

WASTE STREAM	9C911	Reactor and Boiler Systems LLW
---------------------	--------------	---------------------------------------

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.....	179.4 m ³
Future arisings -	1.4.2022 - 31.3.2027.....	196.8 m ³
Total future arisings:		196.8 m ³
Total waste volume:		376.2 m ³
Comment on volumes:	Waste volumes take no account of volume reduction by supercompaction.	
Uncertainty factors on volumes:	Stock (upper): x 1.2	Arisings (upper) x 1.2
	Stock (lower): x 0.8	Arisings (lower) x 0.8

WASTE SOURCE This waste stream covers wastes generated from decommissioning activities in the reactor building and boiler houses.

PHYSICAL CHARACTERISTICS

General description: The types of waste associated with this waste stream include decommissioned plant and equipment, structural materials, scaffolding tubes, plasterboard, asbestos, concrete/rubble, soils, lead shot/shielding and secondary wastes such as wood, coveralls, PPE, enclosure sheeting, other plastics and rubber. Other items likely to be generated as the decommissioning continues including asbestos gaskets and mobile extraction unit filters containing asbestos. Other wastes have also been identified and include HEPA filters and vacuum cleaner bags used for housekeeping and shadow vacuuming and these bags contain non-asbestos dust, debris, swarf, rust, saw dust which are generated across all the waste stream areas.

Physical components (%wt): Metal (38%), Concrete/rubble (6%), Soil (6%), plasterboard (1%), plastics (15%), rubber 8%), wood (4%), Others including asbestos (22%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 0.15

Comment on density: data taken from WCH mass divided by volume

CHEMICAL COMPOSITION

General description and components (%wt): Metal (38%), Concrete/rubble (6%), Soil (6%), plasterboard (1%), plastics (15%), rubber 8%), wood (4%), Others including asbestos (22%).

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.....	~5.0	Stainless type 304. Plant and equipment items, structural materials, pre-activated metal items.	
Other ferrous metals.....			
Iron.....	~29.8	Assumption of 90% iron in all other ferrous metals. Plant and equipment	

WASTE STREAM	9C911	Reactor and Boiler Systems LLW
---------------------	--------------	---------------------------------------

Aluminium.....	2.0	items, structural materials, pre-activated metal items, chicken wire. Scaffold tubes, 50 HEPA filters and legacy plant items.
Beryllium.....		
Cobalt.....		
Copper.....		
Lead.....	0.63	Lead shot / lead shielding.
Magnox/Magnesium.....	~0.05	Trace quantities i.e. in alloys.
Nickel.....		
Titanium.....		
Uranium.....		
Zinc.....	~0.18	50 HEPA filters, galvanized metal coatings, all at trace quantities.
Zircaloy/Zirconium.....		
Other metals.....		

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.....	4.0		
Paper, cotton.....			
Wood.....	4.0		
Halogenated plastics	8.1	Plastic wrappings, PPE, sheeting.	
Total non-halogenated plastics.....	7.2	Plastic wrappings, PPE, sheeting.	
Condensation polymers.....	~3.6		
Others.....	~3.6		
Organic ion exchange materials....			
Total rubber.....	8.0		
Halogenated rubber	~4.0		
Non-halogenated rubber.....	~4.0		
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....			

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..			
Inorganic sludges and flocs.....			
Soil.....	~6.0		

WASTE STREAM	9C911	Reactor and Boiler Systems LLW
---------------------	--------------	---------------------------------------

Brick/Stone/Rubble.....	~6.0	
Cementitious material.....		
Sand.....		
Glass/Ceramics.....		
Graphite.....		
Desiccants/Catalysts.....		
Asbestos.....	~22.6	
Non/low friable.....	~0.40	CAF joints gaskets - chrysotile (white).
Moderately friable.....	~2.0	Mobile extraction unit (MEU) including filters - chrysotile (white).
Highly friable.....	~20.2	Fine clean sweepings - chrysotile (white).
Free aqueous liquids.....		
Free non-aqueous liquids.....		
Powder/Ash.....		

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 Asbestos
waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals.....		
Low flash point liquids.....		
Explosive materials.....		
Phosphorus.....		
Hydrides.....		
Biological etc. materials.....		
Biodegradable materials.....	0	
Putrescible wastes.....		
Non-putrescible wastes.....		
Corrosive materials.....		
Pyrophoric materials.....		
Generating toxic gases.....		

WASTE STREAM	9C911	Reactor and Boiler Systems LLW
---------------------	--------------	---------------------------------------

Reacting with water.....	P	350m2 galvanised metal may be present in the waste eg. in the form of HEPA filters (estimated to be 5.5 m3 and surface area 350 m2).
--------------------------	---	--

Higher activity particles.....

Soluble solids as bulk chemical compounds.....

Hazardous substances / non hazardous pollutants: Asbestos.

(%wt) Type(s) and comment

Acrylamide.....

Benzene.....

Chlorinated solvents.....

Formaldehyde.....

Organometallics.....

Phenol.....

Styrene.....

Tri-butyl phosphate.....

Other organophosphates.....

Vinyl chloride.....

Arsenic.....

Barium.....

Boron..... 0

Boron (in Boral).....

Boron (non-Boral).....

Cadmium.....

Caesium.....

Selenium.....

Chromium.....

Molybdenum.....

Thallium.....

Tin.....

Vanadium.....

Mercury compounds.....

Others..... ~1.0 Plasterboard.

Electronic Electrical Equipment (EEE)

EEE Type 1.....

EEE Type 2.....

EEE Type 3.....

EEE Type 4.....

EEE Type 5.....

WASTE STREAM 9C911 Reactor and Boiler Systems LLW

Complexing agents (%wt): No

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		
Total complexing agents.....	0	

Potential for the waste to contain discrete items: Yes. Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs; Stainless items assumed DIs
 Insulation - In & of itself not a DI; waste stream may include DIs
 Large Concrete Items (LCIs) may be DIs; drummed (ungrounted)/"rubbleised" wastes assumed not Dis

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	On-site	0.30
Supercompaction (HFC)	Off-site	0.30
Incineration	Off-site	28.2
Solidification		
Decontamination		
Metal treatment	Off-site	0.75
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None		70.8

Comment on planned treatments: It is expected that 70% of this waste stream will be sent to Landfill as VLLW.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	1.1	0.15
Expected to be consigned to a Landfill Facility	70.0	0.15
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	28.2	0.40
Expected to be consigned to a Metal Treatment Facility	0.75	1.4
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 05 03*/04, 17 06 01*, 17 02 01, 17 02 03

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

WASTE STREAM 9C911 Reactor and Boiler Systems LLW

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:

Container	Stream volume %	Waste loading m ³	Number of packages
1/3 Height IP-1 ISO			
2/3 Height IP-2 ISO			
1/2 Height WAMAC IP-2 ISO	0.30	43.2	< 1
1/2 Height IP-2 Disposal/Re-usable ISO	0.75	10	< 1
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: 43.2m³ loading volume is calculated based on the fact that you can low force compact two times the normal volume of waste into a 200 litre/0.2m³ drum (400 litres/0.4m³), you can then fit 36 drums (14.4m³) into a ½ height ISO. Each drum can be supercompacted to a 1/3 of its original volume so therefore can get 3 x the amount of uncompacted drums into the final disposal container (43.2m³).

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 has a current WCH. Inventory information is consistent with the current WCH.

Waste consigned for disposal to LLWR in year of generation: No. 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

WASTE STREAM**9C911****Reactor and Boiler Systems LLW**

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:	Data taken from WCH - 1MXN-3DUA-0-WCH-0-4594 V6 decayed two years for RWI 2022.
Other information:	-

WASTE STREAM 9C911 Reactor and Boiler Systems LLW

Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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	1.33E-06	CC 1	1.33E-06	CC 1	Gd 153		8		8
Be 10		8		8	Ho 163		8		8
C 14	4.18E-07	CC 1	4.18E-07	CC 1	Ho 166m		8		8
Na 22		8		8	Tm 170		8		8
Al 26		8		8	Tm 171		8		8
Cl 36	1.53E-06	CC 1	1.53E-06	CC 1	Lu 174		8		8
Ar 39		8		8	Lu 176		8		8
Ar 42		8		8	Hf 178n		8		8
K 40		8		8	Hf 182		8		8
Ca 41		8		8	Pt 193		8		8
Mn 53		8		8	Tl 204		8		8
Mn 54		8		8	Pb 205		8		8
Fe 55	6.9E-07	CC 1	6.9E-07	CC 1	Pb 210		8		8
Co 60	4.1E-07	CC 2	4.1E-07	CC 2	Bi 208		8		8
Ni 59		8		8	Bi 210m		8		8
Ni 63	8.41E-07	CC 1	8.41E-07	CC 1	Po 210		8		8
Zn 65		8		8	Ra 223		8		8
Se 79		8		8	Ra 225		8		8
Kr 81		8		8	Ra 226		8		8
Kr 85		8		8	Ra 228		8		8
Rb 87		8		8	Ac 227		8		8
Sr 90	8.65E-08	CC 1	8.65E-08	CC 1	Th 227		8		8
Zr 93		8		8	Th 228		8		8
Nb 91		8		8	Th 229		8		8
Nb 92		8		8	Th 230		8		8
Nb 93m		8		8	Th 232		8		8
Nb 94	2.48E-08	CC 2	2.48E-08	CC 2	Th 234	2.62E-09	CC 2	2.62E-09	CC 2
Mo 93		8		8	Pa 231		8		8
Tc 97		8		8	Pa 233		8		8
Tc 99		8		8	U 232		8		8
Ru 106		8		8	U 233		8		8
Pd 107		8		8	U 234	2.59E-09	CC 1	2.59E-09	CC 1
Ag 108m	3.3E-08	CC 2	3.3E-08	CC 2	U 235		8		8
Ag 110m		8		8	U 236		8		8
Cd 109		8		8	U 238	2.62E-09	CC 1	2.62E-09	CC 1
Cd 113m		8		8	Np 237		8		8
Sn 119m		8		8	Pu 236		8		8
Sn 121m		8		8	Pu 238	2.64E-09	CC 1	2.64E-09	CC 1
Sn 123		8		8	Pu 239	2.08E-09	CC 1	2.08E-09	CC 1
Sn 126		8		8	Pu 240	2.71E-09	CC 1	2.71E-09	CC 1
Sb 125		8		8	Pu 241	3.79E-07	CC 1	3.79E-07	CC 1
Sb 126		8		8	Pu 242		8		8
Te 125m		8		8	Am 241	1.94E-08	CC 1	1.94E-08	CC 1
Te 127m		8		8	Am 242m		8		8
I 129		8		8	Am 243		8		8
Cs 134	4.52E-09	CC 2	4.52E-09	CC 2	Cm 242		8		8
Cs 135		8		8	Cm 243		8		8
Cs 137	2.82E-07	CC 2	2.82E-07	CC 2	Cm 244	5.68E-09	CC 1	5.68E-09	CC 1
Ba 133	6.46E-09	CC 2	6.46E-09	CC 2	Cm 245		8		8
La 137		8		8	Cm 246		8		8
La 138		8		8	Cm 248		8		8
Ce 144		8		8	Cf 249		8		8
Pm 145		8		8	Cf 250		8		8
Pm 147	4.41E-09	CC 1	4.41E-09	CC 1	Cf 251		8		8
Sm 147		8		8	Cf 252		8		8
Sm 151	1.39E-07	CC 1	1.39E-07	CC 1	Other a				
Eu 152	2.87E-08	CC 2	2.87E-08	CC 2	Other b/g				
Eu 154	1.66E-08	CC 2	1.66E-08	CC 2	Total a	3.77E-08	CC 1	3.77E-08	CC 1
Eu 155	5.67E-09	CC 2	5.67E-09	CC 2	Total b/g	6.23E-06	CC 1	6.23E-06	CC 1

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