

<b>WASTE STREAM</b>	<b>9G35/C</b>	<b>FED Magnox</b>
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**SITE** Trawsfynydd  
**SITE OWNER** Nuclear Decommissioning Authority  
**WASTE CUSTODIAN** Magnox Limited

**WASTE TYPE** ILW

Is the waste subject to Scottish Policy: No

**WASTE VOLUMES**

		Conditioned	Packaged
Stocks:	At 1.4.2022.....	49.3 m <sup>3</sup>	55.6 m <sup>3</sup>
Total future arisings:		0 m <sup>3</sup>	0 m <sup>3</sup>
Total waste volume:		49.3 m <sup>3</sup>	55.6 m <sup>3</sup>
Number of waste packages in stock:	At 1.4.2022.....	17 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** 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):** Grout (84.7% wt), Magnox ZR55 (11.5% wt), Magnox MN80 (3.52% wt), Zircaloy (0.12% wt), Nimonic 80A (0.19% wt) and other materials (~1% wt).

**Sealed sources:** The waste does not contain sealed sources.

**Bulk density (t/m<sup>3</sup>):** 2.15

**Comment on density:** The density of 2.15 Te/m<sup>3</sup> is calculated using the known wastefrom masses and the wastefrom volumes.

**CHEMICAL COMPOSITION**

**General description and components (%wt):** Grout (84.7% wt), Magnox ZR55 (11.5% wt), Magnox MN80 (3.52% wt), Zircaloy (0.12% wt), Nimonic 80A (0.19% wt) and other materials (~1% wt).

**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.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0.06	Weak link brace.	
Other ferrous metals.....	<0.01	Mild steel (fuel pot).	
Iron.....			
Aluminium.....	0		
Beryllium.....	TR		
Cobalt.....			
Copper.....	0		
Lead.....	0		
Magnox/Magnesium.....	15.0	11.47 wt% Magnox alloy ZR55, which contains 0.55 wt% Zr as an alloying constituent from splitters/braces. 3.518 wt% Magnox alloy MN80 from top end fittings.	
Nickel.....	0.19	Nimonic 80A (spring).	
Titanium.....			
Uranium.....	<0.01	Fuel	
Zinc.....	0		
Zircaloy/Zirconium.....	0.12	Zircaloy from top end fitting inserts (pin).	
Other metals.....	0		

Organics (%wt):                      There may be organic materials present in trace quantities. There are no halogenated plastics or rubbers present with the waste.

	(%wt)	Type(s) and comment	% of total C14 activity
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.

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	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	84.7	Grout (9:1 BFS/OPC)	
Sand.....			
Glass/Ceramics.....	0		
Graphite.....	TR		
Desiccants/Catalysts.....			
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.

	(%wt)	Type(s) and comment
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.

	(%wt)	Type(s) and comment
Combustible metals.....	15.0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	0	
Putrescible wastes.....	0	
Non-putrescible wastes.....		

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Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	15.0
Higher activity particles.....	
Soluble solids as bulk chemical compounds.....	

Hazardous substances / None expected  
non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....		
Other organophosphates.....		
Vinyl chloride.....		
Arsenic.....		
Barium.....		
Boron.....	0	
Boron (in Boral).....		
Boron (non-Boral).....		
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.....		

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Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		
Total complexing agents.....		TR

Potential for the waste to contain discrete items: Yes. In & of itself not a DI; Will contain "rogue" items (HDRIs) that will be (Springs are DIs by definition)

**PACKAGING AND CONDITIONING**

Container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	3m <sup>3</sup> box (round corners)	100.0	2.9	2.9	17

Container type comment: -

Range in container waste volume: Not yet determined. No significant variability is expected.

Other information on containers: The container material is stainless steel.

Conditioned density (t/m<sup>3</sup>): 2.15

Conditioned density comment: The conditioned density is calculated using the known waste package mass and package volume.

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.

**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: RN Inventory was taken from the FED best estimate fingerprints (M/EF/TRA/REP/0006/16 Issue 1) and specific activity was calculated using the wastestream volume.

Other information: -

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	6.34E-03	CC 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	1.91E-04	CC 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	2.02E-06	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		8			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	1.23E-05	CC 2			Pb 210		8		
Co 60		8			Bi 208		8		
Ni 59		8			Bi 210m		8		
Ni 63		8			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	2.85E-09	CC 2			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85		8			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	2.20E-04	CC 2			Th 227		8		
Zr 93		8			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m		8			Th 232		8		
Nb 94		8			Th 234	1.3E-07	CC 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	2.06E-08	CC 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	1.52E-07	CC 2		
Ag 108m	3.48E-06	CC 2			U 235	2.96E-09	CC 2		
Ag 110m		8			U 236		8		
Cd 109		8			U 238	1.3E-07	CC 2		
Cd 113m		8			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	4.55E-05	CC 2		
Sn 123		8			Pu 239	2.31E-05	CC 2		
Sn 126		8			Pu 240	2.89E-05	CC 2		
Sb 125	6.47E-08	CC 2			Pu 241	1.61E-04	CC 2		
Sb 126		8			Pu 242		8		
Te 125m	1.62E-08	CC 2			Am 241	1.34E-04	CC 2		
Te 127m		8			Am 242m		8		
I 129		8			Am 243		8		
Cs 134	6.88E-09	CC 2			Cm 242	6.5E-09	CC 2		
Cs 135		8			Cm 243	1.41E-07	CC 2		
Cs 137	9.22E-05	CC 2			Cm 244	1.98E-06	CC 2		
Ba 133	1.67E-06	CC 2			Cm 245		8		
La 137		8			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	5.26E-07	CC 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151		8			Other a				
Eu 152	4.7E-06	CC 2			Other b/g				
Eu 154	2.48E-06	CC 2			<b>Total a</b>	<b>2.34E-04</b>	<b>CC 2</b>	<b>0</b>	
Eu 155	2.65E-07	CC 2			<b>Total b/g</b>	<b>7.03E-03</b>	<b>CC 2</b>	<b>0</b>	

**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