WASTE STREAM	7F26/C	Conditioned Ion Exchange Resin from Nuclear Effluent Plants

SITE Clyde Submarine Base

SITE OWNER Ministry of Defence

WASTE CUSTODIAN Ministry of Defence

WASTE TYPE LLW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2022.....	0 m³	0 m³
Future arisings -	1.4.2022 - 31.3.2025.....	0.7 m³	2.1 m³
	1.4.2025 - 31.3.2030.....	0 m³	0 m³
	1.4.2030 - 31.3.2040.....	0.7 m³	2.1 m³
	1.4.2040 - 31.3.2050.....	0.7 m³	2.1 m³
	1.4.2050 - 31.3.2060.....	0.7 m³	2.1 m³
	1.4.2060 - 31.3.2070.....	0.7 m³	2.1 m³
	1.4.2070 - 31.3.2080.....	0.7 m³	2.1 m³
	1.4.2080 - 31.3.2090.....	0.7 m³	2.1 m³
	1.4.2090 - 31.3.2100.....	0.7 m³	2.1 m³
	1.4.2100 - 31.3.2111.....	0.7 m³	2.3 m³
Total future arisings:		6.1 m³	19.5 m³
Total waste volume:		6.1 m³	19.5 m³

Comment on volumes: Ion Exchange Resin used in the effluent treatment process is periodically replaced to maintain efficiency and meet LLW criterion. Operational experience is that IXR needs to be replaced approximately every 10 years. The IXR is replaced dependent on two key factors: continued efficiency and the LLW activity criterion. The activity retained by the IXR could increase/decrease the frequency of resin changes; however, operational experience and knowledge of the future programme of work substantiate the arisings that have been predicted.

Uncertainty factors on volumes:

Stock (upper):	x	Arisings (upper)	x 2.0
Stock (lower):	x	Arisings (lower)	x 0.75

WASTE SOURCE IXR used to remove radioactivity from low level aqueous radioactive waste from the Naval Programme.

PHYSICAL CHARACTERISTICS

General description: The IXR is polymer based spherical beads of 0.425 - 1.2 mm diameter. Previous disposals used a cement/fly ash mixture to immobilse 7F26(C) in 200 L drums. It is recognised that the Waste Management Framework as provided by LLWR offers alternative solutions to divert from the LLWR, that do not require physical or chemical changes to the wastestream.

Physical components (%vol): Polymer bead resin (60%) in cement/fly ash mixture (40%) in 200 litre drums. Alternatively 100% polymer resin dependent on waste management option selected.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~2

Comment on density: Approximate density of concrete and fly ash mixture combined with known density of the waste stream. Alternatively, 100% polymer resin bulk density is 0.128 t/m3.

CHEMICAL COMPOSITION

General description and components (%wt): Polymer bead resin (60%) in cement/fly ash mixture (40%) in 200 litre drums. Alternatively 100% polymer resin dependent on waste management option selected.

Chemical state: Neutral

Chemical form of radionuclides:
H-3: HTO
C-14: Methane
Cl-36: Chloride
Se-79: None
Tc-99: None
I-129: None
Ra: None

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Th: None
U: None
Np: None
Pu: None

Metals and alloys (%wt): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	10.0		
Other ferrous metals	0		
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	0		

Organics (%wt): -

	(%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	~54.0		
Total rubber	0		
Halogenated rubber	0		
Non-halogenated rubber	0		
Hydrocarbons	0		
Oil or grease	0		
Fuel	0		
Asphalt/Tarmac (cont.coal tar)	0		
Asphalt/Tarmac (no coal tar)	0		
Bitumen	0		
Others	0		
Other organics	0		

Other materials (%wt): -

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	(%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.....	~36.0		
Sand.....	0		
Glass/Ceramics.....	0		
Graphite.....	0		
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): -

	(%wt)	Type(s) and comment
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: No hazardous materials are associated with this waste stream.

	(%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	

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Corrosive materials	0
Pyrophoric materials	0
Generating toxic gases	0
Reacting with water	0
Higher activity particles	0
Soluble solids as bulk chemical compounds	0

Hazardous substances / non hazardous pollutants: -

	(%wt)	Type(s) and comment
Acrylamide	0	
Benzene	0	
Chlorinated solvents	0	
Formaldehyde	0	
Organometallics	0	
Phenol	0	
Styrene	~36.0	MSDS used to estimate ethenylbenzene content
Tri-butyl phosphate	0	
Other organophosphates	0	
Vinyl chloride	0	
Arsenic	0	
Barium	0	
Boron	0	
Boron (in Boral)		
Boron (non-Boral)		
Cadmium	0	
Caesium	0	
Selenium	0	
Chromium	0	
Molybdenum	0	
Thallium	0	
Tin	0	
Vanadium	0	
Mercury compounds	0	
Others	0	
Electronic Electrical Equipment (EEE)		
EEE Type 1	0	
EEE Type 2	0	
EEE Type 3	0	
EEE Type 4	0	
EEE Type 5	0	

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Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids…….		
Other organic complexants.....		As a polystyrene-based polymer, the waste may contain traces of organic materials that act as complexing agents.
Total complexing agents.....	TR	

Potential for the waste to contain discrete items: . No

TREATMENT, PACKAGING AND DISPOSAL

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

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

Comment on planned treatments: Resins are currently solidified, but alternative methods of disposal are being actively explored, for example incineration. If this option is feasible, 100% incineration will be completed off-site in line with UK diversion policy from LLWR.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	100.0	
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: None

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

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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			100.0

Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Disposal at LLWR	Incineration	100.0	2025	High	-

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	~6.09	1

Other information: 200 L drums will be consigned to the LLWR for packing into HHISOs which will subsequantly be grouted.

Waste Planned for Disposal at the LLW Repository:

Container voidage: Less than 10%.

Waste Characterisation Form (WCH): The waste meets the LLWR's Waste Acceptance Criteria (WAC).
The waste does not have a current WCH.

Waste consigned for disposal to LLWR in year of generation: No. Waste will be consigned with other LLW when BPM.

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: The radioactivity in the waste is predominantly activation and corrosion products from the Naval Reactor Plant.

Uncertainty: Specific activity data are assessed by measurement. The uncertainties on the specific activity values have been selected as 1.5 (upper) and 10 (lower) to reflect potential variation of radioactive effluent processed.

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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:	Specific activities in future arisings are based on analysis of the previous dipsosal.
Other information:	The IXR will be subject to radiochemical analysis following each resin change.

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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			7.79E-04	A C 1	Gd 153				
Be 10					Ho 163				
C 14			4.83E-05	A C 1	Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36			2.3E-06	A C 1	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54			3.37E-05	A C 1	Pb 205				
Fe 55			1.01E-05	A C 1	Pb 210				
Co 60			5.62E-04	A C 1	Bi 208				
Ni 59					Bi 210m				
Ni 63			7.7E-06	A C 1	Po 210				
Zn 65					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					Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106					U 233				
Pd 107					U 234				
Ag 108m					U 235				
Ag 110m			3.6E-06	A C 1	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			1.09E-05	A C 1	Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241				
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137					Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a				
Eu 152					Other b/g				
Eu 154					**Total a**	**0**		**0**	
Eu 155					**Total b/g**	**0**		**1.46E-03**	**A 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