

WASTE STREAM	3L22	Fuel Stringer Debris - Debris Vault 4
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SITE Heysham 1

SITE OWNER EDFE NGL

WASTE CUSTODIAN EDFE NGL

WASTE TYPE ILW; SPD3

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	170.6 m ³
Future arisings -	1.4.2019 - 31.3.2024.....	27.5 m ³
	1.4.2024 - 31.3.2026.....	35.6 m ³
Total future arisings:		63.1 m ³
Total waste volume:		233.7 m ³

Comment on volumes: Waste volumes will be variable depending on station operating conditions.

Uncertainty factors on volumes: Stock (upper): x 1.25 Arisings (upper) x 1.5
 Stock (lower): x 0.75 Arisings (lower) x 0.5

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.

Physical components (%vol): Stocks are graphite vacancy blocks , vacancy top assemblies, top reflectors, bottom reflectors, Central Inertial Collector assemblies. Percentage breakdown is not currently assessed.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.5

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

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

Metals and alloys (%wt): -
 Stainless steel..... ~40.0
 Other ferrous metals..... TR
 Iron..... TR
 Aluminium..... TR
 Beryllium..... NE
 Cobalt..... NE
 Copper.....
 Lead..... 0

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	Magnox/Magnesium.....	0
	Nickel.....	NE
	Titanium.....	NE
	Uranium.....	NE
	Zinc.....	TR
	Zircaloy/Zirconium.....	TR
	Other metals.....	NE
Organics (%wt):	To be further assessed.	
	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):	-	
	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

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	Powder/Ash.....	0
Inorganic anions (%wt):	None of the listed inorganic anions are expected to be present at greater than 1% wt.	
	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:

Whilst it is difficult to ignite graphite will eventually burn in air.

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
Active particles.....	P
Soluble solids as bulk chemical compounds.....	0

Hazardous substances /
non hazardous pollutants:

None expected.

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

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Barium.....	NE
Boron.....	NE
Cadmium.....	NE
Caesium.....	NE
Selenium.....	NE
Chromium.....	NE
Molybdenum.....	NE
Thallium.....	NE
Tin.....	NE
Vanadium.....	NE
Mercury compounds.....	NE
Others.....	NE
Electronic Electrical Equipment (EEE)	
EEE Type 1.....	0
EEE Type 2.....	0
EEE Type 3.....	0
EEE Type 4.....	0
EEE Type 5.....	0

Complexing agents (%wt):

Not yet determined	
EDTA.....	NE
DPTA.....	NE
NTA.....	NE
Polycarboxylic acids.....	NE
Other organic complexants.....	NE
Total complexing agents.....	TR

Expect only trace quantities, if any.

PACKAGING AND CONDITIONING

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.
Plant Name:	None.
Location:	Heysham 1 Power Station.
Plant startup date:	~ 2105.
Total capacity (m ³ /y incoming waste):	-
Target start date for packaging this stream:	-
Throughput for this stream (m ³ /y incoming waste):	-
Other information:	All of the waste is expected to be retrieved and conditioned when a conditioning campaign is undertaken. The total plant process rate is not estimated.

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Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages
	4m box (100mm concrete shielding)	100.0	~12.2	~14.3	20

Likely container type comment: -

Range in container waste volume: -

Other information on containers: Stainless steel.

Likely conditioning matrix: BFS/OPC

Other information: -

Conditioned density (t/m³): ~2.0

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

Other information on 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.

Opportunities for alternative disposal routing: No

Treatment	Stream volume (%)	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.

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: Theoretical assessments.

Other information: 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).

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	6E-02	CC 2	9E-03	CC 2	Gd 153				
Be 10	9E-07	CC 2	1E-07	CC 2	Ho 163				
C 14	1E-02	CC 2	7E-02	CC 2	Ho 166m				
Na 22		4		4	Tm 170				
Al 26		4		4	Tm 171				
Cl 36	2E-05	CC 2	2E-05	CC 2	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41	5E-07	CC 2	4E-08	CC 2	Pt 193				
Mn 53					Tl 204				
Mn 54	2E+00	CC 2	7E+01	CC 2	Pb 205				
Fe 55	3E+01	CC 2	5E+02	CC 2	Pb 210	8		8	
Co 60	2E+01	CC 2	2E+02	CC 2	Bi 208				
Ni 59	1E-02	CC 2	9E-02	CC 2	Bi 210m				
Ni 63	2E+00	CC 2	1E+01	CC 2	Po 210	8		8	
Zn 65	1E-07	CC 2	8E-06	CC 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	7E-04	CC 2	2E-04	CC 2	Th 232	8		8	
Nb 94	8E-03	CC 2	4E-02	CC 2	Th 234				
Mo 93	2E-04	CC 2	1E-03	CC 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	6E-04	CC 2	3E-03	CC 2	U 235	8		8	
Ag 110m	5E-02	CC 2	3E+00	CC 2	U 236	8		8	
Cd 109	1E-04	CC 2	4E-03	CC 2	U 238	8		8	
Cd 113m	4E-05	CC 2	6E-05	CC 2	Np 237	8		8	
Sn 119m					Pu 236				
Sn 121m	2E-05	CC 2	2E-06	CC 2	Pu 238	8		8	
Sn 123	5E-08	CC 2	6E-06	CC 2	Pu 239	8		8	
Sn 126		8		8	Pu 240	8		8	
Sb 125	3E-05	CC 2	3E-04	CC 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	2E-10	CC 2		8	Cm 242	8		8	
Cs 135		8		8	Cm 243	8		8	
Cs 137		8		8	Cm 244	8		8	
Ba 133	1E-07	CC 2	9E-07	CC 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	8E-06	CC 2	9E-07	CC 2	Other a	8		8	
Eu 152	2E-02	CC 2	2E-03	CC 2	Other b/g	1E+00	CC 2	1E+03	CC 2
Eu 154	5E-03	CC 2	8E-04	CC 2	Total a	<1E-09	8	<1E-09	8
Eu 155	6E-04	CC 2	3E-04	CC 2	Total b/g	5.52E+01	CC 2	1.78E+03	CC 2

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