

WASTE STREAM	9A49	FED Stainless Steel
---------------------	-------------	----------------------------

SITE Berkeley
SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE ILW

Is the waste subject to Scottish Policy: No

WASTE VOLUMES

	Reported
Stocks: At 1.4.2022.....	0.5 m ³
Total future arisings:	0 m ³
Total waste volume:	0.5 m ³

Comment on volumes: Station operation ceased in March 1989. This waste stream was accumulated between October 1972 and August 1982. The stainless steel was used for flux flattening and was replaced by zirconium on later elements as fuel irradiation had increased and flux flattening by the stainless steel was not required. The volume quoted is the estimated bulk volume of the waste if separated from other wastes with which it is mixed.

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

WASTE SOURCE The source of the waste is the removal of graphite struts and associated zirconium and stainless steel bridge pieces from fuel elements prior to dispatch of the elements to Sellafield.

PHYSICAL CHARACTERISTICS

General description: The waste comprises predominantly stainless steel bridge pieces. The bridge pieces may still be connected to the graphite struts. Approximately 38% of fuel elements used stainless steel top support bridges, (with the rest being zirconium). There will also be a small quantity of nimonic springs, which may be attached to thermocouple wires. A stainless steel top support bridge is 127mm in length and weighs approximately 26g and a Nimonic spring weighs approximately 5g. The thermocouple wires are approximately 380mm in length. It is unlikely that there will be any large items which will require special handling. The waste is loose in the vaults.

Physical components (%wt): Stainless steel bridge pieces (>98.5% wt), Nimonic springs (~0.75% wt) and thermocouples wires (~0.75% wt).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 2.6

Comment on density: The average bulk density 2.6 t/m³ assumes a packing factor to give an overall volume of about three times the displacement volume of the waste.

CHEMICAL COMPOSITION

General description and components (%wt): Stainless steel will account for more than 98.5% of the waste, with 0.75% Nimonic and 0.25% alumina, magnesia and other minor constituents. The stainless steel may be contaminated with fission product, actinides and graphite.

Chemical state: Neutral

Chemical form of radionuclides: H-3: Tritium will probably be present as surface contamination, possibly as water or perhaps as other inorganic or organic compounds.
C-14: Carbon 14 may be present as carbon incorporated in the stainless steel and is likely to be in the form of graphite contamination.
Cl-36: Chlorine 36 will probably be present in surface contamination.
Se-79: The selenium content is insignificant.
Tc-99: The technetium content is insignificant.
Ra: Radium isotope content is insignificant.
Th: The thorium isotope content is insignificant.
U: Chemical form of uranium isotopes has not been determined but may be uranium oxides.
Np: The neptunium content is insignificant.
Pu: Chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

WASTE STREAM	9A49	FED Stainless Steel
---------------------	-------------	----------------------------

Metals and alloys (%wt): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~99.0		99.0
Other ferrous metals.....	0		
Iron.....			
Aluminium.....	0		
Beryllium.....	0		
Cobalt.....			
Copper.....	0		
Lead.....	0		
Magnox/Magnesium.....	0		
Nickel.....	~0.75	Nimonic.	
Titanium.....			
Uranium.....			
Zinc.....	0		
Zircaloy/Zirconium.....	0		
Other metals.....	0	No "other" metals have been identified.	

Organics (%wt): The stainless steel may be contaminated with trace quantities of organic material.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	0		
Paper, cotton.....	0		
Wood.....	0		
Halogenated plastics	0		
Total non-halogenated plastics.....	0		
Condensation polymers.....	0		
Others.....	0		
Organic ion exchange materials....	0		
Total rubber.....	0		
Halogenated rubber	0		
Non-halogenated rubber.....	0		
Hydrocarbons.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	TR		

Other materials (%wt): Graphite contamination.

WASTE STREAM	9A49	FED Stainless Steel
---------------------	-------------	----------------------------

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

Inorganic anions (%wt): None of the inorganic anions listed in the table is expected to be present at greater than trace concentration.

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

Materials of interest for waste acceptance criteria: There are no identified materials likely to represent a fire or other non-radiological hazard.

	(%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	

WASTE STREAM**9A49****FED Stainless Steel**

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 / 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	9A49	FED Stainless Steel
---------------------	-------------	----------------------------

Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		
Total complexing agents.....	TR	

Potential for the waste to contain discrete items: Yes. Stainless Steel so DI by definition

PACKAGING AND CONDITIONING

Conditioning method: This stream is to be co-packaged with 9A63, 9A64, 9A83, 9A84, 9A33, 9A34, 9A35, 9A41, 9A42, 9A43, 9A50, 9A51, 9A54, 9A55, 9A56, 9A74. Packages are assigned to 9A33/C, 9A34, 9A74.

Plant Name: -

Location: Berkeley Site

Plant startup date: -

Total capacity (m³/y incoming waste): -

Target start date for packaging this stream: -

Throughput for this stream (m³/y incoming waste): -

Other information: -

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m ³)	Payload (m ³)	Number of packages

Likely container type comment: -

Range in container waste volume: -

Other information on containers: -

Likely conditioning matrix: -

Other information: -

Conditioned density (t/m³): -

Conditioned density comment: -

Other information on conditioning: -

Opportunities for alternative disposal routing: -

WASTE STREAM**9A49****FED Stainless Steel**

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
---------------------------	------------------------------	-------------------	--	------------------------	---------

RADIOACTIVITY

Source: Activation when the associated fuel elements were irradiated, of nuclides incorporated into the stainless steel. Contamination by fission products and actinides when the fuel elements were in the fuel pond.

Uncertainty: The values quoted are indicative of the activities that might 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: Specific activity is a function of Station operating history. Values were derived from calculations of induced activity and estimates of likely contamination.

Other information: -

WASTE STREAM

9A49

FED Stainless Steel

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	8.63E-03	CC 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	4.00E-01	CC 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26	2E-06	CC 2			Tm 171		8		
Cl 36	7E-06	CC 2			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	1.09E-01	CC 2			Pb 210		8		
Co 60	<2.79E+00	C 3			Bi 208		8		
Ni 59	1E+00	CC 2			Bi 210m		8		
Ni 63	9.00E+01	CC 2			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	4.19E-04	CC 2			Th 227		8		
Zr 93	4E-08	CC 2			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92	8E-08	CC 2			Th 230		8		
Nb 93m	3.70E-01	CC 2			Th 232		8		
Nb 94	6.00E-03	CC 2			Th 234	<7E-07	C 3		
Mo 93	4.99E-03	CC 2			Pa 231		8		
Tc 97		8			Pa 233	<4.16E-08	C 3		
Tc 99	1E-03	CC 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	6.04E-07	CC 2		
Ag 108m	9.75E-03	CC 2			U 235	2E-08	CC 2		
Ag 110m		8			U 236	5.00E-08	CC 2		
Cd 109		8			U 238	7E-07	CC 2		
Cd 113m	2.36E-08	CC 2			Np 237	4.16E-08	CC 2		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	7.99E-05	CC 2		
Sn 123		8			Pu 239	2E-04	CC 2		
Sn 126	3.04E-09	CC 2			Pu 240	2.00E-04	CC 2		
Sb 125	1.14E-09	CC 2			Pu 241	1.46E-03	CC 2		
Sb 126		8			Pu 242	6E-08	CC 2		
Te 125m		8			Am 241	3.44E-04	CC 2		
Te 127m		8			Am 242m	3.71E-07	CC 2		
I 129		8			Am 243	8.00E-08	CC 2		
Cs 134		8			Cm 242	3.06E-07	CC 2		
Cs 135	6E-09	CC 2			Cm 243	4.95E-08	CC 2		
Cs 137	4.95E-04	CC 2			Cm 244	2.25E-07	CC 2		
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	3.81E-08	CC 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	1.78E-06	CC 2			Other a				
Eu 152	1.39E-08	CC 2			Other b/g				
Eu 154	5.95E-07	CC 2			Total a	8.26E-04	CC 2	0	
Eu 155	5.98E-08	CC 2			Total b/g	9.47E+01	CC 2	0	

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