WASTE STREAM 9A917 Empty Drums and Liners

SITE	Berkeley
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	ILW
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	4.0 m^3
Future arisings -	1.4.2022 - 31.3.2024.....	4.0 m^3
Total future arisings:		4.0 m^3
Total waste volume:		8.0 m^3

Comment on volumes: These wastes are expected to occur when drums and liners are emptied of their contents.

Celite: 606 x 92 litre red drums = 606 * 0.092 = 55.75m367 x 113 litre black liners = 67 * 0.113 = 8.91m3IEX: 75 x 180 litre drums = 75 * 0.18 = 13.5m3Total volume = 78.161m3 however an assumption was made that waste will be shredded and only take up 10% of original volume therefore RWI volume set to 8m3.

Uncertainty factors on volumes:

Stock (upper):	x 1.1	Arisings (upper)	x 1.2
Stock (lower):	x 0.9	Arisings (lower)	x 0.8

WASTE SOURCE Mild steel drums, cans and liners that will be emptied of resin and sludge (Celite) during Station decommissioning (see 9A25, 9A57, 9A58 and 9A59). The waste is managed as ILW since it is mixed with other ILW waste streams although activity estimates indicate that this waste is LLW.

PHYSICAL CHARACTERISTICS

General description:	The waste comprises Ion Exchange Material drums from 9A25 (580mm dia x 880mm height), Red Cans (Celite) from 9A57, 9A58 and 9A59 (406mm dia x 711mm height), and Black Can Liners from Celite streams (343mm dia x 1220mm height). The containers are assumed to be emptied of their waste content prior to conditioning. The containers are thin walled and are expected to be corroded. Some residual internal and external contamination is anticipated. There are no large items that may require special handling.
Physical components (%vol):	Empty ion exchange material drums (20 vol%), empty sludge drums (70 vol%), and liners (10 vol%).
Sealed sources:	The waste does not contain sealed sources.
Bulk density (t/m^3):	0.1
Comment on density:	The density range is not estimated. The density estimate assumes that the empty waste cans and liners are stacked tightly together.

CHEMICAL COMPOSITION

General description and components (%wt):	Empty mild steel drums and cans, and mild steel liners. Mild steel (>99 wt%), residual contamination (<1 wt%).
Chemical state:	Neutral
Chemical form of radionuclides:	H-3: Most tritium is expected to be present as water but some may be in the form of other inorganic compounds or as organic compounds. C-14: Carbon 14 will probably be present as graphite. Cl-36: Chlorine 36 may be present as contamination from the wastes held in the drums and liners. The chemical form of chlorine 36 from these wastes may be from barium impurity ($BaCl_2$), inorganic chloride or another undetermined form. U: Chemical form of U isotopes has not been determined but may be oxides. Pu: Chemical form of Pu isotopes has not been determined but may be oxides.
Metals and alloys (%wt):	All of the waste will be in the form of sheet of approximately 1 mm thickness.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	0		
Other ferrous metals	>99.0		
Iron			
Aluminium	0		
Beryllium	TR		
Cobalt			
Copper	0		
Lead	0		
Magnox/Magnesium	TR		
Nickel	TR	Nimonic	
Titanium			
Uranium			
Zinc	0		
Zircaloy/Zirconium	TR		
Other metals	TR	No "other" metals have been identified but there may be trace quantities.	

Organics (%wt): There may be some residual contamination by organic material, including organic ion exchange resins.

	(%wt)	Type(s) and comment	% of total C14 activity
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	<1.0		
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	<1.0		

Other materials (%wt): -

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

Inorganic anions (%wt): The presence of inorganic anions shown in the table has not been fully assessed but is expected to be <1 wt%.

	(%wt)	Type(s) and comment
Fluoride.....	<1.0	
Chloride.....	<1.0	
Iodide.....	<1.0	
Cyanide.....	0	
Carbonate.....	<1.0	
Nitrate.....	<1.0	
Nitrite.....	<1.0	
Phosphate.....	<1.0	
Sulphate.....	<1.0	
Sulphide.....	<1.0	

Materials of interest for waste acceptance criteria: There may be traces of residual Magnox. No material likely to pose a fire or other non-radiological hazard has been identified.

	(%wt)	Type(s) and comment
Combustible metals.....	TR	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	0	
Putrescible wastes.....	0	

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

Hazardous substances / non hazardous pollutants: Toxic metals may be present in trace quantities.

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

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Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids…….		
Other organic complexants.....		
Total complexing agents.....	TR	

Potential for the waste to contain discrete items: Yes. Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs

PACKAGING AND CONDITIONING

Conditioning method: Current strategy is empty cans will be retrieved using R3 module and co-disposed with other vault wastes within existing container allocation

Plant Name: -

Location: Berkeley Site

Plant startup date: -

Total capacity (m^3/y incoming waste): -

Target start date for packaging this stream: -

Throughput for this stream (m^3/y incoming waste): -

Other information: -

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages

Likely container type comment: -

Range in container waste volume: -

Other information on containers: -

Likely conditioning matrix:

Other information: -

Conditioned density (t/m^3): -

Conditioned density comment: -

Other information on conditioning: -

Opportunities for alternative disposal routing: -

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

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RADIOACTIVITY

Source:	Empty drums, cans and can liners contaminated by fission products, and activation products including actinides.
Uncertainty:	The activity values are indicative of the activities that may be expected. Uncertainty is large. Specific activity is a function of Station operating history. The values quoted were derived by extrapolation from available measurements and are indicative of the activities that might be expected. This waste will possibly be LLW or exempt at the time of disposal depending on the processing method.
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:	Calculated from estimates of residual contamination inside drums and external contamination of drums.
Other information:	-

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	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	<1.54E-05	C 3	<1.54E-05	C 3	Gd 153		8		8
Be 10		8		8	Ho 163	2E-08	C C 2	2E-08	C C 2
C 14	<5E-07	C 3	<5E-07	C 3	Ho 166m		8		8
Na 22		8		8	Tm 170		8		8
Al 26	2E-09	C C 2	2E-09	C C 2	Tm 171	2.36E-09	C C 2	2.36E-09	C C 2
Cl 36	<1E-07	C 3	<1E-07	C 3	Lu 174		8		8
Ar 39		8		8	Lu 176		8		8
Ar 42		8		8	Hf 178n		8		8
K 40		8		8	Hf 182		8		8
Ca 41	<2E-08	C 3	<2E-08	C 3	Pt 193		8		8
Mn 53		8		8	Tl 204		8		8
Mn 54		8		8	Pb 205		8		8
Fe 55	<9.44E-07	C 3	<9.44E-07	C 3	Pb 210		8		8
Co 60	<6.21E-06	C 3	<6.21E-06	C 3	Bi 208		8		8
Ni 59	<6E-07	C 3	<6E-07	C 3	Bi 210m		8		8
Ni 63	<5.52E-05	C 3	<5.52E-05	C 3	Po 210		8		8
Zn 65		8		8	Ra 223		8		8
Se 79		8		8	Ra 225		8		8
Kr 81		8		8	Ra 226		8		8
Kr 85		8		8	Ra 228		8		8
Rb 87		8		8	Ac 227		8		8
Sr 90	<3.75E-05	C 3	<3.75E-05	C 3	Th 227		8		8
Zr 93	<3E-08	C 3	<3E-08	C 3	Th 228		8		8
Nb 91		8		8	Th 229		8		8
Nb 92		8		8	Th 230		8		8
Nb 93m	<1.97E-07	C 3	<1.97E-07	C 3	Th 232		8		8
Nb 94	2E-09	C C 2	2E-09	C C 2	Th 234	4E-09	C C 2	4E-09	C C 2
Mo 93	<2E-08	C 3	<2E-08	C 3	Pa 231		8		8
Tc 97		8		8	Pa 233		8		8
Tc 99	<1E-08	C 3	<1E-08	C 3	U 232		8		8
Ru 106		8		8	U 233		8		8
Pd 107		8		8	U 234	3.07E-09	C C 2	3.07E-09	C C 2
Ag 108m	<1.97E-08	C 3	<1.97E-08	C 3	U 235		8		8
Ag 110m		8		8	U 236		8		8
Cd 109		8		8	U 238	4E-09	C C 2	4E-09	C C 2
Cd 113m	<1.64E-07	C 3	<1.64E-07	C 3	Np 237		8		8
Sn 119m		8		8	Pu 236		8		8
Sn 121m	<2.57E-05	C 3	<2.57E-05	C 3	Pu 238	1.83E-06	C C 2	1.83E-06	C C 2
Sn 123		8		8	Pu 239	2E-06	C C 2	2E-06	C C 2
Sn 126		8		8	Pu 240	2E-06	C C 2	2E-06	C C 2
Sb 125		8		8	Pu 241	3.37E-05	C C 2	3.37E-05	C C 2
Sb 126		8		8	Pu 242		8		8
Te 125m		8		8	Am 241	4.79E-06	C C 2	4.79E-06	C C 2
Te 127m		8		8	Am 242m	9.43E-09	C C 2	9.43E-09	C C 2
I 129		8		8	Am 243	3E-09	C C 2	3E-09	C C 2
Cs 134	1.78E-09	C C 2	1.78E-09	C C 2	Cm 242	7.78E-09	C C 2	7.78E-09	C C 2
Cs 135	3E-09	C C 2	3E-09	C C 2	Cm 243	2.28E-09	C C 2	2.28E-09	C C 2
Cs 137	2.28E-04	C C 2	2.28E-04	C C 2	Cm 244	2.52E-08	C C 2	2.52E-08	C C 2
Ba 133		8		8	Cm 245		8		8
La 137		8		8	Cm 246		8		8
La 138		8		8	Cm 248		8		8
Ce 144		8		8	Cf 249		8		8
Pm 145		8		8	Cf 250		8		8
Pm 147	<3.79E-08	C 3	<3.79E-08	C 3	Cf 251		8		8
Sm 147		8		8	Cf 252		8		8
Sm 151	<1.83E-05	C 3	<1.83E-05	C 3	Other a				
Eu 152	3.23E-05	C C 2	3.23E-05	C C 2	Other b/g				
Eu 154	7.61E-06	C C 2	7.61E-06	C C 2	**Total a**	**1.07E-05**	**C C 2**	**1.07E-05**	**C C 2**
Eu 155	9.12E-07	C C 2	9.12E-07	C C 2	**Total b/g**	**4.64E-04**	**C C 2**	**4.64E-04**	**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