WASTE STREAM 7D22 Devonport RA Soft Trash (for Disposal to NWS)

SITE	HMNB Devonport
SITE OWNER	Ministry of Defence
WASTE CUSTODIAN	Babcock International Group
WASTE TYPE	LLW
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	10.4 m³
Future arisings -	1.4.2023 - 31.3.2030.....	~236.8 m³
Total future arisings:		236.8 m³
Total waste volume:		247.2 m³

Comment on volumes: Future arisings have been quoted from the DRDL Future Radioactive Waste Assessment (FRWA) - CDMS Reference: 000173274 Data derived by extrapolation of historical data and a constant generation rate.

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 is produced as a consequence of general support to the Naval Nuclear Propulsion Programme including refit, maintenance and refuelling.

PHYSICAL CHARACTERISTICS

General description: The waste consists of soft materials such as contaminated polythene, plastic, protective clothing (cotton and nylon), paper, acetate swabs, filter papers, rubber gloves and hoses, wood etc. Plastic and other materials are used in reactor compartments and, as such, are non-halogenated. The waste contains no large items that cannot fit inside normal 200 litre drums. Waste will undergo minimal change from the point of generation.

Physical components (%wt): Metal (40%), concrete/rubble (1.0%), biodegradables (21%), plastic/rubber (34%), wood (4%). Metal composition is mostly made up from material of disposal container/drum.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~0.5

Comment on density: Density can vary from 0.2 t/m³ up to 0.5 t/m³. This is dependent on the low force compaction volume reduction factor and composition of waste. Efforts are made to distribute re-assertable materials into as large a number of drums as possible.

CHEMICAL COMPOSITION

General description and components (%wt): Metal (40%), concrete/rubble (1.0%), biodegradables (21%), plastic/rubber (34%), wood (4%). Metal from the drum as it is the primary containment.

Chemical state: Neutral

Chemical form of radionuclides: H-3: Potential to be present as tritiated water (0.02% total activity)
C-14: Potentially present in waste in several forms, carbonate (5.9% total activity)

Metals and alloys (%wt): The only major source of metal within this waste stream is the mild steel drum that is used as the waste primary containment.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	<0.10	Very small quantities of metal swarf	
Other ferrous metals.....	<40.0	Mostly contributed by drum composition - which is mild steel	
Iron.....			
Aluminium.....	<0.01		
Beryllium.....	0		
Cobalt.....	<0.01		

WASTE STREAM 7D22 Devonport RA Soft Trash (for Disposal to NWS)

Copper	<0.01	
Lead	0	
Magnox/Magnesium		
Nickel	<0.01	
Titanium		
Uranium	0	
Zinc	0	
Zircaloy/Zirconium	0	
Other metals	<0.01	Chromium and Molybdenum in metal as an alloy in form of mild steel

Organics (%wt): Cellulose is present in paper, cotton, cloth and wood. Non-halogenated plastic in the form of polythene, rubber in the form of gloves, bungs and hoses. Small quantities of ion exchange resins may be present within the waste (for example, adhered to container surfaces)

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	<24.2		
Paper, cotton	<21.0		
Wood	<4.0		
Halogenated plastics	<0		
Total non-halogenated plastics	<24.5		
Condensation polymers	<0		
Others	<24.0		
Organic ion exchange materials	<0		
Total rubber	<9.0		
Halogenated rubber	<0		
Non-halogenated rubber	<9.0		
Hydrocarbons			
Oil or grease			
Fuel			
Asphalt/Tarmac (cont.coal tar)			
Asphalt/Tarmac (no coal tar)			
Bitumen			
Others			
Other organics	<0		

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials	<0.10		
Inorganic sludges and flocs	<0.10		
Soil	0		
Brick/Stone/Rubble	<1.0		
Cementitious material	<1.0		
Sand	0		
Glass/Ceramics			

WASTE STREAM 7D22 Devonport RA Soft Trash (for Disposal to NWS)

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): The waste contains no inorganic anions.

	(%wt)	Type(s) and comment
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: -

	(%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	~21.0	
Putrescible wastes	0	
Non-putrescible wastes	~21.0	Mainly paper/cotton.
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	

WASTE STREAM 7D22 Devonport RA Soft Trash (for Disposal to NWS)

Hazardous substances / non hazardous pollutants: The waste contains no heavy metals.

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....	0	
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....	0	
Styrene.....		
Tri-butyl phosphate.....	0	
Other organophosphates.....		
Vinyl chloride.....	0	
Arsenic.....	0	
Barium.....		
Boron.....	0	
Boron (in Boral).....		
Boron (non-Boral).....		
Cadmium.....	0	
Caesium.....		
Selenium.....	0	
Chromium.....	~2.3	Chromium in metal as an alloy in form of mild steel
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

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids……		
Other organic complexants.....		Organic complexing agents sodium EDTA and citric acid are used in certain decontamination processes. These should not be present in the

waste but are included for completeness. If present, these compounds will represent << 0.1% by weight of the total waste stream.

Total complexing agents..... <<0.10

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	On-site	~14.8
Supercompaction (HFC)	Off-site	~2.8
Incineration	Off-site	~12.0
Solidification		
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recyling / reuse		
Other / various	Off-site	~85.2
None		

Comment on planned treatments: Stream Volumes estimated from the current planned consignment. Other/various relates to disposal under conditional exemption of waste to local landfill facility.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	~2.8	0.50
Expected to be consigned to a Landfill Facility	~85.2	0.50
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	~12.0	0.50
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: EWC 15-02-03 - Disposed off under conditional exemption to landfill facility

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

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
-	-	-	-	-	-

WASTE STREAM 7D22 Devonport RA Soft Trash (for Disposal to NWS)

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	<2.8	~52	< 1

Other information: A typical conditioning factor for 7D22 drums is 0.25 relative to the original displaced volume of the 200 litre drum.. Waste loading (m3) determined using Raw waste volume (m3)/conditioned waste volume (m3) x TC01/TC02 container expected fill volume payload of 13 m3.

Waste Planned for Disposal at the LLW Repository:

Container voidage: <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 is normally retained until sufficient number of drums are avalible to consign a 'full' load (68 Drums ISO Freight container) This may lead to waste being held on site for prolonged periods post 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: Waste becomes contaminated with (primarily) beta/gamma activation products from submarine primary plant contact. Major nuclides are Fe-55 (34%), Co-60 (41%), C-14 (5 %), Mn-54 (1.3%) and Ni-63 (1.6%).

Uncertainty: A drum monitor is used to assess the gamma activity of the waste using a segmented gamma spectroscopy system. The system accuracy is assessed to be ±20% of gamma activity. Activity of other beta/gamma nuclides associated with the waste is assessed using a generic fingerprint relative to the measured Co-60 activity. Accuracy of the total activity measurement and assessment is considered to be within 50%.

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: Co-60 is measured directly by the drum monitor system using segmented gamma spectroscopy. Other gamma emitters will also be detected if present within the waste. The fingerprint has been derived by the use of best available sampling information and accepted international practice to determine correlations and relationships. All other nuclides are determined relative to Co-60 activity.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: Stocks are a live inventory so there will be fluctuations in activity values.

WASTE STREAM 7D22 Devonport RA Soft Trash (for Disposal to NWS)

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	~1.48E-06	B B 2	~1.48E-06	C C 2	Gd 153				
Be 10					Ho 163				
C 14	~4.48E-07	B B 2	~4.48E-07	C C 2	Ho 166m				
Na 22	~1.49E-11	B B 2	~1.49E-11	C C 2	Tm 170				
Al 26					Tm 171				
Cl 36	~8.29E-12	B B 2	~8.29E-12	C C 2	Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54	~4.21E-08	B B 2	~4.21E-08	C C 2	Pb 205				
Fe 55	~1.92E-06	B B 2	~1.92E-06	C C 2	Pb 210				
Co 60	~2.11E-06	B B 2	~2.11E-06	C C 2	Bi 208				
Ni 59	~3.6E-08	B B 2	~3.6E-08	C C 2	Bi 210m				
Ni 63	~4.56E-08	B B 2	~4.56E-08	C C 2	Po 210				
Zn 65	~1.98E-08	B B 2	~1.98E-08	C C 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	~2.03E-11	B B 2	~2.03E-11	C C 2	Pa 231				
Tc 97					Pa 233				
Tc 99	~1.09E-09	B B 2	~1.09E-09	C C 2	U 232				
Ru 106					U 233				
Pd 107					U 234				
Ag 108m	~2.3E-11	B B 2	~2.3E-11	C C 2	U 235				
Ag 110m	~6.56E-11	B B 2	~6.56E-11	C C 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	~2.72E-08	B B 2	~2.72E-08	C C 2	Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241	~6.21E-12	B B 2	~6.21E-12	C C 2
Te 127m					Am 242m				
I 129	~4.98E-10	B B 2	~4.98E-10	C C 2	Am 243				
Cs 134	~8.55E-10	B B 2	~8.55E-10	C C 2	Cm 242				
Cs 135					Cm 243				
Cs 137	~1.65E-09	B B 2	~1.65E-09	C C 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	~1.37E-09	B B 2	~1.37E-09	C C 2	Other b/g	~4.03E-09	B B 2	~4.03E-09	C C 2
Eu 154	~8.02E-09	B B 2	~8.02E-09	C C 2	**Total a**	**~6.21E-12**	**B B 2**	**~6.21E-12**	**C C 2**
Eu 155	~1.51E-10	B B 2	~1.51E-10	C C 2	**Total b/g**	**~6.15E-06**	**B B 2**	**~6.15E-06**	**C C 2**

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