WASTE STREAM 9A45 Miscellaneous Activated Components

SITE	Berkeley
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	ILW; SPD3
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	~10.0 m³
Total future arisings:		0 m³
Total waste volume:		10.0 m³

Comment on volumes: These components are not expected to arise during Care and Maintenance Preparation. This waste is assumed to be retained to Final Dismantling. Station operation ceased in March 1989.

Uncertainty factors on volumes:

Stock (upper):	x 1.2	Arisings (upper)	x
Stock (lower):	x 0.8	Arisings (lower)	x

WASTE SOURCE Irradiated components removed from the reactors.

PHYSICAL CHARACTERISTICS

General description: Redundant or defective components such as chutes removed from reactor cores. Control rods are 8.5 m long x 50 mm diameter and weigh about 80 kg. Other items weigh about 1 to 1.5 t per item.

Physical components (%vol): Control rods, chutes, periscope and shield plug. Volume breakdown not assessed.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1

Comment on density: The bulk density of the waste ranges in value up to 7.5 t/m³. The minimum value has not been assessed. The average is probably about 1 t/m³.

CHEMICAL COMPOSITION

General description and components (%wt): The waste is principally steel components. Steel (~90%).

Chemical state: Neutral

Chemical form of radionuclides: H-3: Tritium may be incorporated in the waste or present as surface contamination in the form of inorganic or organic compounds.
C-14: Chemical form of carbon 14 has not been determined but may be graphite.
Cl-36: The chemical form of chlorine 36 has not been determined.
Tc-99: The chemical form of technetium 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): Nearly all of the waste is bulk metal. Dimensions have not been assessed.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	NE		
Other ferrous metals.....	~90.0	Carbon steels and boron steels are present.	
Iron.....			
Aluminium.....	NE		
Beryllium.....	TR		
Cobalt.....			
Copper.....	NE		

WASTE STREAM 9A45 Miscellaneous Activated Components

Lead	NE	
Magnox/Magnesium	NE	
Nickel		
Titanium		
Uranium		
Zinc	NE	
Zircaloy/Zirconium	NE	
Other metals	NE	The presence of "other" metals has not been assessed.

Organics (%wt): There may be small quantities (<1 wt%) of organic materials present but none has been identified.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	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	<1.0		

Other materials (%wt): Graphite contamination.

	(%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	<10.0		
Sand			
Glass/Ceramics	NE		
Graphite	TR		
Desiccants/Catalysts			

WASTE STREAM 9A45 Miscellaneous Activated Components

Asbestos	0
Non/low friable	
Moderately friable	
Highly friable	
Free aqueous liquids	0
Free non-aqueous liquids	TR
Powder/Ash	0

Inorganic anions (%wt): Inorganic anions are not expected to be present in more than trace quantities.

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

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		
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: -

	(%wt)	Type(s) and comment
Acrylamide		

WASTE STREAM 9A45 Miscellaneous Activated Components

Benzene.....

Chlorinated solvents.....

Formaldehyde.....

Organometallics.....

Phenol.....

Styrene.....

Tri-butyl phosphate.....

Other organophosphates.....

Vinyl chloride.....

Arsenic.....

Barium.....

Boron.....

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: Yes. Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs; Stainless items assumed DIs

PACKAGING AND CONDITIONING

Conditioning method: The waste is not expected to be supercompacted. The treatment envisaged is the placement of the waste in baskets followed by encapsulation in the container.

WASTE STREAM 9A45 Miscellaneous Activated Components

Plant Name:	None
Location:	Berkeley Site
Plant startup date:	2074
Total capacity (m^3/y incoming waste):	~5000.0
Target start date for packaging this stream:	2074
Throughput for this stream (m^3/y incoming waste):	~2.0
Other information:	Reactor demolition is assumed to start 3 years after the beginning of final decommissioning. The current proposal is to store the waste as at present until reactor dismantling. All waste is expected to be retrieved and conditioned when the conditioning campaign is undertaken.

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
4m box (no shielding)	100.0	16.2	18.9	< 1

Likely container type comment:	The waste is assumed to be in baskets in the waste package so the occupied volume in the package is greater than the original waste volume. Container choice may be influenced by Transport Regulations at the time of Final Site Clearance.
Range in container waste volume:	Not yet determined.
Other information on containers:	The container material is expected to be stainless steel.
Likely conditioning matrix:	Blast Furnace Slag / Ordinary Portland Cement
Other information:	The waste is assumed to be encapsulated.
Conditioned density (t/m^3):	~3.0
Conditioned density comment:	The conditioned waste density assumes that the waste will be encapsulated.
Other information on conditioning:	The waste will be in baskets placed in the waste packages. Baskets of waste from different streams may be placed in the same container. The encapsulation would be likely to be BFS/OPC. The density of the encapsulated waste would probably be about 3 t/m^3.
Opportunities for alternative disposal routing:	-

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

RADIOACTIVITY

Source:	Irradiated components removed from the reactor. Control rods are likely to be components of high activity.
Uncertainty:	Specific activity is a function of Station operating history. 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:	Estimates are based upon theoretical assessments.
Other information:	-

WASTE STREAM 9A45 Miscellaneous Activated Components

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	<8.62E-01	D 3			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	2.00E-02	C D 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	3E-05	C C 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	8.74E-03	C D 2			Pb 210		8		
Co 60	1.39E-01	C D 2			Bi 208		8		
Ni 59	4E-02	C D 2			Bi 210m		8		
Ni 63	2.70E+00	C D 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	<2.79E-05	D 3			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	4E-05	C D 2			Th 234	<7E-09	D 3		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	<1E-08	D 3			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	<6.10E-09	D 3		
Ag 108m	3.90E-05	C D 2			U 235		8		
Ag 110m		8			U 236		8		
Cd 109		8			U 238	<7E-09	D 3		
Cd 113m		8			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	<1.78E-06	D 3		
Sn 123		8			Pu 239	<3E-06	D 3		
Sn 126		8			Pu 240	<4.00E-06	D 3		
Sb 125		8			Pu 241	<2.92E-05	D 3		
Sb 126		8			Pu 242	<2E-09	D 3		
Te 125m		8			Am 241	<9.80E-06	D 3		
Te 127m		8			Am 242m	<1.85E-08	D 3		
I 129		8			Am 243	<6.00E-09	D 3		
Cs 134		8			Cm 242	<1.53E-08	D 3		
Cs 135		8			Cm 243	<2.83E-09	D 3		
Cs 137	<4.95E-05	D 3			Cm 244	<2.83E-08	D 3		
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		8			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	<7.12E-07	D 3			Other a				
Eu 152	3.22E-06	C D 2			Other b/g				
Eu 154	1.50E-06	C D 2			**Total a**	**1.86E-05**	**C D 2**	**0**	
Eu 155		8			**Total b/g**	**3.77E+00**	**C D 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