WASTE STREAM 3M22 Miscellaneous Activated Components & Fuel Stringer Debris

SITE Heysham 2

SITE OWNER EDFE NGL

WASTE CUSTODIAN EDFE NGL

WASTE TYPE ILW; SPD3

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	192.0 m³
Future arisings -	1.4.2019 - 31.3.2030.....	88.0 m³
	1.4.2030 - 31.3.2032.....	60.0 m³
Total future arisings:		148.0 m³
Total waste volume:		340.0 m³

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 The waste is primarily produced as a result of dismantling fuel stringers.

PHYSICAL CHARACTERISTICS

General description: The waste includes tiebar sections, top reflectors, central inertial collectors, anti-gapping units, piston seals and cartridge assemblies, stabilising brushes, other miscellaneous components, control rods and parts of control rod chains, neutron shield plugs and flux measuring detectors. Some additional high activity components, in steel tins, may also be present. Some large items may be present in the waste.

Physical components (%wt): Tie bars, CICs, Bottom Support Assemblies, Upper Stabilising Brushes, and other metallic components. Graphite sleeves/vacancy stringers will also be present. Percentage breakdown of compoenents is not currently assessed. The waste is largely composed of steel (~85%) and graphite (~10%) items, with some nimonic (~5%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.5

Comment on density: Estimated average density of the waste.

CHEMICAL COMPOSITION

General description and components (%wt): The waste is predominantly stainless steel and graphite. There will be traces of organic materials (e.g. oil) and complexing agents (e.g. decontamination chemicals). Stainless steel (~85%), graphite (~10%), nimonic (~5%).

Chemical state: Neutral

Chemical form of radionuclides:
H-3: Diffused into materials
C-14: Graphite
Cl-36: Incorporated into steels
Se-79: Not expected to be significant
Tc-99: Not expected to be significant
I-129: Not expected to be significant
Ra: Not expected to be significant
Th: Not expected to be significant
U: Not expected to be significant
Np: Not expected to be significant
Pu: Not expected to be significant

Metals and alloys (%wt): Some large items may be present in the waste.

Stainless steel.....	~85.0
Other ferrous metals.....	NE
Iron.....	NE
Aluminium.....	NE
Beryllium.....	NE
Cobalt.....	NE

WASTE STREAM	3M22	Miscellaneous Activated Components & Fuel Stringer Debris

	Copper	NE
	Lead	NE
	Magnox/Magnesium	NE
	Nickel	~5.0
	Titanium	NE
	Uranium	NE
	Zinc	NE
	Zircaloy/Zirconium	NE
	Other metals	NE
Organics (%wt):	The waste is expected to contain trace quantities of organic material, but this is thought to be insignificant.	
	Total cellulosics	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	0
	Oil or grease	
	Fuel	
	Asphalt/Tarmac (cont.coal tar)	
	Asphalt/Tarmac (no coal tar)	
	Bitumen	
	Others	
	Other organics	NE
Other materials (%wt):	Graphite will be present.	
	Inorganic ion exchange materials.	0
	Inorganic sludges and flocs	0
	Soil	0
	Brick/Stone/Rubble	0
	Cementitious material	0
	Sand	0
	Glass/Ceramics	0
	Graphite	10.0
	Desiccants/Catalysts	0
	Asbestos	0
	Non/low friable	
	Moderately friable	

WASTE STREAM	3M22	Miscellaneous Activated Components & Fuel Stringer Debris

	Highly friable.....	
	Free aqueous liquids.....	0
	Free non-aqueous liquids.....	0
	Powder/Ash.....	0
Inorganic anions (%wt):	Not estimated but unlikely to be present above trace quantities.	
	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:	The waste is not expected to contain the listed hazardous and problematic materials. While 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:	-	
	Acrylamide.....	NE
	Benzene.....	NE
	Chlorinated solvents.....	NE
	Formaldehyde.....	NE
	Organometallics.....	NE
	Phenol.....	NE
	Styrene.....	NE
	Tri-butyl phosphate.....	NE

WASTE STREAM	3M22	Miscellaneous Activated Components & Fuel Stringer Debris

	Other organophosphates.....	NE	
	Vinyl chloride.....	NE	
	Arsenic.....	NE	
	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	If present there will only be trace quantities.
	Total complexing agents.....	NE	

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:	-
Location:	Heysham 2 Power Station.
Plant startup date:	~2115
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.

WASTE STREAM 3M22 Miscellaneous Activated Components & Fuel Stringer Debris

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m³)	Payload (m³)	Number of packages
4m box (100mm concrete shielding)	100.0	~12.2	~14.3	28

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):	~3.0
Conditioned density comment:	Conditioned denisty is estimated to be in the region of 2-3t/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:	Activation of nuclides within the graphite, steel and the Nimonic will be the main sources of activity.
Uncertainty:	-
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 assessment.
Other information:	-

WASTE STREAM 3M22 Miscellaneous Activated Components & Fuel Stringer Debris

Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	1.28E-01	D D 2	2.59E-01	D D 2	Gd 153				
Be 10	5.77E-07	D D 2	5.77E-07	D D 2	Ho 163				
C 14	2.75E-02	D D 2	2.75E-02	D D 2	Ho 166m				
Na 22		4		4	Tm 170				
Al 26		4		4	Tm 171				
Cl 36	7.30E-06	D D 2	7.30E-06	D D 2	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41	1.99E-05	D D 2	1.99E-05	D D 2	Pt 193				
Mn 53					Tl 204				
Mn 54	9.34E-01	D D 2	1.56E+01	D D 2	Pb 205				
Fe 55	6.45E+01	D D 2	5.29E+02	D D 2	Pb 210		8		8
Co 60	6.4E+01	D D 2	2.41E+02	D D 2	Bi 208				
Ni 59	2.27E-01	D D 2	2.27E-01	D D 2	Bi 210m				
Ni 63	2.84E+01	D D 2	2.84E+01	D D 2	Po 210		8		8
Zn 65	5.03E-06	D D 2	9.80E-05	D D 2	Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226		8		8
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90					Th 227				
Zr 93	1.55E-07	D D 2	1.55E-07	D D 2	Th 228				
Nb 91					Th 229		8		8
Nb 92					Th 230		8		8
Nb 93m	3.18E-04	D D 2	5.54E-04	D D 2	Th 232		8		8
Nb 94	1.25E-02	D D 2	1.25E-02	D D 2	Th 234				
Mo 93	1.89E-03	D D 2	2.10E-03	D D 2	Pa 231		8		8
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106					U 233		8		8
Pd 107					U 234		8		8
Ag 108m	1.44E-03	D D 2	1.44E-03	D D 2	U 235		8		8
Ag 110m	6.20E-02	D D 2	1.18E+00	D D 2	U 236		8		8
Cd 109	1.86E-04	D D 2	2.35E-03	D D 2	U 238		8		8
Cd 113m	2.83E-08	D D 2	5.30E-08	D D 2	Np 237		8		8
Sn 119m	6.41E-09	D D 2	6.41E-09	D D 2	Pu 236				
Sn 121m	4.48E-05	D D 2	5.61E-05	D D 2	Pu 238		8		8
Sn 123	6.41E-07	D D 2	1.66E-05	D D 2	Pu 239		8		8
Sn 126					Pu 240		8		8
Sb 125	1.28E-04	D D 2	8.43E-04	D D 2	Pu 241		8		8
Sb 126					Pu 242		8		8
Te 125m					Am 241				8
Te 127m					Am 242m				8
I 129					Am 243				8
Cs 134	4.48E-09	D D 2	3.84E-08	D D 2	Cm 242		8		8
Cs 135					Cm 243		8		8
Cs 137					Cm 244		8		8
Ba 133	1.37E-06	D D 2	3.05E-06	D D 2	Cm 245		8		8
La 137					Cm 246		8		8
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151	5.08E-06	D D 2	5.64E-06	D D 2	Other a		8		8
Eu 152	6.66E-03	D D 2	1.27E-02	D D 2	Other b/g				
Eu 154	4.46E-03	D D 2	1.14E-02	D D 2	**Total a**	**NE**	**8**	**NE**	**8**
Eu 155	2.11E-03	D D 2	8.62E-03	D D 2	**Total b/g**	**1.58E+02**	**D D 2**	**8.16E+02**	**D D 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