

WASTE STREAM	9A921	AETP and Decontamination LLW
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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.....	5.0 m ³
Future arisings -	1.4.2022 - 31.3.2025.....	29.1 m ³
Total future arisings:		29.1 m ³
Total waste volume:		34.1 m ³

Comment on volumes: Current volume estimates will be subject to review and refinement as Care & Maintenance Preparation proceeds. Arisings are predicted by quantity survey and contamination levels advised by health physics. Volumes include a contingency of 5% by vol secondary wastes (handling / decontamination).

Uncertainty factors on volumes: Stock (upper): x 1.1 Arisings (upper) x 1.2
Stock (lower): x 0.9 Arisings (lower) x 0.8

WASTE SOURCE Waste stream 9A921 consists of wastes that arise from the AETP decontamination and C&M Preps work on Berkeley site. The waste is expected to contain redundant pipework, rubber, plastic, pumps, motors and rags. Both activation and fission product, as well as actinide contamination, is expected.

PHYSICAL CHARACTERISTICS

General description: Soft and hard trash. Metal waste associated with the decommissioning. There are no large items that will require special handling. Includes some secondary wastes. This waste stream consists of wastes arising from the decommissioning of the AETP and decontamination work on the Berkeley Decommissioning Site. It does not include any of the primary waste (i.e. sludge or liquids). The waste is expected to contain redundant pipework, rubber, plastic, pumps, motors and rags.

Physical components (%wt): Metal: 75%, Concrete / rubble; 16%, Biodegradable- non putrescibles 1%, plastics 2%, rubber 1 % and others (Motors, etc = 0.39 m³ / 1.55 t Sand Pressure Filter Media = 2.2 m³ / 1.65 t) 5%

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1.41

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

CHEMICAL COMPOSITION

General description and components (%wt): Metal: 75%, Concrete / rubble; 16%, Biodegradable- non putrescibles 1%, plastics 2%, rubber 1 % and others (Motors, etc = 0.39 m³ / 1.55 t Sand Pressure Filter Media = 2.2 m³ / 1.65 t) 5%

Chemical state: Alkali

Chemical form of radionuclides: H-3: Most tritium is expected to be present as water but some may be in the form of other inorganic compounds or as organic compounds.
C-14: Chemical form of carbon 14 has not been determined but may be graphite.
Cl-36: Chemical form of chlorine 36 has not been determined.
U: Chemical form of uranium isotopes has not been determined but may be uranium oxides.
Pu: Chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): Items will have to be cut for packaging. Large volumes of metal plant typically include steel skip mast shutter, waste retrieval machine, waste retrieval running track, access doors to vault etc.

WASTE STREAM	9A921	AETP and Decontamination LLW
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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~1.4	Tanks, other	
Other ferrous metals.....	~63.7	Mild Steel - Ventilation equipment, deplanting materials	
Iron.....	1.5	Cast iron gully pot, cast iron parts	
Aluminium.....	<0.01	Surface area = 1.5 m2, Sheets, size reduced ladders	
Beryllium.....	0		
Cobalt.....			
Copper.....	~9.0	Cabling	
Lead.....	NE		
Magnox/Magnesium.....	0		
Nickel.....	TR	Alloy Constituent	
Titanium.....			
Uranium.....			
Zinc.....	<0.01	Surface Area = 1 m2, Constituent of galvonised ducting	
Zircaloy/Zirconium.....	0		
Other metals.....	1.0	Other metals have not been identified	
Organics (%wt):	The waste contains cellulose in the form of wood and cloth, halogenated plastic as PVC and non-halogenated plastic which includes polythene.Metal in the waste stream consists of contaminated pipes, railings, ventilation ducts, manhole covers etc.		
	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	~0		
Paper, cotton.....	NE		
Wood.....			
Halogenated plastics	~1.0	Secondary waste arising. Halogenated plastic is present as PVC.	
Total non-halogenated plastics.....	~1.0		
Condensation polymers.....	~1.0	Secondary waste arising	
Others.....	NE		
Organic ion exchange materials....	0		
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.....	TR		
Other materials (%wt):	Concrete scabblings and contaminated brick/blockwork expected. Glass panelling and		

WASTE STREAM	9A921	AETP and Decontamination LLW
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mirror from MCU.

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	NE		
Brick/Stone/Rubble.....	~16.0		
Cementitious material.....	~		
Sand.....	2.9	Sand pressure filter media	
Glass/Ceramics.....	NE		
Graphite.....	0		
Desiccants/Catalysts.....			
Asbestos.....	TR		
Non/low friable.....	TR	Gasketsamosite (brown)	
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt): Trace quantities present.

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

Materials of interest for waste acceptance criteria: No material likely to present a fire or other non-radiological hazard is 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.....	1.0	
Putrescible wastes.....	0	

WASTE STREAM	9A921	AETP and Decontamination LLW
---------------------	--------------	-------------------------------------

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.....	

Hazardous substances /
non hazardous pollutants: None expected

	(%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.....	P	3 off Motors, pumps
EEE Type 3.....	P	12 off vacuum cleaners.
EEE Type 4.....		
EEE Type 5.....		

WASTE STREAM 9A921 AETP and Decontamination 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 Large Concrete Items (LCIs) may be DIs; drummed (ungrouned)/"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	~2.0
Supercompaction (HFC)	Off-site	~2.0
Incineration	Off-site	~7.0
Solidification		
Decontamination		
Metal treatment	Off-site	~70.0
Size reduction		
Decay storage		
Recycling / reuse		
Other / various	Off-site	
None		~21.0

Comment on planned treatments:

70% of this waste stream will be consigned for Metal Recycling and 15% to Landfill as VLLW.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	~8.0	1.4
Expected to be consigned to a Landfill Facility	~15.0	1.4
Expected to be consigned to an On-Site Disposal Facility		
Expected to be consigned to an Incineration Facility	~7.0	0.40
Expected to be consigned to a Metal Treatment Facility	~70.0	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 05, 17 04 07, 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			

WASTE STREAM	9A921	AETP and Decontamination LLW
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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	~2.0	43.2	< 1
1/2 Height IP-2 Disposal/Re-usable ISO	~6.0	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 (on 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 1/2 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 has a current WCH. Inventory information is consistent with the 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: Activity is from fission products, activation products and actinides.

Uncertainty: Specific activity is a function of Station operating history. The values quoted 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 waste stream fingerprint data believed to be from 2013 and decayed by 9 years to stock reference date/start date of first arising. 1MXN-1BNL-0-WCH-0-4632 V1

Other information: -

WASTE STREAM 9A921 AETP and Decontamination 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	1.06E-05	CC 1	1.06E-05	CC 1	Gd 153		8		8
Be 10		8		8	Ho 163		8		8
C 14	1.14E-06	CC 1	1.14E-06	CC 1	Ho 166m		8		8
Na 22		8		8	Tm 170		8		8
Al 26		8		8	Tm 171		8		8
Cl 36		8		8	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	4.36E-08	CC 1	4.36E-08	CC 1	Pb 210		8		8
Co 60	2.53E-07	CC 2	2.53E-07	CC 2	Bi 208		8		8
Ni 59		8		8	Bi 210m		8		8
Ni 63	1.01E-06	CC 1	1.01E-06	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	6.21E-04	CC 1	6.21E-04	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		8		8	Th 234		8		8
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		8		8
Ag 108m		8		8	U 235		8		8
Ag 110m		8		8	U 236		8		8
Cd 109		8		8	U 238		8		8
Cd 113m		8		8	Np 237		8		8
Sn 119m		8		8	Pu 236		8		8
Sn 121m		8		8	Pu 238	4.11E-06	CC 1	4.11E-06	CC 1
Sn 123		8		8	Pu 239	8.07E-06	CC 1	8.07E-06	CC 1
Sn 126		8		8	Pu 240	1.06E-05	CC 1	1.06E-05	CC 1
Sb 125		8		8	Pu 241	1.08E-04	CC 1	1.08E-04	CC 1
Sb 126		8		8	Pu 242		8		8
Te 125m		8		8	Am 241	3.71E-05	CC 1	3.71E-05	CC 1
Te 127m		8		8	Am 242m		8		8
I 129		8		8	Am 243		8		8
Cs 134		8		8	Cm 242		8		8
Cs 135		8		8	Cm 243		8		8
Cs 137	3.41E-03	CC 2	3.41E-03	CC 2	Cm 244		8		8
Ba 133		8		8	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	2.69E-08	CC 1	2.69E-08	CC 1	Cf 251		8		8
Sm 147		8		8	Cf 252		8		8
Sm 151		8		8	Other a				
Eu 152		8		8	Other b/g				
Eu 154	6.9E-07	CC 2	6.9E-07	CC 2	Total a	5.99E-05	CC 2	5.99E-05	CC 2
Eu 155		8		8	Total b/g	4.15E-03	CC 2	4.15E-03	CC 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