

WASTE STREAM	2D42	Magnox Pond Furniture
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SITE Sellafield
SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Limited

WASTE TYPE ILW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	0 m ³
Future arisings -	1.4.2022 - 31.3.2042.....	0 m ³
	1.4.2042 - 31.3.2043.....	1028.0 m ³
	1.4.2043 - 31.3.2044.....	1028.0 m ³
	1.4.2044 - 31.3.2045.....	1028.0 m ³
	1.4.2045 - 31.3.2046.....	1028.0 m ³
Total future arisings:		4112.0 m ³
Total waste volume:		4112.0 m ³

Comment on volumes: Skips and containers are in use and will not become redundant until towards the end of the Magnox programme. At current, it is assumed that skips and containers will be retrieved as part of FHP POCO operations. Volume is envelope volume of containers and the envelope volume of remaining skips. The timescale for the treatment of this arising is uncertain. The total volume has been simplistically split over 4 years aligned to facility POCO but is not based on studies and will therefore change at a later date. There is some uncertainty on whether some Magnox skips may be reused as liners within box encapsulation and disposed of as part of a grouted ILW waste package. At present ~75 skips have been earmarked for reuse in this way.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 1.05
Stock (lower): x Arisings (lower) x 0.95

WASTE SOURCE Waste consists of Magnox skips and containers arising from the transport and pond storage of Magnox fuel elements. There are two types of skips, short and long and the balance between the two may change though total number will not. ~980 skips and containers are associated with FHP. Some additional remaining skips from PFSP and FGMSF may require inclusion.

PHYSICAL CHARACTERISTICS

General description: The waste consists of metal skips and metal containers with concrete ballast contained in the lid. Skips are assumed to be treated separately from containers. Skips and containers are large heavy items - ~2t per container (1.241m W, 1.641m L, 1.5 H) and ~0.45t per skip (0.824m W, 1.18/1.357m L [short and long skip respectively], 1.029m H).

Physical components (%wt): Mild steel in Magnox skips (19.6%), stainless steel in Magnox containers (61.6%), concrete in Magnox containers (18.8%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 0.57

Comment on density: The density is based on the envelope volume of containers and skips with no size reduction and is pessimistic.

CHEMICAL COMPOSITION

General description and components (%wt): Mild Steel in Magnox skips (19.6%), stainless steel in Magnox containers (61.6%), concrete in Magnox containers (18.8%), paint.

Chemical state: Neutral

Chemical form of radionuclides: U: Present as metal and oxides.
Pu: Present as metal and oxides.

Metals and alloys (%wt): Containers are 1241 mm (W) x 1641 mm (L) x 1500 mm (H); skips are 824 mm (W) x 1180 mm (L - short) or 1357 mm (L - long) x 1092 mm (H).

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	61.6	BS3100 grade 304C12.	
Other ferrous metals.....	19.6	BS4360 grade 43A.	
Iron.....	0		
Aluminium.....	0		
Beryllium.....	0		
Cobalt.....	0		
Copper.....	0		
Lead.....	0		
Magnox/Magnesium.....	0		
Nickel.....	0		
Titanium.....	0		
Uranium.....	0		
Zinc.....	0		
Zircaloy/Zirconium.....	0		
Other metals.....	0		

Organics (%wt): The waste contains no organic materials, except for coal tar epoxy paint NF0039/1 and Calvinac HR paint CEGB spec. JFP18-2A.

	(%wt)	Type(s) and comment	% of total C14 activity
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.....	0		
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	TR		

Other materials (%wt): -

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	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	18.8		
Sand.....	0		
Glass/Ceramics.....	0		
Graphite.....	0		
Desiccants/Catalysts.....	0		
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): The listed inorganic anions are unlikely to be present.

	(%wt)	Type(s) and comment
Fluoride.....	0	
Chloride.....	0	
Iodide.....	0	
Cyanide.....	0	
Carbonate.....	0	
Nitrate.....	0	
Nitrite.....	0	
Phosphate.....	0	
Sulphate.....	0	
Sulphide.....	0	

Materials of interest for waste acceptance criteria: There are no hazardous materials present in the waste.

	(%wt)	Type(s) and comment
Combustible metals.....	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.....	0	

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Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Higher activity particles.....	0
Soluble solids as bulk chemical compounds.....	0

Hazardous substances / No toxic metals are present.
non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....	0	
Benzene.....	0	
Chlorinated solvents.....	0	
Formaldehyde.....	0	
Organometallics.....	0	
Phenol.....	0	
Styrene.....	0	
Tri-butyl phosphate.....	0	
Other organophosphates.....	0	
Vinyl chloride.....	0	
Arsenic.....	0	
Barium.....	0	
Boron.....	0	
Boron (in Boral).....		
Boron (non-Boral).....		
Cadmium.....	0	
Caesium.....	0	
Selenium.....	0	
Chromium.....	0	
Molybdenum.....	0	
Thallium.....	0	
Tin.....	0	
Vanadium.....	0	
Mercury compounds.....	0	
Others.....	0	
Electronic Electrical Equipment (EEE)		
EEE Type 1.....	0	
EEE Type 2.....	0	
EEE Type 3.....	0	
EEE Type 4.....	0	
EEE Type 5.....	0	

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Complexing agents (%wt): No

(%wt) Type(s) and comment

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids.....

Other organic complexants.....

Organic complexing agents are unlikely to be present.

Total complexing agents..... 0

Potential for the waste to contain discrete items: Yes. Waste is expected to comprise size-reduced metal panels which may be judged as Discrete Items.

TREATMENT, PACKAGING AND DISPOSAL

Waste that is currently ILW: It has not yet been determined how the waste will become LLW. It is pessimistically assumed that wastes are ILW, but previous experience with MEBs shows stainless steel pond furniture can be decontaminated to LLW.

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:

No further treatments have yet been identified for these wastes.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
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	

Classification codes for waste expected to be consigned to a landfill facility: -

Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):

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Disposal Route	Stream volume %		
	2022/23	2023/24	2024/25
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			

Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Disposal at LLWR	Metal treatment	100.0	-	Medium	Waste consists of surface contaminated items. If an appropriate decontamination technique can be found, then metallic waste treatment may be suitable for all LLW pond skips.

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: The current strategy removes the skips from the ponds in the years given, however they will be consigned straight to FHP for continued storage. No off-site disposition strategy currently exists for these items.

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

Container voidage: -

Waste consigned for disposal to LLWR in year of generation: -

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

Source: Contamination from fuel elements and pond water.

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Uncertainty:	Magnox skips have a broad range of activities as these are highly dependent on the condition of the fuel stored within. Radiological data provided from coupon sampling which yielded highly variable results. In addition, potential in-pond decontamination may route activity toward effluent waste streams and management.
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:	-
Other information:	-

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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				8	Gd 153				
Be 10				8	Ho 163				
C 14				8	Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36			7.00E-08	BB 2	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41				8	Pt 193				
Mn 53					Tl 204				
Mn 54				8	Pb 205				
Fe 55				8	Pb 210				8
Co 60			3.00E-03	DD 2	Bi 208				
Ni 59			1.00E-05	DD 2	Bi 210m				
Ni 63			1.00E-03	DD 2	Po 210				8
Zn 65				8	Ra 223				
Se 79			1.00E-07	DD 2	Ra 225				
Kr 81					Ra 226				8
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90			2.00E-02	DD 2	Th 227				
Zr 93			1.00E-06	DD 2	Th 228				
Nb 91					Th 229				8
Nb 92					Th 230				8
Nb 93m				8	Th 232				8
Nb 94				8	Th 234				
Mo 93				8	Pa 231				8
Tc 97					Pa 233				
Tc 99			3.00E-06	DD 2	U 232				
Ru 106			3.00E-06	DD 2	U 233				8
Pd 107				8	U 234		6.00E-05	DD 2	
Ag 108m				8	U 235		2.00E-06	DD 2	
Ag 110m					U 236				8
Cd 109					U 238		6.00E-05	DD 2	
Cd 113m					Np 237		9.00E-07	DD 2	
Sn 119m					Pu 236				
Sn 121m				8	Pu 238		2.00E-03	DD 2	
Sn 123					Pu 239		1.00E-02	DD 2	
Sn 126			2.00E-07	DD 2	Pu 240		9.00E-03	DD 2	
Sb 125					Pu 241		6.00E-02	DD 2	
Sb 126					Pu 242		2.00E-06	DD 2	
Te 125m					Am 241		9.00E-03	DD 2	
Te 127m					Am 242m				8
I 129			7.00E-09	DD 2	Am 243		1.00E-06	DD 2	
Cs 134			3.00E-03	DD 2	Cm 242				8
Cs 135			2.00E-07	DD 2	Cm 243				8
Cs 137			7.00E-02	DD 2	Cm 244		6.00E-06	DD 2	
Ba 133					Cm 245				8
La 137					Cm 246				8
La 138					Cm 248				
Ce 144			3.00E-07	DD 2	Cf 249				
Pm 145					Cf 250				
Pm 147			2.00E-03	DD 2	Cf 251				
Sm 147					Cf 252				
Sm 151			1.00E-04	DD 2	Other a				
Eu 152				8	Other b/g		1.00E-04	DD 2	
Eu 154				8	Total a	0	*3.01E-02	CC 2	
Eu 155				8	Total b/g	0	*1.59E-01	DC 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