

WASTE STREAM	3L22	Fuel Stringer Debris - Debris Vault 4
--------------	------	---------------------------------------

SITE Heysham 1

SITE OWNER EDF Energy Nuclear Generation Ltd (EDFE NGL)

WASTE CUSTODIAN EDF Energy Nuclear Generation Ltd (EDFE NGL)

WASTE TYPE ILW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025	= 193.8		
Future arisings:	1.4.2025 - 31.3.2027	= 11.0		
	1.4.2027 - 31.3.2030	= 53.4		
Total future arisings:		64.4		
Total waste volume:		258.2		

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

Comment on arising rates: Stock volume updated to 193.8 m3 following station assessment. Waste volumes will be variable depending on station operating conditions. Annual future arising of 5.5 m3/yr estimated during operational life until 2027 and 17.8 m3/yr during 3 years of defueling until 2030. Total future arising increased compared to 2022 due to lifetime extension to 2027 and end of defueling in 2030

Additional information on quantities: -

Uncertainty factors on volumes: Stock (upper): x 1.25 Arisings (upper): x 1.50
Stock (lower): x 0.75 Arisings (lower): x 0.50

WASTE SOURCE Components resulting from the dismantling of fuel element stringers. Some additional high activity components, in steel tins, may also be present

PHYSICAL CHARACTERISTICS

General description: Graphite sleeves, associated metal components and other components may be present. The possibility of large items which may need special handling is not assessed.

Changes since waste generated: -

Bulk density (t/m³): ~ 0.50

Comment on density: The bulk density of the waste ranges in the value up to 8.0t/m³; the average will probably be about 0.5 t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Graphite and steels. Stocks are estimated about 65% wt graphite, 35% wt stainless steel. Arisings will be about 53% wt graphite, 47% wt stainless steel.

Chemical state: Neutral

Sheet metal proportion / thickness: -

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	~ 40.0	-	
Other ferrous metals.....	TR	-	
Iron.....	TR	-	
Aluminium.....	TR	-	
Beryllium.....	NE	-	
Cobalt.....	NE	-	
Copper.....	-	-	
Lead.....	= 0	-	
Magnox/Magnesium.....	= 0	-	
Nickel.....	NE	-	
Titanium.....	NE	-	
Uranium.....	NE	-	
Zinc.....	TR	-	
Zircaloy/Zirconium.....	TR	-	
Other metals.....	NE	-	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	= 0	-	
Paper, cotton.....	= 0	-	
Wood.....	= 0	-	
Halogenated plastics.....	= 0	-	
Total non-halogenated plastics.....	= 0	-	
Condensation polymers.....	= 0	-	
Others.....	= 0	-	
Organic ion exchange materials.....	= 0	-	
Total rubber.....	= 0	-	
Halogenated rubber.....	= 0	-	
Non-halogenated rubber.....	= 0	-	
Hydrocarbons.....	P	-	
Oil or grease.....	-	-	
Fuel.....	-	-	
Asphalt/Tarmac (cont.coal tar).....	-	-	
Asphalt/Tarmac (no coal tar).....	-	-	
Bitumen.....	-	-	
Others.....	-	-	
Other organics.....	NE	-	

Other materials (%wt):

	(%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.....	= 0	-	
Glass/Ceramics.....	-	-	
Graphite.....	~ 60.0	-	
Desiccants/Catalysts.....	= 0	-	
Asbestos.....	= 0	-	
Non/low friable.....	-	-	
Moderately friable.....	-	-	
Highly friable.....	-	-	
Free aqueous liquids.....	= 0	-	
Free non-aqueous liquids.....	= 0	-	
Powder/Ash.....	= 0	-	

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

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
Fluoride.....	< 1.0	-
Chloride.....	< 1.0	-
Iodide.....	< 1.0	-
Cyanide.....	NE	-
Carbonate.....	< 1.0	-
Nitrate.....	< 1.0	-
Nitrite.....	NE	-
Phosphate.....	< 1.0	-
Sulphate.....	< 1.0	-
Sulphide.....	< 1.0	-

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.....	= 0	-
Biodegradable materials.....	= 0	-
Putrescible wastes.....	= 0	-
Non-putrescible wastes.....	= 0	-
Corrosive materials.....	= 0	-
Pyrophoric materials.....	= 0	-
Generating toxic gases.....	= 0	-
Reacting with water.....	= 0	-
Higher activity particles.....	P	-
Soluble solids as bulk chemical compounds.....	= 0	-

Hazardous substances / non hazardous pollutants:

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

Complexing agents (%wt):

Yes		
	(%wt)	Type(s) and comment
EDTA.....	NE	-
DPTA.....	NE	-
NTA.....	NE	-
Polycarboxylic acids.....	NE	-
Other organic complexants.....	NE	Expect only trace quantities, if any.
Total complexing agents.....	TR	-

Physical components:

	Number	Type(s) and comment
Sources.....	= 0	-
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:

-

Conditioning method:

"The waste will be conditioned to satisfy the disposal requirements which are effective at the time of retrieval/conditioning. It is currently assumed that the waste will be placed in 'baskets' in the waste packages and will be encapsulated."

Conditioning plants:

Plant Name	Location
Heysham 1 Waste Management Centre	Heysham 1

Likely conditioning matrix:

-

Further information on the conditioning matrix:

Conditioning matrix will be BFS/OPC. Mix ratios are yet to be established

Waste Packaging:

Likely container type:	Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
	4 m box (100 mm concrete shielding)	100.0	12.2	14.3	22	-

Range in container waste loading:

Other information on packaging and conditioning: Waste will be retained on site pending Final Site Clearance, to let nuclides such as Co-60 undergo considerable radioactive decay. Baskets of different Final Site Clearance ILW wastes may be in the same waste package.

Conditioned density (t/m³): ~ 2.0
 Conditioned density comment: The density of the encapsulated waste is expected to be approximately 2 t/m³.

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: Components resulting from the dismantling of fuel stringers. Activation of Nuclides within the steel and graphite will be the main source of activity.

Uncertainty: Specific activity is a function of station operating history. The values quoted are indicative of the activities that might be expected.

Measurement of radioactivities: "Estimates are based on theoretical assessments. Other beta/gamma nuclides of arisings and stocks (in TBq/m³) include S35 (6E-2, 7E-4); Ca45 (6E-5, 2E-6); Cr51 (9E+2, 4E-1); Co58 (1E+2, 8E-1); Sr89 (2E-6, 7E-9); Zr95 (3E-7, 2E-9); Nb95 (1E+0, 1E-3); Ta182 (1E-3, 2E-5); Sc46 (3E-4, 3E-6); Fe59 (2E+1, 6E-2); Sr85 (1E-6, 7E-9); Sn113 (8E-6, 1E-7); Sb124 (6E-8, 3E-10); Sm145 (1E-6, 9E-8) and W181 (3E-7, 6E-9)."

Chemical form of radionuclides: H-3: Diffused into materials
 C-14: Graphite
 Cl-36: The chlorine will be incorporated in the steel
 Se-79: Selenium content not expected to be significant
 Tc-99: Not determined
 I-129: Not determined
 Ra: Radium content is insignificant
 Th: Thorium content is insignificant
 U: Uranium content is insignificant
 Np: The Neptunium content is insignificant
 Pu: Plutonium content is insignificant

WASTE STREAM 3L22 Fuel Stringer Debris - Debris Vault 4									
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	6.00E-02	C C 2	9.00E-03	C C 2	Gd 153				
Be 10	9.00E-07	C C 2	1.00E-07	C C 2	Ho 163				
C 14	1.00E-02	C C 2	7.00E-02	C C 2	Ho 166m				
Na 22		4		4	Tm 170				
Al 26		4		4	Tm 171				
Cl 36	2.00E-05	C C 2	2.00E-05	C C 2	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41	5.00E-07	C C 2	4.00E-08	C C 2	Pt 193				
Mn 53					Ti 204				
Mn 54	2.00E+00	C C 2	7.00E+01	C C 2	Pb 205				
Fe 55	3.00E+01	C C 2	5.00E+02	C C 2	Pb 210		8		8
Co 60	2.00E+01	C C 2	2.00E+02	C C 2	Bi 208				
Ni 59	1.00E-02	C C 2	9.00E-02	C C 2	Bi 210m				
Ni 63	2.00E+00	C C 2	1.00E+01	C C 2	Po 210		8		8
Zn 65	1.00E-07	C C 2	8.00E-06	C C 2	Ra 223				
Se 79		8		8	Ra 225				
Kr 81					Ra 226		8		8
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90		8		8	Th 227				
Zr 93		8		8	Th 228				
Nb 91					Th 229		8		8
Nb 92					Th 230		8		8
Nb 93m	7.00E-04	C C 2	2.00E-04	C C 2	Th 232		8		8
Nb 94	8.00E-03	C C 2	4.00E-02	C C 2	Th 234				
Mo 93	2.00E-04	C C 2	1.00E-03	C C 2	Pa 231		8		8
Tc 97					Pa 233				
Tc 99		8		8	U 232				
Ru 106		8		8	U 233		8		8
Pd 107		8		8	U 234		8		8
Ag 108m	6.00E-04	C C 2	3.00E-03	C C 2	U 235		8		8
Ag 110m	5.00E-02	C C 2	3.00E+00	C C 2	U 236		8		8
Cd 109	1.00E-04	C C 2	4.00E-03	C C 2	U 238		8		8
Cd 113m	4.00E-05	C C 2	6.00E-05	C C 2	Np 237		8		8
Sn 119m					Pu 236				
Sn 121m	2.00E-05	C C 2	2.00E-06	C C 2	Pu 238		8		8
Sn 123	5.00E-08	C C 2	6.00E-06	C C 2	Pu 239		8		8
Sn 126		8		8	Pu 240		8		8
Sb 125	3.00E-05	C C 2	3.00E-04	C C 2	Pu 241		8		8
Sb 126					Pu 242		8		8
Te 125m					Am 241		8		8
Te 127m					Am 242m		8		8
I 129		8		8	Am 243		8		8
Cs 134	2.00E-10	C C 2		8	Cm 242		8		8
Cs 135		8		8	Cm 243		8		8
Cs 137		8		8	Cm 244		8		8
Ba 133	1.00E-07	C C 2	9.00E-07	C C 2	Cm 245		8		8
La 137					Cm 246		8		8
La 138					Cm 248				
Ce 144		8		8	Cf 249				
Pm 145					Cf 250				
Pm 147		8		8	Cf 251				
Sm 147					Cf 252				
Sm 151	8.00E-06	C C 2	9.00E-07	C C 2	Unsp a		8		8
Eu 152	2.00E-02	C C 2	2.00E-03	C C 2	Unsp b/g	1.00E+00	C C 2	1.00E+03	C C 2
Eu 154	5.00E-03	C C 2	8.00E-04	C C 2	Total a	0	*	0	*
Eu 155	6.00E-04	C C 2	3.00E-04	C C 2	Total b/g	5.52E+01	*	1.78E+03	*

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