WASTE STREAM 9D70 FED Sludge - R2

SITE	Hinkley Point A
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.....	10.0 m^3
Total future arisings:		0 m^3
Total waste volume:		10.0 m^3

Comment on volumes: Estimate of volume of sludge resulting from degradation of the Magnox FED described by stream 9D42.

Uncertainty factors on volumes:

Stock (upper):	x 1.2	Arisings (upper)	x
Stock (lower):	x 0.5	Arisings (lower)	x

WASTE SOURCE Degradation of Magnox FED described by stream 9D42.

PHYSICAL CHARACTERISTICS

General description: Sludge resulting from the degradation of Magnox metal and swarf. The sludge contamination in the vault will be impossible to segregate from the other waste forms in the vault during retrievals.

Physical components (%wt): Magnox sludge (100% wt).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m^3): 1.2

Comment on density: -

CHEMICAL COMPOSITION

General description and components (%wt): Magnesium hydroxide and magnesium carbonate (100% wt).

Chemical state: Alkali

Chemical form of radionuclides:
H-3: Most tritium is expected to be present as surface contamination, possibly as water but perhaps in the form of other inorganic compounds or as organic compounds.
C-14: Carbon 14 will probably be present as graphite.
Cl-36: Chlorine 36 incorporated in the Magnox may be associated with barium impurity (barium chloride). Other Cl-36 may be associated with surface contamination.
Se-79: The selenium content is insignificant.
Tc-99: The chemical form of technetium has not been determined.
Ra: The radium isotope content is insignificant.
Th: The thorium isotope content is insignificant.
U: The chemical form of uranium isotopes may be uranium oxides.
Np: The chemical form of neptunium has not been determined.
Pu: The chemical form of plutonium isotopes may be plutonium oxides.

Metals and alloys (%wt): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	0		
Iron.....			
Aluminium.....	0		
Beryllium.....	TR		
Cobalt.....			

WASTE STREAM 9D70 FED Sludge - R2

Copper	0	
Lead	0	
Magnox/Magnesium	NE	
Nickel		
Titanium		
Uranium		
Zinc	0	
Zircaloy/Zirconium	P	Predominantly from degradation of Magnox alloy ZR55, which contains 0.55 wt% Zr as an alloying constituent.
Other metals	0	

Organics (%wt): -

	(%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	0		

Other materials (%wt): Probably traces of graphite.

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials	0		
Inorganic sludges and flocs	100.0	Predominantly from degradation of Magnox alloy ZR55, which contains 0.55 wt% Zr as an alloying constituent.	
Soil	0		
Brick/Stone/Rubble	0		
Cementitious material	0		
Sand			

WASTE STREAM 9D70 FED Sludge - R2

Glass/Ceramics	0
Graphite	TR
Desiccants/Catalysts	
Asbestos	0
Non/low friable	
Moderately friable	
Highly friable	
Free aqueous liquids	NE
Free non-aqueous liquids	0
Powder/Ash	NE

Inorganic anions (%wt): Carbonate and hydroxide are present.

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

Materials of interest for waste acceptance criteria: -

	(%wt)	Type(s) and comment
Combustible metals	NE	
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	NE	
Higher activity particles		
Soluble solids as bulk chemical compounds		

WASTE STREAM 9D70 FED Sludge - R2

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.....		
EEE Type 3.....		
EEE Type 4.....		
EEE Type 5.....		

Complexing agents (%wt):

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

WASTE STREAM 9D70 FED Sludge - R2

Potential for the waste to contain discrete items: No. In & of itself not a DI; assumed not likely to contain any "rogue" items that could be.

PACKAGING AND CONDITIONING

Conditioning method: Waste will be co-disposed with FED (9D42), springs (9D44) and gravel (9D46) streams in varying proportions which cannot be determined at this stage.

Plant Name: -

Location: -

Plant startup date: -

Total capacity (m^3/y incoming waste): -

Target start date for packaging this stream: -

Throughput for this stream (m^3/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: Waste will be co-disposed with FED/springs/gravel streams in varying proportions. Container numbers are assigned to these other streams to prevent double accounting as the sludge contamination in the vault will be impossible to segregate from the other waste forms in the vault during retrievals as it takes up interstitial space in amongst the FED etc.

Range in container waste volume: -

Other information on containers: -

Likely conditioning matrix: Not specified

Other information: -

Conditioned density (t/m^3): -

Conditioned density comment: -

Other information on conditioning: -

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: The source of the waste is the removal of splitters from fuel elements prior to dispatch of the elements to Sellafield. Activation of trace nuclides in the Magnox and contamination by fission products and actinides will be main sources of activity.

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

WASTE STREAM 9D70 FED Sludge - R2

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:	Values were derived from measurements, calculations of induced activity and estimates of likely contamination.
Other information:	-

WASTE STREAM 9D70 FED Sludge - R2

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	<1.29E-02	C 3			Gd 153		8		
Be 10	1E-07	C C 2			Ho 163		8		
C 14	5.00E-04	C C 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26	<4E-07	C 3			Tm 171		8		
Cl 36	2E-04	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	<2E-05	C 3			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	<8.74E-06	C 3			Pb 210		8		
Co 60	<1.39E-03	C 3			Bi 208		8		
Ni 59	2E-05	C C 2			Bi 210m		8		
Ni 63	3.61E-03	C C 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	C C 2			Th 227		8		
Zr 93	7E-05	C C 2			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	6.22E-05	C C 2			Th 232		8		
Nb 94		8			Th 234	3E-08	C C 2		
Mo 93	6.99E-05	C C 2			Pa 231		8		
Tc 97		8			Pa 233	4.21E-09	C C 2		
Tc 99	1E-05	C C 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	3.09E-08	C C 2		
Ag 108m	2.94E-06	C C 2			U 235		8		
Ag 110m		8			U 236	4.00E-09	C C 2		
Cd 109		8			U 238	3E-08	C C 2		
Cd 113m	<9.45E-05	C 3			Np 237	4.21E-09	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m	<4.11E-04	C 3			Pu 238	1.78E-05	C C 2		
Sn 123		8			Pu 239	1.00E-05	C C 2		
Sn 126		8			Pu 240	2.00E-05	C C 2		
Sb 125	2.05E-07	C C 2			Pu 241	2.91E-04	C C 2		
Sb 126		8			Pu 242	1E-08	C C 2		
Te 125m	5.14E-08	C C 2			Am 241	4.92E-05	C C 2		
Te 127m		8			Am 242m	8.36E-08	C C 2		
I 129		8			Am 243	3.00E-08	C C 2		
Cs 134		8			Cm 242	6.90E-08	C C 2		
Cs 135		8			Cm 243	2.12E-08	C C 2		
Cs 137	4.26E-05	C C 2			Cm 244	2.26E-07	C C 2		
Ba 133	<2.24E-05	C 3			Cm 245		8		
La 137	<4E-06	C 3			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145	1.67E-05	C C 2			Cf 250		8		
Pm 147	<7.60E-06	C 3			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	8.02E-05	C C 2			Other a				
Eu 152	1.39E-03	C C 2			Other b/g				
Eu 154	5.97E-03	C C 2			**Total a**	**9.73E-05**	**C C 2**	**0**	
Eu 155	3.59E-05	C C 2			**Total b/g**	**2.73E-02**	**C C 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