WASTE STREAM 7E29 Intermediate Level Ion Exchange Resin (Decontamination)

SITE	Rosyth Royal Dockyard
SITE OWNER	Babcock International Group
WASTE CUSTODIAN	Babcock International Group
WASTE TYPE	ILW
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	22.4 m³
Future arisings -	1.4.2022 - 31.3.2023.....	< 0.1 m³
	1.4.2023 - 31.3.2024.....	< 0.1 m³
	1.4.2024 - 31.3.2025.....	< 0.1 m³
	1.4.2025 - 31.3.2037.....	~0.6 m³
Total future arisings:		0.8 m³
Total waste volume:		23.2 m³

Comment on volumes: It is difficult to estimate future arisings due to a number of plans still being in development. The previous estimated arisings for the past 3 years have not actually been realised. An estimate is presented here for resins expected to arise from use of the portable effluent treatment plant in support of submarine dismantling operations and resin transfer activities. Future arisings are expected to be LLW as measures will be in place to remove from use before can reach ILW levels. Estimate of current stocks is accurate information based on ILW store records.

Uncertainty factors on volumes:				
	Stock (upper):	x 1.0	Arisings (upper)	x 1.0
	Stock (lower):	x 1.0	Arisings (lower)	x 0.2

WASTE SOURCE Current stocks have come from submarine refitting. Future arisings expected from use of the portable effluent treatment plant.

PHYSICAL CHARACTERISTICS

General description:	The waste consists of ion exchange resin. The resin is polystyrene bead based, consisting of uniform spheroids of approximately 1mm diameter. The resin is all solid and currently stored in water. The waste is non-compactable. It is planned that the waste will undergo thermal treatment and likely be encapsulated in cement prior to disposal.
Physical components (%wt):	Ion exchange resin (100%)
Sealed sources:	The waste does not contain sealed sources.
Bulk density (t/m³):	1.1
Comment on density:	The bulk density of the raw waste is 1.1 t/m3.

CHEMICAL COMPOSITION

General description and components (%wt):	Polystyrene bead resin contaminated with absorbed species (100%). The beads are surface coated with complexing agent.
Chemical state:	Neutral
Chemical form of radionuclides:	H-3: Mainly present as tritiated water. C-14: Present in metal salts e.g. carbonates.
Metals and alloys (%wt):	-

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

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Cobalt.....
Copper.....
Lead.....
Magnox/Magnesium.....
Nickel.....
Titanium.....
Uranium.....
Zinc.....
Zircaloy/Zirconium.....
Other metals.....

Organics (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....			
Paper, cotton.....			
Wood.....			
Halogenated plastics			
Total non-halogenated plastics.....			
Condensation polymers.....			
Others.....			
Organic ion exchange materials....	100.0	Polystyrene bead resin	
Total rubber.....			
Halogenated rubber			
Non-halogenated rubber.....			
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar).....			
Bitumen.....			
Others.....			
Other organics.....			

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..			
Inorganic sludges and flocs.....			
Soil.....			
Brick/Stone/Rubble.....			
Cementitious material.....			
Sand.....			
Glass/Ceramics.....			
Graphite.....			

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Desiccants/Catalysts.....

Asbestos.....

Non/low friable.....

Moderately friable.....

Highly friable.....

Free aqueous liquids.....

Free non-aqueous liquids.....

Powder/Ash.....

Inorganic anions (%wt): There are no inorganic anions in the waste.

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

Materials of interest for waste acceptance criteria: There are no materials of interest as listed below present in the waste.

	(%wt)	Type(s) and comment
Combustible metals.....		
Low flash point liquids.....		
Explosive materials.....		
Phosphorus.....		
Hydrides.....		
Biological etc. materials.....		
Biodegradable materials.....		
Putrescible wastes.....		
Non-putrescible wastes.....		
Corrosive materials.....		
Pyrophoric materials.....		
Generating toxic gases.....		
Reacting with water.....		
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

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Hazardous substances / non hazardous pollutants: There are no heavy metals or other hazardous or non hazardous pollutants in the waste.

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

Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA.....	0.81	The beads are surface coated with organic complexing agents. These are EDTA, citric acid and triammonium citrate (average concentration is 0.81% by weight). The complexing agents will be destroyed by a thermal treatment process prior to disposal.
DPTA.....		
NTA.....		
Polycarboxylic acids…….		

Other organic complexants.....

Total complexing agents..... ~0.81

Potential for the waste to contain discrete items: No.

TREATMENT, PACKAGING AND DISPOSAL

Waste that is currently ILW: The resin contains significant quantities of cobalt-60 which will undergo radioactive decay. The average specific activity information for resins holdings indicates that they have now decayed from ILW to LLW. However, the resins are stored in a number of containers and when looked at on an individual container basis there are a number which still remain ILW. It is forecast that individual containers will remain as ILW for approximately the next 5 years.

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		
Metal treatment		
Size reduction		
Decay storage		
Recyling / reuse		
Other / various	Off-site	100.0
None		

Comment on planned treatments: The resins currently in stock can not be directly disposed of to LLWR due to the use of EDTA during the decontamination process employed during previous activities. It is planned that these resins will be treated by a suitable thermal treatment process to destroy the chemical complexing agent present. Resins will be transported off-site to a suitable waste contractor for this treatment and for their subsequent preparation for disposal. Resins currently scheduled to be sent for treatment by the end of 2023 - treatment will be done in large batches and it is expected that on average in these large batches they will be LLW.

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: -

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			

Opportunities for alternative disposal routing: -

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

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			

Other information: Likely to be encapsulated in cement or other suitable matrix to enable disposal. Waste expected to be consigned by the waste contractor following treatment.

Waste Planned for Disposal at the LLW Repository:

Container voidage: -

-

Waste consigned for disposal to LLWR in year of generation: -

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 main sources of activity are tritium and activation products.

Uncertainty: The specific activities are averaged measured values of samples taken from 7E29 resins.

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'.

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Measurement of radioactivities:	Representative samples of all the 7E29 wastes in their resin catch tanks have been taken and analysed for the radioactivity content. Further sampling and analysis is planned before resins are sent for treatment.
Other information:	-

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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	1.99E-06	B B 1	8.45E-07	B B 1	Gd 153				
Be 10					Ho 163				
C 14	2.35E-03	B B 1	2.34E-03	B B 1	Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36					Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54	2.12E-09	B B 1	4.39E-07	B B 1	Pb 205				
Fe 55	9.79E-05	B B 1	5.27E-05	B B 1	Pb 210				
Co 60	5.96E-03	B B 1	9.70E-04	B B 1	Bi 208				
Ni 59					Bi 210m				
Ni 63	4.09E-03	B B 1	4.92E-04	B B 1	Po 210				
Zn 65	1.95E-09	B B 1	8.47E-07	B B 1	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					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	4.41E-06	B B 1	1.46E-05	B B 1	Pu 241				
Sb 126					Pu 242				
Te 125m	1.10E-06	B B 1			Am 241				
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137	6.60E-05	B B 1	1.21E-05	B B 1	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**	**1.26E-02**	**B B 1**	**3.88E-03**	**B B 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