

**WASTE STREAM****3L20****Miscellaneous Activated Components - Debris Vault 3****SITE** Heysham 1**SITE OWNER** EDFE NGL**WASTE CUSTODIAN** EDFE NGL**WASTE TYPE** ILW; SPD3**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	0.1 m <sup>3</sup>
Future arisings -	1.4.2019 - 31.3.2024.....	0 m <sup>3</sup>
	1.4.2024 - 31.3.2025.....	3.3 m <sup>3</sup>
Total future arisings:		3.3 m <sup>3</sup>
Total waste volume:		3.4 m <sup>3</sup>

Comment on volumes: Waste volumes will be variable depending on station operating conditions. Current stocks audited and waste vol. reduced to 0.1m<sup>3</sup>. Change in decommissioning strategy is now to leave Control rods in Reactor pressure vessel until Stage 3 decommissioning rather than consign to DV3 and end of defuelling and retrieve later.

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** Irradiated reactor control rods, control rod chains and graphite specimen assemblies.**PHYSICAL CHARACTERISTICS**

General description: Redundant or defective components such as control rods, control rod chains and graphite specimen assemblies. The possibility of large items which may need special handling is not assessed.

Physical components (%vol): Not assessed.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): 1

Comment on density: -

**CHEMICAL COMPOSITION**

General description and components (%wt): Irradiated components principally steel removed from the reactor. Other materials not assessed.

Chemical state: Neutral

Chemical form of radionuclides: H-3: Diffused into material  
 C-14: Activated graphite  
 Cl-36: Incorporated into steel  
 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): -

Stainless steel.....	P
Other ferrous metals.....	P
Iron.....	P
Aluminium.....	TR
Beryllium.....	NE
Cobalt.....	NE
Copper.....	TR
Lead.....	TR

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	Magnox/Magnesium.....	0
	Nickel.....	NE
	Titanium.....	NE
	Uranium.....	NE
	Zinc.....	TR
	Zircaloy/Zirconium.....	0
	Other metals.....	NE
Organics (%wt):	To be further assessed following further operating experience.	
	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.....	0
	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.....	0
	Graphite.....	NE
	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):	Only trace quantities anticipated.	
	Fluoride.....	TR
	Chloride.....	TR
	Iodide.....	TR
	Cyanide.....	NE
	Carbonate.....	TR
	Nitrate.....	TR
	Nitrite.....	NE
	Phosphate.....	TR
	Sulphate.....	TR
	Sulphide.....	TR
Materials of interest for waste acceptance criteria:	No materials that might give rise to a fire or other non-radioactive hazard have been identified.	
	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:	Note that control rod cans contain 4.25-5% wt boronated steel inserts.	
	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

May be present in trace quantities.

**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 <sup>3</sup> /y incoming waste):	-
Target start date for packaging this stream:	-
Throughput for this stream (m <sup>3</sup> /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 <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	4m box (100mm concrete shielding)	100.0	~12.2	~14.3	< 1

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/m<sup>3</sup>):

~3.0

Conditioned density comment:

The density of the encapsulated waste is expected to be approximately 3 t/m<sup>3</sup>.

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:

Irradiated components removed from the reactor. Activated material removed from the reactor core is likely to be of high specific 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 Estimates.

Other information:

Estimates are based upon theoretical assessments. Other beta/gamma nuclides of arisings (in TBq/m<sup>3</sup>) include Cr51 (4E+2), Co58 (1E+2), Nb95 (3E-1) and Ru103 (2E-4). Other beta/gamma nuclides also include Fe59.

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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		6		6	Gd 153				
Be 10		8		8	Ho 163				
C 14	5E-02	CD 2	5E-02	CD 2	Ho 166m				
Na 22		4		4	Tm 170				
Al 26		4		4	Tm 171				
Cl 36		6			Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41		8			Pt 193				
Mn 53					Tl 204				
Mn 54	4E+00	CD 2	1E+01	CD 2	Pb 205				
Fe 55	2E+02	CD 2	3E+02	CD 2	Pb 210		8		
Co 60	8E+01	CD 2	1E+02	CD 2	Bi 208				
Ni 59	2E-01	CD 2	2E-01	CD 2	Bi 210m				
Ni 63	1E+01	CD 2	1E+01	CD 2	Po 210		8		
Zn 65	9E-06	CD 2	3E-05	CD 2	Ra 223				
Se 79		8		8	Ra 225				
Kr 81					Ra 226		8		
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90		8			Th 227				
Zr 93		8			Th 228				
Nb 91					Th 229		8		
Nb 92					Th 230		8		
Nb 93m	5E-05	CD 2	5E-05	CD 2	Th 232		8		
Nb 94	1E-03	CD 2	1E-03	CD 2	Th 234				
Mo 93	5E-04	CD 2	5E-04	CD 2	Pa 231		8		
Tc 97					Pa 233				
Tc 99		8			U 232				
Ru 106		8			U 233		8		
Pd 107		8			U 234		8		
Ag 108m	4E-03	CD 2	4E-03	CD 2	U 235		8		
Ag 110m					U 236		8		
Cd 109					U 238		8		
Cd 113m					Np 237		8		
Sn 119m					Pu 236				
Sn 121m		8		8	Pu 238		8		
Sn 123					Pu 239		8		
Sn 126		8		8	Pu 240		8		
Sb 125					Pu 241		8		
Sb 126					Pu 242		8		
Te 125m					Am 241		8		
Te 127m					Am 242m		8		
I 129		8		8	Am 243		8		
Cs 134		6		6	Cm 242		8		
Cs 135		8		8	Cm 243		8		
Cs 137		6		6	Cm 244		8		
Ba 133					Cm 245		8		
La 137					Cm 246		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		8	Other a		8		8
Eu 152		8		8	Other b/g	5E+02	CD 2	5E+02	CD 2
Eu 154		8		8	<b>Total a</b>	<b>&lt;1E-09</b>	<b>8</b>	<b>&lt;1E-09</b>	<b>8</b>
Eu 155		8		8	<b>Total b/g</b>	<b>7.94E+02</b>	<b>CD 2</b>	<b>9.20E+02</b>	<b>CD 2</b>

**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