

WASTE STREAM	9J314	Miscellaneous Metals and Materials (Reactor and Non-Reactor) LLW
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SITE Hunterston A

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 -	1.4.2072 - 31.3.2080.....	1852.0 m ³
Total future arisings:		1852.0 m ³
Total waste volume:		1852.0 m ³

Comment on volumes: Arisings are assumed to arise at a uniform rate over 8 years. Final Dismantling & Site Clearance is assumed to commence in 2071 lasting for 9 years. Volumes and radioactivity have been calculated for 85 years after reactor shutdown.

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

WASTE SOURCE A variety of materials from active plant dismantling.

PHYSICAL CHARACTERISTICS

General description: A variety of materials including metals and insulation materials.

Physical components (%wt): The waste consists of insulation materials (~80%wt), temporary active drains (~11%wt), vacuum clean and wash down area items (~3%wt) and metals (~6%wt).

Sealed sources: -

Bulk density (t/m³): ~1

Comment on density: The density is of the raw waste.

CHEMICAL COMPOSITION

General description and components (%wt): A variety of materials including zirconium (<0.5% wt), aluminium (<0.5%wt), lead (~3%wt), copper (~2%wt), pressure vessel insulation (~80%wt) other materials (~14%wt).

Chemical state: Neutral

Chemical form of radionuclides: H-3: The chemical form of tritium has not been assessed, but may be incorporated into the steel.
 C-14: The chemical form of carbon 14 has not been assessed but may be graphite.
 Cl-36: The chemical form of chlorine 36 has not been assessed.
 Se-79: The selenium-79 content is insignificant.
 Tc-99: The technetium-99 content is insignificant.
 Ra: The radium content is insignificant.
 Th: The thorium content is insignificant.
 U: The uranium content is insignificant.
 Np: The neptunium isotope content is insignificant.
 Pu: The plutonium content is insignificant.

Metals and alloys (%wt): Items will be cut for packaging, but an assessment of the item dimensions has not been made.

Stainless steel.....	0
Other ferrous metals.....	0
Iron.....	
Aluminium.....	<0.50
Beryllium.....	0
Cobalt.....	
Copper.....	~2.0
Lead.....	~3.0
Magnox/Magnesium.....	NE

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	Nickel.....		
	Titanium.....		
	Uranium.....		
	Zinc.....	NE	
	Zircaloy/Zirconium.....	<0.50	
	Other metals.....	NE	"Other" metals have not been assessed.
Organics (%wt):	Not fully assessed. Halogenated rubbers are not expected, halogenated plastics have not been estimated.		
	Total cellulose.....	0	
	Paper, cotton.....	0	
	Wood.....	0	
	Halogenated plastics	NE	
	Total non-halogenated plastics.....	NE	
	Condensation polymers.....	NE	
	Others.....	NE	
	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):	Traces of graphite may be present.		
	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs.....	3.0	vacuum clean and wash down area items
	Soil.....	0	
	Brick/Stone/Rubble.....	0	
	Cementitious material.....	11.0	temporary active drains
	Sand.....		
	Glass/Ceramics.....	80.0	MMM (Man Made Mineral Fibre) insulation material
	Graphite.....	TR	
	Desiccants/Catalysts.....		
	Asbestos.....	NE	
	Non/low friable.....		
	Moderately friable.....		
	Highly friable.....		
	Free aqueous liquids.....	0	

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	Free non-aqueous liquids.....	0
	Powder/Ash.....	0
Inorganic anions (%wt):	Not fully assessed.	
	Fluoride.....	NE
	Chloride.....	NE
	Iodide.....	NE
	Cyanide.....	0
	Carbonate.....	NE
	Nitrate.....	NE
	Nitrite.....	NE
	Phosphate.....	NE
	Sulphate.....	NE
	Sulphide.....	NE

Materials of interest for waste acceptance criteria: The presence or absence of asbestos has yet to be confirmed.

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:

-
Acrylamide.....
Benzene.....
Chlorinated solvents.....
Formaldehyde.....
Organometallics.....
Phenol.....
Styrene.....
Tri-butyl phosphate.....
Other organophosphates.....
Vinyl chloride.....

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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):

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

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		100.0

Comment on planned treatments:

-

WASTE STREAM**9J314****Miscellaneous Metals and Materials (Reactor and Non-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: (Not applicable to this waste stream)

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			

Other information: -

Waste Planned for Disposal at the LLW Repository: (Not applicable to this waste stream)

Container voidage: -

Waste Characterisation Form (WCH): -

Waste consigned for disposal to LLWR in 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

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Source:	Activation of the materials and impurities. There may be some contamination.
Uncertainty:	Only very approximate estimates have been made of the total specific activities. The activities quoted are those at the time of Final Dismantling & Site Clearance (about 85 years after Station shutdown).
Definition of total alpha and total beta/gamma:	Total beta/gamma is defined as the sum of the listed activities of all nuclides other than alpha emitters. All alpha emitter activities are insignificant.
Measurement of radioactivities:	For the reactor materials the specific activities were estimated from neutron activation calculations of the material and its impurities, however this was less than 1% of the total volume. The specific activity of the reactor thermal insulation was assumed to be similar to that for Trawsfynydd which accounts for about 80% of the volume. There is no data for the remaining 20% of the total volume.
Other information:	-

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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			3.7E-05	CC 2	Gd 153				8
Be 10				8	Ho 163				8
C 14			7.13E-05	CC 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26			1E-06	CC 2	Tm 171				8
Cl 36			1.18E-06	CC 2	Lu 174				8
Ar 39				8	Lu 176				8
Ar 42				8	Hf 178n				8
K 40				8	Hf 182				8
Ca 41			1.56E-05	CC 2	Pt 193				8
Mn 53				8	Tl 204				8
Mn 54				8	Pb 205				8
Fe 55				8	Pb 210				8
Co 60			2.83E-08	CC 2	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			2.73E-05	CC 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				8	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			1.53E-09	CC 2	Th 234				8
Mo 93			1.23E-08	CC 2	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				8	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			1.18E-08	CC 2	Pu 238				8
Sn 123				8	Pu 239				8
Sn 126				8	Pu 240				8
Sb 125				8	Pu 241				8
Sb 126				8	Pu 242				8
Te 125m				8	Am 241				8
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				6	Cm 244				8
Ba 133			2.68E-08	CC 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			1.89E-06	CC 2	Other a				
Eu 152			8.83E-06	CC 2	Other b/g				
Eu 154			1.4E-07	CC 2	Total a	0		0	
Eu 155				8	Total b/g	0		1.64E-04	CC 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