

WASTE STREAM	9B79/C	FED Magnox - Solid Secondary Waste
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SITE Bradwell

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE ILW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025		= 0.4	2.6
Future arisings:				0.0
Total future arisings:			0.0	0.0
Total waste volume:			0.4	2.6

Number of waste packages in stock: At 1.4.2025..... 2 packages

Comment on arising rates: -

Additional information on quantities: -

Uncertainty factors on volumes:

Stock (upper):	x 1.00	Arisings (upper):	x -
Stock (lower):	x 1.00	Arisings (lower):	x -

WASTE SOURCE Consists of segregated items, isolated prior to processing of FED through the FED dissolution plant, and insoluble items obtained after processing through the FED dissolution plant.

PHYSICAL CHARACTERISTICS

General description: Secondary solid waste consists primarily of nimonic springs, thermocouple wires and fuel fragments. Additionally, the volume will include a small fraction of top end fittings (spiders) containing zirconium alloy. Springs weigh approx 5g each and are estimated to be 33mm long and 10mm diameter. Thermocouples components are comprised of stainless steel and other metals. Top end fittings comprised of zirconium alloy and weigh approx 88g each. Also consists of sludge-entrained organics, assumed to be oils and adhesive tape used to manage particulates.

Changes since waste generated: -

Bulk density (t/m³): = 0.70

Comment on density: The density is calculated using known wastestream mass and volume.

CHEMICAL COMPOSITION

General description and components (%wt): The waste is comprised of solid waste removed from FED prior to it undergoing dissolution and residues from the chemical dissolution of Magnox. The waste will primarily consist of MAC (miscellaneous activated components) including segregated Nimonic springs, thermocouple wires and small fractions of fuel fragments and top end fittings.

Chemical state: -

Sheet metal proportion / thickness: Magnox MN80 is the primary component, accounting for 80.2wt%. Stainless steel from thermocouples is 10.5wt%, zirconium alloy from the spider is 2.7wt%, Nimonic 80A from top end fitting springs is 3.5wt%, uranium as pieces of segregated fuel is 3wt%.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 10.5	Thermocouples, nose cones, miscellaneous (e.g. head, lifter and metal)	
Other ferrous metals.....	= 0	-	
Iron.....	-	-	
Aluminium.....	NE	-	
Beryllium.....	TR	-	
Cobalt.....	-	-	
Copper.....	TR	-	
Lead.....	TR	-	
Magnox/Magnesium.....	= 80.2	Spider, nose cones, miscellaneous (e.g. end-cap, FED piece and fin)	
Nickel.....	= 3.5	Present as Nimonic 80A, Top End Fitting springs, miscellaneous (e.g. part of head and lifter).	
Titanium.....	-	-	
Uranium.....	= 3.0	Pieces of segregated fuel and miscellaneous particulates	
Zinc.....	NE	-	
Zircaloy/Zirconium.....	= 2.7	Spider, miscellaneous (e.g. pin)	
Other metals.....	= 0	-	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	NE	-	
Paper, cotton.....	NE	-	
Wood.....	NE	-	
Halogenated plastics.....	= 0	-	
Total non-halogenated plastics.....	= 0	-	
Condensation polymers.....	= 0	-	
Others.....	= 0	-	
Organic ion exchange materials.....	TR	-	
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.....	= 0.10	Sludge-entrained organics, assumed to be oils and adhesive tape used to manage particulate	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	NE	-	
Inorganic sludges and flocs.....	= 0	-	
Soil.....	= 0	-	
Brick/Stone/Rubble.....	= 0	-	
Cementitious material.....	= 0	-	
Sand.....	-	-	
Glass/Ceramics.....	= 0	-	
Graphite.....	NE	-	
Desiccants/Catalysts.....	-	-	
Asbestos.....	= 0	-	
Non/low friable.....	-	-	
Moderately friable.....	-	-	
Highly friable.....	-	-	
Free aqueous liquids.....	P	-	
Free non-aqueous liquids.....	TR	-	
Powder/Ash.....	= 0	-	

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.....	NE	-
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.....	= 0	-
Low flash point liquids.....	= 0	-
Explosive materials.....	= 0	-
Phosphorus.....	= 0	-
Hydrides.....	= 0	-
Biological etc. materials.....	TR	-
Biodegradable materials.....	0	-
Putrescible wastes.....	= 0	-
Non-putrescible wastes.....		-
Corrosive materials.....	= 0	-
Pyrophoric materials.....	= 0	-
Generating toxic gases.....	NE	-
Reacting with water.....	= 0	-
Higher activity particles.....		-
Soluble solids as bulk chemical compounds.....		-

Hazardous substances / non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....	0	-
Benzene.....		-
Chlorinated solvents.....		-
Formaldehyde.....		-
Organometallics.....		-
Phenol.....		-
Styrene.....		-
Tri-butyl phosphate.....		-
Other organophosphates.....		-
Vinyl chloride.....		-
Arsenic.....		-
Barium.....		-
Boron.....		-
Boron (in Boral).....		-
Boron (non-Boral).....		-
Cadmium.....		-
Caesium.....		-
Selenium.....		-
Chromium.....		-
Molybdenum.....		-
Thallium.....		-
Tin.....		-
Vanadium.....		-
Mercury compounds.....		-
Others.....		-

Complexing agents (%wt):

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

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		

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 (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
500 I RS drum (50mm Pb)	100.0	0.18	0.18	2	-

Range in container waste loading: Not yet determined.

Other information on packaging and conditioning:

The container material is cast iron.

Conditioned density (t/m³):

~ 0.70

Conditioned density comment:

The conditioned density is calculated using the known mass and volume of the wastestream.

Management Routes:

Disposal Route	Stream volume %	Raw density t/m³	Start date
Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland)	100.0		
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			

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

Opportunities for alternative disposal routing: No

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
-	-	-	-	-

RADIOACTIVITY

Source: Activation of metal components that were in close proximity to fuel during generating operation. In addition to activation, a significant amount of contamination is expected.

Uncertainty: Specific activities of both waste packages were determined using gamma spectroscopy and fingerprints.

Measurement of radioactivities: Specific activities of both waste packages were measured and derived using gamma spectroscopy and the application of fingerprints. Specific activities of each waste package along with wastestream volume was used to calculate specific activity.

Chemical form of radionuclides:

- H-3: -
- C-14: Carbon 14 may be present as graphite.
- Cl-36: The chemical form of chlorine 36 may be inorganic chloride.
- Se-79: -
- Tc-99: -
- I-129: -
- Ra: -
- Th: -
- U: Uranium is present as pieces of segregated fuel and miscellaneous particulates.
- Np: -
- Pu: The chemical form of plutonium isotopes has not been determined but will probably be plutonium oxides.

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code		Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3	2.18E-01	C C 2			Gd 153		8		
Be 10	4.90E-07	C C 2			Ho 163	2.96E-06	C C 2		
C 14	8.46E-03	C C 2			Ho 166m	8.98E-04	C C 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171	7.31E-07	C C 2		
Cl 36	1.06E-05	C C 2			Lu 174	1.81E-07	C C 2		
Ar 39	5.22E-04	C C 2			Lu 176		8		
Ar 42	9.67E-09	C C 2			Hf 178n	1.54E-03	C C 2		
K 40	2.96E-09	C C 2			Hf 182		8		
Ca 41	1.84E-05	C C 2			Pt 193	2.67E-04	C C 2		
Mn 53	7.92E-09	C C 2			Ti 204	7.22E-04	C C 2		
Mn 54	1.51E-09	C C 2			Pb 205		8		
Fe 55	5.05E-02	C C 2			Pb 210	1.68E-09	C C 2		
Co 60	1.00E+00	C C 2			Bi 208		8		
Ni 59	5.70E-02	C C 2			Bi 210m		8		
Ni 63	5.75E+00	C C 2			Po 210	1.59E-09	C C 2		
Zn 65		8			Ra 223	1.66E-04	C C 2		
Se 79	3.18E-06	C C 2			Ra 225	8.20E-09	C C 2		
Kr 81	2.62E-06	C C 2			Ra 226	6.61E-09	C C 2		
Kr 85	5.78E-02	C C 2			Ra 228	1.62E-09	C C 2		
Rb 87	5.08E-09	C C 2			Ac 227	1.65E-04	C C 2		
Sr 90	2.33E+00	C C 2			Th 227	1.64E-04	C C 2		
Zr 93	1.70E-04	C C 2			Th 228	7.00E-07	C C 2		
Nb 91	1.66E-06	C C 2			Th 229	8.21E-09	C C 2		
Nb 92		8			Th 230	8.21E-08	C C 2		
Nb 93m	9.90E-04	C C 2			Th 232	1.63E-09	C C 2		
Nb 94	1.44E-04	C C 2			Th 234	2.20E-04	C C 2		
Mo 93	1.17E-04	C C 2			Pa 231	1.29E-08	C C 2		
Tc 97		8			Pa 233	1.04E-05	C C 2		
Tc 99	1.23E-03	C C 2			U 232	6.80E-07	C C 2		
Ru 106	1.06E-08	C C 2			U 233	2.67E-06	C C 2		
Pd 107	7.41E-06	C C 2			U 234	1.96E-04	C C 2		
Ag 108m	3.07E-05	C C 2			U 235	5.70E-06	C C 2		
Ag 110m		8			U 236	2.10E-05	C C 2		
Cd 109		8			U 238	2.20E-04	C C 2		
Cd 113m	2.20E-04	C C 2			Np 237	1.04E-05	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m	1.18E-03	C C 2			Pu 238	2.22E-02	C C 2		
Sn 123		8			Pu 239	8.02E-02	C C 2		
Sn 126	2.76E-05	C C 2			Pu 240	7.95E-02	C C 2		
Sb 125	5.08E-05	C C 2			Pu 241	1.51E-04	C C 2		
Sb 126	3.86E-06	C C 2			Pu 242	3.80E-05	C C 2		
Te 125m	1.27E-05	C C 2			Am 241	1.91E-01	C C 2		
Te 127m		8			Am 242m		8		
I 129	2.57E-06	C C 2			Am 243	7.13E-05	C C 2		
Cs 134	5.63E-04	C C 2			Cm 242		8		
Cs 135	5.58E-05	C C 2			Cm 243	2.67E-05	C C 2		
Cs 137	3.21E+00	C C 2			Cm 244	3.20E-04	C C 2		
Ba 133	3.24E-04	C C 2			Cm 245	3.03E-08	C C 2		
La 137	9.49E-07	C C 2			Cm 246	1.82E-09	C C 2		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145	2.41E-06	C C 2			Cf 250		8		
Pm 147	6.15E-04	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	2.94E-02	C C 2			Unsp a				
Eu 152	3.19E-05	C C 2			Unsp b/g				
Eu 154	7.58E-03	C C 2			Total a	3.74E-01	*	0	*
Eu 155	5.34E-04	C C 2			Total b/g	1.27E+01	*	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