WASTE STREAM 1A12 ILW Containing Tritium

SITE	Amersham
SITE OWNER	GE Healthcare Limited
WASTE CUSTODIAN	GE Healthcare Limited
WASTE TYPE	ILW
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	184.5 m^3
Total future arisings:		0 m^3
Total waste volume:		184.5 m^3

Comment on volumes: No future arisings all legacy waste for disposal. Volume of waste known exactly - waste is in 369 x 500l DEVA drums.

Uncertainty factors on volumes:

Stock (upper):	x 1.0	Arisings (upper)	x
Stock (lower):	x 1.0	Arisings (lower)	x

WASTE SOURCE Small scale radiochemical manufacturing from Cardiff Laboratories, which ceased in 2009 all waste has been packaged awaiting disposal therefore no further arisings.

PHYSICAL CHARACTERISTICS

General description: The waste consists of liquids, solids and absorbed liquids. The solids (72% by volume) include glassware, rubber gloves, paper tissues, chromatography papers, pipette tips etc. These are doubly contained in 2 tin-plate cans and 2 PVC bags and then held in 500l DEVA drums. Absorbed liquids (18% by volume) are absorbed onto vermiculite and contained in a glass jar, a tin-plate can and then a PVC bag. These are held in 500l DEVA drums. The free liquid waste stream consists of organic and inorganic (aqueous) solvents (10% by volume) held in screw top Duran bottles in a screwtop Safepak in a 6l tin-plate steel can in a sealed PVC bag. These are held in 500l DEVA drums. The waste will have undergone decay.

Physical components (%wt): The free liquid waste consists of both aqueous and organic solvents (10%). The solid and absorbed liquid waste contains glass, various metals, plastics, rubber, cellulose and a wide range of organic and inorganic chemical forms. Glass (45%), cellulose (9%), metals (21%), rubber (<0.1%), plastics (0.5%), non aqueous liquids (10.2%) organic ion exchange materials (2.1%) and other organics (2.1%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m^3): ~~0.7

Comment on density: Solids in cans (~0.26 t/m^3), solids in fibreboard drums (~0.18 t/m^3), absorbed liquids in cans (~0.45 t/m^3), liquids (~1 t/m^3). The average density (~0.7) of the overall waste container includes the weight of the outer container.

CHEMICAL COMPOSITION

General description and components (%wt): The liquid waste consists of organic solvents including industrial methylated spirits, ethanol and acetonitrile. (10%). The solid and absorbed liquid waste (90%) contains glass, various metals, plastics, rubber, cellulose and a wide range of organic and inorganic chemical forms. Glass (45%), cellulose (9%), metals (21%), rubber (<0.1%), plastics (0.5%), non aqueous liquids (10.2%) organic ion exchange materials (2.1%) and other organics (2.1%).

Chemical state: Neutral

Chemical form of radionuclides: H-3: Tritium is present as a replacement for hydrogen in the solvent or chemical dissolved in the solvent. Also < 1% present in corrosion resistant alloys as elemental tritium.

Metals and alloys (%wt): Waste contained in tinplate cans. Thickness of waste is typically < 5mm. There is a relatively high surface area to weight ratio.

WASTE STREAM 1A12 ILW Containing Tritium

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	<4.5		
Other ferrous metals	<9.0		
Iron	0		
Aluminium	<2.8		
Beryllium	0		
Cobalt	0		
Copper	<2.3		
Lead	<0.50		
Magnox/Magnesium	<0.45		
Nickel	<0.50		
Titanium	0		
Uranium	0		
Zinc	<0.45		
Zircaloy/Zirconium	0		
Other metals	<0.50	Other metals include tin.	

Organics (%wt): The organic solvents include, for example but not exhaustive list, industrial methylated spirits, ethanol and acetonitrile (5%). The solid and absorbed liquid waste contains cellulose as paper (10%), a range of plastics and rubber, and small quantities of ion exchange resins. Halogenated plastics comprise PVC (0.5%). Non-halogenated plastics(0.1%) comprise polyethylene, polystyrene, polypropylene, perspex. Organic ion-exchange resins (2.1%) comprise Dowex, Amberlite, Celite, Sephadex. Halogenated rubber comprises neoprene. Non-halogenated rubber (0.02%) comprises pure latex, natural latex. Polyvinyl chloride and neoprene may be present.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	~9.0	Paper.	
Paper, cotton	~9.0		
Wood	0		
Halogenated plastics	~0.50	PVC.	
Total non-halogenated plastics	~0.10	Polyethylene, polystyrene, polypropylene, perspex.	
Condensation polymers	0		
Others	~0.10		
Organic ion exchange materials	~2.1	Dowex, Amberlite, Celite , Sephadex.	
Total rubber	<0.01		
Halogenated rubber	<0.01	Neoprene.	
Non-halogenated rubber	<0.01	Pure latex, natural latex.	
Hydrocarbons	0		
Oil or grease	0		
Fuel	0		
Asphalt/Tarmac (cont.coal tar)	0		
Asphalt/Tarmac (no coal tar)	0		
Bitumen	0		
Others	0		
Other organics	~7.1	Organic solvents (5%) and	

WASTE STREAM 1A12 ILW Containing Tritium

Organic Ion exchange Resins (2.1%).

Other materials (%wt): Glass, free non-aqueous liquids, aqueous based solvents, for example water, dilute sodium hydroxide etc, potential for tiny amount of asbestos contamination.

	(%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.....	0		
Sand.....	0		
Glass/Ceramics.....	~45.0	Glass	
Graphite.....	0		
Desiccants/Catalysts.....	0		
Asbestos.....	<<0.01		
Non/low friable.....	<0.01		
Moderately friable.....	<0.01		
Highly friable.....	<0.01		
Free aqueous liquids.....	~5.0		
Free non-aqueous liquids.....	~10.2		
Powder/Ash.....			

Inorganic anions (%wt): The total content of inorganic anions is <3% and includes nitrates, sulphides, sulphates, chlorides, iodides and phosphates.

	(%wt)	Type(s) and comment
Fluoride.....	0	
Chloride.....	<0.40	
Iodide.....	<0.05	
Cyanide.....	0	
Carbonate.....	0	
Nitrate.....	<0.40	
Nitrite.....	0	
Phosphate.....	<0.90	
Sulphate.....	<0.90	
Sulphide.....	<0.60	

Materials of interest for waste acceptance criteria: The waste contains low flash point (<22 degrees C) liquids absorbed on vermiculite, cement or silica; hydrides, and asbestos. A small proportion (<3%) of the waste comprises putrescible or biological waste. This is treated by autoclaving or otherwise disinfected before packaging. The liquid waste portion of the waste stream consists of aqueous and organic solvents only.

WASTE STREAM 1A12 ILW Containing Tritium

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	~1.0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	<0.40	
Biological etc. materials.....	0	
Biodegradable materials.....	<2.0	
Putrescible wastes.....	<2.0	
Non-putrescible wastes.....	0	
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 / non hazardous pollutants: Small amount of lead. Boron (non-Boral) in borosilicate glass calculated using 10% of glass is borosilicate and the boron content is 8% of the borosilicate glass.

	(%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.....	~~0.36	
Boron (in Boral).....		
Boron (non-Boral).....	~~0.36	Borosillicate glass
Cadmium.....	0	
Caesium.....	0	
Selenium.....	0	
Chromium.....	0	
Molybdenum.....	0	
Thallium.....	0	
Tin.....	<1.0	tinplate cans

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

Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA.....	<0.50	
DPTA.....	<0.50	
NTA.....	TR	
Polycarboxylic acids…….		
Other organic complexants.....	<2.5	Complexing agents include amines (<0.5%), phosphines(<0.005%), citric acid (<0.5%), oxalic acid (<0.5%), succinic acid (<0.05%), LOMI reagents (<0.05%), acid/alkaline permanganate mixtures (<0.5%), citric/oxalic acid mixtures (<0.5%).
Total complexing agents.....	~3.5	

Potential for the waste to contain discrete items: No. Waste is well understood, no discrete items identified. Waste is not destined for LLWR or GDF disposal.

TREATMENT, PACKAGING AND DISPOSAL

Waste that is currently ILW: Decay to incineration Waste Acceptance levels. All waste will have decayed by 2090.

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	Off-site On-site	100.0 100.0

Comment on planned treatments: Waste to be decay stored on-site then repacked for disposal by incineration off site.

WASTE STREAM 1A12 ILW Containing Tritium

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	~0.70

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):

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
Incineration	Recycle	~10.0	2025	Low	Potential for the liquid component to be recycled via H3at (Culham) - no work completed to date. Liquid component ~10% by volume but ~50% activity

Waste Packaging for Disposal: (Not applicable to this waste stream)

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			

Other information: No waste to be transferred to LLWR.

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

Container voidage: -

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WASTE STREAM 1A12 ILW Containing Tritium

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:	Solid and absorbed liquid - activity exists as contaminated residues from small scale radiochemical preparations. The activity is evenly distributed between absorbed liquids and solids. Free liquids - the activity is present as radiolabelled compounds dissolved in organic/aqueous solvents. The free liquids make up 10% by volume of the wastestream but contribute 52% of the activity.
Uncertainty:	Liquid component of the waste stream has been measured, solid component has been calculated by accountancy. All waste records have been QA checked back to the original record prior to transfer of the DEVA drums from Cardiff site to Grove Centre site. Uncertainty estimated at ±20%.
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:	The waste only contains H-3 and is either measured by liquid scintillation counting or assessed following specific operations from radioactivity balance data. Activity was measured at time of waste generation and decay factors are applied according to the age of the waste drum.
Other information:	-

WASTE STREAM 1A12 ILW Containing Tritium

Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	1.08E+01	A A 1			Gd 153				
Be 10					Ho 163				
C 14					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					Pb 205				
Fe 55					Pb 210				
Co 60					Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210				
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90					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					U 232				
Ru 106					U 233				
Pd 107					U 234				
Ag 108m					U 235				
Ag 110m					U 236				
Cd 109					U 238				
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238				
Sn 123					Pu 239				
Sn 126					Pu 240				
Sb 125					Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241				
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137					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**		**0**	
Eu 155					**Total b/g**	**1.08E+01**	**A A 1**	**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