

<b>WASTE STREAM</b>	<b>9J63</b>	<b>CCP Sludge</b>
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**SITE** Hunterston A  
**SITE OWNER** Nuclear Decommissioning Authority  
**WASTE CUSTODIAN** Magnox Limited  
**WASTE TYPE** ILW  
 Is the waste subject to Scottish Policy: Yes

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2022.....	58.7 m <sup>3</sup>
Total future arisings:		0 m <sup>3</sup>
Total waste volume:		58.7 m <sup>3</sup>
Comment on volumes:	No further arisings are expected.	
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. The stream has been expanded to include the following sludge waste streams: CCP (20m3), PWTP Sand Filter 1&2 (6.69 m3), CCP wall UHP washing (21.88 m3), Ponds Floor Dry Shavings (10.11 m3).

**PHYSICAL CHARACTERISTICS**

General description: Results show the waste includes high specific gravity and large particle sizes (small pieces of aggregate). In places the waste is in clay like form which can only be mobilised by the addition of water with agitation, along with hard sludge areas that have had to be broken up and size reduced via the macerator. There is also a significant amount of metallic debris.

Physical components (%wt): Sludge and water (100%)

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): ~1.1

Comment on density: The density is indicative only and represents raw 'as stored' sludge.

**CHEMICAL COMPOSITION**

General description and components (%wt): Aluminium hydroxide, silicic acid, silica, potassium ferrous-ferro-cyanide, magnesium hydroxide and water. Proportions have not been determined.

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.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	<1.0		
Iron.....			
Aluminium.....			
Beryllium.....	0		
Cobalt.....			

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Copper.....	0
Lead.....	0
Magnox/Magnesium.....	
Nickel.....	
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. Trace quantity of halogenated plastics and rubbers present, if any.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	0		
Paper, cotton.....	0		
Wood.....	0		
Halogenated plastics .....	TR		
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): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	~100.0	including approximately 1% aluminium hydroxide and 2% magnesium hydroxide	
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	0		
Sand.....			

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Glass/Ceramics.....	0
Graphite.....	0
Desiccants/Catalysts.....	
Asbestos.....	0
Non/low friable.....	
Moderately friable.....	
Highly friable.....	
Free aqueous liquids.....	P
Free non-aqueous liquids.....	TR
Powder/Ash.....	0

Inorganic anions (%wt):           Some ferrous-ferro-cyanide anticipated.

	(%wt)	Type(s) and comment
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.

	(%wt)	Type(s) and comment
Combustible metals.....	~2.0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	0	
Putrescible wastes.....	0	
Non-putrescible wastes.....		
Corrosive materials.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	~2.0	
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

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Hazardous substances /  
non hazardous pollutants: -

	(%wt)	
Acrylamide.....		Type(s) and comment
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....		
Other organophosphates.....		
Vinyl chloride.....		
Arsenic.....		
Barium.....		
Boron.....	0	
Boron (in Boral).....		
Boron (non-Boral).....		
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

	(%wt)	
EDTA.....		Type(s) and comment
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		
Total complexing agents.....	0	

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Potential for the waste to contain discrete items:

No. In &amp; of itself not a DI; assumed not likely to contain any "rogue" items that could be.

**PACKAGING AND CONDITIONING**

Conditioning method: Waste will be mechanically retrieved adjacent to its current location in the PPS. It will be loaded into small (approx. 130- 165 L) cans for solidification in a tumble mixer machine, prior to loading into a 3m<sup>3</sup> stainless steel box for entombment using the SILWE facility. The project expects to use 500 cans and 63 boxes.

Plant Name: SILWE

Location: Hunterston A Decommissioning Site

Plant startup date: -

Total capacity (m<sup>3</sup>/y incoming waste): ~100.0

Target start date for packaging this stream: -

Throughput for this stream (m<sup>3</sup>/y incoming waste): ~60.0

Other information: All the waste being held in a tank is expected to be retrieved when a conditioning campaign is undertaken.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	3m <sup>3</sup> box (round corners)	100.0	0.932	2.9	63

Likely container type comment: -

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 matrix is expected to be 9:1 BFS/OPC.

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.

Opportunities for alternative disposal routing: -

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

**RADIOACTIVITY**

Source: The principal source of radioactivity is Cs-137, Sr-90 and Pu-241 from fuel.

Uncertainty: The values quoted are indicative of the activities that might 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'.

**WASTE STREAM****9J63****CCP Sludge**Measurement of  
radioactivities:

Activities have been taken from WD-CALC-4227 decayed to 01/04/2022

Other information:

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	1.26E-04	CC 1			Gd 153		8		
Be 10	9.98E-08	CC 2			Ho 163	4.22E-08	CC 2		
C 14	4.02E-05	CC 1			Ho 166m	1.33E-05	CC 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	1.49E-06	CC 1			Lu 174		8		
Ar 39	5.19E-05	CC 2			Lu 176		8		
Ar 42		8			Hf 178n	1.99E-05	CC 2		8
K 40	2.65E-06	CC 2			Hf 182		8		
Ca 41	1.22E-06	CC 2			Pt 193	3.57E-05	CC 2		
Mn 53		8			Tl 204	2.38E-06	CC 2		
Mn 54		8			Pb 205		8		
Fe 55	2.86E-07	CC 1			Pb 210	7.49E-06	CC 2		
Co 60	2.22E-05	CC 1			Bi 208		8		
Ni 59	5.02E-06	CC 1			Bi 210m		8		
Ni 63	2.23E-06	CC 1			Po 210	7.35E-06	CC 2		
Zn 65		8			Ra 223		8		
Se 79	6.99E-08	CC 2			Ra 225		8		
Kr 81	8.28E-07	CC 2			Ra 226	1.58E-05	CC 2		
Kr 85	6.09E-04	CC 2			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	1.43E-02	CC 1			Th 227		8		
Zr 93	2.24E-06	CC 2			Th 228	4.35E-08	CC 2		
Nb 91	1.02E-09	CC 2			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	1.53E-05	CC 2			Th 232		8		
Nb 94	3.47E-06	CC 1			Th 234	1.85E-06	CC 2		
Mo 93	7.10E-08	CC 2			Pa 231		8		
Tc 97		8			Pa 233	2.26E-06	CC 2		
Tc 99	1.14E-05	CC 1			U 232	4.21E-08	CC 2		
Ru 106	2.41E-08	CC 1			U 233	9.56E-08	CC 2		
Pd 107	1.57E-07	CC 2			U 234	3.40E-06	CC 1		
Ag 108m	4.86E-06	CC 1			U 235	2.95E-08	CC 1		
Ag 110m		8			U 236	2.61E-07	CC 1		
Cd 109	9.12E-08	CC 2			U 238	1.85E-06	CC 1		
Cd 113m	3.56E-06	CC 2			Np 237	2.26E-06	CC 2		
Sn 119m		8			Pu 236		8		
Sn 121m	2.10E-05	CC 2			Pu 238	7.53E-04	CC 1		
Sn 123		8			Pu 239	8.05E-04	CC 1		
Sn 126	5.36E-07	CC 2			Pu 240	7.97E-04	CC 1		
Sb 125	1.08E-06	CC 1			Pu 241	1.15E-02	CC 1		
Sb 126	7.50E-08	CC 2			Pu 242	3.93E-06	CC 2		
Te 125m	2.71E-07	CC 2			Am 241	3.70E-03	CC 1		
Te 127m		8			Am 242m	5.01E-06	CC 2		
I 129	1.28E-07	CC 2			Am 243	6.26E-06	CC 2		
Cs 134	6.28E-08	CC 1			Cm 242	4.13E-06	CC 1		
Cs 135	7.82E-07	CC 2			Cm 243	5.87E-06	CC 1		
Cs 137	9.82E-03	CC 1			Cm 244	6.50E-05	CC 1		
Ba 133	3.16E-06	CC 1			Cm 245	9.18E-09	CC 2		
La 137	6.26E-09	CC 2			Cm 246	1.14E-09	CC 2		
La 138		8			Cm 248		8		
Ce 144	1.85E-09	CC 1			Cf 249		8		
Pm 145	1.26E-07	CC 2			Cf 250		8		
Pm 147	9.07E-07	CC 1			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	2.36E-04	CC 1			Other a				
Eu 152	6.31E-06	CC 1			Other b/g				
Eu 154	4.84E-05	CC 1			<b>Total a</b>	<b>6.17E-03</b>	<b>CC 2</b>	<b>0</b>	
Eu 155	3.15E-06	CC 1			<b>Total b/g</b>	<b>3.69E-02</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