

WASTE STREAM	2C920	Reactor Decommissioning Preparations
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SITE Chapelcross

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 m ³
Future arisings -	1.4.2022 - 31.3.2025.....	4188.6 m ³
Total future arisings:		4188.6 m ³
Total waste volume:		4188.6 m ³

Comment on volumes: -

Uncertainty factors on volumes:
 Stock (upper): x Arisings (upper) x 1.2
 Stock (lower): x Arisings (lower) x 0.8

WASTE SOURCE Waste is from Chapelcross reactor buildings and contaminated land. The waste is likely to arise from maintenance and decommissioning operations involving the removal and replacement of plant and equipment.

PHYSICAL CHARACTERISTICS

General description: The waste is generally hard, bulky or irregular in shape and may contain any of the following; scaffolding boards and tubes, steelwork, redundant plant and equipment, structural materials and pipework, cardboard, bird droppings and bird carcasses (birds that get into the reactor buildings through open/damaged windows), plasterboard ceiling and wall tiles, rubber gaskets and seals, oils, paints and solvents, tarmac/bitumen, EEE and Hoover bags. Hoover bags will typically contain concrete dust, metal swarf, wood shavings, plastics and asbestos (asbestos enclosure work only). Approximately 230kg of Hoover bags is expected over the lifetime of the WCH, with an expected average bag weight of 5-10kg. There will also be some secondary waste, and may be some contaminated soil associated with legacy operations.

Physical components (%wt): Metal (~56%), concrete (~5%), Soil (5%), Biodegradable (5%), Plasterboard (1%), Wood (~4%), Plastics (~7%), Rubber (3%), other organic (5%) and others (9%) including asbestos and paints/solvents.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): ~1.18

Comment on density: Density calculated from WCH mass divided by volume

CHEMICAL COMPOSITION

General description and components (%wt): Metal (~56%), concrete (~5%), Soil (5%), Biodegradable (5%), Plasterboard (1%), Wood (~4%), Plastics (~7%), Rubber (3%), other organic (5%) and others (9%) including asbestos and paints/solvents.

Chemical state: Neutral

Chemical form of radionuclides:
 H-3: The chemical form of tritium has not been determined.
 C-14: The chemical form of carbon 14 has not been determined.
 Se-79: The chemical form of selenium has not been determined.
 Tc-99: The chemical form of technetium has not been determined.
 Ra: Radium isotope content is expected to be insignificant.
 Th: The thorium content is insignificant.
 U: Uranium isotope content is expected to be insignificant.
 Np: Neptunium isotope content is expected to be insignificant.
 Pu: Chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): This waste stream will contain metal of various sizes and thicknesses.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	2.8	Metals deplanting and legacy metals (pipework, motors, pumps, tanks, frames, benches, tools, scaffold tubes/fittings, electrical boxes, heaters, ducting, shielding)	
Other ferrous metals.....	47.1	Metals deplanting and legacy metals (pipework, motors, pumps, tanks, frames, benches, tools, scaffold tubes/fittings, electrical boxes, heaters, ducting, shielding)	
Iron.....	0.56	Cast iron reactor fittings: radiators, lights, brackets.	
Aluminium.....	4.4	Scaffold poles, ladders and walkway sections	
Beryllium.....			
Cobalt.....			
Copper.....			
Lead.....	0.56	Metals deplanting and legacy metals - lead blocks (shielding)	
Magnox/Magnesium.....			
Nickel.....			
Titanium.....			
Uranium.....			
Zinc.....	0.06	Zinc oxide coating on galvanised scaffold tubes, floor plates/grates, handrails	
Zircaloy/Zirconium.....	0		
Other metals.....	0		
Organics (%wt):	-		
	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	~4.0		
Paper, cotton.....	0		
Wood.....	~4.0		
Halogenated plastics	0		
Total non-halogenated plastics.....	~7.5	Soft wastes. Plastics from controlled area works.	
Condensation polymers.....	0		
Others.....	~7.5	Soft wastes. Plastics from controlled area works.	
Organic ion exchange materials....	0		
Total rubber.....	3.0		
Halogenated rubber	1.5		
Non-halogenated rubber.....	1.5		
Hydrocarbons.....	4.1		
Oil or grease	3.9	Liquid	
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...	0.05	Land Remediation	
Asphalt/Tarmac (no coal tar)....	0.10	Land Remediation	

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Bitumen.....	0.10	Land Remediation	
Others.....			
Other organics.....	0.43	Paints/solvents	
Other materials (%wt):	-		
	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	5.0		
Brick/Stone/Rubble.....	~5.0		
Cementitious material.....	0		
Sand.....			
Glass/Ceramics.....	0.83	Pipe insulation	
Graphite.....	0		
Desiccants/Catalysts.....			
Asbestos.....	8.0		
Non/low friable.....	1.4	Asbestos within cement roof sheets, galbestos roof sheets, gaskets, rope window seals. bulk will be Chrysotile (white asbestos) with smaller quantities of Crocidolite (blue) and Amosite (brown)	
Moderately friable.....			
Highly friable.....	6.6	Pipe insulation: bulk will be Chrysotile (white asbestos) with smaller quantities of Crocidolite (blue) and Amosite (brown)	
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		
Inorganic anions (%wt):	-		
	(%wt)	Type(s) and comment	
Fluoride.....	NE		
Chloride.....	NE		
Iodide.....	NE		
Cyanide.....	NE		
Carbonate.....	NE		
Nitrate.....	NE		
Nitrite.....	NE		
Phosphate.....	NE		
Sulphate.....	NE		
Sulphide.....	NE		
Materials of interest for waste acceptance criteria:	-		

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	(%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.....	5.5	
Putrescible wastes.....	1.5	Bird Droppings, small animal carcasses
Non-putrescible wastes.....	4.0	Wood
Corrosive materials.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	P	9431m2 Reactive metals in the form of aluminium scaffold tubes and smaller quantities of galvanised metals.
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

Hazardous substances / -
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.....		

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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:

Container	Stream volume %	Waste loading m ³	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	3.0	10	13
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: -

Waste Planned for Disposal at the LLW Repository:

Container voidage: -

Waste Characterisation Form (WCH): The waste meets the LLWR's Waste Acceptance Criteria (WAC).
The waste has a current WCH.
Inventory information is consistent with the current WCH.

Waste consigned for disposal to LLWR in year of generation: -

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: Activation and contamination of materials.

Uncertainty: Activity values are current best estimates. Specific activity is a function of operating history. The values 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'.

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radioactivities:The specific activities have been taken from the approved WCH for the stream - 1MXN-
1CHA-0-WCH-0-4675 V7 decayed by two years to 01/04/2022 for start date of arisings

Other information:

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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			7.96E-05	CC 1	Gd 153				8
Be 10				8	Ho 163				8
C 14			6.07E-06	CC 1	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			4.38E-06	CC 1	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			7.17E-05	CC 1	Pb 210				8
Co 60			5.81E-05	CC 2	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			4.58E-05	CC 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			7.05E-06	CC 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		6.55E-08	CC 2	
Mo 93				8	Pa 231				8
Tc 97				8	Pa 233		5.79E-07	CC 2	
Tc 99			7.35E-08	CC 1	U 232		3E-09	CC 1	
Ru 106				8	U 233				8
Pd 107				8	U 234		8.36E-08	CC 1	
Ag 108m				8	U 235		3.08E-09	CC 1	
Ag 110m				8	U 236				8
Cd 109				8	U 238		6.55E-08	CC 1	
Cd 113m				8	Np 237		5.79E-07	CC 2	
Sn 119m				8	Pu 236				8
Sn 121m				8	Pu 238		2.86E-07	CC 1	
Sn 123				8	Pu 239		1.87E-07	CC 1	
Sn 126				8	Pu 240		2.45E-07	CC 1	
Sb 125			1.34E-08	CC 2	Pu 241		3.8E-06	CC 1	
Sb 126				8	Pu 242		8.4E-09	CC 1	
Te 125m			3.35E-09	CC 2	Am 241		6.25E-07	CC 1	
Te 127m				8	Am 242m				8
I 129				8	Am 243		1.96E-08	CC 1	
Cs 134			2.61E-09	CC 2	Cm 242				8
Cs 135				8	Cm 243		1.52E-08	CC 1	
Cs 137			1.5E-05	CC 2	Cm 244		3.15E-07	CC 1	
Ba 133			1.69E-07	CC 2	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			6.89E-09	CC 1	Cf 251				8
Sm 147				8	Cf 252				8
Sm 151			2E-07	CC 1	Other a				
Eu 152			1.5E-07	CC 2	Other b/g				
Eu 154			1.27E-07	CC 2	Total a	0	2.44E-06	CC 2	
Eu 155			3.57E-08	CC 2	Total b/g	0	2.93E-04	CC 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