

WASTE STREAM	7E29 Intermediate Level Ion Exchange Resin (Decontamination)
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SITE Rosyth Royal Dockyard
SITE OWNER Ministry of Defence
WASTE CUSTODIAN Babcock International Group
WASTE TYPE ILW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	22.4 m ³
Future arisings -	1.4.2019 - 31.3.2020.....	0.1 m ³
	1.4.2020 - 31.3.2021.....	0.1 m ³
	1.4.2021 - 31.3.2031.....	0.3 m ³
Total future arisings:		0.5 m ³
Total waste volume:		22.9 m ³

Comment on volumes: Waste streams 7E26, 7E27, and 7E28 are now redundant and have been incorporated into 7E29. Arising rates are constant now that submarine refitting ended at Rosyth Dockyard in 2003. Future arisings will only come from operations at the Portable Effluent Treatment Plant. 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 Submarine refitting.

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 but stored in water. The waste is all non-compactable and suitable for thermal treatment to destroy complexing agents likely followed by eventual encapsulation in cement into an ISO disposal container. There are no large items present.

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: Carbon-14 is present in metal salts e.g. carbonates.

Metals and alloys (%wt):

-
Stainless steel..... 0
Other ferrous metals..... 0
Iron..... 0
Aluminium.....
Beryllium..... 0
Cobalt..... 0
Copper.....
Lead..... 0
Magnox/Magnesium..... 0
Nickel.....
Titanium.....

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	Uranium.....	0
	Zinc.....	0
	Zircaloy/Zirconium.....	0
	Other metals.....	0
Organics (%wt):	-	
	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....	100.0
	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):	-	
	Inorganic ion exchange materials.	0
	Inorganic sludges and flocs.....	0
	Soil.....	0
	Brick/Stone/Rubble.....	0
	Cementitious material.....	0
	Sand.....	
	Glass/Ceramics.....	
	Graphite.....	0
	Desiccants/Catalysts.....	
	Asbestos.....	0
	Non/low friable.....	0
	Moderately friable.....	0
	Highly friable.....	0
	Free aqueous liquids.....	0
	Free non-aqueous liquids.....	0
	Powder/Ash.....	
Inorganic anions (%wt):	There are no inorganic anions in the waste.	

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Fluoride.....	0
Chloride.....	0
Iodide.....	0
Cyanide.....	0
Carbonate.....	0
Nitrate.....	0
Nitrite.....	0
Phosphate.....	0
Sulphate.....	0
Sulphide.....	0

Materials of interest for
waste acceptance criteria:

-	
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.....	0
Soluble solids as bulk chemical compounds.....	0

Hazardous substances /
non hazardous pollutants:

There are no heavy metals in this waste.	
Acrylamide.....	
Benzene.....	0
Chlorinated solvents.....	
Formaldehyde.....	
Organometallics.....	
Phenol.....	0
Styrene.....	
Tri-butyl phosphate.....	0
Other organophosphates.....	
Vinyl chloride.....	0
Arsenic.....	0
Barium.....	
Boron.....	0

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Cadmium..... 0

Caesium.....

Selenium..... 0

Chromium..... 0

Molybdenum..... 0

Thallium.....

Tin..... 0

Vanadium..... 0

Mercury compounds.....

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

Complexing agents (%wt):

Yes

EDTA..... 0.81

DPTA.....

NTA.....

Polycarboxylic acids.....

Other organic complexants.....

Total complexing agents..... ~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.

LAW TREATMENT, PACKAGING AND DISPOSAL

Waste that is currently ILW: The resin contains significant quantities of cobalt-60 which will undergo radioactive decay. The waste will be stored in its raw form. The activity in the waste will decay to LLW levels within a period of 4 years.

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

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

Comment on planned treatments:

When it has decayed to LLW, the resin will be treated using a thermal process to destroy complexing agents and likely encapsulated in cement into an ISO disposal container, prior to disposal at the LLWR. Conditioned resin contains a 1:2.5 ratio of resin to concrete.

Disposal Routes:

Disposal Route	Stream volume %
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	

Upcoming (2019/20-2021/22) waste routing (if expected to change from above)

Disposal Route	Stream volume %		
	2019/20	2020/21	2021/22
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			

Waste Packaging for Disposal:

Container	Stream volume %	Waste loading m ³	Number of packages
1/3 Height IP-1 ISO	100.0	~4.2	6
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: -

Waste Consigned to the LLW Repository:

Container voidage: The voidage inaccessible to grout will be less than 10%.

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Waste Characterisation Form (WCH):

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

The waste is currently ILW and contains complexing agents including EDTA making it currently not suitable for disposal at the LLWR. The waste will eventually decay to LLW and will be thermally treated to destroy complexing agents, which will make it suitable for disposal to the LLWR.

Waste consigned for disposal to LLWR in year of generation:

No. The waste is categorised as ILW, but will undergo radioactive decay such that it will be categorised as LLW and after thermal treatment to destroy complexing agents disposed off at the LLWR.

Potential for the waste to contain discrete items:

No

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 all 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'.

Measurement of radioactivities:

Representative samples of all of the 7E29 wastes in their resin catch tanks have been taken and analysed for their radioactivity content.

Other information:

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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	2.38E-06	BB 1	8.45E-07	BB 1	Gd 153				
Be 10					Ho 163				
C 14	2.35E-03	BB 1	2.34E-03	BB 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	9.98E-09	BB 1	4.39E-07	BB 1	Pb 205				
Fe 55	2.11E-04	BB 1	5.27E-05	BB 1	Pb 210				
Co 60	8.93E-03	BB 1	9.70E-04	BB 1	Bi 208				
Ni 59					Bi 210m				
Ni 63	4.21E-03	BB 1	4.92E-04	BB 1	Po 210				
Zn 65	3.01E-09	BB 1	8.47E-07	BB 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	9.26E-06	BB 1	1.46E-05	BB 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	7.13E-05	BB 1	1.21E-05	BB 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	1.58E-02	BB 1	3.88E-03	BB 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