

<b>WASTE STREAM</b>	<b>9C323</b>	<b>Reactor and Boiler Systems LLW</b>
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**SITE** Dungeness A  
**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Magnox Limited

**WASTE TYPE** LLW

Is the waste subject to Scottish Policy: No

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2022.....	0 m <sup>3</sup>
Future arisings -	1.4.2092 - 31.3.2095.....	209.9 m <sup>3</sup>
Total future arisings:		209.9 m <sup>3</sup>
Total waste volume:		209.9 m <sup>3</sup>
Comment on volumes:	Waste which has been deferred from 9C911 C&M Prep to FSC and decayed to start date of 2092. Final Dismantling & Site Clearance is assumed to commence in 2088 with reactor dismantling commencing in 2092 and lasting for 3 years.	
Uncertainty factors on volumes:	Stock (upper): x	Arisings (upper) x 1.2
	Stock (lower): x	Arisings (lower) x 0.8

**WASTE SOURCE** -

**PHYSICAL CHARACTERISTICS**

General description: Mild steel and mixed trash. Any large items will be cut to fit standard packages.  
 Physical components (%wt): Steel components, scrapped plant items, protective sheeting, decontamination materials, filters and drums containing the waste. The breakdown is metal (including the steel drum) ~30%wt, plastic ~30%wt, wood ~8%wt, glass/rubble ~12%wt and others 20% (including about 1% asbestos and some rubber).  
 Sealed sources: The waste does not contain sealed sources.  
 Bulk density (t/m<sup>3</sup>): 0.45  
 Comment on density: Density is based on the typical weight of a 200 litre drum.

**CHEMICAL COMPOSITION**

General description and components (%wt): The waste consists of metal, plastic, rubble, wood and glass all in the form of scrapped plant, protective sheeting, decontamination materials and filters. The filters may contain aluminium. The breakdown is metal (including the steel drum) ~30%wt, plastic ~30%wt, wood ~8%wt, glass/rubble ~12%wt and others 20% (including about 1% asbestos and some rubber).  
 Chemical state: Neutral  
 Chemical form of radionuclides: H-3: Tritium is present as surface contamination of waste by tritiated liquor.  
 C-14: The chemical form of Carbon 14 has not been determined but may be graphite.  
 Cl-36: Chlorine 36 may be present as a contaminant of graphite dust.  
 U: The chemical form of uranium isotopes has not been determined but may be uranium oxides.  
 Pu: The chemical form of plutonium isotopes has not been determined but may be plutonium oxides.  
 Metals and alloys (%wt): Metal thickness may vary from ~1mm to ~30mm.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	<8.0	Nickel and chromium present as constituents of stainless steel.	
Other ferrous metals.....	>21.0		
Iron.....			
Aluminium.....	<1.0		
Beryllium.....	0		

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Cobalt.....		
Copper.....	NE	
Lead.....	TR	
Magnox/Magnesium.....	TR	
Nickel.....		
Titanium.....		
Uranium.....		
Zinc.....	TR	
Zircaloy/Zirconium.....	TR	
Other metals.....	NE	"Other" metals have not been identified.

Organics (%wt):                      The waste may contain halogenated rubber as neoprene, and contain halogenated plastics as PVC.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	~8.0		
Paper, cotton.....	0		
Wood.....	<8.0		
Halogenated plastics .....	~30.0		
Total non-halogenated plastics.....	NE		
Condensation polymers.....	NE		
Others.....	NE		
Organic ion exchange materials....	0		
Total rubber.....	<19.0		
Halogenated rubber .....	<9.5		
Non-halogenated rubber.....	<9.5		
Hydrocarbons.....			
Oil or grease .....			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	TR		

Other materials (%wt):                      -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	~3.0		
Brick/Stone/Rubble.....	~3.0		
Cementitious material.....	~3.0		
Sand.....			
Glass/Ceramics.....	~3.0		

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Graphite.....	NE
Desiccants/Catalysts.....	
Asbestos.....	~1.0
Non/low friable.....	
Moderately friable.....	
Highly friable.....	
Free aqueous liquids.....	0
Free non-aqueous liquids.....	0
Powder/Ash.....	0

Inorganic anions (%wt):           Not expected, but possibly present in trace quantities.

	(%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:           Asbestos may be present.

	(%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.....		
Putrescible wastes.....	0	
Non-putrescible wastes.....		
Corrosive materials.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	0	
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

Hazardous substances / Asbestos ~1% wt.  
non hazardous pollutants:

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		
Chlorinated solvents.....		
Formaldehyde.....		
Organometallics.....		
Phenol.....		
Styrene.....		
Tri-butyl phosphate.....		
Other organophosphates.....		
Vinyl chloride.....		
Arsenic.....		
Barium.....		
Boron.....		
Boron (in Boral).....		
Boron (non-Boral).....		
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):

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		
Total complexing agents.....	NE	

**WASTE STREAM**

**9C323**

**Reactor and Boiler Systems LLW**

Potential for the waste to contain discrete items:

Yes. Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs; All stainless items assumed DIs. NB if recycled then DI Limits n/a

**TREATMENT, PACKAGING AND DISPOSAL**

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

Treatment	On-site / Off site	Stream volume %
Low force compaction		
Supercompaction (HFC)		
Incineration		27.6
Solidification		
Decontamination		
Metal treatment		27.6
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None		44.8

Comment on planned treatments:

6.05% is expected to be disposed of as VLLW

**Disposal Routes:**

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	38.8	
Expected to be consigned to a Landfill Facility	6.1	
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	27.6	
Expected to be consigned to a Metal Treatment Facility	27.6	
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:

17 04 05, 17 02 01, 17 02 03, 17 06 01\*

**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: -**

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

**Waste Packaging for Disposal:**

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Container	Stream volume %	Waste loading m <sup>3</sup>	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	38.7	10	9

Other information: -

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

Container voidage: .

Waste Characterisation Form (WCH): -

Waste consigned for disposal to LLWR in year of generation: The timing of consignment of the waste for disposal cannot be determined at present.

**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: 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 equivalent operational waste stream and appropriately decayed for FSC.

Other information: The activities quoted are those at 85 years after reactor shutdown, i.e. in 2091. There may be some contamination by Cs137.

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3			1.1E-06	CC 2	Gd 153				8
Be 10				8	Ho 163				8
C 14			2.8E-05	CC 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			9.77E-05	CC 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				8	Pb 210				8
Co 60			3.54E-09	CC 2	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			3.51E-05	CC 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			1.33E-07	CC 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			1.11E-06	CC 2	Th 234		1.72E-09	CC 2	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		1.79E-09	CC 2	8
Ag 108m			1.26E-06	CC 2	U 235				8
Ag 110m				2	U 236				8
Cd 109				8	U 238		1.72E-09	CC 2	8
Cd 113m				8	Np 237				8
Sn 119m				8	Pu 236				8
Sn 121m				8	Pu 238		4.35E-08	CC 2	8
Sn 123				8	Pu 239		5.78E-08	CC 2	8
Sn 126				8	Pu 240		7.51E-08	CC 2	8
Sb 125				8	Pu 241		1.78E-07	CC 2	8
Sb 126				8	Pu 242				8
Te 125m				8	Am 241		4.17E-07	CC 2	8
Te 127m				8	Am 242m				8
I 129				8	Am 243				8
Cs 134				2	Cm 242				8
Cs 135				8	Cm 243				8
Cs 137			7.55E-07	CC 2	Cm 244		9.64E-10	CC 2	8
Ba 133			3.2E-09	CC 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				8	Cf 251				8
Sm 147				8	Cf 252				8
Sm 151			4.78E-08	CC 2	Other a				8
Eu 152			4.31E-08	CC 2	Other b/g				8
Eu 154			3.11E-09	CC 2	<b>Total a</b>	<b>0</b>	<b>5.98E-07</b>	<b>CC 2</b>	8
Eu 155				8	<b>Total b/g</b>	<b>0</b>	<b>1.65E-04</b>	<b>CC 2</b>	8

**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