

WASTE STREAM	2F20	LWR Pond Furniture (Racks and Frames) from First Generation Oxide Storage Pond
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SITE Sellafield
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Sellafield Limited
WASTE TYPE LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m ³
Future arisings -	1.4.2019 - 31.3.2020.....	0 m ³
	1.4.2020 - 31.3.2021.....	0 m ³
	1.4.2021 - 31.3.2022.....	574.6 m ³
	1.4.2022 - 31.3.2023.....	574.6 m ³
	1.4.2023 - 31.3.2024.....	435.1 m ³
	1.4.2024 - 31.3.2029.....	295.6 m ³
	1.4.2029 - 31.3.2030.....	295.0 m ³
	1.4.2030 - 31.3.2031.....	185.0 m ³
	1.4.2031 - 31.3.2032.....	652.5 m ³
	1.4.2032 - 31.3.2033.....	652.5 m ³
	1.4.2033 - 31.3.2034.....	567.8 m ³
	1.4.2034 - 31.3.2035.....	349.0 m ³
	1.4.2035 - 31.3.2036.....	349.0 m ³
	1.4.2036 - 31.3.2037.....	349.0 m ³
	1.4.2037 - 31.3.2038.....	349.0 m ³
	1.4.2038 - 31.3.2039.....	349.0 m ³
	1.4.2039 - 31.3.2040.....	349.0 m ³
	1.4.2040 - 31.3.2041.....	209.4 m ³
	1.4.2041 - 31.3.2042.....	209.4 m ³
	1.4.2042 - 31.3.2043.....	209.4 m ³
1.4.2043 - 31.3.2044.....	209.4 m ³	
1.4.2044 - 31.3.2045.....	209.4 m ³	
1.4.2045 - 31.3.2046.....	209.4 m ³	
Total future arisings:		7583.1 m ³
Total waste volume:		7583.1 m ³

Comment on volumes: Arisings are a function of removal as part of POCO activities across the ponds used for LWR storage or to accommodate alternative business. Waste will not be generated until after 2021. 2F20 includes several different racks and containers of varying shapes and volumes.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 1.1
 Stock (lower): x Arisings (lower) x 0.9

WASTE SOURCE Storage racks, skips and frames used to store LWR fuel.

PHYSICAL CHARACTERISTICS

General description: Open structures of varying geometries. All items are large (<20m³) and heavy (<2t). The waste will be decontaminated using N10, HiFoam and usual treatment. Residual, less mobile activity to be removed by abrasive disk.

Physical components (%vol): MEB storage racks (70%), Individual bottle racks (14%), Skips, inc. MSRs (13%), frames (3%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.11

Comment on density: Densities are 0.4 t/m³ for open frames and 0.1 t/m³ for MEB storage frames, based on envelope volumes. The average rack density is approximately 0.11 t/m³, calculated as weight of rack 1150 kg / uncompacted volume 11.25 m³.

CHEMICAL COMPOSITION

General description and components (%wt): Mild steel (94%), stainless steel (3%), aluminium alloy (1%), paint.

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Chemical state:	Neutral	
Chemical form of radionuclides:	C-14: Oxides. Tc-99: Oxides. U: Oxides. Pu: Oxides.	
Metals and alloys (%wt):	70% sheet metal (approx 5mm), 30% bulk metal (25-75mm).	
	Stainless steel.....	3.0 304L.
	Other ferrous metals.....	94.0
	Iron.....	
	Aluminium.....	1.0
	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
		The waste contains aluminium alloy (1%).
Organics (%wt):	Paint is present. Neoprene 'O'-rings 0.023%.	
	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.....	NE
	Halogenated rubber	0.02
	Non-halogenated rubber.....	NE
	Hydrocarbons.....	
	Oil or grease	
	Fuel.....	
	Asphalt/Tarmac (cont.coal tar)...	
	Asphalt/Tarmac (no coal tar)....	
	Bitumen.....	
	Others.....	
	Other organics.....	P
Other materials (%wt):	There may be some sludge in the IBRs and skips but none on the MEB racks and LWR frames which constitute the bulk of this waste stream.	

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Inorganic ion exchange materials. 0
 Inorganic sludges and flocs..... <2.0
 Soil..... 0
 Brick/Stone/Rubble..... 0
 Cementitious material..... 0
 Sand.....
 Glass/Ceramics.....
 Graphite..... 0
 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):

Inorganic anions are not expected to be present.
 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 in the waste.
 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
 Corrosive materials..... 0
 Pyrophoric materials..... 0
 Generating toxic gases..... 0
 Reacting with water..... 0
 Active particles..... P

There may be some active

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particles in the sludge.

Hazardous substances /
non hazardous pollutants:

Soluble solids as bulk chemical compounds..... 0

Toxic metals are not present.

Acrylamide.....

Benzene..... 0

Chlorinated solvents.....

Formaldehyde.....

Organometallics.....

Phenol..... 0

Styrene.....

Tri-butyl phosphate..... 0

Other organophosphates.....

Vinyl chloride..... 0

Arsenic..... 0

Barium.....

Boron..... 0

Cadmium..... 0

Caesium.....

Selenium..... 0

Chromium..... 0

Molybdenum..... 0

Thallium.....

Tin..... 0

Vanadium..... 0

Mercury compounds.....

Others..... 0

Electronic Electrical Equipment (EEE)

EEE Type 1.....

EEE Type 2.....

EEE Type 3.....

EEE Type 4.....

EEE Type 5.....

Complexing agents (%wt):

Yes

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids.....

Other organic complexants..... TR

Total complexing agents..... TR

Traces of N10 and other chemicals may be present from decontamination process.

WASTE STREAM**2F20****LWR Pond Furniture (Racks and Frames) from First Generation Oxide Storage Pond****TREATMENT, PACKAGING AND DISPOSAL**

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:

Treatment and disposal plans are currently under development. Options being considered include on-site treatment (decontamination & size reduction) & disposal as LLW and consignment to an off-site metals treatment facility.

Disposal Routes:

Disposal Route	Stream volume %
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

Upcoming (2019/20-2021/22) Waste Routing (if expected to change from above):

Disposal Route	Stream volume %		
	2019/20	2020/21	2021/22
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			

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: -

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

Container voidage: -

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Waste Characterisation Form (WCH): -

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

Potential for the waste to contain discrete items: -

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: The activity on storage racks and frames arises from pond water contamination and could probably be readily removed by decontamination procedures. Individual bottle racks and fuel skips are also contaminated with fuel crud dislodged during storage (see 2F36 and 2F15).

Uncertainty: The nuclide activity values represent only the skips which constitute a small proportion of the wastestream. The bulk of the wastestream consists of racks and frames which have considerably lower activity.

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: Radiometric analysis of 3 skips and 5 open baskets was carried out and the measured Co-60 activity of the worst case skip divided by the volume of a skip (15.4m³). The other isotopes are derived from the Co-60 measurement in combination with analysis of fuel crud and external data.

Other information: -

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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					Gd 153				
Be 10					Ho 163				
C 14			~1.16E-12	BC 2	Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36					Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54			~1.20E-11	BC 2	Pb 205				
Fe 55			~1.91E-06	BC 2	Pb 210				
Co 60			~2.55E-06	AA 1	Bi 208				
Ni 59			~6.93E-09	BC 2	Bi 210m				
Ni 63			~8.64E-09	BC 2	Po 210				
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90			~7.32E-08	BC 2	Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232				
Nb 94					Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99			~2.05E-11	BC 2	U 232				
Ru 106					U 233				
Pd 107					U 234		~1.39E-11	BC 2	
Ag 108m					U 235				
Ag 110m					U 236		~1.39E-11	BC 2	
Cd 109					U 238		~1.39E-11	BC 2	
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238		~3.26E-08	BC 2	
Sn 123					Pu 239		~7.16E-09	BC 2	
Sn 126					Pu 240				
Sb 125					Pu 241		~7.33E-08	BC 2	
Sb 126					Pu 242				
Te 125m					Am 241		~7.52E-07	BC 2	
Te 127m					Am 242m				
I 129			~4.09E-14	BC 2	Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243		~1.21E-10	BC 2	
Cs 137			~1.00E-07	BC 2	Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a				
Eu 152					Other b/g				
Eu 154					Total a	0	7.92E-07	BC 2	
Eu 155					Total b/g	0	4.72E-06	BC 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