WASTE STREAM 9E26 FED Magnox

SITE Oldbury

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE ILW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	85.3 m³
Total future arisings:		0 m³
Total waste volume:		85.3 m³

Comment on volumes: Future arisings are zero because the vault is full. Fuel element spiders have not been accumulated on site in significant numbers since the commissioning of a new desplittering machine in 1983.

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: -

Bulk density (t/m³): 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. Magnox with impurities which may include berylium. Also some traces of zirconium as alloy in the Magnox and as a 'free' metal.

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	Stainless steel	0	
	Other ferrous metals	0	
	Iron		
	Aluminium	P	
	Beryllium	TR	Magnox with impurities which may include berylium.
	Cobalt		
	Copper	0	
	Lead	0	
	Magnox/Magnesium	>99.5	Will consist predominantly of Magnox alloy ZR55. includes 0.55% zirconium and 0.5% aluminium. Traces of Nimonic 80A will be present in the waste.
	Nickel		
	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.		
	Total cellulosics	0	
	Paper, cotton	0	
	Wood	0	
	Halogenated plastics	0	
	Total non-halogenated plastics	0	There are no halogenated plastics or rubbers present.
	Condensation polymers	0	
	Others	0	
	Organic ion exchange materials	0	
	Total rubber	0	There are no halogenated plastics or rubbers present.
	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):	-		

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	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.	
	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.....	>99.5
	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.....	>99.5
	Active particles.....	

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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

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LAW TREATMENT, PACKAGING AND DISPOSAL

Waste that is currently ILW: -

Planned on-site / off-site treatments(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		100.0

Comment on planned treatments: -

Disposal Routes:

Disposal Route	Stream volume %
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	100.0

Upcoming (2019/20-2021/22) waste routing (if expected to change from above)

Disposal Route	Stream volume %		
	2019/20	2020/21	2021/22
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			

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: -

Waste Consigned to the LLW Repository:

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Container voidage:	-
Waste Characterisation Form (WCH):	-
Waste consigned for disposal to LLWR in year of generation:	-
Potential for the waste to contain discrete items:	-

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 the 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.
Other information:	-

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	4.82E-04	C C 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	5.00E-03	C C 2			Ho 166m		8		
Na 22					Tm 170		8		
Al 26	4E-07	C C 2			Tm 171		8		
Cl 36		8			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	9.12E-05	C C 2			Pb 210		8		
Co 60	1.83E-04	C C 2			Bi 208		8		
Ni 59		8			Bi 210m		8		
Ni 63	5.64E-04	C C 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	6.45E-05	C C 2			Th 227		8		
Zr 93	4E-07	C C 2			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	1.60E-07	C C 2			Th 232		8		
Nb 94		8			Th 234		8		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99		8			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234		8		
Ag 108m	9.85E-07	C C 2			U 235		8		
Ag 110m		8			U 236		8		
Cd 109		8			U 238		8		
Cd 113m		8			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	9.32E-07	C C 2		
Sn 123		8			Pu 239	7.00E-07	C C 2		
Sn 126		8			Pu 240	9.00E-07	C C 2		
Sb 125	3.10E-07	C C 2			Pu 241	5.19E-05	C C 2		
Sb 126		8			Pu 242		8		
Te 125m	7.77E-08	C C 2			Am 241	3.88E-06	C C 2		
Te 127m		8			Am 242m		8		
I 129		8			Am 243		8		
Cs 134		8			Cm 242		8		
Cs 135		8			Cm 243	7.32E-09	C C 2		
Cs 137	5.69E-05	C C 2			Cm 244	2.12E-07	C C 2		
Ba 133	4.44E-06	C C 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		8			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151		8			Other a				
Eu 152		8			Other b/g	<5.29E-09	C 3		
Eu 154	9.66E-06	C C 2			**Total a**	**6.63E-06**	**C C 2**	**0**	
Eu 155	8.33E-07	C C 2			**Total b/g**	**6.51E-03**	**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