WASTE STREAM 3L20 Miscellaneous Activated Components - Debris Vault 3

SITE	Heysham 1
SITE OWNER	EDFE NGL
WASTE CUSTODIAN	EDFE NGL
WASTE TYPE	ILW; SPD3
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	0.1 m³
Future arisings -	1.4.2022 - 31.3.2024.....	0 m³
	1.4.2024 - 31.3.2025.....	3.3 m³
Total future arisings:		3.3 m³
Total waste volume:		3.4 m³

Comment on volumes: Waste volumes will be variable depending on station operating conditions. Current stocks audited and waste vol. reduced to 0.1m3. 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/m³): 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): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	P		
Other ferrous metals.....	P		
Iron.....	P		
Aluminium.....	TR		

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Beryllium	NE
Cobalt	NE
Copper	TR
Lead	TR
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.

	(%wt)	Type(s) and comment	% of total C14 activity
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): -

	(%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	0		

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Graphite	NE
Desiccants/Catalysts	0
Asbestos	0
Non/low friable	
Moderately friable	
Highly friable	
Free aqueous liquids	0
Free non-aqueous liquids	0
Powder/Ash	0

Inorganic anions (%wt): Only trace quantities anticipated.

	(%wt)	Type(s) and comment
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.

	(%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	

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Hazardous substances / non hazardous pollutants: Note that control rod cans contain 4.25-5% wt boronated steel inserts.

	(%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	
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

	(%wt)	Type(s) and comment
EDTA	NE	
DPTA	NE	
NTA	NE	
Polycarboxylic acids	NE	
Other organic complexants	NE	May be present in trace quantities.
Total complexing agents	TR	

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Potential for the waste to contain discrete items: Yes.

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.

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	< 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^3): ~3.0

Conditioned density comment: The density of the encapsulated waste is expected to be approximately 3 t/m^3.

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

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	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.

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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/m³) 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/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3		6		6	Gd 153				
Be 10		8		8	Ho 163				
C 14	5E-02	C C 2	5E-02	C C 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	C C 2	1E+01	C C 2	Pb 205				
Fe 55	2E+02	C C 2	3E+02	C C 2	Pb 210		8		
Co 60	8E+01	C C 2	1E+02	C C 2	Bi 208				
Ni 59	2E-01	C C 2	2E-01	C C 2	Bi 210m				
Ni 63	1E+01	C C 2	1E+01	C C 2	Po 210		8		
Zn 65	9E-06	C C 2	3E-05	C C 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	C C 2	5E-05	C C 2	Th 232		8		
Nb 94	1E-03	C C 2	1E-03	C C 2	Th 234				
Mo 93	5E-04	C C 2	5E-04	C C 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	C C 2	4E-03	C C 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	C C 2	5E+02	C C 2
Eu 154		8		8	**Total a**	**<1E-09**	**8**	**<1E-09**	**8**
Eu 155		8		8	**Total b/g**	**7.94E+02**	**C C 2**	**9.20E+02**	**C C 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