

<b>WASTE STREAM</b>	<b>9A310</b>	<b>Stainless Steel (Reactor) ILW</b>
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**SITE** Berkeley  
**SITE OWNER** Nuclear Decommissioning Authority  
**WASTE CUSTODIAN** Magnox Limited  
**WASTE TYPE** ILW

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	0 m <sup>3</sup>
Future arisings -	1.4.2074 - 31.3.2077.....	52.0 m <sup>3</sup>
Total future arisings:		52.0 m <sup>3</sup>
Total waste volume:		52.0 m <sup>3</sup>

Comment on volumes: Waste arisings are assumed to occur at a uniform rate over 3 years. Final Dismantling & Site Clearance is assumed to commence in 2070 with reactor dismantling commencing in 2074 and lasting for 3 years. The volumes and radioactivity have been calculated for 85 years after reactor shutdown, i.e. 2074.

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

**WASTE SOURCE** Stainless steel items from reactor dismantling.

**PHYSICAL CHARACTERISTICS**

General description: A variety of stainless steel items including control rod components and BCD piping. Waste can be packaged in standard containers.

Physical components (%vol): Stainless steel items (100%).

Sealed sources: -

Bulk density (t/m<sup>3</sup>): ~1.4

Comment on density: The density is of the waste as cut for packaging.

**CHEMICAL COMPOSITION**

General description and components (%wt): Stainless steels (100%).

Chemical state: Neutral

Chemical form of radionuclides: 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.

Metals and alloys (%wt): Items will have been cut for packaging. Thicknesses are likely to vary from a few mm to about 25 mm.

Stainless steel.....	100.0	Stainless steel types are BS970-321S12, BS970-EN59, BS970-EN56 and EN58B.
Other ferrous metals.....	0	
Iron.....		
Aluminium.....	0	
Beryllium.....	0	
Cobalt.....		
Copper.....	0	
Lead.....	0	
Magnox/Magnesium.....	0	
Nickel.....		
Titanium.....		
Uranium.....		

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	Zinc.....	0	
	Zircaloy/Zirconium.....	0	
	Other metals.....	0	There are no "other" metals.
Organics (%wt):	None expected. No halogenated plastics or rubbers will be present.		
	Total cellulosics.....	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 .....		
	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	
	Free non-aqueous liquids.....	0	
	Powder/Ash.....	0	
Inorganic anions (%wt):	Trace quantities of chloride may be present.		

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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:

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.....	

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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

**PACKAGING AND CONDITIONING**

Conditioning method:      The waste is not expected to be supercompacted. It will be placed in baskets in the waste packages followed by encapsulation with BFS/OPC.

Plant Name:      None

Location:      Berkeley Site

Plant startup date:      2074

Total capacity (m<sup>3</sup>/y incoming waste):      ~5000.0

Target start date for packaging this stream:      2074

Throughput for this stream (m<sup>3</sup>/y incoming waste):      ~13.0

Other information:      It is currently intended that FDSC wastes will be grouted.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	4m box (100mm concrete shielding)	100.0	12.25	14.3	5

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Likely container type comment: 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. Container choice may be influenced by Transport Regulations at the time of Final Site Clearance.

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: -

Conditioned density (t/m<sup>3</sup>): ~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 Dismantling & Site Clearance ILW wastes may be in the same waste package. As encapsulation is now intended, the matrix is likely to be BFS/OPC and the density of the conditioned waste product will be about 3 t/m<sup>3</sup>.

Opportunities for alternative disposal routing: No

Treatment	Stream volume (%)	Comment
-	-	-

**RADIOACTIVITY**

Source: Activation of the stainless steel and impurities.

Uncertainty: The values quoted were derived by calculation from available material specification and are indicative of the activities that are 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: Specific activities have been estimated using a neutron activation calculation.

Other information: The activities quoted are those at 85 years after reactor shutdown, i.e. in 2074. There may be some contamination by Cs137.

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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	Gd 153				8
Be 10				8	Ho 163				8
C 14			6.68E-02	C C 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			2.58E-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		4.56E-07	C C 2	8
Mn 54				8	Pb 205				8
Fe 55			8.19E-08	C C 2	Pb 210				8
Co 60			4.26E-04	C C 2	Bi 208				8
Ni 59			1.42E-01	C C 2	Bi 210m				8
Ni 63			8.8E+00	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			8E-09	C C 2	Th 230				8
Nb 93m				6	Th 232				8
Nb 94			4.23E-04	C C 2	Th 234				8
Mo 93			4.91E-04	C C 2	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99			1.09E-04	C C 2	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			4.35E-05	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	<b>Total a</b>	<b>0</b>	<b>0</b>		
Eu 155				8	<b>Total b/g</b>	<b>0</b>	<b>9.01E+00</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