

WASTE STREAM	9G35	FED Magnox
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SITE Trawsfynydd
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Magnox Limited
WASTE TYPE ILW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	155.3 m ³
Total future arisings:		0 m ³
Total waste volume:		155.3 m ³
Comment on volumes:	-	
Uncertainty factors on volumes:	Stock (upper):	x 1.2
	Stock (lower):	x 0.8
	Arisings (upper):	x
	Arisings (lower):	x

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

PHYSICAL CHARACTERISTICS

General description: The waste consists of Magnox metal which may be contaminated by fission products and actinides. Components may weigh up to about 100 g and be approximately 2 mm x 25 mm x (75-750) mm. It is anticipated that the waste volume will include some fuel element top end fittings which will incorporate highly active Nimonic springs (waste stream 9G41) together with some zirconium alloy. There are no large items in the waste which will require special handling.

Physical components (%wt): Magnox (>94.5% wt), zirconium (<0.5% wt), gravel and other materials (~5%).

Sealed sources: -

Bulk density (t/m³): 0.35

Comment on density: The bulk density of 0.35 t/m³ assumes a packing factor of 5 times the displacement volume. The packing factor will be variable.

CHEMICAL COMPOSITION

General description and components (%wt): Magnox metal constitutes >94.5% by weight, zirconium constitutes <0.5% by weight and gravel and other material constitutes ~5% by weight.

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 chemical form of technetium has not been determined.
Ra: Radium isotope content is not significant.
Th: The thorium isotope content is insignificant.
U: Chemical form of uranium isotopes has not been determined but may be uranium oxides.
Np: The chemical form of neptunium has not been determined.
Pu: Chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): There are no bulk metal items present in this waste stream.

Stainless steel.....	0
Other ferrous metals.....	0
Iron.....	
Aluminium.....	0
Beryllium.....	TR
Cobalt.....	

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Copper..... 0
 Lead..... 0
 Magnox/Magnesium..... >94.5

 Nickel.....
 Titanium.....
 Uranium.....
 Zinc..... 0
 Zircaloy/Zirconium.....
 Other metals..... <0.10

Will consist predominantly of Magnox alloy ZR55, which contains 0.55 wt% Zr as an alloying constituent.

Very small amounts of nickel-chromium and nickel-aluminium thermocouple material.

Organics (%wt):

There may be organic materials present in trace quantities. There are no halogenated plastics or rubbers present with the waste.

Total cellulose..... 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
 Hydrocarbons.....
 Oil or grease
 Fuel.....
 Asphalt/Tarmac (cont.coal tar)...
 Asphalt/Tarmac (no coal tar)....
 Bitumen.....
 Others.....
 Other organics..... TR

Other materials (%wt):

Expect traces of graphite.
 Inorganic ion exchange materials. 0
 Inorganic sludges and flocs..... 0
 Soil..... 0
 Brick/Stone/Rubble..... ~5.0
 Cementitious material..... 0
 Sand.....
 Glass/Ceramics..... 0
 Graphite..... TR
 Desiccants/Catalysts.....

Gravel

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	Asbestos.....	0
	Non/low friable.....	
	Moderately friable.....	
	Highly friable.....	
	Free aqueous liquids.....	0
	Free non-aqueous liquids.....	0
	Powder/Ash.....	TR
Inorganic anions (%wt):	Inorganic anions are not expected to be present at greater than trace concentrations.	
	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:	Magnox will ignite under appropriate conditions.	
	Combustible metals.....	>94.5
	Low flash point liquids.....	0
	Explosive materials.....	0
	Phosphorus.....	0
	Hydrides.....	0
	Biological etc. materials.....	0
	Biodegradable materials.....	
	Putrescible wastes.....	0
	Non-putrescible wastes.....	
	Corrosive materials.....	0
	Pyrophoric materials.....	0
	Generating toxic gases.....	0
	Reacting with water.....	>94.5
	Active particles.....	
	Soluble solids as bulk chemical compounds.....	
Hazardous substances / non hazardous pollutants:	None expected.	
	Acrylamide.....	
	Benzene.....	
	Chlorinated solvents.....	
	Formaldehyde.....	
	Organometallics.....	

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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

Conditioning method: Waste will be encapsulated in BFS/OPC. Packaged waste will include FED Nimonic waste stream 9G41.

Plant Name: FED Retrieval and Processing Plant

Location: Trawsfynydd Decommissioning Site

Plant startup date: -

Total capacity (m³/y incoming waste): ~200.0

Target start date for packaging this stream: -

Throughput for this stream (m³/y incoming waste): ~95.0

Other information: Waste is combined with Nimonic stream 9G41, retrieved, packaged and encapsulated in 3m³ boxes. The waste is sorted to ensure package dose rates do

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not exceed specified on-site handling limits.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	3m ³ box (round corners)	100.0	2.59	2.7	60

Likely container type comment:

-

Range in container waste volume:

Not yet determined. No significant variability is expected.

Other information on containers:

The container material is expected to be stainless steel.

Likely conditioning matrix:

Blast Furnace Slag / Ordinary Portland Cement

Other information:

The encapsulation matrix will be 3:1 BFS/OPC.

Conditioned density (t/m³):

1.9

Conditioned density comment:

The density is expected to be in the range 1.85 to 1.95 t/m³.

Other information on conditioning:

Waste streams 9G35 and 9G41 will be processed as a single waste for disposal as ILW. Nimonic springs are distributed throughout the waste.

Opportunities for alternative disposal routing:

Treatment	Stream volume (%)	Comment
-	-	-

RADIOACTIVITY

Source:

The source of the waste is the removal of splitters from fuel elements prior to dispatch of the elements to Sellafield. Activation of trace nuclides in the Magnox and contamination by fission products and actinides will be main sources of activity.

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:

Values were derived from measurements, calculations of induced activity and estimates of likely contamination. Allowance has been made for zirconium alloy in top end fittings.

Other information:

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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	<1.21E-02	C 3			Gd 153		8		
Be 10	1E-07	CC 2			Ho 163		8		
C 14	5.00E-04	CC 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26	<4E-07	C 3			Tm 171		8		
Cl 36	2E-04	CC 2			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40		8			Hf 182		8		
Ca 41	<2E-05	C 3			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	<4.04E-06	C 3			Pb 210		8		
Co 60	<1.53E-03	C 3			Bi 208		8		
Ni 59	2E-05	CC 2			Bi 210m		8		
Ni 63	3.76E-03	CC 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	3.22E-05	CC 2			Th 227		8		
Zr 93	7E-05	CC 2			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	4.91E-05	CC 2			Th 232		8		
Nb 94		8			Th 234	3E-08	CC 2		
Mo 93	7.00E-05	CC 2			Pa 231		8		
Tc 97		8			Pa 233	4.12E-09	CC 2		
Tc 99	1E-05	CC 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	3.06E-08	CC 2		
Ag 108m	2.97E-06	CC 2			U 235		8		
Ag 110m		8			U 236	4.00E-09	CC 2		
Cd 109		8			U 238	3E-08	CC 2		
Cd 113m	<3.18E-05	C 3			Np 237	4.12E-09	CC 2		
Sn 119m		8			Pu 236		8		
Sn 121m	<3.56E-04	C 3			Pu 238	1.86E-05	CC 2		
Sn 123		8			Pu 239	1.00E-05	CC 2		
Sn 126		8			Pu 240	2.00E-05	CC 2		
Sb 125	9.32E-08	CC 2			Pu 241	2.59E-04	CC 2		
Sb 126		8			Pu 242	1E-08	CC 2		
Te 125m	2.33E-08	CC 2			Am 241	4.40E-05	CC 2		
Te 127m		8			Am 242m	8.61E-08	CC 2		
I 129		8			Am 243	3.00E-08	CC 2		
Cs 134		8			Cm 242	7.11E-08	CC 2		
Cs 135		8			Cm 243	2.44E-08	CC 2		
Cs 137	4.07E-05	CC 2			Cm 244	2.84E-07	CC 2		
Ba 133	<1.11E-05	C 3			Cm 245		8		
La 137	<4E-06	C 3			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145	1.41E-05	CC 2			Cf 250		8		
Pm 147	<3.71E-06	C 3			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	8.39E-05	CC 2			Other a				
Eu 152	1.89E-03	CC 2			Other b/g				
Eu 154	9.66E-03	CC 2			Total a	9.31E-05	CC 2	0	
Eu 155	1.95E-05	CC 2			Total b/g	3.07E-02	CC 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