

WASTE STREAM	9A930	Active Waste Vault Retrieval Decommissioning.
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SITE Berkeley

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 ³
Future arisings -	1.4.2022 - 31.3.2024.....	~165.0 m ³
Total future arisings:		165.0 m ³
Total waste volume:		165.0 m ³
Comment on volumes:	The dates above are under review. The demolition will not start until all the vaults have been emptied. Arisings are predicted by quantity estimates.	
Uncertainty factors on volumes:	Stock (upper): x	Arisings (upper) x 1.2
	Stock (lower): x	Arisings (lower) x 0.8

WASTE SOURCE Plant arisings from Active Waste Vault Retrieval building. Steel components from dismantling plant and pipework in the Retrieval Building.

PHYSICAL CHARACTERISTICS

General description: Consists of soft and hard trash resulting from Active Waste Vault Retrievals (AWVR), as well as the eventual deplant and demolition of the building in readiness for the sites entry into the Care & Maintenance (C&M) phase. This waste will include varied quantities of steel, deplanting materials, general waste, ventilation plant ducting and cable trays, other scrap and concrete. The secondary waste arisings (used PPE, plastic sheeting, tackys and wipealls) from vault retrievals will constitute majority of the LLW generated until the vaults have been emptied. The volume of waste will then increase significantly with the Post Operational Clean Out (POCO) deplanting and demolition of the Active Waste Vaults (AWV) facility.

Physical components (%vol): Varied quantities of steels, deplanting materials, general waste, Light Iron Duct Work (Ventilation Plant ducting and cable trays), general scrap (Ventilation equipment etc), cabling, fibre insulation and concrete. % Breakdown by volume, ~32% metals, ~25% concrete, ~12% plastics (non-halogenated), ~24% Cellulosics, 2% rubber, and ~5% glass.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1.31

Comment on density: Calculated from WCH mass divided by volume.

CHEMICAL COMPOSITION

General description and components (%wt): 55% Metal, 29% concrete, 4% plastic, 1% rubber, 8% cellulosic, 3% glass.

Chemical state: Neutral

Chemical form of radionuclides:
H-3: Any tritium is expected to be present as water.
C-14: Carbon-14 maybe present as graphite.
Cl-36: The chlorine 36 content is insignificant.
U: Chemical form of uranium has not been determined but may be uranium oxides.
Pu: Chemical form of plutonium has not been determined but may be plutonium oxides.

Metals and alloys (%wt): Items will have been cut for packaging. Thicknesses are likely to vary from a few mm to about 25 mm.

WASTE STREAM

9A930

Active Waste Vault Retrieval Decommissioning.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	NE		
Other ferrous metals.....	~24.3	Mild steel - Ventilation equipment, deplanting materials	
Iron.....			
Aluminium.....	NE		
Beryllium.....	0		
Cobalt.....			
Copper.....	~29.9	Cabling	
Lead.....	NE		
Magnox/Magnesium.....	TR		
Nickel.....			
Titanium.....			
Uranium.....			
Zinc.....	0.80	Galvanised vent ducting	
Zircaloy/Zirconium.....	NE		
Other metals.....	NE	"Other" metals not identified	
Organics (%wt):	Trace amounts of ion exchange resin could be present.		
	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	8.0		
Paper, cotton.....	~4.0		
Wood.....	~4.0		
Halogenated plastics	NE		
Total non-halogenated plastics.....	4.0		
Condensation polymers.....	NE		
Others.....	~4.0	Secondary waste arising	
Organic ion exchange materials....	NE		
Total rubber.....	~1.0		
Halogenated rubber	NE		
Non-halogenated rubber.....	~1.0		
Hydrocarbons.....	0.20		
Oil or grease	0.10	Hydraulic oil	
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	NE		
Other materials (%wt):	-		

WASTE STREAM

9A930

Active Waste Vault Retrieval Decommissioning.

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	NE		
Inorganic sludges and flocs.....	NE		
Soil.....	NE		
Brick/Stone/Rubble.....	NE		
Cementitious material.....	~29.0		
Sand.....			
Glass/Ceramics.....	~3.0		
Graphite.....	NE		
Desiccants/Catalysts.....			
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	TR		
Free non-aqueous liquids.....			
Powder/Ash.....	NE		

Inorganic anions (%wt): -

	(%wt)	Type(s) and comment
Fluoride.....	NE	
Chloride.....	NE	
Iodide.....	NE	
Cyanide.....	0	
Carbonate.....	NE	
Nitrate.....	NE	
Nitrite.....	NE	
Phosphate.....	NE	
Sulphate.....	NE	
Sulphide.....	NE	

Materials of interest for waste acceptance criteria: -

	(%wt)	Type(s) and comment
Combustible metals.....	NE	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	8.0	
Putrescible wastes.....	0	
Non-putrescible wastes.....	8.0	

WASTE STREAM	9A930	Active Waste Vault Retrieval Decommissioning.
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Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	NE
Reacting with water.....	0
Higher activity particles.....	
Soluble solids as bulk chemical compounds.....	

Hazardous substances / None expected
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.....	0	
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.....		

WASTE STREAM 9A930 Active Waste Vault Retrieval Decommissioning.

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 Large Concrete Items (LCIs) may be DIs; drummed (ungroued)/"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	Off-site	37.4
Supercompaction (HFC)		
Incineration		
Solidification		
Decontamination	Off-site	32.2
Metal treatment		
Size reduction		
Decay storage		
Recycling / reuse		
Other / various	30.4	
None		

Comment on planned treatments: 30.4% by volume of the waste stream is expected to be disposed of as VLLW to landfill

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	30.4	1.3
Expected to be consigned to a Landfill Facility		
Expected to be consigned to an On-Site Disposal Facility	37.4	0.40
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	32.2	1.4
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 01 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			

WASTE STREAM 9A930 Active Waste Vault Retrieval Decommissioning.

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: (Not applicable to this waste stream)

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			
1/2 Height IP-2 Disposal/Re-usable ISO			
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: -

Waste Planned for Disposal at the LLW Repository: (Not applicable to this waste stream)

Container voidage: -

Waste Characterisation Form (WCH): -

Waste consigned for disposal to LLWR in year of 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: Contamination of steelwork, equipment and structure materials.

Uncertainty: -

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 sampling plan was based on the ILW (FED) stored in the vaults as opposed to the secondary LLW arisings that have arisen with the recent retrieved operations. The FED that was initially retrieved was subjected to a number of gamma spectrometry measurements using a High Resolution Gamma Spectrometer (HRGS) in order to determine the concentration of gamma emitting radionuclides in the waste. Each item of FED retrieved was subjected to HRGS measurements and radiochemical analyses. This has been used to determine the fingerprint for 9A930, whereby:- historic data from past LLW disposals (VLLW, Combustible, Supercompaction, Metallic Treatment and Direct) have been used in estimating the total activity in the stocks and arisings for this waste stream and the resulting nuclide fractions used to determine the nuclide activities for this waste stream.

Other information: -

WASTE STREAM 9A930 Active Waste Vault Retrieval Decommissioning.

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			7.05E-05	CC 1	Gd 153				8
Be 10				8	Ho 163				8
C 14			2.2E-05	CC 1	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			6.59E-09	CC 1	Lu 174				8
Ar 39				8	Lu 176				8
Ar 42				8	Hf 178n				8
K 40				8	Hf 182				8
Ca 41			3.53E-08	CC 2	Pt 193		2.08E-07	CC 2	
Mn 53				8	Tl 204		8.06E-09	CC 2	
Mn 54				8	Pb 205				8
Fe 55			2.66E-08	CC 1	Pb 210				8
Co 60			7.91E-07	CC 2	Bi 208				8
Ni 59			1.78E-08	CC 2	Bi 210m				8
Ni 63			1.28E-07	CC 1	Po 210				8
Zn 65				8	Ra 223				8
Se 79				8	Ra 225				8
Kr 81				8	Ra 226				8
Kr 85			3.21E-08	CC 2	Ra 228				8
Rb 87				8	Ac 227				8
Sr 90			1.42E-06	CC 1	Th 227				8
Zr 93				8	Th 228				8
Nb 91				8	Th 229				8
Nb 92				8	Th 230				8
Nb 93m			6.1E-09	CC 2	Th 232				8
Nb 94			2.48E-08	CC 2	Th 234				8
Mo 93			3.59E-09	CC 2	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99				8	U 232				8
Ru 106				8	U 233		4.19E-09	CC 2	
Pd 107				8	U 234				8
Ag 108m			1.91E-08	CC 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		7.32E-08	CC 1	
Sn 123				8	Pu 239		9.65E-08	CC 1	
Sn 126				8	Pu 240		9.76E-08	CC 1	
Sb 125				8	Pu 241		4.11E-06	CC 1	
Sb 126				8	Pu 242		2.51E-09	CC 1	
Te 125m				8	Am 241		4.06E-07	CC 1	
Te 127m				8	Am 242m				8
I 129				8	Am 243				8
Cs 134			2.4E-09	CC 2	Cm 242				8
Cs 135				8	Cm 243				8
Cs 137			4.55E-07	CC 2	Cm 244		5.04E-09	CC 1	
Ba 133			1.32E-08	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			1.49E-07	CC 1	Other a				
Eu 152			1.78E-07	CC 2	Other b/g				
Eu 154			2.58E-07	CC 2	Total a	0	6.85E-07	BB 2	
Eu 155			1.46E-08	CC 2	Total b/g	0	1.00E-04	BB 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