WASTE STREAM 9B79/C FED Magnox - Solid Secondary Waste

SITE Bradwell

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE ILW

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2019.....	0.4 m³	2.6 m³
Total future arisings:		0 m³	0 m³
Total waste volume:		0.4 m³	2.6 m³
Number of waste packages in stock:	At 1.4.2019.....	2 package(s)	

Comment on volumes: -

Uncertainty factors on volumes:

Stock (upper):	x 1.1	Arisings (upper)	x
Stock (lower):	x 0.9	Arisings (lower)	x

WASTE SOURCE Consists of segregated items, isolated prior to processing of FED through the FED dissolution plant, and insoluble items obtained after processing through the FED dissolution plant.

PHYSICAL CHARACTERISTICS

General description: 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. Springs weigh approx 5g each and are estimated to be 33mm long and 10mm diameter. Thermocouples components are comprised of stainless steel and other metals. Top end fittings comprised of zirconium alloy and weigh approx 88g each.

Physical components (%wt): The waste stream consists primarily of MAC (miscellaneous activated components) including segregated Nimonic springs, thermocouple wires and small fractions of fuel fragments and top end fittings.

Sealed sources: -

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. The waste will primarily consist of MAC (miscellaneous activated components) including segregated Nimonic springs, thermocouple wires and small fractions of fuel fragments and top end fittings.

Chemical state: -

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.

Stainless steel.....	~1.0
Other ferrous metals.....	~2.0
Iron.....	
Aluminium.....	NE
Beryllium.....	TR

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	Cobalt		
	Copper	TR	
	Lead	TR	
	Magnox/Magnesium	<1.0	
	Nickel	~95.0	Present as Nimonic alloy.
	Titanium		
	Uranium		
	Zinc	NE	
	Zircaloy/Zirconium	~1.0	
	Other metals	~1.0	The "other" metal content has not been fully assessed.
Organics (%wt):	The cellulosic material content of the waste has not been assessed as it is not believed that any will be present. There are no halogenated plastics or rubbers 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	
	Hydrocarbons		
	Oil or grease		
	Fuel		
	Asphalt/Tarmac (cont.coal tar)		
	Asphalt/Tarmac (no coal tar)		
	Bitumen		
	Others		
	Other organics	<1.0	
Other materials (%wt):	-		
	Inorganic ion exchange materials.	NE	
	Inorganic sludges and flocs	0	
	Soil	0	
	Brick/Stone/Rubble	0	
	Cementitious material	0	
	Sand		
	Glass/Ceramics	0	
	Graphite	NE	
	Desiccants/Catalysts		
	Asbestos	0	
	Non/low friable		

	Moderately friable.....	
	Highly friable.....	
	Free aqueous liquids.....	P
	Free non-aqueous liquids.....	TR
	Powder/Ash.....	0
Inorganic anions (%wt):	Not fully assessed. Carbonates are expected to be present.	
	Fluoride.....	NE
	Chloride.....	NE
	Iodide.....	NE
	Cyanide.....	NE
	Carbonate.....	NE
	Nitrate.....	NE
	Nitrite.....	NE
	Phosphate.....	NE
	Sulphate.....	NE
	Sulphide.....	NE
Materials of interest for waste acceptance criteria:	Biological components are not expected to be present in the waste stream.	
	Combustible metals.....	<1.0
	Low flash point liquids.....	0
	Explosive materials.....	0
	Phosphorus.....	0
	Hydrides.....	0
	Biological etc. materials.....	TR
	Biodegradable materials.....	
	Putrescible wastes.....	0
	Non-putrescible wastes.....	
	Corrosive materials.....	0
	Pyrophoric materials.....	0
	Generating toxic gases.....	NE
	Reacting with water.....	0
	Active particles.....	
	Soluble solids as bulk chemical compounds.....	
Hazardous substances / non hazardous pollutants:	-	
	Acrylamide.....	
	Benzene.....	
	Chlorinated solvents.....	
	Formaldehyde.....	
	Organometallics.....	
	Phenol.....	
	Styrene.....	

Tri-butyl phosphate.....

Other organophosphates.....

Vinyl chloride.....

Arsenic.....

Barium.....

Boron.....

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): Yes

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids……

Other organic complexants.....

Total complexing agents..... TR

PACKAGING AND CONDITIONING

Container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
500 l RS drum (50mm Pb)	100.0	0.175	0.175	2

Container type comment: -

Range in container waste volume: Not yet determined.

Other information on containers: The container material is cast iron.

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: -

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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.
Uncertainty:	Specific activities of both waste packages were determined using gamma spectroscopy and fingerprints. The above values (Tbq/m3) are representative of the waste across the packages and each package's specific activity falls within the quoted uncertainty bands.
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 of both waste packages were measured and derived using gamma spectroscopy and the application of fingerprints.
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	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	3.05E-01	C C 2			Gd 153		8		
Be 10	4.9E-07	C C 2			Ho 163	2.97E-06	C C 2		
C 14	8.47E-03	C C 2			Ho 166m	9.01E-04	C C 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171	6.37E-06	C C 2		
Cl 36	1.06E-05	C C 2			Lu 174	5.80E-07	C C 2		
Ar 39	5.30E-04	C C 2			Lu 176		8		
Ar 42	1.10E-08	C C 2			Hf 178n	1.77E-03	C C 2		
K 40	2.96E-09	C C 2			Hf 182		8		
Ca 41	1.84E-05	C C 2			Pt 193	2.90E-04	C C 2		
Mn 53	7.92E-09	C C 2			Tl 204	2.16E-03	C C 2		
Mn 54	1.96E-07	C C 2			Pb 205		8		
Fe 55	2.31E-01	C C 2			Pb 210		8		
Co 60	2.22E+00	B B 1			Bi 208		8		
Ni 59	5.7E-02	C C 2			Bi 210m		8		
Ni 63	5.99E+00	C C 2			Po 210		8		
Zn 65	4.95E-09	C C 2			Ra 223	6.83E-09	C C 2		
Se 79	3.18E-06	C C 2			Ra 225	6.51E-09	C C 2		
Kr 81	2.62E-06	C C 2			Ra 226		8		
Kr 85	8.49E-02	C C 2			Ra 228	1.60E-09	C C 2		
Rb 87	5.08E-09	C C 2			Ac 227	6.85E-09	C C 2		
Sr 90	2.68E+00	C C 2			Th 227	6.75E-09	C C 2		
Zr 93	1.7E-04	C C 2			Th 228	7.43E-07	C C 2		
Nb 91	1.67E-06	C C 2			Th 229	6.52E-09	C C 2		
Nb 92		8			Th 230	7.13E-08	C C 2		
Nb 93m	1.20E-03	C C 2			Th 232	1.63E-09	C C 2		
Nb 94	1.44E-04	C C 2			Th 234	2.2E-04	C C 2		
Mo 93	1.17E-04	C C 2			Pa 231	1.22E-08	C C 2		
Tc 97		8			Pa 233	1.00E-05	C C 2		
Tc 99	1.23E-03	C C 2			U 232	7.21E-07	C C 2		
Ru 106	6.58E-07	C C 2			U 233	1.98E-06	C C 2		
Pd 107	7.41E-06	C C 2			U 234	1.95E-04	C C 2		
Ag 108m	3.10E-05	C C 2			U 235	5.7E-06	C C 2		
Ag 110m		8			U 236	2.10E-05	C C 2		
Cd 109	2.23E-08	C C 2			U 238	2.2E-04	C C 2		
Cd 113m	2.98E-04	C C 2			Np 237	1.00E-05	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m	1.26E-03	C C 2			Pu 238	2.33E-02	C C 2		
Sn 123		8			Pu 239	8.02E-02	C C 2		
Sn 126	2.76E-05	C C 2			Pu 240	7.95E-02	C C 2		
Sb 125	2.30E-04	C C 2			Pu 241	1.27E+00	C C 2		
Sb 126	3.86E-06	C C 2			Pu 242	3.8E-05	C C 2		
Te 125m	5.76E-05	C C 2			Am 241	2.00E-01	C C 2		
Te 127m		8			Am 242m	2.30E-04	C C 2		
I 129	2.57E-06	C C 2			Am 243	7.13E-05	C C 2		
Cs 134	4.24E-03	C C 2			Cm 242	1.89E-04	C C 2		
Cs 135	5.58E-05	C C 2			Cm 243	3.07E-05	C C 2		
Cs 137	3.69E+00	C C 2			Cm 244	4.03E-04	C C 2		
Ba 133	4.80E-04	C C 2			Cm 245	3.03E-08	C C 2		
La 137	9.49E-07	C C 2			Cm 246	1.82E-09	C C 2		
La 138		8			Cm 248		8		
Ce 144	4.30E-08	C C 2			Cf 249		8		
Pm 145	3.04E-06	C C 2			Cf 250		8		
Pm 147	3E-03	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	3.08E-02	C C 2			Other a				
Eu 152	4.34E-05	C C 2			Other b/g				
Eu 154	1.23E-02	C C 2			**Total a**	**3.84E-01**	**C C 2**	**0**	
Eu 155	1.26E-03	C C 2			**Total b/g**	**1.66E+01**	**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