WASTE STREAM 7D30/C Devonport Conditioned Sludge (for Disposal to LLWR)

SITE HMNB Devonport

SITE OWNER Ministry of Defence

WASTE CUSTODIAN Babcock International Group

WASTE TYPE LLW

WASTE VOLUMES

		Conditioned	Packaged
Stocks:	At 1.4.2019.....	8.0 m³	11.1 m³
Future arisings -	1.4.2019 - 31.3.2030.....	~88.0 m³	122.6 m³
Total future arisings:		88.0 m³	122.6 m³
Total waste volume:		96.0 m³	133.7 m³

Comment on volumes: The volumes are conditioned volumes. Generation of waste is programme driven so may vary significantly.

Uncertainty factors on volumes:

Stock (upper):	x 2.0	Arisings (upper)	x 2.0
Stock (lower):	x 0.5	Arisings (lower)	x 0.5

WASTE SOURCE The waste arises from the operation of the radioactive effluent treatment facilities. Particulate material can settle in tanks forming the sludge which is removed. Similar sludges are also removed from portable effluent tanks during periodic maintenance operations.

PHYSICAL CHARACTERISTICS

General description: Conditioning method is encapsulation. The waste is a slurry of some inactive materials such as dust & rust particles. The active component is traces of Co-60 and other activation products. The waste is encapsulated in BFS/OPC (9:1 blend) within a 200 l mild steel drum. An inactive grout is applied to the drum to seal the active surface. There are no large items in this waste. Waste is currently stored awaiting conditioning before consignment to the LLWR.

Physical components (%wt): The composition of the encapsulated product is 23% metal (this includes the drums and also an allowance for the primary disposal container), 67.9% encapsulated sludge, 9% soft organics and 0.1% plastics / rubber.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 1.15

Comment on density: The density is that of the conditioned waste in a mild steel 200L drum.

CHEMICAL COMPOSITION

General description and components (%wt): Tank cleaning sludge. The solid content of the raw sludge is mainly inactive inorganic materials such as rust particles, concrete and sand particles, non-asbestos lagging dust, together with a minor component of organic debris particles. The active component of the slurry is traces of crud which include Co-60, Fe-55 and Ni-63. The composition of the encapsulated product is 23% metal (this includes the drums and also an allowance for the primary disposal container), 67.9% encapsulated sludge, 9% soft organics and 0.1% plastics / rubber.

Chemical state: Alkali

Chemical form of radionuclides: H-3: HTO will be present in the overstanding liquid. This will be assessed when the waste is sampled.
C-14: C-14 will be present in the waste. The exact quantity will be determined by representative sampling.

Metals and alloys (%wt): No sheet metal present. Only metal present in the conditioned waste product will be the 200 l drum which acts as the primary containment.

Stainless steel.....	0	
Other ferrous metals.....	23.0	Mild steel drum.
Iron.....	0	
Aluminium.....	0	
Beryllium.....	0	
Cobalt.....	0	

WASTE STREAM	7D30/C Devonport Conditioned Sludge (for Disposal to LLWR)

	Copper	0
	Lead	0
	Magnox/Magnesium	0
	Nickel	0
	Titanium	0
	Uranium	0
	Zinc	0
	Zircaloy/Zirconium	0
	Other metals	0
Organics (%wt):	Possibility that there may be a small amount of polythene/paper in the waste. This will also be declared prior to disposal if found to be the case.	
	Total cellulosics	~9.0
	Paper, cotton	~9.0
	Wood	
	Halogenated plastics	
	Total non-halogenated plastics	~0.05
	Condensation polymers	
	Others	
	Organic ion exchange materials	0
	Total rubber	~0.05
	Halogenated rubber	
	Non-halogenated rubber	
	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	68.0
	Sand	0
	Glass/Ceramics	0
	Graphite	0
	Desiccants/Catalysts	
	Asbestos	0
	Non/low friable	
	Moderately friable	

WASTE STREAM	7D30/C Devonport Conditioned Sludge (for Disposal to LLWR)

	Highly friable.....	
	Free aqueous liquids.....	0
	Free non-aqueous liquids.....	0
	Powder/Ash.....	0
Inorganic anions (%wt):	Trace inorganic anions may be present. Silicates will be present.	
	Fluoride.....	0
	Chloride.....	0
	Iodide.....	0
	Cyanide.....	0
	Carbonate.....	0
	Nitrate.....	0
	Nitrite.....	0
	Phosphate.....	0
	Sulphate.....	TR
	Sulphide.....	0
Materials of interest for waste acceptance criteria:	There are no hazardous materials present in the waste.	
	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:	No toxic heavy metals will be present in the waste.	
	Acrylamide.....	
	Benzene.....	0
	Chlorinated solvents.....	
	Formaldehyde.....	
	Organometallics.....	
	Phenol.....	0
	Styrene.....	
	Tri-butyl phosphate.....	0

Other organophosphates.....		
Vinyl chloride.....	0	
Arsenic.....	0	
Barium.....		
Boron.....	P	Estimated to be less than 18mg/kg
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.....		Complexing agents are not expected in this wastestream.
Total complexing agents.....	0	

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	Off-site	100.0

Comment on planned treatments: There is a possibility that some lower activity sludges may undergo disposal via incineration as part of waste diversion option.

WASTE STREAM 7D30/C Devonport Conditioned Sludge (for Disposal to LLWR)

Disposal Routes:

Disposal Route	Stream volume %
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

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 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	~14	7

Other information: Drums containing encapsulated/solidified sludge will be sent in a 1/2 height container for final grouting at LLWR. When conditioned the volume of waste will increase approximately by a factor of 4. It is assumed each 1/2 Height IP-2 Disposal/Re-usable ISO (TC01/TC02) will approximately have a 14 m3 waste loading therefore it will only contain 3.5 m3 of raw waste.

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. It is possible that the waste will be held until sufficient is available to send a 'full' load. Waste will be forwarded as soon as is reasonably practicable.

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:

WASTE STREAM 7D30/C Devonport Conditioned Sludge (for Disposal to LLWR)

Inaccessible voidage:	-
Other information:	-

RADIOACTIVITY

Source:	The waste is contaminated with cobalt-60, iron-55, carbon-14, nickel-63 and other beta/gamma emitters. Activity is from activation products that have collected in the sludge during liquid effluent processing operations.
Uncertainty:	The specific activity values are an estimate of the activity of current stocks only. All waste is representatively sampled prior to conditioning. It is expected that the waste will be encapsulated.
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:	Gamma activity of the waste is determined by the use of segmented gamma drum monitor. Representative sampling of drum contents and radiochemical analysis determines activity of other radionuclides. Volume of waste in drum is also assessed as part of the sampling procedure. Generic fingerprint is used for nuclides that are less than limit of detection of the analysis technique being used.
Other information:	-

WASTE STREAM 7D30/C Devonport Conditioned Sludge (for Disposal to LLWR)

Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	~~8.05E-06	C C 2	~8.05E-06	C C 2	Gd 153				
Be 10					Ho 163				
C 14	~~3.87E-05	C C 2	~3.87E-05	C C 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	~~4.18E-06	C C 2	~4.18E-06	C C 2	Pb 205				
Fe 55	~~1.59E-04	C C 2	~1.59E-04	C C 2	Pb 210				
Co 60	~~4.49E-04	C C 2	~4.49E-04	C C 2	Bi 208				
Ni 59	~~1.53E-07	C C 2	~1.53E-07	C C 2	Bi 210m				
Ni 63	~~5.64E-06	C C 2	~5.64E-06	C C 2	Po 210				
Zn 65	~~1.42E-06	C C 2	~1.42E-06	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					Pa 231				
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106					U 233				
Pd 107					U 234				
Ag 108m					U 235				
Ag 110m	~~1.15E-07	C C 2	~1.15E-07	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	~~1.30E-06	C C 2	~1.30E-06	C C 2	Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241				
Te 127m					Am 242m				
I 129					Am 243				
Cs 134	~~2.3E-07	C C 2	~2.3E-07	C C 2	Cm 242				
Cs 135					Cm 243				
Cs 137	~~5.37E-07	C C 2	~5.37E-07	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	~~5.75E-07	C C 2	~5.75E-07	C C 2	Other b/g	~~4.98E-07	C C 2	~4.98E-07	C C 2
Eu 154					**Total a**	**0**		**0**	
Eu 155					**Total b/g**	**~~6.70E-04**	**C C 2**	**~6.70E-04**	**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