

WASTE STREAM	9A980	Caesium Removal Plant 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.....	33.1 m ³
Total future arisings:		33.1 m ³
Total waste volume:		33.1 m ³

Comment on volumes: Arisings are predicted by quantity survey and contamination levels advised by health physics. Volumes include a contingency of 5% by vol secondary wastes from handling / decontamination. The demolition will not start until all the tanks have been emptied.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 1.1
 Stock (lower): x Arisings (lower) x 0.9

WASTE SOURCE This waste stream consists of steel components from dismantling plant and pipework in the CRP, concrete from the CRP structure, and secondary waste arising from decommissioning and handling operations. Activation and fission product, as well as actinide, contamination is expected.

PHYSICAL CHARACTERISTICS

General description: Mainly pipework and tanks that had been in contact with ion exchange material and sludge, and contaminated building rubble. If necessary items will be reduced in size to fit containers. Includes some secondary waste. Volume of 1.9m3 added to incorporate streams 9A938 (CRP Resin Tank SRST1) and 9A939 (CRP Sludge Tank) that were set to historic.

Physical components (%wt): 64.5% Steel and Ferrous (Tanks from Caesium Removal Plant (CRP) Post Operational Clean Out (POCO), Deplanting Platforms, General Waste (Deplant & demolish Buildings), Light Iron Duct Work (Ventilation Plant ducting and cable trays), General Scrap (Ventilation equipment etc.), 20% Concrete (Covers etc), 12% Cable-Cu, 1% Fibre Insulation, 1% plastic, 1% biodegradable non-putrescible, 1% rubber.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1.45

Comment on density: Based on WCH data, mass divided by volume

CHEMICAL COMPOSITION

General description and components (%wt): 64.5% Steel & Ferrous, 12% copper, 20% concrete, 1% plastic, 1% biodegradable non-putrescible, 1% rubber, 1% insulation.

Chemical state: Neutral

Chemical form of radionuclides: H-3: Any tritium is expected to be present as water, but some may be in the form of other inorganic compounds or as organic compounds.
 Cl-36: The chlorine 36 content is insignificant.
 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.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~52.9	Tanks, pumps, deplanting material	
Other ferrous metals.....	~11.6	Ventilation equipment, deplanting materials, drums, valves, couplings	
Iron.....	~0.30		
Aluminium.....	~0.01	Surface Area = 1 m ² , Sheets,	

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		hoover body	
Beryllium.....	0		
Cobalt.....			
Copper.....	~12.0	Cabling	
Lead.....	0		
Magnox/Magnesium.....	0		
Nickel.....			
Titanium.....			
Uranium.....	0		
Zinc.....	0		
Zircaloy/Zirconium.....	0		
Other metals.....	NE	"Other" metals not identified	
Organics (%wt):	Trace amounts of ion exchange resin on tank components could be present.		
	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	~0		
Paper, cotton.....			
Wood.....			
Halogenated plastics	NE		
Total non-halogenated plastics.....	~1.0		
Condensation polymers.....	~0		
Others.....	~1.0		
Organic ion exchange materials....	TR		
Total rubber.....	~1.0		
Halogenated rubber	~0.50		
Non-halogenated rubber.....	~0.50		
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	NE		
Other materials (%wt):	-		
	(%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.....	~20.0		
Sand.....			
Glass/Ceramics.....	~0.20	Man made mineral fibre insulation	

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

Inorganic anions (%wt): There may be traces of inorganic ions from ion exchange materials.

	(%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.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....	1.0	
Putrescible wastes.....	0	
Non-putrescible wastes.....	~1.0	
Corrosive materials.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	0	
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

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non hazardous pollutants:

None expected. Whilst there is no known evidence of asbestos in CRP waste, there remains the possibility for some asbestos in gaskets, etc. This will be assessed for each item prior to disposal.

(%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..... P 5 off Hoover motors

EEE Type 4.....

EEE Type 5.....

Complexing agents (%wt): No

(%wt) Type(s) and comment

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids.....

Other organic complexants.....

Total complexing agents..... 0

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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 (ungrouted)/"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	~0.50
Supercompaction (HFC)	Off-site	~0.50
Incineration	Off-site	~9.0
Solidification		
Decontamination		
Metal treatment	Off-site	~68.0
Size reduction		
Decay storage		
Recycling / reuse		
Other / various		
None		~22.5

Comment on planned treatments:

14% to go as VLLW.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	9.0	1.5
Expected to be consigned to a Landfill Facility	14.0	1.5
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	9.0	0.40
Expected to be consigned to a Metal Treatment Facility	68.0	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 07, 17 01 01, 17 06 03*

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 ³	Number of packages
1/3 Height IP-1 ISO			
2/3 Height IP-2 ISO			
1/2 Height WAMAC IP-2 ISO	~0.50	~43.2	< 1
1/2 Height IP-2 Disposal/Re-usable ISO	~8.5	~10	< 1
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: It is likely that this waste will be placed in a container with other LLW. 43.2m³ loading volume (in the WAMAC container) 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 super-compacted to a 1/3 of its original volume so therefore we can get 3 x the amount of un-compacted drums into the final disposal container (43.2m³).

Waste Planned for Disposal at the LLW Repository:

Container voidage: No significant inaccessible voidage is expected.

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: Yes.

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 steel pipework, vessels and concrete structure.

Uncertainty: The values quoted were derived by calculation and are indicative of the activities that are 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-1BNL-0-WCH-0-2242 V6) and decayed by 9 years to 2022

Other information: -

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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			5.47E-06	CC 1	Gd 153				8
Be 10				8	Ho 163				8
C 14			5.93E-07	CC 1	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36				8	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			2.26E-08	CC 1	Pb 210				8
Co 60			1.31E-07	CC 1	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			5.23E-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				8	Ra 228				8
Rb 87				8	Ac 227				8
Sr 90			3.22E-04	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				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				8	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		2.13E-06	CC 1	
Sn 123				8	Pu 239		4.18E-06	CC 1	
Sn 126				8	Pu 240		5.53E-06	CC 1	
Sb 125				8	Pu 241		5.61E-05	CC 1	
Sb 126				8	Pu 242			8	
Te 125m				8	Am 241		1.93E-05	CC 1	
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			1.77E-03	CC 1	Cm 244			8	
Ba 133				8	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			1.39E-08	CC 1	Cf 251			8	
Sm 147				8	Cf 252			8	
Sm 151				8	Other a				
Eu 152				8	Other b/g				
Eu 154			3.58E-07	CC 2	Total a	0	3.11E-05	CC 1	
Eu 155				8	Total b/g	0	2.15E-03	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