WASTE STREAM 4B06 Desiccants and Catalysts

SITE	Hunterston B
SITE OWNER	EDFE NGL
WASTE CUSTODIAN	EDFE NGL
WASTE TYPE	ILW
Is the waste subject to Scottish Policy:	Yes

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	260.0 m³
Future arisings -	1.4.2022 - 31.3.2024.....	0 m³
	1.4.2024 - 31.3.2025.....	34.0 m³
Total future arisings:		34.0 m³
Total waste volume:		294.0 m³

Comment on volumes: Waste volumes will be variable depending on station operating conditions. Current stock volumes are known fairly accurately but there is likely to be some uncertainty on the values. The volume of desiccant waste in each tower is known and so future arising volumes are predictable.

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 Exhausted desiccants and catalysts that have been used for the drying and recombination of carbon dioxide reactor coolant. Small amounts of steel balls and charcoal.

PHYSICAL CHARACTERISTICS

General description: The waste consists of exhausted 'Mobil sorbead' desiccant with charcoal (the desiccant material consists of silica beads of a flowing nature) together with catalyst (material consists of a granular alumina-platinum alloy and steel shielding spheres). There are no large items associated with the waste.

Physical components (%wt): Catalyst (~1.3%), shielding spheres (steel) (~2.9%), desiccant (~93.7%), shielding spheres (ceramic) (0.9%), charcoal (1.1%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.8

Comment on density: The average density of this waste stream (desiccant and catalyst) is estimated to be 1t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): Silica gel, very small quantities of charcoal, cylindrical pellets of platinum on alumina (catalyst), and ceramic and steel balls. Alumina-platinum catalyst (1.3%), steel (2.9%), silica gel (93.7%), charcoal (1.1%), ceramic (0.9%). The use of charcoal in the desiccant has been discontinued.

Chemical state: Neutral

Chemical form of radionuclides:
H-3: Tritiated water absorbed onto desiccant.
C-14: May be present as Graphite contamination
Cl-36: Activation of sulphide components within the gas stream.
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): -

WASTE STREAM 4B06 Desiccants and Catalysts

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	0		
Other ferrous metals	~2.9		
Iron	0		
Aluminium	0		
Beryllium	0		
Cobalt	0		
Copper	0		
Lead	0		
Magnox/Magnesium	0		
Nickel	0		
Titanium	0		
Uranium	0		
Zinc	0		
Zircaloy/Zirconium	0		
Other metals	NE	Platinum on alumina	

Organics (%wt): This waste contains no organic materials.

	(%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	0		
Fuel			
Asphalt/Tarmac (cont.coal tar)			
Asphalt/Tarmac (no coal tar)			
Bitumen			
Others			
Other organics	NE		

Other materials (%wt): -

WASTE STREAM 4B06 Desiccants and Catalysts

	(%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.....	0.90		
Graphite.....	1.1	Charcoal	
Desiccants/Catalysts.....	95.0		
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): None of the listed inorganic anions are expected to be present at greater than trace concentrations.

	(%wt)	Type(s) and comment
Fluoride.....	TR	
Chloride.....	TR	
Iodide.....	TR	
Cyanide.....	0	
Carbonate.....	TR	
Nitrate.....	TR	
Nitrite.....	NE	
Phosphate.....	TR	
Sulphate.....	TR	
Sulphide.....	TR	

Materials of interest for waste acceptance criteria: Carbon fines (<1%wt) filtered by desiccant are a spontaneous combustion hazard at >150 degrees C. in air.

	(%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	

WASTE STREAM 4B06 Desiccants and Catalysts

Non-putrescible wastes.....	0	
Corrosive materials.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	0	
Higher activity particles.....	0	Not expected to be present
Soluble solids as bulk chemical compounds.....	0	

Hazardous substances / non hazardous pollutants: This waste is not expected to contain any listed substances.

	(%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	

WASTE STREAM 4B06 Desiccants and Catalysts

Complexing agents (%wt): Not yet determined

	(%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.....	NE	

Potential for the waste to contain discrete items: No.

TREATMENT, PACKAGING AND DISPOSAL

Waste that is currently ILW: This waste is ILW at the time of arising. Stocks have been accumulated in vaults over the station lifetime and have been stored since generation. Therefore varying degrees of radioactive decay will have occurred depending upon date of removal and placement into the vaults. Future arisings will be decay stored. Waste will be dispatched when it is retrieved from the vault. Following this, the desiccant is transferred to Winfrith for decontamination to LLW. Waste will be consigned as ILW prior to decontamination and therefore the decay period to LLW is not known.

Planned on-site / off-site treatment(s):

Treatment	On-site / Off site	Stream volume %
Low force compaction		
Supercompaction (HFC)		
Incineration		
Solidification	Off-site	100.0
Decontamination	Off-site	100.0
Metal treatment		
Size reduction		
Decay storage	On-site	100.0
Recyling / reuse		
Other / various		
None		

Comment on planned treatments: For stocks in the vault radioactive decay will have occurred. Future arisings will be decay stored and then decontaminated to LLW and encapsulated.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	100.0	NE
Expected to be consigned to a Landfill Facility		
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility		
Expected to be consigned to a Metal Treatment Facility		
Expected to be consigned as Out of Scope		
Expected to be recycled / reused		
Disposal route not known		

Classification codes for waste expected to be consigned to a landfill facility: -

Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):

WASTE STREAM 4B06 Desiccants and Catalysts

Disposal Route	Stream volume %		
	2022/23	2023/24	2024/25
Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be consigned to an On-Site Disposal Facility Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be consigned as Out of Scope Expected to be recycled / reused Disposal route not known			

Opportunities for alternative disposal routing: Not yet determined

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Disposal at LLWR	Incineration	-	-	Medium	-

Waste Packaging for Disposal:

Container	Stream volume %	Waste loading m³	Number of packages
1/3 Height IP-1 ISO 2/3 Height IP-2 ISO 1/2 Height WAMAC IP-2 ISO 1/2 Height IP-2 Disposal/Re-usable ISO 2m box (no shielding) 4m box (no shielding) Other	100.0	~6.26	47

Other information: Waste volume following solidification is assumed to be 300%. Internal volume of 18.77m^3 assumed.

Waste Planned for Disposal at the LLW Repository:

Container voidage: -

The waste does not meet the LLWR's Waste Acceptance Criteria (WAC).

Does not meet WAC until desiccant is washed and decontaminated.

Waste consigned for disposal to LLWR in year of generation: No. Waste is ILW when generated and needs decontaminating to LLW.

Non-Containerised Waste for In-Vault Grouting: (Not applicable to this waste stream)

Stream volume (%): -

Waste stream variation: -

Bounding cuboidal volume:

Inaccessible voidage: -

Other information: -

RADIOACTIVITY

Source: Contamination by tritium and activation products will be the main sources of activity.

Uncertainty: Present estimates are indicative of the activities that are expected. The values given are from one set of desiccant samples taken from Hinkley Point B (HPB) in 2019, so give a good indication of activities present. Specific activity is a function of operating history.

WASTE STREAM 4B06 Desiccants and Catalysts

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:	Analysis of HPB desiccant samples from 2019, retrieved from the vaults.
Other information:	-

WASTE STREAM 4B06 Desiccants and Catalysts

Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	3.09E-02	C C 1	3.86E-02	C C 1	Gd 153				
Be 10					Ho 163				
C 14	4.02E-05	C C 1	5.03E-05	C C 1	Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36	4.14E-05	C C 1	5.18E-05	C C 1	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40		8		8	Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54		8		8	Pb 205				
Fe 55	1.2E-05	C C 1	1.5E-05	C C 1	Pb 210				
Co 60	1.56E-06	C C 1	1.95E-06	C C 1	Bi 208				
Ni 59					Bi 210m				
Ni 63		8		8	Po 210				
Zn 65		8		8	Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90					Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232				
Nb 94		8		8	Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106		8		8	U 233				
Pd 107					U 234				
Ag 108m	2.96E-09	C C 1	3.7E-09	C C 1	U 235				
Ag 110m		8		8	U 236				
Cd 109					U 238				
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238				
Sn 123					Pu 239				
Sn 126					Pu 240				
Sb 125		8		8	Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241		8		8
Te 127m					Am 242m				
I 129					Am 243				
Cs 134		8		8	Cm 242				
Cs 135					Cm 243				
Cs 137	3.32E-07	C C 1	4.15E-07	C C 1	Cm 244				
Ba 133	2.32E-09	C C 1	2.9E-09	C C 1	Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144		8		8	Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a		8		8
Eu 152		8		8	Other b/g		8		8
Eu 154		8		8	**Total a**	**0**	**8**	**0**	**8**
Eu 155		8		8	**Total b/g**	**3.1E-02**	**C C 1**	**3.1E-02**	**C C 1**

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