WASTE STREAM	2D112	Plutonium Plants Initial/Interim Decommissioning: Stores

SITE Sellafield

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Limited

WASTE TYPE LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m³
Future arisings -	1.4.2019 - 31.3.2031.....	0 m³
	1.4.2031 - 31.3.2043.....	7.7 m³
	1.4.2043 - 31.3.2048.....	0 m³
	1.4.2048 - 31.3.2058.....	6.4 m³
	1.4.2058 - 31.3.2068.....	182.7 m³
	1.4.2068 - 31.3.2072.....	2.6 m³
	1.4.2072 - 31.3.2078.....	0 m³
	1.4.2078 - 31.3.2090.....	15.1 m³
	1.4.2090 - 31.3.2121.....	0 m³
Total future arisings:		214.4 m³
Total waste volume:		214.4 m³

Comment on volumes: Arisings are in line with current decommissioning programmes and strategy. Waste within this waste stream is generated from a number of decommissioning projects which will commence at a future date. As a result of this, minimal characterisation of waste volumes and fingerprints has been carried out and hence there is a large uncertainty in the potential arisings. Preliminary assessments indicate that the volumes may vary from -50% to +300% for LLW.

Uncertainty factors on volumes:

Stock (upper):	x	Arisings (upper)	x 4.0
Stock (lower):	x	Arisings (lower)	x 0.5

WASTE SOURCE Dismantling of plutonium product stores and plutonium contaminated material stores.

PHYSICAL CHARACTERISTICS

General description: Plant and equipment, instruments and fittings, internal building fabric, soft waste ie. rubber, PVC, paper. Most items size reduced in-situ. Some large items may be present.

Physical components (%vol): Plant and equipment (14%), ducting (66%), electrical cabling, hardware and instruments (7%), internal fabric and furniture (1%), secondary steelwork (2%), soft waste (10%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.5

Comment on density: Density stated is average for LLW.

CHEMICAL COMPOSITION

General description and components (%wt): Stainless steel (6%), mild steel (77%), copper (3%), aluminium (0.5%), plastic (10%), rubber (2%), cellulose (1%), glass (0.5%). Percentages are by volume.

Chemical state: Neutral

Chemical form of radionuclides:
H-3: The tritium content is insignificant.
C-14: The carbon-14 content is insignificant.
Cl-36: The chlorine content is insignificant.
Se-79: The selenium content is insignificant.
Tc-99: The technetium content is insignificant.
I-129: The iodine content is insignificant.
Ra: The radium content is insignificant.
Th: The thorium content is insignificant.
U: The uranium content is insignificant.
Np: The neptunium content is insignificant.
Pu: The chemical form of plutonium has not been determined however it is likely to be an oxide

Metals and alloys (%wt): Some sheet metal present (~30%), bulk metal (70%).

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	Stainless steel	6.0	The most commonly used stainless steel is 304L.
	Other ferrous metals	77.0	
	Iron	~0	
	Aluminium	0.50	
	Beryllium	0	
	Cobalt	0	
	Copper	3.0	
	Lead	TR	
	Magnox/Magnesium	0	
	Nickel	0	
	Titanium	0	
	Uranium	0	
	Zinc	0	
	Zircaloy/Zirconium	0	
	Other metals	0	
Organics (%wt):	PVC oversuits, Windscale suits, waste bags, rubber gloves.		
	Total cellulosics	1.0	
	Paper, cotton	TR	
	Wood	~1.0	
	Halogenated plastics	7.5	
	Total non-halogenated plastics	2.5	
	Condensation polymers	1.3	
	Others	1.3	
	Organic ion exchange materials	0	
	Total rubber	2.0	
	Halogenated rubber	P	
	Non-halogenated rubber	P	
	Hydrocarbons		
	Oil or grease		
	Fuel		
	Asphalt/Tarmac (cont.coal tar)		
	Asphalt/Tarmac (no coal tar)		
	Bitumen		
	Others		
	Other organics	0	
Other materials (%wt):	-		
	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs	0	
	Soil	0	
	Brick/Stone/Rubble	TR	
	Cementitious material	TR	
	Sand	0	

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	Glass/Ceramics	~0.50	
	Graphite	0	
	Desiccants/Catalysts	0	
	Asbestos	P	The volume and type of asbestos has not been determined. However its presence is not likely in arisings beyond 2070.
	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:	Putrescible waste is organic matter. Asbestos is cement cladding, sheets, ceiling tiles and roof cladding.		
	Combustible metals	0	
	Low flash point liquids	0	
	Explosive materials	0	
	Phosphorus	0	
	Hydrides	0	
	Biological etc. materials	0	
	Biodegradable materials	TR	
	Putrescible wastes	TR	Trace.
	Non-putrescible wastes	0	
	Corrosive materials	0	
	Pyrophoric materials	0	
	Generating toxic gases	0	
	Reacting with water	0	
	Active particles	0	
	Soluble solids as bulk chemical compounds	0	

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Hazardous substances / non hazardous pollutants: Lead is present in trace quantities. Asbestos.

Acrylamide.....

Benzene.....

Chlorinated solvents.....

Formaldehyde.....

Organometallics.....

Phenol.....

Styrene.....

Tri-butyl phosphate.....

Other organophosphates.....

Vinyl chloride.....

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

TREATMENT, PACKAGING AND DISPOSAL

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Planned on-site / off-site treatment(s):

Treatment	On-site / Off site	Stream volume %
Low force compaction		
Supercompaction (HFC)	On-site	10.0
Incineration		
Solidification		
Decontamination		
Metal treatment	Off-site	72.0
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		18.0

Comment on planned treatments: Although there are no firm plans in place, based on current experience we have assumed the treatment methods set out in the table for the purposes of the 2019 UK Inventory. For Inventory purposes, it is assumed that supercompaction will continue after the closure of WAMAC in 2028.

Disposal Routes:

Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository	28.0
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	72.0
Expected to be consigned as Out of Scope	
Expected to be recycled / reused	
Disposal route not known	

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:

Container	Stream volume %	Waste loading m³	Number of packages
1/3 Height IP-1 ISO			
2/3 Height IP-2 ISO			
1/2 Height WAMAC IP-2 ISO	10.0	50.8	< 1
1/2 Height IP-2 Disposal/Re-usable ISO	18.0	15.7	3
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: -

Waste Planned for Disposal at the LLW Repository:

Container voidage: Voidage will be highly variable dependent on feed material from multiple buildings.

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Waste Characterisation Form (WCH):	It is not yet determined if the waste meets LLWR's Waste Acceptance Criteria (WAC). This waste stream covers future decommissioning projects. Waste from future projects will require WCHs prior to acceptance for disposal to the LLWR.
Waste consigned for disposal to LLWR in year of generation:	Yes.
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 main sources of activity are plutonium isotopes.
Uncertainty:	Waste within this waste stream is generated from a number of decommissioning projects which will commence at a future date. The uncertainties quoted for each nuclide represent both the uncertainty in quantification without detailed sampling and the likely variation of nuclide in different building consigned wastes under this waste stream. It is exceptionally unlikely that all the waste included in this waste stream will have the same variation in nuclide fingerprint. Also activity levels will depend on degree of decontamination achieved.
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:	Future arisings activities are based on actual activities of similar recent disposals.
Other information:	-

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	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				8	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				8	Bi 208				
Ni 59				8	Bi 210m				
Ni 63				8	Po 210				8
Zn 65				8	Ra 223				
Se 79				8	Ra 225				
Kr 81					Ra 226				8
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90				8	Th 227				
Zr 93				8	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				8	U 232				
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m				8	U 235				8
Ag 110m					U 236				8
Cd 109					U 238				8
Cd 113m					Np 237				8
Sn 119m					Pu 236				
Sn 121m				8	Pu 238			1.99E-08	C C 2
Sn 123					Pu 239			4.39E-08	C C 2
Sn 126				8	Pu 240			4.70E-08	C C 2
Sb 125					Pu 241			3.29E-06	C C 2
Sb 126					Pu 242				8
Te 125m					Am 241			1.10E-08	C C 2
Te 127m					Am 242m				8
I 129				8	Am 243				8
Cs 134				8	Cm 242				8
Cs 135				8	Cm 243				8
Cs 137				8	Cm 244				8
Ba 133					Cm 245				8
La 137					Cm 246				8
La 138					Cm 248				
Ce 144				8	Cf 249				
Pm 145					Cf 250				
Pm 147				8	Cf 251				
Sm 147					Cf 252				
Sm 151				8	Other a				8
Eu 152				8	Other b/g				8
Eu 154				8	**Total a**	**0**		**1.22E-07**	**C C 2**
Eu 155				8	**Total b/g**	**0**		**3.29E-06**	**C C 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