WASTE STREAM 9C105 Reactor and Boiler Systems LLW

SITE	Dungeness A
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m³
Future arisings -	1.4.2025 - 31.3.2092.....	134.0 m³
Total future arisings:		134.0 m³
Total waste volume:		134.0 m³

Comment on volumes: Arisings are assumed to be approximately 2m³ per year for each of the years of Care & Maintenance.

Uncertainty factors on volumes:				
	Stock (upper):	x	Arisings (upper)	x 1.2
	Stock (lower):	x	Arisings (lower)	x 0.8

WASTE SOURCE Wastes from the general reactor area during the Care and Maintenance period.

PHYSICAL CHARACTERISTICS

General description: Principally mixed plastic sheeting and protective clothing all in mild steel drums. Any items will be cut to fit standard packages.

Physical components (%wt): The waste comprises principally various plastics and cloth (~75%wt), all in mild steel drums. Steel drum approximately 25%wt, percentage breakdown of other components not fully assessed.

Sealed sources: -

Bulk density (t/m³): ~0.4

Comment on density: The density estimate may be subject to revision.

CHEMICAL COMPOSITION

General description and components (%wt): The waste comprises various plastics and cloth in mild steel drums. Steel drum approximately 25%wt, percentage breakdown of other components not fully assessed.

Chemical state: Neutral

Chemical form of radionuclides:
H-3: Tritium may be present as surface contamination of waste by tritiated liquor.
C-14: Carbon 14 may be in the form of graphite dust.
Cl-36: Chlorine 36 may be present as a contaminant of graphite dust.
Se-79: The selenium content is insignificant.
Tc-99: The technetium content is insignificant.
Ra: The radium isotope content is insignificant.
Th: The thorium content is insignificant.
U: The uranium isotope content is insignificant.
Np: The neptunium content is insignificant.
Pu: The chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): Bulk and sheet metal are not expected to be present in significant quantities and have not been assessed. Mild steel drums containing the waste will arise at about 10 per year.

Stainless steel.....	0
Other ferrous metals.....	~25.0
Iron.....	
Aluminium.....	0
Beryllium.....	0
Cobalt.....	
Copper.....	0
Lead.....	0
Magnox/Magnesium.....	0

WASTE STREAM	9C105	Reactor and Boiler Systems LLW	
	Nickel		
	Titanium		
	Uranium	0	
	Zinc	0	
	Zircaloy/Zirconium	0	
	Other metals	0	"Other" metals have not been identified.
Organics (%wt):	-		
	Total cellulosics	~55.0	
	Paper, cotton	~55.0	
	Wood	0	
	Halogenated plastics	~10.0	
	Total non-halogenated plastics	0	
	Condensation polymers	0	
	Others	0	
	Organic ion exchange materials	0	
	Total rubber	NE	
	Halogenated rubber	NE	
	Non-halogenated rubber	NE	
	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		
	Glass/Ceramics	0	
	Graphite	0	
	Desiccants/Catalysts		
	Asbestos	0	
	Non/low friable		
	Moderately friable		
	Highly friable		
	Free aqueous liquids	0	
	Free non-aqueous liquids	0	

WASTE STREAM	9C105 Reactor and Boiler Systems LLW

Powder/Ash..... 0

Inorganic anions (%wt): None expected, but possibly present in trace quantities.

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: No materials likely to pose a fire or other non-radiological hazard have been identified. Asbestos is not expected to be present.

Combustible metals..... 0

Low flash point liquids..... 0

Explosive materials..... 0

Phosphorus..... 0

Hydrides..... 0

Biological etc. materials..... 0

Biodegradable materials.....

Putrescible wastes..... 0

Non-putrescible wastes.....

Corrosive materials..... 0

Pyrophoric materials..... 0

Generating toxic gases..... 0

Reacting with water..... 0

Active particles.....

Soluble solids as bulk chemical compounds.....

Hazardous substances / non hazardous pollutants: Not expected, but if any, present in trace quantities only. None expected.

Acrylamide.....

Benzene.....

Chlorinated solvents.....

Formaldehyde.....

Organometallics.....

Phenol.....

Styrene.....

Tri-butyl phosphate.....

Other organophosphates.....

Vinyl chloride.....

Arsenic.....

Barium.....

Boron.....

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

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids……

Other organic complexants.....

Total complexing agents..... TR

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: -

WASTE STREAM 9C105 Reactor and Boiler Systems LLW

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	21.6	7

Other information: 21.6m3 loading volume is calculated based on the fact that you can fit 36 off (200 litre/0.2m3) drums (7.2m3) into a ½ height ISO, each drum can be super-compacted to a 1/3 of its original volume so therefore 3 x the amount of un-compacted drums will fit into the final disposal container (21.6m3).

Waste Planned for Disposal at the LLW Repository:

Container voidage: -

Waste Characterisation Form (WCH): The waste meets the LLWR's Waste Acceptance Criteria (WAC).
The waste does not have a current WCH.

Waste consigned for disposal to LLWR in year of generation: The timing of consignment of waste for disposal cannot be determined at present. Disposal to the LLWR at the start of Care & Maintenance is expected, later disposal route to be established.

Potential for the waste to contain discrete items: -

Non-Containerised Waste for In-Vault Grouting: (Not applicable to this waste stream)

Stream volume (%): -

Waste stream variation: -

Bounding cuboidal volume:

WASTE STREAM 9C105 Reactor and Boiler Systems LLW

Inaccessible voidage:	-
Other information:	-

RADIOACTIVITY

Source:	Activation and contamination of materials.
Uncertainty:	Activity values are current best estimates. Specific activity is a function of operating history. The values are indicative of the activities that would be expected.
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:	The specific activities have been estimated from the Operational Reactor and Boiler systems LLW waste stream (9C11) using a suitable decay period.
Other information:	Activity estimates are shown in the table.

WASTE STREAM 9C105 Reactor and Boiler Systems LLW

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			1E-04	C C 2	Gd 153				8
Be 10				8	Ho 163				8
C 14			2E-05	C C 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			1E-06	C C 2	Lu 174				8
Ar 39				8	Lu 176				8
Ar 42				8	Hf 178n				8
K 40				8	Hf 182				8
Ca 41				8	Pt 193				8
Mn 53				8	Tl 204				8
Mn 54				8	Pb 205				8
Fe 55			7E-05	C C 2	Pb 210				8
Co 60			3E-05	C C 2	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			9E-06	C C 2	Po 210				8
Zn 65				8	Ra 223				8
Se 79				8	Ra 225				8
Kr 81				8	Ra 226				8
Kr 85				8	Ra 228				8
Rb 87				8	Ac 227				8
Sr 90			7E-08	C C 2	Th 227				8
Zr 93				8	Th 228				8
Nb 91				8	Th 229				8
Nb 92				8	Th 230				8
Nb 93m				8	Th 232				8
Nb 94				8	Th 234				8
Mo 93				8	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99				8	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			2E-07	C C 2	U 235				8
Ag 110m				8	U 236				8
Cd 109				8	U 238				8
Cd 113m				8	Np 237				8
Sn 119m				8	Pu 236				8
Sn 121m				8	Pu 238			4E-09	C C 2
Sn 123				8	Pu 239			3E-09	C C 2
Sn 126				8	Pu 240			3E-09	C C 2
Sb 125			7E-09	C C 2	Pu 241			3E-07	C C 2
Sb 126				8	Pu 242				8
Te 125m			7E-09	C C 2	Am 241			2E-08	C C 2
Te 127m				8	Am 242m				8
I 129				8	Am 243				8
Cs 134				8	Cm 242				8
Cs 135				8	Cm 243				8
Cs 137			3E-07	C C 2	Cm 244				8
Ba 133			4E-08	C C 2	Cm 245				8
La 137				8	Cm 246				8
La 138				8	Cm 248				8
Ce 144				8	Cf 249				8
Pm 145				8	Cf 250				8
Pm 147			3E-09	C C 2	Cf 251				8
Sm 147				8	Cf 252				8
Sm 151				8	Other a				
Eu 152			3E-07	C C 2	Other b/g				
Eu 154			1E-07	C C 2	**Total a**	**0**		**3E-08**	**C C 2**
Eu 155			3E-08	C C 2	**Total b/g**	**0**		**2.31E-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