

WASTE STREAM	9A67	Miscellaneous Contaminated Items from Post Irradiation Examination
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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.....	0.1 m ³
Total future arisings:		0 m ³
Total waste volume:		0.1 m ³
Comment on volumes:	This waste was accumulated in 1966. There will be no further arisings of this waste stream.	
Uncertainty factors on volumes:	Stock (upper): x 1.1	Arisings (upper) x
	Stock (lower): x 0.9	Arisings (lower) x

WASTE SOURCE The waste is contaminated magnesium chloride and magnesium hydroxide resulting from the examination of irradiated fuel at Berkeley Nuclear Laboratories (now Berkeley Technology Centre).

PHYSICAL CHARACTERISTICS

General description: The waste is contaminated magnesium chloride and magnesium hydroxide in paint tins and bottles which are contained in a thin walled steel liner of nominal length 1.219 m and nominal diameter 0.343 m. There are no large items that may require special handling.

Physical components (%vol): The physical constituents include magnesium chloride and magnesium hydroxide. The waste is contained within mild steel paint tins, in glass bottles (with plastic tops) and in a mild steel black can liner. % Breakdown, ~25% ferrous metals, ~25% Magnox, ~25% chloride and ~25% glass.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 0.14

Comment on density: Density calculated using mass of container and external volume.

CHEMICAL COMPOSITION

General description and components (%wt): The waste includes magnesium hydroxide, magnesium chloride, glass and mild steel.

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: Chemical form of carbon 14 has not been determined but may be graphite.
 Cl-36: The chemical form of chlorine 36 in these wastes is not known.
 U: Chemical form of uranium isotopes has not been determined but may be uranium oxides.
 Pu: Chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): The only metal present will be the thin walled mild steel black can liner.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	NE		
Other ferrous metals.....	~25.0		
Iron.....			
Aluminium.....	0		
Beryllium.....	0		
Cobalt.....			
Copper.....	0		

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Lead.....	0	
Magnox/Magnesium.....	~25.0	
Nickel.....		
Titanium.....		
Uranium.....		
Zinc.....	0	
Zircaloy/Zirconium.....	0	
Other metals.....	0	No "other" metals are anticipated.

Organics (%wt): A little plastic (bottle tops) and a trace of cellulose may be present.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	TR		
Paper, cotton.....	TR		
Wood.....	0		
Halogenated plastics	0		
Total non-halogenated plastics.....	NE		
Condensation polymers.....	NE		
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.....	0		

Other materials (%wt): Traces of graphite may be present.

	(%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.....			
Glass/Ceramics.....	~25.0		
Graphite.....	TR		
Desiccants/Catalysts.....			
Asbestos.....	0		

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Non/low friable.....

Moderately friable.....

Highly friable.....

Free aqueous liquids..... 0

Free non-aqueous liquids..... 0

Powder/Ash..... NE

Inorganic anions (%wt): Hydroxide anions will be present.

(%wt) Type(s) and comment

Fluoride..... 0

Chloride..... ~25.0

Iodide..... 0

Cyanide..... 0

Carbonate..... NE

Nitrate..... 0

Nitrite..... 0

Phosphate..... 0

Sulphate..... 0

Sulphide..... 0

Materials of interest for waste acceptance criteria: There will not be any hazardous or problematic materials present.

(%wt) Type(s) and comment

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.....

Corrosive materials..... 0

Pyrophoric materials..... 0

Generating toxic gases..... 0

Reacting with water..... 0

Higher activity particles.....

Soluble solids as bulk chemical compounds.....

Hazardous substances / non hazardous pollutants: None expected.

(%wt) Type(s) and comment

Acrylamide.....

Benzene.....

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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.....
 Electronic Electrical Equipment (EEE)
 EEE Type 1.....
 EEE Type 2.....
 EEE Type 3.....
 EEE Type 4.....
 EEE Type 5.....

Complexing agents (%wt):

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....	TR	Organic complexing agents may be present in small quantities.
Total complexing agents.....	<1.0	

Potential for the waste to contain discrete items: Yes. In & of itself not a DI; waste stream may include DIs (notably any stainless steel components)

PACKAGING AND CONDITIONING

Conditioning method: This stream will be co-packaged together in Concrete boxes (9A61, 9A62, 9A32, 9A40, 9A48, 9A53, 9A73). The remainder of vault 1 waste will be co-packaged together in Type VI DCIC containers (9A25, 9A31, 9A39, 9A47, 9A52, 9A60 and

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9A66). Packages for vault 1 are assigned to 9A25, 9A32 & 9A73.

Plant Name: -
 Location: Berkeley Site
 Plant startup date: -
 Total capacity (m³/y incoming waste): -
 Target start date for packaging this stream: -
 Throughput for this stream (m³/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/m³): -
 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
-	-	-	-	-	-

RADIOACTIVITY

Source: The waste has become contaminated from the processes concerned with the examination of irradiated fuel at Berkeley Nuclear Laboratories (now Berkeley Technology Centre).
 Uncertainty: The values quoted are indicative of the expected activities.
 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: Specific activities were derived by estimation based upon available information.
 Other information: Specific activity is a function of operating history.

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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	2.58E-04	CC 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	9.99E-06	CC 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	7E-07	CC 2			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	1.97E-07	CC 2			Pb 210		8		
Co 60	9.73E-06	CC 2			Bi 208		8		
Ni 59	1E-06	CC 2			Bi 210m		8		
Ni 63	7.21E-05	CC 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	1.21E-08	CC 2			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85		8			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	4.89E-03	CC 2			Th 227		8		
Zr 93	6E-07	CC 2			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	3.85E-07	CC 2			Th 232		8		
Nb 94		8			Th 234	3E-07	CC 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233	4.15E-08	CC 2		
Tc 99	3E-06	CC 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	3.09E-07	CC 2		
Ag 108m	<2.94E-06	C 3			U 235	7E-09	CC 2		
Ag 110m		8			U 236	4.00E-08	CC 2		
Cd 109		8			U 238	3E-07	CC 2		
Cd 113m		8			Np 237	4.15E-08	CC 2		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	1.78E-04	CC 2		
Sn 123		8			Pu 239	1.00E-04	CC 2		
Sn 126	4.35E-08	CC 2			Pu 240	2.00E-04	CC 2		
Sb 125		8			Pu 241	9.74E-04	CC 2		
Sb 126	6.09E-09	CC 2			Pu 242	1E-07	CC 2		
Te 125m		8			Am 241	3.26E-04	CC 2		
Te 127m		8			Am 242m	8.36E-07	CC 2		
I 129	6E-09	CC 2			Am 243	3.00E-07	CC 2		
Cs 134		8			Cm 242	6.90E-07	CC 2		
Cs 135	1E-07	CC 2			Cm 243	1.41E-07	CC 2		
Cs 137	4.95E-03	CC 2			Cm 244	1.13E-06	CC 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	7.60E-09	CC 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	1.78E-05	CC 2			Other a				
Eu 152	9.19E-08	CC 2			Other b/g				
Eu 154	5.95E-06	CC 2			Total a	8.06E-04	CC 2	0	
Eu 155	8.35E-08	CC 2			Total b/g	1.12E-02	CC 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