

WASTE STREAM**2C920****Reactor Decommissioning Preparations**

SITE Chapelcross
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Magnox Limited
WASTE TYPE LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m ³
Future arisings -	1.4.2019 - 31.3.2025.....	4572.3 m ³
Total future arisings:		4572.3 m ³
Total waste volume:		4572.3 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 from Chapelcross Reactor Areas, turbine hall etc and contaminated land**PHYSICAL CHARACTERISTICS**

General description: Waste from ventilation plant (filter fan units and steam heaters from each reactor), fuelling machines, electrical controls, ladders, scaffolding etc. Additional plant includes lifting equipment, storage tanks, bins barriers and furniture. Stainless steel piping, valves and other ventilation plant. 39 miscellaneous storage containers, contaminated soil. There will be some secondary waste. The waste is generally hard, bulky or irregular in shape and may contain any of the following; scaffolding planks and poles, miscellaneous steelwork, redundant plant and equipment, reactor shield plugs, flux scanner tubes, structural materials and pipe sections. The items to be disposed from the flux scanner tubes consist of contaminated metal internal parts removed from plant.

Physical components (%wt): Metal (~89%), concrete (~7%), Wood (~2%), Plastics (~2%).**Sealed sources:** -**Bulk density (t/m³):** ~1.9**Comment on density:** -**CHEMICAL COMPOSITION****General description and components (%wt):** Metal (~89%), concrete (~7%), Wood (~2%), Plastics (~2%).**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.

Stainless steel.....	~8.0	Metals deplanting and legacy metal
Other ferrous metals.....	~80.0	Metals from reactor top ducts, convoluted pipe, filter pots and elbows. General reactor deplanting and legacy metal
Iron.....		
Aluminium.....	<0.20	Scaffolding poles
Beryllium.....		

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	Cobalt.....		
	Copper.....	<0.20	Copper piping from reactor deplanting
	Lead.....	<0.20	Lead shielding blocks
	Magnox/Magnesium.....	0	
	Nickel.....		
	Titanium.....		
	Uranium.....		
	Zinc.....		
	Zircaloy/Zirconium.....	0	
	Other metals.....	0	
Organics (%wt):	-		
	Total cellulosics.....	~2.0	
	Paper, cotton.....	0	
	Wood.....	~2.0	
	Halogenated plastics	0	
	Total non-halogenated plastics.....	~2.0	Barriers in the building, soft waste
	Condensation polymers.....	0	
	Others.....	~2.0	
	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):	-		
	Inorganic ion exchange materials.	0	
	Inorganic sludges and flocs.....	0	
	Soil.....	NE	
	Brick/Stone/Rubble.....	~7.0	
	Cementitious material.....	0	
	Sand.....		
	Glass/Ceramics.....	TR	
	Graphite.....	0	
	Desiccants/Catalysts.....		
	Asbestos.....	<1.0	Asbestos within cement. sheeting, gaskets, rope seals chrysotile (white)

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	Non/low friable.....	<1.0	Asbestos within cement sheeting, gaskets, rope seals chrysotile (white)
	Moderately friable.....		
	Highly friable.....		
	Free aqueous liquids.....	0	
	Free non-aqueous liquids.....	0	
	Powder/Ash.....	0	
Inorganic anions (%wt):	-		
	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:	-		
	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	
	Active particles.....		
	Soluble solids as bulk chemical compounds.....		
Hazardous substances / non hazardous pollutants:	-		
	Acrylamide.....		
	Benzene.....		
	Chlorinated solvents.....		
	Formaldehyde.....		
	Organometallics.....		

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Phenol.....

Styrene.....

Tri-butyl phosphate.....

Other organophosphates.....

Vinyl chloride.....

Arsenic.....

Barium.....

Boron.....

Cadmium.....

Caesium.....

Selenium.....

Chromium.....

Molybdenum.....

Thallium.....

Tin.....

Vanadium.....

Mercury compounds.....

Others.....

Electronic Electrical Equipment (EEE)

EEE Type 1..... P

100. off Stripped down circuit boards

EEE Type 2.....

EEE Type 3.....

EEE Type 4.....

EEE Type 5.....

Complexing agents (%wt):

No

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids.....

Other organic complexants.....

Total complexing agents..... 0

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	Off-site	23.0
Supercompaction (HFC)		
Incineration		
Solidification	Off-site	54.0
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recycling / reuse	23.0	
Other / various		
None		

Comment on planned treatments:

It is expected that 19% of this waste stream will be sent to Landfill as VLLW.

Disposal Routes:

Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository	4.0
Expected to be consigned to a Landfill Facility	19.0
Expected to be consigned to an On-Site Disposal Facility	
Expected to be consigned to an Incineration Facility	23.0
Expected to be consigned to a Metal Treatment Facility	54.0
Expected to be consigned as Out of Scope	
Expected to be recycled / reused	
Disposal route not known	

Upcoming (2019/20-2021/22) Waste Routing (if expected to change from above):

Disposal Route	Stream volume %		
	2019/20	2020/21	2021/22
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			

Waste Packaging for Disposal:

Container	Stream volume %	Waste loading m ³	Number of packages
1/3 Height IP-1 ISO	4.0	10	19
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			

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.

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

Potential for the waste to contain discrete items: -

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'.

Measurement of radioactivities: The specific activities have been taken from the approved WCH for the stream - 1MXN-1CHA-0-WCH-0-4198

Other information: -

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3			2.84E-05	CC 1	Gd 153				8
Be 10				8	Ho 163				8
C 14			1.86E-06	CC 1	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			1.61E-08	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			4.34E-05	CC 1	Pb 210				8
Co 60			2.55E-05	CC 2	Bi 208				8
Ni 59				8	Bi 210m				8
Ni 63			1.4E-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			2.31E-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		2E-08	CC 2	
Mo 93				8	Pa 231				8
Tc 97				8	Pa 233		1.77E-07	CC 2	
Tc 99			2.25E-08	CC 2	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234		2.57E-08	CC 2	
Ag 108m				8	U 235				8
Ag 110m				8	U 236				8
Cd 109				8	U 238		2E-08	CC 2	
Cd 113m				8	Np 237		1.77E-07	CC 2	
Sn 119m				8	Pu 236				8
Sn 121m				8	Pu 238		8.88E-08	CC 2	
Sn 123				8	Pu 239		5.89E-08	CC 2	
Sn 126				8	Pu 240		7.23E-08	CC 2	
Sb 125			8.11E-09	CC 2	Pu 241		1.34E-06	CC 2	
Sb 126				8	Pu 242		2.85E-09	CC 2	
Te 125m			2.03E-09	CC 2	Am 241		1.87E-07	CC 2	
Te 127m				8	Am 242m				8
I 129				8	Am 243		5.7E-09	CC 2	
Cs 134			2E-09	CC 2	Cm 242				8
Cs 135				8	Cm 243		5.12E-09	CC 2	
Cs 137			4.86E-06	CC 2	Cm 244		1.07E-07	CC 2	
Ba 133			6.19E-08	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			4.56E-09	CC 2	Cf 251				8
Sm 147				8	Cf 252				8
Sm 151			6.19E-08	CC 2	Other a				
Eu 152			5.29E-08	CC 2	Other b/g				
Eu 154			4.83E-08	CC 2	Total a	0	7.50E-07	CC 2	
Eu 155			1.67E-08	CC 2	Total b/g	0	1.22E-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