WASTE STREAM 5C41 Operational LLW Sludge

SITE Harwell

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	~9.0 m³
Total future arisings:		0 m³
Total waste volume:		9.0 m³
Comment on volumes:	-	
Uncertainty factors on volumes:	Stock (upper): x 1.05	Arisings (upper) x
	Stock (lower): x 0.95	Arisings (lower) x

WASTE SOURCE The waste arises from floc decontamination of low level liquors at Harwell.

PHYSICAL CHARACTERISTICS

General description:	Comprises of low level slurry which will be in-drum cemented. Dried slurry is a solid containing mainly hydrated ferric hydroxide typically contaminated with Cs, Sr, Co and U. Slurry is generated by floc precipitation to decontaminate aqueous low level waste from buildings at Harwell. There are no large items present in this waste stream.
Physical components (%wt):	On average: ~ 14% solids ~ 86% water
Sealed sources:	-
Bulk density (t/m³):	~1
Comment on density:	Raw bulk density ~ 1 t/m3 with the conditioned density = 1.26 t/m3 (when encapsulated).

CHEMICAL COMPOSITION

General description and components (%wt):	Dry ferric hydroxide solids (14%) and water (86%).
Chemical state:	Alkali
Chemical form of radionuclides:	H-3: Tritium is associated with ferric hydroxide. Ra: Basic radium salts are associated with ferric hydroxide. Th: Basic thorium salts are associated with ferric hydroxide. U: Basic uranium salts are associated with ferric hydroxide. Pu: Basic plutonium salts are associated with ferric hydroxide.
Metals and alloys (%wt):	-
	Stainless steel..... 0
	Other ferrous metals..... 0
	Iron.....
	Aluminium..... 0
	Beryllium.....
	Cobalt.....
	Copper..... 0
	Lead..... 0
	Magnox/Magnesium..... 0
	Nickel.....
	Titanium.....
	Uranium.....
	Zinc..... 0
	Zircaloy/Zirconium..... 0

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	Other metals.....	0	
Organics (%wt):	Only trace amounts of organic material present.		
	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.....	0	
	Halogenated rubber	0	
	Non-halogenated rubber.....	0	
	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.....	14.0	Dry ferric hydroxide solids
	Soil.....	0	
	Brick/Stone/Rubble.....	0	
	Cementitious material.....	0	
	Sand.....		
	Glass/Ceramics.....	0	
	Graphite.....	0	
	Desiccants/Catalysts.....		
	Asbestos.....	0	
	Non/low friable.....		
	Moderately friable.....		
	Highly friable.....		
	Free aqueous liquids.....	86.0	
	Free non-aqueous liquids.....	0	
	Powder/Ash.....	0	
Inorganic anions (%wt):	No inorganic anions are present in significant quantities apart from hydroxides and carbonates.		

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Fluoride..... 0

Chloride..... 0

Iodide..... 0

Cyanide..... 0

Carbonate..... P

Nitrate..... 0

Nitrite..... 0

Phosphate..... 0

Sulphate..... 0

Sulphide..... 0

Materials of interest for waste acceptance criteria: Trace levels of toxic metals possibly present, but not at levels that make the waste hazardous.Free liquid will not present any non-radiological hazards after the sludge is encapsulated in cement.

Combustible metals..... 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..... 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.....

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): Yes

EDTA..... Low, possibly amine polycarboxylic acids (e.g. EDTA) and oxalates

DPTA.....

NTA.....

Polycarboxylic acids……

Other organic complexants.....

Total complexing agents..... NE

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 Recyling / reuse Other / various None		100.0

Comment on planned treatments: Waste will be solidified into 227 litre drums prior to consignment in a HHISO to LLWR.

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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:

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 1/2 Height IP-2 Disposal/Re-usable ISO 2m box (no shielding) 4m box (no shielding) Other	100.0	3.6	3

Other information: The primary waste containment will be a 227-litre mild steel drum. There will be 36 drums per HHISO.

Waste Planned for Disposal at the LLW Repository:

Container voidage: Voidage <<10%

Waste Characterisation Form (WCH): The waste meets the LLWR's Waste Acceptance Criteria (WAC).
The waste does not have a current WCH.

Waste consigned for disposal to LLWR in year of generation: No. Waste will be retrieved and solidified in a single campaign.

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: -

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RADIOACTIVITY

Source:	Contamination of liquid effluents from a range of activities/sources used on the Harwell site.
Uncertainty:	Good analytical data based on modern analytical techniques and equipment, but composition of arisings will vary with nature of work generating the 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:	Laboratory analysis.
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	1.5E-05	B B 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14		8			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36		8			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40		8			Hf 182		8		
Ca 41		8			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55		8			Pb 210	8.17E-06	B B 2		
Co 60	1.56E-05	B B 2			Bi 208		8		
Ni 59		8			Bi 210m		8		
Ni 63		8			Po 210	7.86E-06	B B 2		
Zn 65		8			Ra 223		8		
Se 79		8			Ra 225		8		
Kr 81		8			Ra 226	2.65E-05	B B 2		
Kr 85		8			Ra 228	4.09E-06	B B 2		
Rb 87		8			Ac 227		8		
Sr 90	5.22E-03	B B 2			Th 227		8		
Zr 93		8			Th 228	3.49E-06	B B 2		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m		8			Th 232	5.34E-06	B B 2		
Nb 94		8			Th 234	1.97E-04	B B 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233	6.59E-09	B B 2		
Tc 99		8			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	9.08E-09	B B 2		
Ag 108m		8			U 235	1.58E-06	B B 2		
Ag 110m		8			U 236		8		
Cd 109		8			U 238	1.97E-04	B B 2		
Cd 113m		8			Np 237	6.65E-09	B B 2		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	6.94E-05	B B 2		
Sn 123		8			Pu 239	4.91E-05	B B 2		
Sn 126		8			Pu 240	1.4E-04	B B 2		
Sb 125		8			Pu 241	1.68E-03	B B 2		
Sb 126		8			Pu 242		8		
Te 125m		8			Am 241	1.72E-03	B B 2		
Te 127m		8			Am 242m		8		
I 129		8			Am 243		8		
Cs 134	4.46E-06	B B 2			Cm 242		8		
Cs 135		8			Cm 243		8		
Cs 137	5.72E-03	B B 2			Cm 244	2.51E-05	B B 2		
Ba 133		8			Cm 245		8		
La 137		8			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147		8			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151		8			Other a				
Eu 152		8			Other b/g				
Eu 154		8			**Total a**	**2.25E-03**	**B B 2**	**0**	
Eu 155		8			**Total b/g**	**1.29E-02**	**B B 2**	**0**	

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