WASTE STREAM 9A921 AETP and Decontamination LLW

SITE	Berkeley
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m³
Future arisings -	1.4.2019 - 31.3.2020.....	12.6 m³
	1.4.2020 - 31.3.2022.....	17.7 m³
Total future arisings:		30.3 m³
Total waste volume:		30.3 m³

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	Arisings (upper)	x 1.2
Stock (lower):	x	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 (%vol): Metal: 75%, Concrete / rubble; 16%, Biodegradable- non putrescibles 1%, plastics 2%, rubber 1 % and others (Motors, etc = 0.39 m3 / 1.55 tSand Pressure Filter Media = 2.2 m3 / 1.65 t) 5%

Sealed sources: -

Bulk density (t/m³): ~1.41

Comment on density: Calculated from the WCH data

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 tSand 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.

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.

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 mirror from MCU.

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	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs.....	0	
	Soil.....	NE	
	Brick/Stone/Rubble.....	~16.0	
	Cementitious material.....	~	
	Sand.....	2.0	Sand pressure filter media
	Glass/Ceramics.....	NE	
	Graphite.....	0	
	Desiccants/Catalysts.....		
	Asbestos.....	2.5	
	Non/low friable.....	2.5	Gasketsamosite (brown)
	Moderately friable.....		
	Highly friable.....		
	Free aqueous liquids.....	0	
	Free non-aqueous liquids.....	0	
	Powder/Ash.....	0	
Inorganic anions (%wt):	Trace quantities present.		
	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.		
	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	
	Active particles.....		

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	Soluble solids as bulk chemical compounds.....		
Hazardous substances / non hazardous pollutants:	None expected		
	Acrylamide.....		
	Benzene.....		
	Chlorinated solvents.....		
	Formaldehyde.....		
	Organometallics.....		
	Phenol.....		
	Styrene.....		
	Tri-butyl phosphate.....		
	Other organophosphates.....		
	Vinyl chloride.....		
	Arsenic.....		
	Barium.....		
	Boron.....		
	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.....		
Complexing agents (%wt):	No		
	EDTA.....		
	DPTA.....		
	NTA.....		
	Polycarboxylic acids……		
	Other organic complexants.....		
	Total complexing agents.....	0	

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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		
Recyling / 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 %
Expected to be consigned to the LLW Repository	~8.0
Expected to be consigned to a Landfill Facility	~15.0
Expected to be consigned to an On-Site Disposal Facility	
Expected to be consigned to an Incineration Facility	~7.0
Expected to be consigned to a Metal Treatment Facility	~70.0
Expected to be consigned as Out of Scope	
Expected to be recycled / reused	
Disposal route not known	

Upcoming (2019/20-2021/22) Waste Routing (if expected to change from above):

Disposal Route	Stream volume %		
	2019/20	2020/21	2021/22
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 Packaging for Disposal:

Container	Stream volume %	Waste loading m³	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 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 has a current WCH. 100 m3 of contaminated soil previously included in this waste stream is now identified within waste stream 9A928 - Contaminated Soil. This occurred subsequent to publishing the current WSCD.
Waste consigned for disposal to LLWR in year of generation:	Yes.
Potential for the waste to contain discrete items:	-

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 from 2017 and decayed by two years to start date of first arising. ref: 1MXN-1BNL-0-WCH-2241 Update V3.
Other information:	-

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3			1.57E-05	C C 1	Gd 153				8
Be 10				8	Ho 163				8
C 14			1.14E-06	C C 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			2.57E-07	C C 1	Pb 210				8
Co 60			6.34E-07	C C 1	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			1.07E-06	C C 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			7.34E-04	C C 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				
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			4.34E-06	C C 1
Sn 123				8	Pu 239			8.07E-06	C C 1
Sn 126				8	Pu 240			1.07E-05	C C 1
Sb 125				8	Pu 241			1.52E-04	C C 1
Sb 126				8	Pu 242				8
Te 125m				8	Am 241			3.61E-05	C C 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			4.00E-03	C C 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			1.71E-07	C C 1	Cf 251				8
Sm 147				8	Cf 252				8
Sm 151				8	Other a				
Eu 152				8	Other b/g				
Eu 154			1.22E-06	C C 2	**Total a**	**0**		**5.92E-05**	**C C 2**
Eu 155				8	**Total b/g**	**0**		**4.91E-03**	**C C 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