

WASTE STREAM	9B79	FED Magnox - Solid Secondary Waste
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SITE Bradwell
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Magnox Limited
WASTE TYPE ILW

WASTE VOLUMES

Stocks:	At 1.4.2013.....	0 m ³
Future arisings -	1.4.2013 - 31.3.2015.....	0.5 m ³
Total future arisings:		0.5 m ³
Total waste volume:		0.5 m ³

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

Uncertainty 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:

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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 cellulose.....	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):

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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 (m³/y incoming waste): -

Target start date for packaging this stream: 2012

Throughput for this stream (m³/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 1.32m ³ .)	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/m³): 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/m ³				Nuclide	Average specific activity, TBq/m ³			
	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	CC 2	Ho 163				8
Be 10				8	Ho 166m				8
C 14			6E-06	CC 2	Tm 170				8
Cl 36			2E-04	CC 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	CC 2	Tl 204				8
Fe 55			1.85E+01	CC 2	Pb 205				8
Co 60			4.72E+02	CC 2	Pb 210				8
Ni 59			1E+01	CC 2	Bi 208				8
Ni 63			1.96E+03	CC 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	CC 2	Ac 227				8
Zr 93			2E-09	CC 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	CC 2	
Tc 97				8	Pa 231				8
Tc 99			1E-08	CC 2	Pa 233		4.02E-09	CC 2	
Ru 106			5.08E-08	CC 2	U 232				8
Pd 107				8	U 233				8
Ag 108m				8	U 234		3.02E-08	CC 2	
Ag 110m				8	U 235				8
Cd 109				8	U 236		4E-09	CC 2	
Cd 113m				8	U 238		3E-08	CC 2	
Sn 119m				8	Np 237		4.02E-09	CC 2	
Sn 121m				8	Pu 236				8
Sn 123				8	Pu 238		1.95E-05	CC 2	
Sn 126				8	Pu 239		1E-05	CC 2	
Sb 125				8	Pu 240		2E-05	CC 2	
Sb 126				8	Pu 241		6.92E-04	CC 2	
Te 125m				8	Pu 242		1E-08	CC 2	
Te 127m				8	Am 241		2.35E-05	CC 2	
I 129				8	Am 242m		9.85E-08	CC 2	
Cs 134			3.65E-07	CC 2	Am 243		3E-08	CC 2	
Cs 135				8	Cm 242		8.06E-08	CC 2	
Cs 137			6.53E-05	CC 2	Cm 243		2.8E-08	CC 2	
Ba 133				8	Cm 244		3.57E-07	CC 2	
La 137				8	Cm 245				8
La 138				8	Cm 246				8
Ce 144			6.95E-09	CC 2	Cm 248				8
Pm 145				8	Cf 249				8
Pm 147			1.81E-06	CC 2	Cf 250				8
Sm 147				8	Cf 251				8
Sm 151			8.79E-08	CC 2	Cf 252				8
Eu 152			2.57E-09	CC 2	Other a				8
Eu 154			4.71E-07	CC 2	Other b/g		2E-04	CC 2	
Eu 155			1.31E-07	CC 2	Total a	0	7.35E-05	CC 2	
Gd 153				8	Total b/g	0	2.46E+03	CC 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