WASTE STREAM 9E28 FED Magnox

SITE	Oldbury
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	ILW
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	80.3 m^3
Total future arisings:		0 m^3
Total waste volume:		80.3 m^3
Comment on volumes:	-	
Uncertainty factors on volumes:	Stock (upper): x 1.2	Arisings (upper) x
	Stock (lower): x 0.8	Arisings (lower) x

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

PHYSICAL CHARACTERISTICS

General description:	The waste consists of activated Magnox metal and swarf which is contaminated by fission products and actinides. Individual components may weigh up to about 100 g and be approx. 2 mm x 25 mm x (75-900) mm. A few Nimonic springs will also be present. There are no large items in the waste which will require special handling.
Physical components (%wt):	Magnox (>99.5% wt). The waste volume will include some fuel element top end fittings which will incorporate a few highly active Nimonic springs together with some zirconium alloy.
Sealed sources:	The waste does not contain sealed sources.
Bulk density (t/m^3):	0.35
Comment on density:	The bulk density of the waste ranges from 0.1 to 1.7 t/m3 with an average value of 0.35 t/m3. The average density of 0.35 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 (>99.5% wt including impurities). Activation of trace components within the Magnox. Fission product and actinide contamination. It is anticipated that the waste will include a few fuel element top end fittings which will incorporate highly active Nimonic springs together with some zirconium alloy.
Chemical state:	Neutral
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 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 technetium content is insignificant. Ra: Radium isotope content is insignificant. Th: Thorium content is insignificant. U: Chemical form of U isotopes has not been determined but may be oxides. Np: The neptunium content is insignificant. Pu: Chemical form of Pu isotopes has not been determined but may be oxides.
Metals and alloys (%wt):	No bulk metallic items present. Traces of Nimonic 80A will be present in the waste.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	0		
Other ferrous metals	0		
Iron			
Aluminium	P		
Beryllium	TR	Magnox with impurities which may include beryllium.	
Cobalt			
Copper	0		
Lead	0		
Magnox/Magnesium	>99.5	Will consist predominantly of Magnox alloy ZR55. includes 0.55% zirconium and 0.5% aluminium.	
Nickel	TR	Traces of Nimonic 80A will be present in the waste.	
Titanium			
Uranium			
Zinc	0		
Zircaloy/Zirconium	P	Some traces of zirconium as alloy in the Magnox and as a 'free' metal.	
Other metals	0		

Organics (%wt): There may be organics present in trace quantities.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	0		
Paper, cotton	0		
Wood	0		
Halogenated plastics	0	There are no halogenated plastics or rubbers present.	
Total non-halogenated plastics	0		
Condensation polymers	0		
Others	0		
Organic ion exchange materials	0		
Total rubber	0		
Halogenated rubber	0	There are no halogenated plastics or rubbers present.	
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): Traces of graphite may be present.

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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.....	0		
Sand.....			
Glass/Ceramics.....	0		
Graphite.....	TR		
Desiccants/Catalysts.....			
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	TR		
Free non-aqueous liquids.....	0		
Powder/Ash.....	NE		

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.....	>99.5	
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.....	>99.5
Higher activity particles.....	
Soluble solids as bulk chemical compounds.....	

Hazardous substances / non hazardous pollutants: Toxic metals may be present as impurities incorporated into the Magnox.

	(%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 likely contain "rogue" items (HDRIs) that will be (see Nimonic/Others)

TREATMENT, PACKAGING AND DISPOSAL

Waste that is currently ILW: -

Planned on-site / off-site treatment(s):

Treatment	On-site / Off site	Stream volume %
Low force compaction Supercompaction (HFC) Incineration Solidification Decontamination Metal treatment Size reduction Decay storage Recyling / reuse Other / various None	Off-site	100.0

Comment on planned treatments: -

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	100.0	0.35
Expected to be consigned to a Landfill Facility		
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility		
Expected to be consigned to a Metal Treatment Facility		
Expected to be consigned as Out of Scope		
Expected to be recycled / reused		
Disposal route not known		

Classification codes for waste expected to be consigned to a landfill facility: -

Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):

Disposal Route	Stream volume %		
	2022/23	2023/24	2024/25
Expected to be consigned to the LLW Repository			
Expected to be consigned to a Landfill Facility			
Expected to be consigned to an On-Site Disposal Facility			
Expected to be consigned to an Incineration Facility			
Expected to be consigned to a Metal Treatment Facility			
Expected to be consigned as Out of Scope			
Expected to be recycled / reused			
Disposal route not known			

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Opportunities for alternative disposal routing: -

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Disposal at LLWR	Disposal at a Geological Disposal Facility	NE	2023	Medium	Baseline position is LLW disposal but this is under threat - under investigation still

Waste Packaging for Disposal:

Container	Stream volume %	Waste loading m^3	Number of packages
1/3 Height IP-1 ISO 2/3 Height IP-2 ISO 1/2 Height WAMAC IP-2 ISO 1/2 Height IP-2 Disposal/Re-usable ISO 2m box (no shielding) 4m box (no shielding) Other	100.0	14.4	6

Other information: Assessment and further modelling of FED characterisation has resulted in a change and, therefore, a review of the current waste strategy is underway. In addition, FED sort and segregation learning from Bradwell and Hinkley Point A is available and provides empirical data to review the current sort and segregation strategy for FED at Oldbury and Sizewell A.

Waste Planned for Disposal at the LLW Repository:

Container voidage: -

-

Waste consigned for disposal to LLWR in year of generation: -

Non-Containerised Waste for In-Vault Grouting: (Not applicable to this waste stream)

Stream volume (%): -

Waste stream variation: -

Bounding cuboidal volume:

Inaccessible voidage: -

Other information: -

RADIOACTIVITY

Source: The source of the waste is the removal of splitters from fuel 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. Data taken from M/EF/OLA/EAN/0002/21 and underpinning calc sheets

Other information: Although the gross beta/gamma activity in the FED material is LLW, this waste stream is not discrete. The FED material is intimately mixed with highly active Nimonic Springs.

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	5.23E-02	C C 2			Gd 153	1.05E-09	C C 2		
Be 10		8			Ho 163	1.67E-08	C C 2		
C 14	1.67E-04	C C 2			Ho 166m	3.08E-07	C C 2		
Na 22	6.30E-08	C C 2			Tm 170		8		
Al 26		8			Tm 171	3.81E-06	C C 2		
Cl 36	1.93E-05	C C 2			Lu 174		8		
Ar 39	2.88E-08	C C 2			Lu 176		8		
Ar 42		8			Hf 178n	1.64E-09	C C 2		
K 40		8			Hf 182		8		
Ca 41	1.61E-07	C C 2			Pt 193		8		
Mn 53		8			Tl 204	1.44E-04	C C 2		
Mn 54	8.97E-08	C C 2			Pb 205		8		
Fe 55	6.52E-04	C C 2			Pb 210		8		
Co 60	2.04E-03	C C 2			Bi 208		8		
Ni 59	1.22E-05	C C 2			Bi 210m		8		
Ni 63	1.42E-03	C C 2			Po 210		8		
Zn 65	2.31E-07	C C 2			Ra 223		8		
Se 79		8			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85	1.18E-09	C C 2			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	2.67E-05	C C 2			Th 227		8		
Zr 93	1.25E-05	C C 2			Th 228		8		
Nb 91	1.79E-09	C C 2			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	5.51E-05	C C 2			Th 232		8		
Nb 94	1.30E-06	C C 2			Th 234		8		
Mo 93	1.75E-07	C C 2			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	2.34E-08	C C 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234		8		
Ag 108m	6.60E-06	C C 2			U 235		8		
Ag 110m	7.20E-08	C C 2			U 236		8		
Cd 109	1.65E-05	C C 2			U 238		8		
Cd 113m	3.85E-04	C C 2			Np 237		8		
Sn 119m	1.97E-09	C C 2			Pu 236		8		
Sn 121m	4.74E-07	C C 2			Pu 238	1.83E-06	C C 2		
Sn 123		8			Pu 239	2.43E-06	C C 2		
Sn 126		8			Pu 240	3.06E-06	C C 2		
Sb 125	2.06E-06	C C 2			Pu 241	5.16E-05	C C 2		
Sb 126		8			Pu 242		8		
Te 125m	5.16E-07	8			Am 241	7.43E-06	C C 2		
Te 127m		8			Am 242m		8		
I 129		8			Am 243		8		
Cs 134	9.12E-06	C C 2			Cm 242		8		
Cs 135		8			Cm 243	1.76E-09	C C 2		
Cs 137	3.47E-05	C C 2			Cm 244	4.43E-08	C C 2		
Ba 133	7.31E-06	C C 2			Cm 245		8		
La 137	1.62E-09	C C 2			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145	3.34E-07	C C 2			Cf 250		8		
Pm 147	9.37E-05	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	1.56E-05	C C 2			Other a				
Eu 152	1.95E-07	C C 2			Other b/g				
Eu 154	2.03E-05	C C 2			**Total a**	**1.48E-05**	**C C 2**	**0**	
Eu 155	4.10E-05	C C 2			**Total b/g**	**5.75E-02**	**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