WASTE STREAM 9R113 Redundant Radioactive Sources

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.....	< 0.1 m³
Future arisings -	1.4.2035 - 31.3.2036.....	< 0.1 m³
Total future arisings:		< 0.1 m³
Total waste volume:		< 0.1 m³

Comment on volumes: A small number of sources accounted for in future arisings maybe disposed of prior to 2035. Common volume assumption of 0.0002m3 per source (10cm x 10cm x 2cm) has been applied. Data from site source register shows 126 sources in stock and 59 forecast future arisings. Total of 185 sources.

Uncertainty factors on volumes:

Stock (upper):	x 1.1	Arisings (upper)	x 1.1
Stock (lower):	x 0.9	Arisings (lower)	x 0.9

WASTE SOURCE Redundant sealed sources used for a variety of purposes around the site.

PHYSICAL CHARACTERISTICS

General description:	Radioactive sources that have been used for instrument calibrations and laboratory purposes. These items are now surplus to requirements and cannot be recycled. There are no large items.
Physical components (%wt):	Metal (95%), Plastic (5%).
Sealed sources:	The waste contains sealed sources. 185 sources
Bulk density (t/m³):	~1
Comment on density:	Density refers to sources on bases only, when they have been stripped of all extraneous materials, which are disposed of as non-active material. Redundant sources will then be encapsulated for disposal as LLW.

CHEMICAL COMPOSITION

General description and components (%wt):	Metal (95%), Plastic (5%).
Chemical state:	Neutral
Chemical form of radionuclides:	-
Metals and alloys (%wt):	-

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....			
Other ferrous metals.....			
Iron.....			
Aluminium.....			
Beryllium.....			
Cobalt.....			
Copper.....			
Lead.....			
Magnox/Magnesium.....			

WASTE STREAM 9R113 Redundant Radioactive Sources

Nickel.....			
Titanium.....			
Uranium.....			
Zinc.....			
Zircaloy/Zirconium.....			
Other metals.....	95.0	Unsure what metal type.	

Organics (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	0		
Paper, cotton.....			
Wood.....			
Halogenated plastics			
Total non-halogenated plastics.....	5.0		
Condensation polymers.....			
Others.....	5.0		
Organic ion exchange materials....			
Total rubber.....	0		
Halogenated rubber			
Non-halogenated rubber.....			
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.....			
Brick/Stone/Rubble.....			
Cementitious material.....			
Sand.....			
Glass/Ceramics.....			
Graphite.....			
Desiccants/Catalysts.....			
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			

WASTE STREAM 9R113 Redundant Radioactive Sources

Highly friable.....	
Free aqueous liquids.....	0
Free non-aqueous liquids.....	0
Powder/Ash.....	0

Inorganic anions (%wt): -

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

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.....	0	
Putrescible wastes.....	0	
Non-putrescible wastes.....		
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.....		

WASTE STREAM 9R113 Redundant Radioactive Sources

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.....	

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: Not yet determined. Subject to DI type assessment (specific clauses within WAC)

TREATMENT, PACKAGING AND DISPOSAL

WASTE STREAM 9R113 Redundant Radioactive Sources

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

Treatment	On-site / Off site	Stream volume %
Low force compaction Supercompaction (HFC) Incineration Solidification Decontamination Metal treatment Size reduction Decay storage Recyling / reuse Other / various None	On-site	100.0

Comment on planned treatments: Sources will be stripped of all extraneous material and encapsulated in grout in "paint-tin" type containers. The majority of sources are LLW but the possibility remains that some may be ILW and have to be treated as such. This is under review.

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository	100.0	2.4
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		

Classification codes for waste expected to be consigned to a landfill facility: -

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:

WASTE STREAM 9R113 Redundant Radioactive Sources

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 1/2 Height IP-2 Disposal/Re-usable ISO 2m box (no shielding) 4m box (no shielding) Other	100.0	~15.5	< 1

Other information: Only one paint-tin type container is allowed per disposal container for sealed sources. It is expected that this stream will be disposed with other LLW streams. Waste will not be drummed and supercompacted but encapsulated into 100ml grout.

Waste Planned for Disposal at the LLW Repository:

Container voidage: Significant inaccessible voidage is not 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: No. Only one paint tin sized container of encapsulated sources can be disposed of per HHISO so timings of waste disposal are to be spread over a number of years.

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: Redundant sealed sources used for a variety of purposes around the power station site.

Uncertainty: Data taken from site source register and decayed to common stock reference date/start date of first arising

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 on specific activities is obtained from site records.

Other information: The values quoted are indicative of the activities that might be expected.

WASTE STREAM 9R113 Redundant Radioactive Sources

Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3		8		6	Gd 153		8		8
Be 10		8		8	Ho 163		8		8
C 14		8	1.76E-05	B B 2	Ho 166m		8		8
Na 22		6		8	Tm 170		8		8
Al 26		8		8	Tm 171		8		8
Cl 36		6	1.05E-05	B B 2	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		6		8	Pb 205		8		8
Fe 55		8		8	Pb 210		8		8
Co 60		6	2.28E-02	B B 2	Bi 208		8		8
Ni 59		8		8	Bi 210m		8		8
Ni 63		8		8	Po 210		8		8
Zn 65		6		8	Ra 223		8		8
Se 79		8		8	Ra 225		8		8
Kr 81		8		8	Ra 226		8		6
Kr 85		8		8	Ra 228		6		8
Rb 87		8		8	Ac 227		8		8
Sr 90		8	3.61E-06	B B 2	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		6		8	U 238		8		8
Cd 113m		8		8	Np 237		6		8
Sn 119m		8		8	Pu 236		8		8
Sn 121m		8		8	Pu 238		8		8
Sn 123		8		8	Pu 239		8	5.00E-07	B B 2
Sn 126		8		8	Pu 240		8		8
Sb 125		8		8	Pu 241		8		8
Sb 126		8		8	Pu 242		8		8
Te 125m		8		8	Am 241	4E+00	B B 2	4.14E-05	B B 2
Te 127m		8		8	Am 242m		8		8
I 129		8		8	Am 243		8		8
Cs 134		8	1.4E-04	B B 2	Cm 242		8		8
Cs 135		8		8	Cm 243		8		8
Cs 137		8	1.19E-01	B B 2	Cm 244		8		8
Ba 133		6		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		8		8	Cf 251		8		8
Sm 147		8		8	Cf 252		8		8
Sm 151		8		8	Other a				
Eu 152		6	2.20E-02	B B 2	Other b/g				
Eu 154		8	6.62E-04	B B 2	**Total a**	**4E+00**	**B B 2**	**4.19E-05**	**B B 2**
Eu 155		8		8	**Total b/g**	**0**	**B B 2**	**1.64E-01**	**B B 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