

<b>WASTE STREAM</b>	<b>7D31</b>	<b>Devonport Filters (for Disposal to LLWR)</b>
---------------------	-------------	-------------------------------------------------

**SITE** HMNB Devonport

**SITE OWNER** Ministry of Defence

**WASTE CUSTODIAN** Babcock International Group

**WASTE TYPE** LLW

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	3.0 m <sup>3</sup>
Future arisings -	1.4.2019 - 31.3.2030.....	~37.0 m <sup>3</sup>
Total future arisings:		37.0 m <sup>3</sup>
Total waste volume:		40.0 m <sup>3</sup>
Comment on volumes:	Assumed a generation rate of 10m <sup>3</sup> every 3 years. Volume generation dependant on work demand.	
Uncertainty factors on volumes:	Stock (upper): x 1.5	Arisings (upper) x 2.0
	Stock (lower): x 0.5	Arisings (lower) x 0.5

**WASTE SOURCE** The waste originates from radioactive effluent treatment. The filters are used to remove radioactive particulates from the liquid during processing. Liquid arises from the refit, repair and maintenance of nuclear powered submarines.

**PHYSICAL CHARACTERISTICS**

General description:	Majority of the filters currently used on site are polypropylene cartridge filters of varying length and pore sizes. Filters will be wet when generated & will be stored in the waste drum.	
Physical components (%wt):	Metal (52%), Biodegradable - non-putrescibles (32%), Plastics (non-halogenated) (8%), Rubber (8%)	
Sealed sources:	The waste does not contain sealed sources.	
Bulk density (t/m <sup>3</sup> ):	~0.189	
Comment on density:	The density is variable, as it depends on the type of filter employed.	

**CHEMICAL COMPOSITION**

General description and components (%wt):	Metal (52%), Biodegradable - non-putrescibles (32%), Plastics (non-halogenated) (8%), Rubber (8%)	
Chemical state:	Neutral	
Chemical form of radionuclides:	H-3: Very small quantities of HTO on filter medium. C-14: Average ~5-10% of the total waste stream. Filters are sampled and analysed prior to disposal so the C-14 activity will vary.	
Metals and alloys (%wt):	Metal frames from a single type of filter.	
	Stainless steel.....	~10.0
	Other ferrous metals.....	~42.0
	Iron.....	
	Aluminium.....	0
	Beryllium.....	0
	Cobalt.....	0
	Copper.....	0
	Lead.....	0
	Magnox/Magnesium.....	0
	Nickel.....	0
	Titanium.....	0
	Uranium.....	0

Most of the metal content is mild steel (due to the drum).

**WASTE STREAM**

**7D31**

**Devonport Filters (for Disposal to LLWR)**

	Zinc.....	0	
	Zircaloy/Zirconium.....	0	
	Other metals.....	0	
Organics (%wt):	The waste contains cellulose in the form of cotton based cloth and plastics in the form of polypropylene. Cotton filters will be replaced in the near future.		
	Total cellulosics.....	32.0	Proportion of filter construction material.
	Paper, cotton.....	32.0	
	Wood.....	0	
	Halogenated plastics .....	0	
	Total non-halogenated plastics.....	8.0	Proportion of filter construction material.
	Condensation polymers.....	0	
	Others.....	8.0	
	Organic ion exchange materials....	0	
	Total rubber.....	8.0	Proportion of filter construction material.
	Halogenated rubber .....	0	
	Non-halogenated rubber.....	8.0	
	Hydrocarbons.....		
	Oil or grease .....		
	Fuel.....		
	Asphalt/Tarmac (cont.coal tar)...		
	Asphalt/Tarmac (no coal tar)....		
	Bitumen.....		
	Others.....		
	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.....	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):	There are no free anions in the waste.		

**WASTE STREAM****7D31****Devonport Filters (for Disposal to LLWR)**

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.....	32.0
Putrescible wastes.....	0
Non-putrescible wastes.....	~32.0
Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	0
Reacting with water.....	0
Active particles.....	0
Soluble solids as bulk chemical compounds.....	0

Cotton based cloth and plastics  
in the form of polypropylene.

Hazardous substances /  
non hazardous pollutants:

There are no toxic heavy metals within the waste.

Acrylamide.....	
Benzene.....	0
Chlorinated solvents.....	
Formaldehyde.....	
Organometallics.....	
Phenol.....	0
Styrene.....	
Tri-butyl phosphate.....	0
Other organophosphates.....	
Vinyl chloride.....	0
Arsenic.....	0
Barium.....	

**WASTE STREAM****7D31****Devonport Filters (for Disposal to LLWR)**

Boron..... NE  
 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.....  
     EEE Type 2.....  
     EEE Type 3.....  
     EEE Type 4.....  
     EEE Type 5.....

Complexing agents (%wt):

No  
 EDTA.....  
 DPTA.....  
 NTA.....  
 Polycarboxylic acids.....  
 Other organic complexants.....  
 Total complexing agents..... 0

There are no complexing agents present.

**TREATMENT, PACKAGING AND DISPOSAL**

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

Treatment	On-site / Off site	Stream volume %
Low force compaction		
Supercompaction (HFC)	Off-Site	~74.0
Incineration	Off-site	~26.0
Solidification	Off-site	~74.0
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None		

Comment on planned treatments:

Stream volumes estimated from previous inventory of filters. Due to the nature of the filters some may be incinerated, dismantling may occur in rare occasions. The percentage estimated to be incinerated was based on dose rate only.

**WASTE STREAM****7D31****Devonport Filters (for Disposal to LLWR)****Disposal Routes:**

Disposal Route	Stream volume %	
Expected to be consigned to the LLW Repository	~74.0	
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		~26.0
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 <sup>3</sup>	Number of packages
1/3 Height IP-1 ISO	~74.0	~35	< 1
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:**

The raw waste is consigned to an external contractor for treatment/supercompaction. The waste is then consigned to LLWR depot in half height ISO freight containers.

**Waste Planned for Disposal at the LLW Repository:****Container voidage:**

&lt;10%

**Waste Characterisation Form (WCH):**

The waste meets the LLWR's Waste Acceptance Criteria (WAC).  
The waste has a current WCH.  
Inventory information is consistent with the current WCH.

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

No. Waste will normally be consigned within 12 months of generation.  
Waste is conditioned on a batch basis and following sampling and analysis of the drum contents.

**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:**

-

**WASTE STREAM****7D31****Devonport Filters (for Disposal to LLWR)**

Other information:

-

**RADIOACTIVITY**

Source:

The radioactivity arises from particulate activation products, mainly Co-60, Fe-55, C-14, Ni-63, Mn-54 and Sb-125. The radioactivity is removed from liquids during treatment by filtration. The radioactivity is fixed to the filter medium.

Uncertainty:

Each drum used for storage of the 7D31 waste filters at Devonport Royal Dockyard is individually characterised by representative sampling.

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:

Each drum used for storage of the 7D31 waste filters at Devonport Royal Dockyard is individually characterised by representative sampling. Specific activity figures have been derived from current stock data and represent a reasonably consistent waste origin, therefore future arisings, which are expected to remain consistent, can only be estimated based on the same SA estimated figure i.e. the values are specific activity not total activity (which would vary depending on expected volume).

Other information:

-

**WASTE STREAM**

**7D31**

**Devonport Filters (for Disposal to LLWR)**

Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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	~4.2E-06	CC 2	~4.2E-06	CC 2	Gd 153				
Be 10					Ho 163				
C 14	~2.02E-05	CC 2	~2.02E-05	CC 2	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	~2.18E-06	CC 2	~2.18E-06	CC 2	Pb 205				
Fe 55	~8.39E-05	CC 2	~8.39E-05	CC 2	Pb 210				
Co 60	~8.41E-05	CC 2	~8.41E-05	CC 2	Bi 208				
Ni 59	~8E-08	CC 2	~8E-08	CC 2	Bi 210m				
Ni 63	~2.94E-06	CC 2	~2.94E-06	CC 2	Po 210				
Zn 65	~7.4E-07	CC 2	~7.4E-07	CC 2	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	~6E-08	CC 2	~6E-08	CC 2	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	~6.8E-07	CC 2	~6.8E-07	CC 2	Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241				
Te 127m					Am 242m				
I 129					Am 243				
Cs 134	~1.2E-07	CC 2	~1.2E-07	CC 2	Cm 242				
Cs 135					Cm 243				
Cs 137	~2.8E-07	CC 2	~2.8E-07	CC 2	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	~3E-07	CC 2	~3E-07	CC 2	Other b/g	~2.6E-07	CC 2	~2.6E-07	CC 2
Eu 154					<b>Total a</b>	<b>NE</b>		<b>NE</b>	
Eu 155					<b>Total b/g</b>	<b>~2E-04</b>	<b>CC 2</b>	<b>~2E-04</b>	<b>CC 2</b>

**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