WASTE STREAM 9A40 FED Magnox

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.....	24.0 m^3
Total future arisings:		0 m^3
Total waste volume:		24.0 m^3

Comment on volumes: Station operation ceased in March 1989. This waste stream was accumulated between April 1967 and October 1972. The volume quoted is the estimated bulk volume of the waste if separated from other wastes with which it is mixed.

Uncertainty factors on volumes:

Stock (upper):	x 1.3	Arisings (upper)	x
Stock (lower):	x 0.8	Arisings (lower)	x

WASTE SOURCE The source of the waste is the removal of splitters and top end guides from fuel elements prior to dispatch of the elements to Sellafield.

PHYSICAL CHARACTERISTICS

General description: The waste comprises Magnox splitters and top end guides removed from fuel elements prior to dispatch of the element to Sellafield. These sections were removed during the desplittering operation. The desplittering process can distort the splitter assemblies and splitters, and can break the top end guide. The Magnox splitters and top end guide are 496mm and 107mm in length respectively. Components may weigh up to about 30g. The total weight of Magnox removed from each element was 118g. From the dimensions and masses quoted above and recognising that the components will be broken and distorted during the desplittering operation it is therefore unlikely that there will be any large items which will require special handling.

Physical components (%vol): Magnox is the only constituent identified (>99%vol).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m^3): 0.57

Comment on density: The density of 0.57 t/m^3 assumes a packing factor to give an overall volume of about three times the displacement volume of the waste. The actual density can be up to 1.7 t/m^3.

CHEMICAL COMPOSITION

General description and components (%wt): Magnox metal (Type AL80) >99% wt. Fission product and actinide contamination. Also graphite contamination. Activation of impurities within the Magnox.

Chemical state: Alkali

Chemical form of radionuclides:
H-3: Tritium is expected to be present as surface contamination, possibly as water, but perhaps in the form of other inorganic or organic compounds.
C-14: Carbon 14 will probably be present as graphite.
Cl-36: Chlorine 36 incorporated in the Magnox may be associated with barium impurity (barium chloride). Other chlorine 36 may be associated with surface contamination.
Se-79: The selenium content is insignificant.
Tc-99: The technetium content is insignificant.
Ra: Radium isotope content is insignificant.
Th: The thorium isotope content is insignificant.
U: Chemical form of U isotopes has not been determined but may be oxides.
Np: The neptunium content is insignificant.
Pu: Chemical form of Pu isotopes has not been determined but may be oxides.

Metals and alloys (%wt): The thickness of some 75% wt of the waste will be of the order of a mm or less, the other 25% wt of the waste will be a few mm thick.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	0		
Other ferrous metals	0		
Iron			
Aluminium	0		
Beryllium	TR		
Cobalt			
Copper	0		
Lead	0		
Magnox/Magnesium	>99.0	The waste is Magnox AL80 which includes 0.8% wt aluminium as an alloying constituent.	
Nickel			
Titanium			
Uranium			
Zinc	TR		
Zircaloy/Zirconium	0		
Other metals	0	The waste is entirely Magnox.	

Organics (%wt): This loose Magnox is currently stored in the same vault as the drums of ion exchange material, although in different sub-sections. It may be possible that the Magnox has been contaminated with the ion exchange material that has leaked from the drums.

	(%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	TR		
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): Contamination by graphite.

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	(%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.....	0		
Graphite.....	TR		
Desiccants/Catalysts.....			
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	TR		
Free non-aqueous liquids.....	0		
Powder/Ash.....	P		

Inorganic anions (%wt): Inorganic anions are not expected to be present at greater than trace concentrations.

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

Materials of interest for waste acceptance criteria: There are no identified materials likely to represent a fire or other non-radiological hazard.

	(%wt)	Type(s) and comment
Combustible metals.....	>99.0	
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.....		

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Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	>99.0
Higher activity particles.....	
Soluble solids as bulk chemical compounds.....	

Hazardous substances / non hazardous pollutants: None expected.

	(%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.....		
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. In & of itself not a DI; Will likely contain "rogue" items (HDRIs) that will be (see Nimonic/Others)

PACKAGING AND CONDITIONING

Conditioning method: This stream will be co-packaged together in Concrete boxes (9A61, 9A62, 9A67, 9A32, 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 9A66). Packages for vault 1 are assigned to 9A25, 9A32 & 9A73.

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: -

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

RADIOACTIVITY

Source:	Activation, when the associated fuel elements were irradiated, of nuclides incorporated into the Magnox. Contamination by fission products and actinides when the fuel elements were in the fuel pond.
Uncertainty:	The values quoted are indicative of the activities that might be expected.
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 activity is a function of Station operating history. Values were derived from measurements, calculations of induced activity and estimates of likely contamination.
Other information:	-

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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	8.63E-03	C C 2			Gd 153		8		
Be 10	1E-07	C C 2			Ho 163		8		
C 14	9.99E-05	C C 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26	2E-05	C C 2			Tm 171		8		
Cl 36	2E-04	C C 2			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40		8			Hf 182		8		
Ca 41	<1E-05	C 3			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	1.97E-07	C C 2			Pb 210		8		
Co 60	<4.17E-05	C 3			Bi 208		8		
Ni 59	1E-05	C C 2			Bi 210m		8		
Ni 63	9.00E-04	C C 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79		8			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85		8			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	3.50E-04	C C 2			Th 227		8		
Zr 93	3E-08	C C 2			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	1.82E-08	C C 2			Th 232		8		
Nb 94		8			Th 234	7E-07	C C 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233	4.16E-08	C C 2		
Tc 99	2E-07	C C 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	6.04E-07	C C 2		
Ag 108m	1.95E-06	C C 2			U 235	2E-08	C C 2		
Ag 110m		8			U 236	5.00E-08	C C 2		
Cd 109		8			U 238	7E-07	C C 2		
Cd 113m	<1.42E-05	C 3			Np 237	4.16E-08	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m	<8.21E-05	C 3			Pu 238	7.11E-05	C C 2		
Sn 123		8			Pu 239	2E-04	C C 2		
Sn 126	3.04E-09	C C 2			Pu 240	2.00E-04	C C 2		
Sb 125	4.54E-09	C C 2			Pu 241	1.46E-03	C C 2		
Sb 126		8			Pu 242	6E-08	C C 2		
Te 125m	1.14E-09	C C 2			Am 241	3.44E-04	C C 2		
Te 127m		8			Am 242m	3.71E-07	C C 2		
I 129		8			Am 243	8.00E-08	C C 2		
Cs 134		8			Cm 242	3.06E-07	C C 2		
Cs 135	6E-09	C C 2			Cm 243	4.25E-08	C C 2		
Cs 137	4.95E-04	C C 2			Cm 244	2.25E-07	C C 2		
Ba 133	<7.49E-06	C 3			Cm 245		8		
La 137	<3E-06	C 3			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	<3.81E-07	C 3			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	1.78E-06	C C 2			Other a				
Eu 152	9.19E-09	C C 2			Other b/g				
Eu 154	5.95E-07	C C 2			**Total a**	**8.17E-04**	**C C 2**	**0**	
Eu 155	2.38E-08	C C 2			**Total b/g**	**1.23E-02**	**C C 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