WASTE STREAM 9B79 FED Magnox - Solid Secondary Waste

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

WASTE VOLUMES

Stocks:	At 1.4.2013.....	0 m³
Future arisings -	1.4.2013 - 31.3.2015.....	0.5 m³
Total future arisings:		0.5 m³
Total waste volume:		0.5 m³

Comment on volumes: The Magnox dissolution plant is expected to commence operations in 2012 with completion in 2015.
It is currently assumed that there is a maximum of 1000 nimonic springs present in the vaults, with a minimum of 250 expected. The number of springs will be estimated once detailed characterisation of Vaults 1A and 1B has been completed

Uncertainity factors on volumes:

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

WASTE SOURCE -

PHYSICAL CHARACTERISTICS

General description: Insoluble constituents of Magnox. There are no large items that may require special handling. Secondary solid waste will consist primarily of nimonic springs, thermocouple wires and potentially fuel fragments. Additionally, the volume will include a small fraction of top end fittings (spiders) containing zirconium alloy. It is conservatively estimated that there are approx 1000 nimonic springs within the vaults, however the quantity may be as low as 250. Springs weigh approx 5g each and are estimated to be 33mm long and 10mm diameter. An estimate of the number of thermocouples has not been made. Thermocouples components are comprised of stainless steel and other metals. Top end fittings (aka spiders) total volume across all vaults is assessed as being 0.001m3. Top end fittings comprised of zirconium alloy and weigh approx 88g each. The fuel fragments will be comprised of fission fragments and uranium, total volume across all vaults is assessed as being 0.014m3. The fuel fragments will be comprised of fission fragments and uranium.

Physical components (%wt): The waste stream consists primarily of small metal and metal alloy items.

Bulk density (t/m³): ~1.9

Comment on density: The density is based on the assessment completed for Sizewell and Hinkley waste streams.

CHEMICAL COMPOSITION

General description and components (%wt): The waste is comprised of solid waste removed from FED prior to it undergoing dissolution and residues from the chemical dissolution of Magnox (including Fe, Co, Zn, Zr and Al). The waste will primarily consist of highly activated stainless steel. Siliceous materials including sand, and a range of other materials may be present in the solid residue remaining after the dissolution process is complete.

Chemical state: It is unknown whether the waste will be alkaline, oxidising, reducing or neither.

Chemical form of radionuclides:
C-14: Carbon 14 may be present as graphite.
Cl-36: The chemical form of chlorine 36 may be inorganic chloride.
U: The chemical form of uranium isotopes has not been determined but will probably be uranium oxides.
Pu: The chemical form of plutonium isotopes has not been determined but will probably be plutonium oxides.

Metals and alloys (%wt): Nimonic will be the primary component, accounting for upwards of 95% of the waste stream. Small proportions of other metals from thermocouples and zirconium alloy may be present as well.

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Stainless steel	~1.0	Bronze	NE
Other ferrous metals	~2.0	Inconel	NE
Aluminium	NE	Nimonic	~95.0
Copper	TR	Stellite	NE
Lead	TR	Boral	NE
Zinc	NE	Dural	NE
Magnox/Magnesium	<1.0	Monel	NE
Zircaloy	~1.0	Uranium	NE
Brass	NE	Beryllium	TR
		Other metals (below)	~1.0

Other metals: The "other" metal content has not been fully assessed.

Inorganic anions (%wt): Not fully assessed. Carbonates are expected to be present.

Fluoride	NE	Nitrate	NE
Chloride	NE	Nitrite	NE
Iodide	NE	Phosphate	NE
Cyanide	NE	Sulphate	NE
Carbonate	NE	Sulphide	NE

Listed substances: Not yet determined.

Hazardous and problematic materials (%wt): Biological components are not expected to be present in the waste stream.

Combustible metals	<1.0	Strong oxidising agents	0
Low flash point liquids	0	Pyrophoric materials	0
Explosive materials	0	Generating toxic gases	NE
Phosphorus	0	Reacting with water	0
Hydrides	0	Asbestos	0
Putrescible wastes	0	Free aqueous liquids	P
Biological etc. materials	TR	Free non-aqueous liquids	TR
Powder	0		

Asbestos types and proportions: -

Complexing agents (%wt): Not yet determined.

Complexing agents	TR

Organics (%wt): The cellulosic material content of the waste has not been assessed as it is not believed that any will be present.

Total cellulosics	NE
Paper, cotton	NE
Wood	NE
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
Other organics	<1.0

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

Other materials (%wt): -

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

PACKAGING AND CONDITIONING

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Conditioning method:	No further conditioning is expected. The solid wastes will be packaged directly into containers to minimise handling operations. Packaging will occur during retrieval operations and throughout dissolution operations.
Plant Name:	FED Retrieval and Dissolution plants
Location:	Bradwell Site
Plant startup date:	2012
Total capacity (m^3/y incoming waste):	-
Target start date for packaging this stream:	2012
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 (MOSAIK with 120mm shielding. Displacement volume 1.32m3.)	100.0	~0.149	0.166	

Likely container type comment:	-
Range in container waste volume:	Not yet determined.
Other information on containers:	The container material is expected to be cast iron. Based on experience at Dungeness A, some internal shielding may be required, reducing the volume available for waste. 120mm shielding is expected.
Likely conditioning matrix:	None
Other information:	-
Conditioned density (t/m^3):	1.9
Conditioned density comment:	No conditioning matrix is envisaged, therefore density of the waste will remain unchanged.
Other information on conditioning:	-

RADIOACTIVITY

Source:	Activation of metal components that were in close proximity to fuel during generating operation. In addition to activation, a significant amount of contamination is expected.
Accuracy:	The fingerprint data for this waste stream is based on the fingerprint developed by Sizewell A and in comparison to measured fingerprints for waste in vaults at Bradwell
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:	-
Other information:	The fingerprint is limited to the nimonic springs and does not assess the presence of top end fittings, thermocouples or fuel fragments as no data is available for these items.

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Nuclide	Average specific activity, TBq/m³				Nuclide	Average specific activity, TBq/m³			
	Waste at 1.4.2013	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2013	Bands and Code	Future arisings	Bands and Code
H 3			2.53E-03	C C 2	Ho 163				8
Be 10				8	Ho 166m				8
C 14			6E-06	C C 2	Tm 170				8
Cl 36			2E-04	C C 2	Tm 171				8
Ar 39				8	Lu 174				8
Ar 42				8	Lu 176				8
K 40				8	Hf 178n				8
Ca 41				8	Hf 182				8
Mn 53				8	Pt 193				8
Mn 54			3.52E-03	C C 2	Tl 204				8
Fe 55			1.85E+01	C C 2	Pb 205				8
Co 60			4.72E+02	C C 2	Pb 210				8
Ni 59			1E+01	C C 2	Bi 208				8
Ni 63			1.96E+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			4.66E-05	C C 2	Ac 227				8
Zr 93			2E-09	C C 2	Th 227				8
Nb 91				8	Th 228				8
Nb 92				8	Th 229				8
Nb 93m				8	Th 230				8
Nb 94				8	Th 232				8
Mo 93				8	Th 234			3E-08	C C 2
Tc 97				8	Pa 231				8
Tc 99			1E-08	C C 2	Pa 233			4.02E-09	C C 2
Ru 106			5.08E-08	C C 2	U 232				8
Pd 107				8	U 233				8
Ag 108m				8	U 234			3.02E-08	C C 2
Ag 110m				8	U 235				8
Cd 109				8	U 236			4E-09	C C 2
Cd 113m				8	U 238			3E-08	C C 2
Sn 119m				8	Np 237			4.02E-09	C C 2
Sn 121m				8	Pu 236				8
Sn 123				8	Pu 238			1.95E-05	C C 2
Sn 126				8	Pu 239			1E-05	C C 2
Sb 125				8	Pu 240			2E-05	C C 2
Sb 126				8	Pu 241			6.92E-04	C C 2
Te 125m				8	Pu 242			1E-08	C C 2
Te 127m				8	Am 241			2.35E-05	C C 2
I 129				8	Am 242m			9.85E-08	C C 2
Cs 134			3.65E-07	C C 2	Am 243			3E-08	C C 2
Cs 135				8	Cm 242			8.06E-08	C C 2
Cs 137			6.53E-05	C C 2	Cm 243			2.8E-08	C C 2
Ba 133				8	Cm 244			3.57E-07	C C 2
La 137				8	Cm 245				8
La 138				8	Cm 246				8
Ce 144			6.95E-09	C C 2	Cm 248				8
Pm 145				8	Cf 249				8
Pm 147			1.81E-06	C C 2	Cf 250				8
Sm 147				8	Cf 251				8
Sm 151			8.79E-08	C C 2	Cf 252				8
Eu 152			2.57E-09	C C 2	Other a				8
Eu 154			4.71E-07	C C 2	Other b/g			2E-04	C C 2
Eu 155			1.31E-07	C C 2	**Total a**	**0**		**7.35E-05**	**C C 2**
Gd 153				8	**Total b/g**	**0**		**2.46E+03**	**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 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