		8
Cl 36		8	9E-06	C C 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	9.22E-07	C C 2	Pb 210		8		8
Co 60		8	6.19E-06	C C 2	Bi 208		8		8
Ni 59		8		8	Bi 210m		8		8
Ni 63		8	7.36E-06	C C 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	2.25E-07	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		8	Th 232		8		8
Nb 94		8		8	Th 234		8		8
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		8	U 235		8		8
Ag 110m		8		8	U 236		8		8
Cd 109		8		8	U 238		8		8
Cd 113m		8		8	Np 237		8		8
Sn 119m		8		8	Pu 236		8		8
Sn 121m		8		8	Pu 238		8	2.73E-09	C C 2
Sn 123		8		8	Pu 239		8	5E-09	C C 2
Sn 126		8		8	Pu 240		8	5.99E-09	C C 2
Sb 125		8		8	Pu 241		8	4.49E-08	C C 2
Sb 126		8		8	Pu 242		8		8
Te 125m		8		8	Am 241		8	8.03E-09	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		8
Cs 137		8	3.79E-07	C C 2	Cm 244		8		8
Ba 133		8	3.63E-08	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		8	Cf 251		8		8
Sm 147		8		8	Cf 252		8		8
Sm 151		8		8	Other a				
Eu 152		8	4.83E-08	C C 2	Other b/g				
Eu 154		8	7.6E-08	C C 2	Total a	0	2.18E-08	C C 2	
Eu 155		8	3.71E-09	C C 2	Total b/g	0	1.56E-04	C C 2	

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