WASTE STREAM	9F23	FED Magnox

SITE Sizewell A

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE LLW

WASTE VOLUMES

	Reported (m^3)
Stocks: At 1.4.2025	= 261.0
Future arisings:	
Total future arisings:	**0.0**
Total waste volume:	**261.0**

OR

Conditioned (m^3)	Packaged (m^3)

Number of waste packages in stock: At 1.4.2025…… - packages

Comment on arising rates: -

Additional information on quantities: The process of de-splittering and de-lugging of fuel elements no longer takes place so no further waste arisings will occur.

Uncertainty factors on volumes:

Stock (upper):	x 1.10	Arisings (upper):	x -
Stock (lower):	x 0.90	Arisings (lower):	x -

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

PHYSICAL CHARACTERISTICS

General description: The waste consists of Magnox metal swarf and sludge which may be contaminated by fission products and actinides. Individual components may weigh up to about 20 g and be approx. 2 mm x 25 mm x (50-100) mm for splitters (after cutting) and 4 mm x 15 mm x 100 mm for lugs. There are some Nimonic springs but these are identified as a different waste stream, 9F43. There are no large items in the waste which will require special handling although there are some splitters of the order 2 mm x 25 mm x 1 m long. From the site ILW logbook it is known that a number of bags (>25) of sludge from R1 and R2 reception bay were added into cells 2 and 3 between 1970 and 1980. There are also records of the addition of “debris” from R1 and R2 reception bay into cells 2 and 3 between 1968 and 1978.

Changes since waste generated: -

Bulk density (t/m^3): = 0.32

Comment on density: Bulk densities of waste in each cell are 0.31 te/m3 (Cell 2), 0.31 te/m3 (Cell 3) and 0.49 te/m3 (Cell 4).

CHEMICAL COMPOSITION

General description and components (%wt): Magnox metal, magnesium hydroxide, magnesium carbonate (>99% wt in total including impurities).

Chemical state: Alkali

Sheet metal proportion / thickness: Magnox metal incorporating impurities which may include beryllium. Magnox splitters will generally be 2 mm x 25 mm x (50-100) mm in size though some may be up to 2 mm x 25 mm x 1 m. Magnox lugs will be about 4 mm x 15 mm x 100 mm. The Magnox FED will constitute >99% of the waste.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel	= 0	-	
Other ferrous metals	= 0	-	
Iron		-	
Aluminium	= 0	-	
Beryllium	TR	-	
Cobalt		-	
Copper	= 0	-	
Lead	= 0	-	
Magnox/Magnesium	> 99.0	Will consist predominantly of Magnox alloy ZR55. includes 0.5% zirconium	
Nickel		-	
Titanium		-	
Uranium		-	
Zinc	= 0	-	
Zircaloy/Zirconium	P	-	
Other metals	= 0	No "other" metals present.	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	= 0	-	
Paper, cotton	= 0	-	
Wood	= 0	-	
Halogenated plastics	= 0	-	
Total non-halogenated plastics	TR	known presence of bags containing sludge from logbook and camera inspection	
Condensation polymers	TR	-	
Others	TR	-	
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):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials	= 0	-	
Inorganic sludges and flocs	P	Magnox debris can form an inorganic sludge in damp conditions. The extent of corrosion is only apparent on retrieval. It is also known that a number of bags (>25) of sludge were added into cells 2&3 during the 1970's.	
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	P	-	
Free non-aqueous liquids	= 0	-	
Powder/Ash	TR	-	

COMPONENTS OF MATERIALS, WASTE PROPERTIES, MATERIALS NOT CONTRIBUTING TO MASS

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
Fluoride	NE	-
Chloride	NE	-
Iodide	NE	-
Cyanide	= 0	-
Carbonate	NE	-
Nitrate	NE	-
Nitrite	NE	-
Phosphate	NE	-
Sulphate	NE	-
Sulphide	NE	-

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals	> 99.0	-
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		-
Corrosive materials	= 0	-
Pyrophoric materials	= 0	-
Generating toxic gases	= 0	-
Reacting with water	> 99.0	-
Higher activity particles		-
Soluble solids as bulk chemical compounds		-

Hazardous substances / 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		-

Complexing agents (%wt): Not yet determined

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

Physical components:

	Number	Type(s) and comment
Sources		-
Electronic & Electrical Equipment (EEE)		-
EEE Type 1		-
EEE Type 2		-
EEE Type 3		-
EEE Type 4		-
EEE Type 5		-

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off-site	Stream volume %
Size reduction Decay storage Low force compaction Supercompaction (HFC) Incineration Drying/dewatering/liquid separation Tie down/fixatives/strippable coating/painting application Decontamination Metal treatment Recycling / reuse Thermal treatment, including vitrification Encapsulation Polymer encapsulation Other physical treatment Other chemical treatment Containerisation Treatment not yet determined None	Off-site	= 100.0

Comments on planned treatments: -

Conditioning method: -

Conditioning plants:

Plant Name	Location

Likely conditioning matrix: -

Further information on the conditioning matrix: -

Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m^3)	Payload (m^3)	Number of packages	Estimated start date for packaging
1/2 Height IP-2 Disposal/Re-usable ISO (TC01/TC02)	100.0	14.4	18.3	19	-

Range in container waste loading: -

Other information on packaging and conditioning: -

Conditioned density (t/m^3): -
Conditioned density comment: -

Management Routes:

Disposal Route	Stream volume %	Raw density t/m^3	Start date
Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland) Expected to be Non-NSD HAW managed under Scottish Government's policy Expected to be disposed to LLW Vaults NRS Dounreay Expected to be consigned to the Geological Disposal Facility Expected to be consigned to a Near Surface Disposal Facility Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be disposed On-Site Expected to be managed by In-Situ Disposal Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be Out of Scope Expected to be recycled / reused Disposal route not known	= 100.0	0.32	

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

Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
LLWR	GDF	-	RED	Baseline position is LLW disposal but this is under threat - under investigation still

RADIOACTIVITY

Source: The source of the waste is the removal of splitters and lugs 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. The activity estimates make no allowance for any Nimonic springs (9F43) or zirconium in the top end fittings but the resulting average activities would be likely to lie within the uncertainties associated with the average activity of Magnox. Activity estimate makes no allowance for the presence of ponds sludge in the cells. Contamination by fission products and actinides has the potential to be higher than estimated in current data.

Uncertainty: The values quoted are indicative of activities that might be expected. Specific activity is from sampling of the waste at the top of the cells. Activity information does not include any estimate for the sludge bags known to have been placed in cells 2 & 3 from the ponds.

Measurement of radioactivities: -

Chemical form of radionuclides:

H-3: The tritium is expected to be present possibly as water but perhaps in the form of other inorganic compounds or as organic compounds.
C-14: The carbon 14 will probably be present as graphite.
Cl-36: The 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.
I-129: -
Ra: The radium isotope content is insignificant.
Th: The thorium isotope content is insignificant.
U: Chemical form of uranium isotopes may be uranium oxides.
Np: The chemical form of neptunium has not been determined.
Pu: Chemical form of plutonium isotopes may be plutonium oxides.

WASTE STREAM **9F23** **FED Magnox**

Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3	3.10E-03	C C 2			Gd 153		8		
Be 10	8.69E-08	C C 2			Ho 163	1.09E-08	C C 2		
C 14	1.43E-04	C C 2			Ho 166m	2.06E-07	C C 2		
Na 22		8			Tm 170		8		
Al 26	1.25E-09	C C 2			Tm 171		8		
Cl 36	1.65E-05	C C 2			Lu 174		8		
Ar 39	2.23E-08	C C 2			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40		8			Hf 182		8		
Ca 41	1.38E-07	C C 2			Pt 193		8		
Mn 53		8			Tl 204	1.41E-06	C C 2		
Mn 54		8			Pb 205		8		
Fe 55	3.81E-06	C C 2			Pb 210		8		
Co 60	2.30E-05	C C 2			Bi 208		8		
Ni 59	8.24E-06	C C 2			Bi 210m		8		
Ni 63	8.36E-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	1.52E-05	C C 2			Th 227		8		
Zr 93	6.83E-06	C C 2			Th 228	2.73E-08	C C 2		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	9.01E-06	C C 2			Th 232		8		
Nb 94	6.72E-07	C C 2			Th 234	1.95E-08	C C 2		
Mo 93	8.88E-08	C C 2			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	3.97E-08	C C 2			U 232	3.02E-08	C C 2		
Ru 106		8			U 233	6.84E-08	C C 2		
Pd 107		8			U 234	6.20E-08	C C 2		
Ag 108m	1.46E-06	C C 2			U 235		8		
Ag 110m		8			U 236	1.32E-09	C C 2		
Cd 109		8			U 238	1.95E-08	C C 2		
Cd 113m	4.94E-05	C C 2			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m	7.42E-07	C C 2			Pu 238	4.47E-07	C C 2		
Sn 123		8			Pu 239	4.29E-07	C C 2		
Sn 126		8			Pu 240	5.06E-07	C C 2		
Sb 125	1.25E-08	C C 2			Pu 241	1.23E-05	C C 2		
Sb 126		8			Pu 242	5.20E-09	C C 2		
Te 125m	3.14E-09	C C 2			Am 241	2.49E-06	C C 2		
Te 127m		8			Am 242m		8		
I 129		8			Am 243		8		
Cs 134	1.22E-09	C C 2			Cm 242		8		
Cs 135		8			Cm 243	2.09E-09	C C 2		
Cs 137	2.08E-05	C C 2			Cm 244	2.37E-08	C C 2		
Ba 133	1.50E-06	C C 2			Cm 245		8		
La 137	1.38E-09	C C 2			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145	8.10E-08	C C 2			Cf 250		8		
Pm 147	3.02E-08	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	6.06E-06	C C 2			Unsp a				
Eu 152	9.55E-08	C C 2			Unsp b/g				
Eu 154	1.31E-06	C C 2			**Total a**	**4.11E-06**	*	**0**	*
Eu 155	9.73E-07	C C 2			**Total b/g**	**4.25E-03**	*	**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 the 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
* Total calculated from the 114 declared radionuclides