

<b>WASTE STREAM</b>	<b>9J33/C</b>	<b>Conditioned Sludge</b>
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**SITE** Hunterston A  
**SITE OWNER** Nuclear Decommissioning Authority  
**WASTE CUSTODIAN** Magnox Limited  
**WASTE TYPE** ILW

**WASTE VOLUMES**

		Conditioned	Packaged
Stocks:	At 1.4.2019.....	70.4 m <sup>3</sup>	83.5 m <sup>3</sup>
Total future arisings:		0 m <sup>3</sup>	0 m <sup>3</sup>
Total waste volume:		70.4 m <sup>3</sup>	83.5 m <sup>3</sup>
Number of waste packages in stock:	At 1.4.2019.....	32 package(s)	
Comment on volumes:	-		
Uncertainty factors on volumes:	Stock (upper):	x 1.1	Arisings (upper) x
	Stock (lower):	x 0.9	Arisings (lower) x

**WASTE SOURCE** Sludge arisings from the spent fuel storage pond. SRT2 and SRT3

**PHYSICAL CHARACTERISTICS**

General description: Sludge contains a mixture of Magnox sludge and a low density aluminium hydroxide floc. There are no large items in this waste stream.  
Physical components (%wt): Sludge (79%), grout (21%)  
Sealed sources: -  
Bulk density (t/m<sup>3</sup>): ~2  
Comment on density: this represents the conditioned waste density

**CHEMICAL COMPOSITION**

General description and components (%wt): Sludge (79%), consisting of Aluminium hydroxide, silicic acid, silica, potassium ferrous-ferro-cyanide, magnesium hydroxide and water. Grout (21%)  
Chemical state: Neutral  
Chemical form of radionuclides: H-3: Tritium will be present as water.  
C-14: Carbon 14 will be present as graphite.  
Cl-36: The chemical form of chlorine 36 has not been determined.  
Se-79: The selenium content is insignificant.  
Tc-99: The technetium content is insignificant.  
Ra: Radium isotope content is insignificant.  
Th: The thorium isotope content is insignificant.  
U: Uranium isotope content is insignificant.  
Np: The neptunium content is insignificant.  
Pu: The chemical form of plutonium isotopes has not been determined but may be present as plutonium oxides.  
Metals and alloys (%wt): No sheet metal expected in this waste stream.  
Stainless steel..... 0  
Other ferrous metals..... <0.50  
Iron.....  
Aluminium.....  
Beryllium..... 0  
Cobalt.....  
Copper..... 0  
Lead..... 0  
Magnox/Magnesium.....  
Nickel.....

**WASTE STREAM**

**9J33/C**

**Conditioned Sludge**

	Titanium.....		
	Uranium.....		
	Zinc.....	0	
	Zircaloy/Zirconium.....	0	
	Other metals.....	TR	"Other" metals include nickel, chromium, cobalt, calcium and strontium at trace quantities.
Organics (%wt):	Small amounts of rubber coating from pond walls, hydraulic fluid and oil spillage, and some ion exchange resins, may be 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....	TR	
	Total rubber.....	TR	
	Halogenated rubber .....	TR	
	Non-halogenated rubber.....	TR	
	Hydrocarbons.....		
	Oil or grease .....		
	Fuel.....		
	Asphalt/Tarmac (cont.coal tar)...		
	Asphalt/Tarmac (no coal tar)....		
	Bitumen.....		
	Others.....		
	Other organics.....	TR	
Other materials (%wt):	-		
	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs.....	-79.0	Including <0.5% aluminium hydroxide and <1% magnesium hydroxide
	Soil.....	0	
	Brick/Stone/Rubble.....	0	
	Cementitious material.....	21.0	Grout
	Sand.....		
	Glass/Ceramics.....	0	
	Graphite.....	0	
	Desiccants/Catalysts.....		
	Asbestos.....	0	
	Non/low friable.....		
	Moderately friable.....		
	Highly friable.....		
	Free aqueous liquids.....	P	

**WASTE STREAM****9J33/C****Conditioned Sludge**

	Free non-aqueous liquids.....	TR
	Powder/Ash.....	0
Inorganic anions (%wt):	Some ferrous-ferro-cyanide anticipated.	
	Fluoride.....	TR
	Chloride.....	TR
	Iodide.....	TR
	Cyanide.....	NE
	Carbonate.....	TR
	Nitrate.....	TR
	Nitrite.....	TR
	Phosphate.....	TR
	Sulphate.....	TR
	Sulphide.....	TR

Materials of interest for  
waste acceptance criteria:

The waste is unlikely to present a fire hazard, but this requires confirmation since Magnox may be present and will ignite under appropriate conditions. Potassium ferrous-ferro-cyanide may be hazardous.

Combustible metals.....	<1.0
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.....	<1.0
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): No  
     EDTA.....  
     DPTA.....  
     NTA.....  
     Polycarboxylic acids.....  
     Other organic complexants.....  
     Total complexing agents..... 0

**PACKAGING AND CONDITIONING**

Container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	3m <sup>3</sup> drum	100.0	~2.2	2.2	32

Container type comment: -  
 Range in container waste volume: Not yet determined. No significant variability is expected.  
 Other information on containers: The container material is stainless steel.  
 Conditioned density (t/m<sup>3</sup>): ~2.0  
 Conditioned density comment: The conditioned density range is not estimated.  
 Other information on conditioning: Wet ILW recovery and encapsulation plant used to condition Waste.

**RADIOACTIVITY**

Source: -  
 Uncertainty: The values quoted are indicative of the activities that might be expected.

**WASTE STREAM****9J33/C****Conditioned Sludge**

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:

Activity information taken from CALC 1064 issue 2.

Other information:

-

## WASTE STREAM

9J33/C

## Conditioned Sludge

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	9.67E-04	CC 1			Gd 153		8		
Be 10	1.6E-07	CC 2			Ho 163	2.81E-07	CC 2		
C 14	1.34E-04	CC 1			Ho 166m	8.65E-05	CC 2		
Na 22		8			Tm 170				
Al 26		8			Tm 171	3.38E-09	CC 2		
Cl 36	1.15E-06	CC 1			Lu 174	4.39E-09	CC 2		
Ar 39	8.94E-05	CC 2			Lu 176		8		
Ar 42	1.44E-09	CC 2			Hf 178n	9.09E-05	CC 2		
K 40		8			Hf 182		8		
Ca 41	2.08E-05	CC 1			Pt 193	6.1E-05	CC 2		
Mn 53		8			Tl 204	1.17E-05	CC 2		
Mn 54		8			Pb 205		8		
Fe 55	1.97E-04	CC 1			Pb 210		8		
Co 60	4.3E-04	CC 1			Bi 208		8		
Ni 59	4.23E-06	CC 1			Bi 210m		8		
Ni 63	6.51E-04	CC 1			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	3.48E-07	CC 2			Ra 225		8		
Kr 81	1.34E-06	CC 2			Ra 226		8		
Kr 85	5.68E-03	CC 2			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	8.73E-02	CC 1			Th 227		8		
Zr 93	1.54E-05	CC 2			Th 228	1.33E-07	CC 2		
Nb 91	3.84E-09	CC 2			Th 229		8		
Nb 92		8			Th 230	4.32E-09	CC 2		
Nb 93m	4.85E-05	CC 2			Th 232		8		
Nb 94	8.59E-06	CC 2			Th 234	1.27E-05	CC 2		
Mo 93	2.67E-07	CC 2			Pa 231	1.05E-09	CC 2		
Tc 97		8			Pa 233	1.33E-06	CC 2		
Tc 99	1.3E-04	CC 1			U 232	1.29E-07	CC 2		
Ru 106		8			U 233	1.99E-07	CC 2		
Pd 107	1.08E-06	CC 2			U 234	1.08E-05	CC 1		
Ag 108m	4.89E-06	CC 2			U 235	4.16E-07	CC 1		
Ag 110m		8			U 236	1.54E-06	CC 2		
Cd 109		8			U 238	1.27E-05	CC 1		
Cd 113m	3.15E-05	CC 2			Np 237	1.33E-06	CC 2		
Sn 119m		8			Pu 236		8		
Sn 121m	1.53E-04	CC 2			Pu 238	6.6E-03	CC 1		
Sn 123		8			Pu 239	6.72E-03	CC 1		
Sn 126	3.69E-06	CC 2			Pu 240	6.66E-03	CC 1		
Sb 125	3.33E-06	CC 2			Pu 241	1.27E-01	CC 1		
Sb 126	5.16E-07	CC 2			Pu 242	1.16E-05	CC 2		
Te 125m	8.35E-07	CC 2			Am 241	3.01E-02	CC 1		
Te 127m		8			Am 242m	3.53E-05	CC 2		
I 129	3.66E-06	CC 1			Am 243	4.31E-05	CC 2		
Cs 134	6.82E-07	CC 1			Cm 242	2.91E-05	CC 1		
Cs 135	4.43E-06	CC 2			Cm 243	3.7E-05	CC 1		
Cs 137	9.34E-01	CC 1			Cm 244	4.42E-04	CC 1		
Ba 133	1.18E-05	CC 2			Cm 245	6.32E-08	CC 2		
La 137	1.59E-08	CC 2			Cm 246	7.85E-09	CC 2		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145	2.44E-07	CC 2			Cf 250		8		
Pm 147	2E-04	CC 1			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	1.15E-02	CC 1			Other a				
Eu 152	1.08E-06	CC 2			Other b/g				
Eu 154	8.76E-04	CC 1			<b>Total a</b>	<b>5.07E-02</b>	<b>CC 2</b>	<b>0</b>	
Eu 155	1.76E-04	8			<b>Total b/g</b>	<b>1.17E+00</b>	<b>CC 2</b>	<b>0</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