WASTE STREAM 9A43 FED Magnox

SITE	Berkeley
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	ILW

WASTE VOLUMES

Stocks:	At 1.4.2013.....	7.0 m³
Total future arisings:		0 m³
Total waste volume:		7.0 m³

Comment on volumes: Station operation ceased in March 1989. This waste stream was accumulated between May 1991 and December 1993. The volume quoted is the estimated bulk volume of the waste if separated from other wastes with which it is mixed.

Uncertainity 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).

Bulk density (t/m³): 0.57

Comment on density: The average bulk density of 0.57 t/m³ assumes a packing factor to give an overall volume of about three times the displacement volume of the waste.

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: Magnesium hydroxide, formed by the corrosion of Magnox, may be present. The waste may be a reducing agent.

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 waste is Magnox AL80 which includes 0.8% wt aluminium as an alloying constituent. 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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Stainless steel	0	Bronze	0
Other ferrous metals	0	Inconel	0
Aluminium	0	Nimonic	0
Copper	0	Stellite	0
Lead	0	Boral	0
Zinc	0	Dural	0
Magnox/Magnesium	>99.0	Monel	0
Zircaloy	0	Uranium	NE
Brass	0	Beryllium	TR
		Other metals (below)	0

Other metals: The waste is entirely Magnox.

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

Fluoride	TR	Nitrate	TR
Chloride	TR	Nitrite	TR
Iodide	0	Phosphate	TR
Cyanide	0	Sulphate	TR
Carbonate	TR	Sulphide	0

Listed substances: Not present.

Hazardous and problematic materials (%wt): There are no identified materials likely to represent a fire or other non-radiological hazard.

Combustible metals	>99.0	Strong oxidising agents	0
Low flash point liquids	0	Pyrophoric materials	0
Explosive materials	0	Generating toxic gases	0
Phosphorus	0	Reacting with water	>99.0
Hydrides	0	Asbestos	0
Putrescible wastes	0	Free aqueous liquids	TR
Biological etc. materials	0	Free non-aqueous liquids	0
Powder	P		

Asbestos types and proportions: -

Complexing agents (%wt): Not yet determined. Only trace quantities, if any, are expected.

Complexing agents	TR

Organics (%wt): The Magnox may be contaminated with trace quantities of organic material.

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
Other organics	TR

Halogenated plastics and rubber (%wt): There are no halogenated plastics or rubbers present.

Other materials (%wt): Contamination by graphite.

Inorganic ion exchange materials	0
Inorganic sludges and flocs	0
Soil	0
Rubble	0
Concrete, cement and sand	0
Glass	0
Ceramics	0
Graphite	TR

PACKAGING AND CONDITIONING

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Conditioning method: -

Plant Name: -

Location: Berkeley Site

Plant startup date: 2013

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

Target start date for packaging this stream: 2014

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)	Container displacement volume (m^3)
Other (DCIC. Displacement volume 5.44m3)	100.0	~2.5	2.83	

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: -

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.

Accuracy: The values quoted are indicative of the activities that might be expected.

Definition of total alpha and total beta/gamma: Totals shown on table of radionuclide activities are the sums of the listed alpha or beta/gamma emitting radionuclides plus 'other alpha' or 'other beta/gamma.'

Measurement of specific activities: 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: Other beta/gamma nuclides include (in TBq/m3): Al26 (4E-5).

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Nuclide	Average specific activity, TBq/m³ Waste at 1.4.2013	Bands and Code	Future arisings	Bands and Code	Nuclide	Average specific activity, TBq/m³ Waste at 1.4.2013	Bands and Code	Future arisings	Bands and Code
H 3	2.14E-03	C C 2			Ho 163		8		
Be 10	2E-07	C C 2			Ho 166m		8		
C 14	2E-04	C C 2			Tm 170		8		
Cl 36	3E-04	C C 2			Tm 171		8		
Ar 39		8			Lu 174		8		
Ar 42		8			Lu 176		8		
K 40		8			Hf 178n		6		
Ca 41	<2E-05	C 3			Hf 182		8		
Mn 53		8			Pt 193		8		
Mn 54		8			Tl 204		8		
Fe 55	4.29E-04	C C 2			Pb 205		8		
Co 60	<2.27E-03	C 3			Pb 210		8		
Ni 59	2E-05	C C 2			Bi 208		8		
Ni 63	2.88E-03	C C 2			Bi 210m		8		
Zn 65		8			Po 210		8		
Se 79		8			Ra 223		8		
Kr 81		8			Ra 225		8		
Kr 85		8			Ra 226		8		
Rb 87		8			Ra 228		8		
Sr 90	6.07E-05	C C 2			Ac 227		8		
Zr 93	5E-08	C C 2			Th 227		8		
Nb 91		8			Th 228		8		
Nb 92		8			Th 229		8		
Nb 93m	1.9E-08	C C 2			Th 230		8		
Nb 94		8			Th 232		8		
Mo 93		8			Th 234	5E-08	C C 2		
Tc 97		8			Pa 231		8		
Tc 99	2E-07	C C 2			Pa 233	6.13E-09	C C 2		
Ru 106		8			U 232		8		
Pd 107		8			U 233		8		
Ag 108m	3.96E-06	C C 2			U 234	5.04E-08	C C 2		
Ag 110m		8			U 235	1E-09	C C 2		
Cd 109		8			U 236	7E-09	C C 2		
Cd 113m	<2.23E-04	C 3			U 238	5E-08	C C 2		
Sn 119m		8			Np 237	6.13E-09	C C 2		
Sn 121m	<2.76E-04	C 3			Pu 236		8		
Sn 123		8			Pu 238	1.9E-05	C C 2		
Sn 126		8			Pu 239	2E-05	C C 2		
Sb 125	8.73E-06	C C 2			Pu 240	3E-05	C C 2		
Sb 126		8			Pu 241	1.5E-03	C C 2		
Te 125m	9.27E-06	C C 2			Pu 242	2E-08	C C 2		
Te 127m		8			Am 241	7.6E-05	C C 2		
I 129		8			Am 242m	1.94E-07	C C 2		
Cs 134	1.33E-08	C C 2			Am 243	5E-08	C C 2		
Cs 135		8			Cm 242	1.6E-07	C C 2		
Cs 137	6.09E-05	C C 2			Cm 243	5.23E-08	C C 2		
Ba 133	<1.35E-04	C 3			Cm 244	4.77E-07	C C 2		
La 137	<5E-06	C 3			Cm 245		8		
La 138		8			Cm 246		8		
Ce 144		8			Cm 248		8		
Pm 145		8			Cf 249		8		
Pm 147	<8.19E-04	C 3			Cf 250		8		
Sm 147		8			Cf 251		8		
Sm 151	1.9E-07	C C 2			Cf 252		8		
Eu 152	2.2E-09	C C 2			Other a		8		
Eu 154	3.09E-07	C C 2			Other b/g	4E-05	C C 2		
Eu 155	8.61E-08	C C 2			**Total a**	**1.46E-04**	**C C 2**		
Gd 153		8			**Total b/g**	**<1.14E-02**	**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 the average specific activity.

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