WASTE STREAM	2D401	AHF Metallic uranium wastes to WEP

SITE Sellafield

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Ltd

WASTE TYPE ILW

WASTE VOLUMES

		Reported (m^3)
Stocks:	At 1.4.2025	= 0
Future arisings:	1.4.2025 - 31.3.2026	= 0.4
	1.4.2026 - 31.3.2027	= 0.4
Total future arisings:		**0.9**
Total waste volume:		**0.9**

OR

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

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

Comment on arising rates: Well defined arising rate.

Additional information on quantities: Waste volumes is well defined with very specific packing arrangements dictated for this waste type.

Uncertainty factors on volumes:

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

WASTE SOURCE

The AHF is used for the storage of an inventory of legacy Magnox and Windscale Pile fuel waste which exists in various physical forms, including un-irradiated fuel such as uranium elements, bars, and standards. Additionally, the facility stores irradiated fuel wastes in sealed bottles that have previously been stored in the FGMSP, as well as fuel pieces and debris; “Uranium Swarf” consisting of uranium swarf, cuttings, sweepings and flask debris; and mounts – thin slices of fuel mounted in epoxy and plastic rings which are used to undertake Post-Irradiation Examination (PIE).

All of this material will be loaded into specially designed furniture in waste baskets, and then transferred to the WEP to be packaged into 500 litre drums using cementitious grout, for long-term interim storage in the Encapsulated Product Stores, and eventual disposal in a Geological Disposal Facility.

PHYSICAL CHARACTERISTICS

General description: Magnox and Tokai Mura fuel elements originating from FGMSP, stored in bottles. The remainder is fuel pieces and debris including fuel from Chapelcross, ex-Wylfa, and other Magnox fuel samples from FGMSP. There are standard un-irradiated Magnox fuel elements, taken from Springfields and inserted into Magnox cans. 4” by 4” high cemented cans of waste from PIE at the Berkeley Nuclear Laboratories. It is thought that these contain both uranium swarf and small pieces of fuel. A range of materials including material from the Magnox Reprocessing Plant sump filters. There is also Magnox and uranium swarf generated from cutting Magnox fuel to produce metallographic samples. Fuel sweepings are mixed with fire powder and corrosion products. Magnox fuel mounts and flask debris consisting of uranium and Magnox. Windscale Pile elements from the Piles water and air ducts and a piece of cladding stored loose within a bit bin.

Changes since waste generated: Air and water based corrosion

Bulk density (t/m^3): = 6.6

Comment on density: Material mass and material volume of the waste stream.

CHEMICAL COMPOSITION

General description and components (%wt): See detailed breakdown.

Chemical state: Neutral

Sheet metal proportion / thickness: Uranium components in bar and particulate form, steel components in sheet form 1-3mm thick, aluminium components in sheet form 1-3mm thick, Magnox components in cladding and particulate form.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel	= 46.4	316L	< 0.1
Other ferrous metals	= 19.9	Various and unknown grades, likely standard mild steel	< 0.1
Iron		-	
Aluminium	= 0.19	Unknown but likely akin to 1050	< 0.1
Beryllium		-	
Cobalt		-	
Copper		-	
Lead		-	
Magnox/Magnesium	= 3.3	Predominantly AL80 but includes MN80, MN150	
Nickel		-	
Titanium		-	
Uranium	= 21.4	Magnox uranium grade and Windscale Pile uranium grade	100.0
Zinc		-	
Zircaloy/Zirconium	TR	Zirconium Alloy	
Other metals	TR	Nimonic 80A	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics		-	
Paper, cotton		-	
Wood		-	
Halogenated plastics		-	
Total non-halogenated plastics	= 0.03	Epoxy resin	< 0.1
Condensation polymers		-	
Others		-	
Organic ion exchange materials		-	
Total rubber	= 0.14	EPDM	
Halogenated rubber		-	
Non-halogenated rubber		-	
Hydrocarbons		-	
Oil or grease		-	
Fuel		-	
Asphalt/Tarmac (cont.coal tar)		-	
Asphalt/Tarmac (no coal tar)		-	
Bitumen		-	
Others		-	
Other organics		-	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials		-	
Inorganic sludges and flocs		-	
Soil		-	
Brick/Stone/Rubble		-	
Cementitious material	= 6.0	Cement mixture of 1 part sharp sand, 1 part cement, 1-1½ parts 1:1 detergent/water mixture intimately mixed with uranium swarf. Cement mixture of 3 parts sharp sand, 1-1½ parts cement, ¾ part kaolin, 1-1½ parts water added to base of tin, basket added and topped off with this mixture.	< 0.1
Sand		-	
Glass/Ceramics		-	
Graphite	TR	CY9 carbon	< 0.1
Desiccants/Catalysts		-	
Asbestos		-	
Non/low friable		-	
Moderately friable		-	
Highly friable		-	
Free aqueous liquids		-	
Free non-aqueous liquids		-	
Powder/Ash	= 2.6	Rust, dusts, potassium chloride fire supressant	< 0.1

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

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
Fluoride		-
Chloride	= 0.35	KCl fire suppressant
Iodide		-
Cyanide		-
Carbonate		-
Nitrate		-
Nitrite		-
Phosphate		-
Sulphate		-
Sulphide		-

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals		-
Low flash point liquids		-
Explosive materials		-
Phosphorus		-
Hydrides		-
Biological etc. materials		-
Biodegradable materials		-
Putrescible wastes		-
Non-putrescible wastes		-
Corrosive materials		-
Pyrophoric materials		-
Generating toxic gases		-
Reacting with water		-
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		-
Boron (in Boral)		-
Boron (non-Boral)		-
Cadmium		-
Caesium		-
Selenium		-
Chromium		-
Molybdenum		-
Thallium		-
Tin		-
Vanadium		-
Mercury compounds		-
Others		-

Complexing agents (%wt): No

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

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	On-site	= 100.0

Comments on planned treatments: Necessary size reduction of long items, pre-grouting of powders and then encapsulation in WEP.

Conditioning method: Encapsulation in grout at Wastes Encapsulation Plant

Conditioning plants:

Plant Name	Location
Wastes Encapsulation Plant (WEP)	Sellafield

Likely conditioning matrix: None

Further information on the conditioning matrix: 5:1 GGBS:CEM I 0.47 - 0.59 w/s

Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m^3)	Payload (m^3)	Number of packages	Estimated start date for packaging
500 l drum (basket for waste)	100.0	0.05	0.50	16	2025

Range in container waste loading: 3 waste loading scenarios will be generated depending on the nature of the basket loading geometry. 17 Fuel elements OR 12 7"x9" paint tins OR 49 4"x4" paint tins.

Other information on packaging and conditioning: N/A

Conditioned density (t/m^3): ~ 2.0

Conditioned density comment: Total waste form volume is 502 L with grout density of 1.74 kg/L. Total waste mass of 5.686 t with 0.863m3 volume. 64.6 L voidage per drum. 16 drums.

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		2077

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: Irradiation in various reactors.

Uncertainty: Estimate is suitably conservative based on derived fingerprints based on irradiation history and cooling.

Measurement of radioactivities: Estimate is suitably conservative based on derived fingerprints based on irradiation history and cooling.

Chemical form of radionuclides:

H-3: As metal and oxides
C-14: As metal and oxides
Cl-36: As metal and oxides
Se-79: As metal and oxides
Tc-99: As metal and oxides
I-129: As metal and oxides
Ra: As metal and oxides
Th: As metal and oxides
U: As metal and oxides
Np: As metal and oxides
Pu: As metal and oxides

WASTE STREAM **2D401** **AHF Metallic uranium wastes to WEP**

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			= 6.97E-01	A A 2	Gd 153			= 2.52E-10	A A 2
Be 10			= 1.98E-06	A A 2	Ho 163			= 3.94E-07	A A 2
C 14			= 2.04E-02	A A 2	Ho 166m			= 1.34E-04	A A 2
Na 22					Tm 170				
Al 26					Tm 171			= 5.92E-07	A A 2
Cl 36			= 3.50E-06	A A 2	Lu 174			= 5.58E-11	A A 2
Ar 39			= 1.97E-04	A A 2	Lu 176			= 1.48E-10	A A 2
Ar 42			= 6.67E-12	A A 2	Hf 178n			= 1.59E-04	A A 2
K 40			= 1.05E-08	A A 2	Hf 182			= 4.74E-11	A A 2
Ca 41			= 1.13E-04	A A 2	Pt 193			= 1.90E-07	A A 2
Mn 53			= 1.32E-10	A A 2	Tl 204			= 5.73E-08	A A 2
Mn 54			= 3.79E-08	A A 2	Pb 205			= 2.11E-11	A A 2
Fe 55			= 6.85E-03	A A 2	Pb 210			= 1.16E-08	A A 2
Co 60			= 2.08E-01	A A 2	Bi 208			= 4.76E-11	A A 2
Ni 59			= 3.76E-03	A A 2	Bi 210m			= 2.32E-11	A A 2
Ni 63			= 3.85E-01	A A 2	Po 210			= 5.71E-09	A A 2
Zn 65			= 4.02E-12	A A 2	Ra 223			= 1.49E-07	A A 2
Se 79			= 2.61E-03	A A 2	Ra 225			= 1.61E-07	A A 2
Kr 81			= 4.74E-09	A A 2	Ra 226			= 1.61E-07	A A 2
Kr 85			= 1.07E+01	A A 2	Ra 228			= 1.74E-05	A A 2
Rb 87			= 1.67E-07	A A 2	Ac 227			= 2.35E-07	A A 2
Sr 90			= 2.76E+02	A A 2	Th 227			= 2.32E-07	A A 2
Zr 93			= 1.42E-02	A A 2	Th 228			= 2.14E-05	A A 2
Nb 91			= 5.65E-09	A A 2	Th 229			= 1.46E-08	A A 2
Nb 92			= 1.54E-12	A A 2	Th 230			= 5.16E-06	A A 2
Nb 93m			= 1.06E-02	A A 2	Th 232			= 6.04E-09	A A 2
Nb 94			= 5.14E-06	A A 2	Th 234			= 1.74E-02	A A 2
Mo 93			= 2.61E-06	A A 2	Pa 231			= 4.77E-07	A A 2
Tc 97			= 2.92E-12	A A 2	Pa 233			= 9.59E-04	A A 2
Tc 99			= 1.14E-01	A A 2	U 232			= 2.10E-05	A A 2
Ru 106			= 4.24E-03	A A 2	U 233			= 4.81E-06	A A 2
Pd 107			= 7.92E-04	A A 2	U 234			= 1.52E-02	A A 2
Ag 108m			= 7.09E-07	A A 2	U 235			= 4.18E-04	A A 2
Ag 110m			= 5.89E-08	A A 2	U 236			= 1.81E-03	A A 2
Cd 109			= 3.70E-12	A A 2	U 238			= 1.74E-02	A A 2
Cd 113m			= 4.17E-02	A A 2	Np 237			= 9.59E-04	A A 2
Sn 119m			= 1.39E-08	A A 2	Pu 236			= 3.09E-07	A A 2
Sn 121m			= 1.43E-01	A A 2	Pu 238			= 4.03E+00	A A 2
Sn 123					Pu 239			= 6.24E+00	A A 2
Sn 126			= 5.88E-03	A A 2	Pu 240			= 8.33E+00	A A 2
Sb 125			= 1.25E-01	A A 2	Pu 241			= 1.83E+02	A A 2
Sb 126			= 8.23E-04	A A 2	Pu 242			= 6.26E-03	A A 2
Te 125m			= 3.03E-02	A A 2	Am 241			= 2.10E+01	A A 2
Te 127m					Am 242m			= 4.17E-02	A A 2
I 129			= 2.47E-04	A A 2	Am 243			= 1.85E-02	A A 2
Cs 134			= 8.73E-02	A A 2	Cm 242			= 3.41E-02	A A 2
Cs 135			= 5.86E-03	A A 2	Cm 243			= 9.18E-03	A A 2
Cs 137			= 3.97E+02	A A 2	Cm 244			= 2.04E-01	A A 2
Ba 133			= 4.08E-07	A A 2	Cm 245			= 2.23E-05	A A 2
La 137			= 3.71E-08	A A 2	Cm 246			= 2.67E-06	A A 2
La 138			= 4.63E-12	A A 2	Cm 248			= 3.38E-12	A A 2
Ce 144			= 4.82E-04	A A 2	Cf 249			= 1.08E-11	A A 2
Pm 145			= 2.65E-09	A A 2	Cf 250			= 1.16E-11	A A 2
Pm 147			= 2.15E+00	A A 2	Cf 251				
Sm 147			= 7.18E-08	A A 2	Cf 252				
Sm 151			= 2.64E+00	A A 2	Unsp a				
Eu 152			= 2.13E-02	A A 2	Unsp b/g				
Eu 154			= 2.11E+00	A A 2	**Total a**	**0**	*	**3.99E+01**	*
Eu 155			= 2.80E-01	A A 2	**Total b/g**	**0**	*	**8.77E+02**	*

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