

WASTE STREAM	9E311	Mild Steel (Reactor) ILW
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SITE Oldbury
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Magnox Limited
WASTE TYPE ILW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m ³
Future arisings -	1.4.2096 - 31.3.2101.....	489.1 m ³
Total future arisings:		489.1 m ³
Total waste volume:		489.1 m ³

Comment on volumes: Waste arisings are assumed to occur at a uniform rate over 5 years. Final Site Clearance is assumed to commence in 2091. 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 Mild steel items from the reactor structure.

PHYSICAL CHARACTERISTICS

General description: A variety of mild steel items.
 Physical components (%wt): Mild steel items (100%).
 Sealed sources: -
 Bulk density (t/m³): ~1.4
 Comment on density: The density is of the waste as cut for packaging.

CHEMICAL COMPOSITION

General description and components (%wt): Mild steel (100%).
 Chemical state: Neutral
 Chemical form of radionuclides: H-3: The tritium content is insignificant.
 C-14: The carbon 14 is incorporated in the steel. There also may be some contamination as graphite.
 Cl-36: The chlorine 36 is incorporated in the steel.
 Se-79: The selenium content is insignificant.
 Tc-99: The technetium content is insignificant.
 Ra: The radium content is insignificant.
 Th: The thorium content is insignificant.
 U: The uranium content is insignificant.
 Np: The neptunium content is insignificant.
 Pu: The plutonium content is insignificant.

Metals and alloys (%wt): All of the waste will be bulk metal items which have been cut for packaging. Metal thicknesses will probably range from a few mm to about 100 mm.

Stainless steel.....	0	
Other ferrous metals.....	100.0	Mild steel type is BS15.
Iron.....		
Aluminium.....	0	
Beryllium.....	0	
Cobalt.....	<0.03	Data based on test specimens of a general Magnox reactor pressure vessel.
Copper.....	0	
Lead.....	0	
Magnox/Magnesium.....	0	

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Nickel..... <0.15

Data based on test specimens of a general Magnox reactor pressure vessel.

Titanium.....

Uranium.....

Zinc..... 0

Zircaloy/Zirconium..... 0

Other metals..... TR

Silver and niobium.

Organics (%wt):

None expected. There are no halogenated plastics and rubbers present.

Total cellulose..... 0

 Paper, cotton..... 0

 Wood..... 0

Halogenated plastics 0

Total non-halogenated plastics..... 0

 Condensation polymers..... 0

 Others..... 0

Organic ion exchange materials.... 0

Total rubber..... 0

 Halogenated rubber 0

 Non-halogenated rubber..... 0

Hydrocarbons.....

 Oil or grease 0

 Fuel.....

 Asphalt/Tarmac (cont.coal tar)...

 Asphalt/Tarmac (no coal tar)....

 Bitumen.....

 Others.....

Other organics..... 0

Other materials (%wt):

Some graphite dust may be associated with reactor materials.

Inorganic ion exchange materials. 0

Inorganic sludges and flocs..... 0

Soil..... 0

Brick/Stone/Rubble..... 0

Cementitious material..... 0

Sand.....

Glass/Ceramics..... 0

Graphite..... TR

Desiccants/Catalysts.....

Asbestos..... 0

 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):	There may be a trace of chloride present.	
	Fluoride.....	0
	Chloride.....	TR
	Iodide.....	0
	Cyanide.....	0
	Carbonate.....	0
	Nitrate.....	0
	Nitrite.....	0
	Phosphate.....	0
	Sulphate.....	0
	Sulphide.....	0
Materials of interest for waste acceptance criteria:	-	
	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.....	

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Arsenic.....
 Barium.....
 Boron.....
 Cadmium.....
 Caesium.....
 Selenium.....
 Chromium.....
 Molybdenum..... <0.30

 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.....

Data based on test specimens of a general Magnox reactor pressure vessel.

Complexing agents (%wt):

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

PACKAGING AND CONDITIONING

Conditioning method: The waste is not expected to be supercompacted. The treatment envisaged is the placement of the waste in baskets followed by encapsulation.
 Plant Name: None
 Location: Oldbury Power Station
 Plant startup date: 2096
 Total capacity (m³/y incoming waste): ~5000.0
 Target start date for packaging this stream: 2096
 Throughput for this stream (m³/y incoming waste): ~82.0
 Other information: The processing strategy has not yet been determined.

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Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	4m box (no shielding)	100.0	16.2	18.9	31

Likely container type comment: The container choice may be influenced by Transport Regulations at the time of Final Site Clearance. The waste is assumed to be in baskets in the waste package so the occupied volume in the package is greater than the original waste volume.

Range in container waste volume: Not yet determined. No significant variability is expected.

Other information on containers: The container material is expected to be stainless steel.

Likely conditioning matrix: Blast Furnace Slag / Ordinary Portland Cement

Other information: The waste is assumed to be encapsulated.

Conditioned density (t/m³): ~3.0

Conditioned density comment: The conditioned waste density assumes that the waste will be encapsulated.

Other information on conditioning: The waste will be in baskets placed in the waste packages. Baskets of different Final Site Clearance ILW wastes may be in the same waste package. The encapsulation matrix is likely to be BFS/OPC and the density of conditioned waste product would be about 3 t/m³.

Opportunities for alternative disposal routing: No

Treatment	Stream volume (%)	Comment
-	-	-

RADIOACTIVITY

Source: Activation of the mild steel and its impurities.

Uncertainty: The values quoted were derived by calculation from available material specifications and are indicative of the activities that are to be expected. The major source of uncertainty is the impurity levels.

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: The specific activities were estimated from neutron activation calculations of impurities in mild steel.

Other information: The activities quoted are those at 85 years after reactor shutdown. There may be some contamination by Cs137.

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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				8	Gd 153				8
Be 10					Ho 163				8
C 14			1.33E-02	C C 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			2.56E-06	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		6.72E-08	C C 2	2
Mn 54				8	Pb 205				8
Fe 55			6.96E-08	C C 2	Pb 210				8
Co 60			8.63E-05	C C 2	Bi 208				8
Ni 59			8.17E-04	C C 2	Bi 210m				8
Ni 63			4.66E-02	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				8	Th 227				8
Zr 93				8	Th 228				8
Nb 91				8	Th 229				8
Nb 92			1.23E-09	C C 2	Th 230				8
Nb 93m				6	Th 232				8
Nb 94			6.74E-07	C C 2	Th 234				8
Mo 93			8.69E-05	C C 2	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99			1.92E-05	C C 2	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			8.51E-06	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				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				8	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				8	Other b/g				
Eu 154				8	Total a	0	0		
Eu 155				8	Total b/g	0	6.09E-02	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