WASTE STREAM 2C314 Miscellaneous Metal (Reactor) ILW

SITE Chapelcross

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE ILW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m³
Future arisings -	1.4.2089 - 31.3.2095.....	21.0 m³
Total future arisings:		21.0 m³
Total waste volume:		21.0 m³

Comment on volumes: For inventory purposes the arisings are assumed to arise at a uniform rate over six years. Final Dismantling & Site Clearance is assumed to commence in 2085 with reactor dismantling commencing in 2089 and lasting for 6 years. The volumes and radioactivity have been calculated for 85 years after reactor shutdown, i.e. 2089

Uncertainty factors on volumes:

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

WASTE SOURCE A variety of miscellaneous metallic wastes resulting from reactor dismantling.

PHYSICAL CHARACTERISTICS

General description: Reactor components including channel sleeves, control rods, tie rods, zirconium pins, CGO thermocouples, core thermocouples and thermocouple ducts.

Physical components (%vol): Boron Steel control rods (~21%wt), support struts (~78%wt) and thermocouples (~1%).

Sealed sources: -

Bulk density (t/m³): 1

Comment on density: The density is of the waste as prepared for packaging.

CHEMICAL COMPOSITION

General description and components (%wt): Boron steel (21%wt), Magnox alloy (~78% wt), alumel (0.46% wt), chromel (0.45%wt) and invar (<0.1%).

Chemical state: Neutral

Chemical form of radionuclides:
H-3: The tritium content is insignificant.
C-14: The carbon 14 is incorporated in the metal. There may also be some contamination as graphite.
Se-79: The selenium content is insignificant.
Tc-99: The chemical form of technetium has not been determined.
Ra: The radium content is insignificant.
Th: The thorium content is insignificant.
U: The uranium content is insignificant.
Np: The neptunium content is insignificant.
Pu: The plutonium content is insignificant.

Metals and alloys (%wt): All of the waste will have been cut to fit a standard ILW box.

Stainless steel.....	0	
Other ferrous metals.....	21.0	All of the waste included in this waste stream is from a wide range of miscellaneous metals.
Iron.....		
Aluminium.....	0	
Beryllium.....		
Cobalt.....		
Copper.....	0	
Lead.....	0	
Magnox/Magnesium.....	78.0	

WASTE STREAM 2C314 Miscellaneous Metal (Reactor) ILW

	Nickel	~1.0	Chromel and alumel are present at 0.45% wt and 0.45% wt respectively. Invar is present at <0.1% wt.
	Titanium		
	Uranium		
	Zinc	0	
	Zircaloy/Zirconium	0	
	Other metals		
Organics (%wt):	None expected. No halogenated plastics or rubbers will be present.		
	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):	Some graphite dust may be associated with reactor materials.		
	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	0	

WASTE STREAM 2C314 Miscellaneous Metal (Reactor) ILW

	Free non-aqueous liquids..... 0
	Powder/Ash..... 0
Inorganic anions (%wt):	Trace quantities of chloride may be present.
	Fluoride..... 0
	Chloride..... TR
	Iodide..... 0
	Cyanide..... 0
	Carbonate..... 0
	Nitrate..... 0
	Nitrite..... 0
	Phosphate..... 0
	Sulphate..... 0
	Sulphide..... 0
Materials of interest for waste acceptance criteria:	Magnox will ignite under appropriate conditions.
	Combustible metals..... 78.0
	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..... 78.0
	Active particles.....
	Soluble solids as bulk chemical compounds.....
Hazardous substances / non hazardous pollutants:	None expected.
	Acrylamide.....
	Benzene.....
	Chlorinated solvents.....
	Formaldehyde.....
	Organometallics.....
	Phenol.....
	Styrene.....
	Tri-butyl phosphate.....
	Other organophosphates.....
	Vinyl chloride.....

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Arsenic.....

Barium.....

Boron.....

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):

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids……

Other organic complexants.....

Total complexing agents..... TR

PACKAGING AND CONDITIONING

Conditioning method:	The waste is not expected to be supercompacted. It will be placed in baskets in the waste packages, and is now assumed to be encapsulated.
Plant Name:	-
Location:	Chapelcross Power Station
Plant startup date:	2089
Total capacity (m^3/y incoming waste):	~5000.0
Target start date for packaging this stream:	2089
Throughput for this stream (m^3/y incoming waste):	~3.0
Other information:	-

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
4m box (200mm concrete shielding)	100.0	9.4	10.9	3

WASTE STREAM 2C314 Miscellaneous Metal (Reactor) ILW

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.
Range in container waste volume:	Not yet determined. No signifcant variability is expected.
Other information on containers:	The container material is expected to be stainless steel. Container choice may be influenced by Transport Regulations at the time of final site clearance.
Likely conditioning matrix:	Blast Furnace Slag / Ordinary Portland Cement
Other information:	The waste is now assumed to be encapsulated.
Conditioned density (t/m³):	2.0
Conditioned density comment:	The conditioned waste density assumes the waste will be encapsulated.
Other information on conditioning:	The waste will be in baskets placed in the waste packages. Baskets of different Final Dismantling & Site Clearance ILW wastes may be in the same waste package. Should encapsulation not be required the density of the waste product would be about 1.2 t/m3.
Opportunities for alternative disposal routing:	

Treatment	Stream volume (%)	Comment
-	-	-

RADIOACTIVITY

Source:	Activation of the materials and impurities. There may be some contamination.
Uncertainty:	The values quoted were derived by calculation from available material specification and are indicative of the activities that are expected. The major source of uncertainty is the impurity levels.
Definition of total alpha and total beta/gamma:	All alpha emitters activities are insignificant.
Measurement of radioactivities:	The specific activities have been estimated using a neutron activation calculation using available material specifications. The major source of uncertainty is the impurity levels.
Other information:	There may be some contamination by Cs137.The activities quoted are those at 85 years after reactor shutdown, i.e. in 2089.

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	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				8	Gd 153				8
Be 10				8	Ho 163				8
C 14			2.82E-03	C C 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26			3.4E-07	C C 2	Tm 171				8
Cl 36				8	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			1.2E-08	C C 2
Mn 54				8	Pb 205				8
Fe 55			1.84E-09	C C 2	Pb 210				8
Co 60			1.65E-03	C C 2	Bi 208				8
Ni 59			9.18E-02	C C 2	Bi 210m				8
Ni 63			6.74E+00	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				8	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			1.58E-03	C C 2	Th 234				8
Mo 93			1E-03	C C 2	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99			1.13E-05	C C 2	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			9.94E-05	C C 2	U 235				8
Ag 110m				8	U 236				8
Cd 109				8	U 238				8
Cd 113m				8	Np 237				8
Sn 119m				8	Pu 236				8
Sn 121m				8	Pu 238				8
Sn 123				8	Pu 239				8
Sn 126				8	Pu 240				8
Sb 125				8	Pu 241				8
Sb 126				8	Pu 242				8
Te 125m				8	Am 241				8
Te 127m				8	Am 242m				8
I 129				8	Am 243				8
Cs 134				8	Cm 242				8
Cs 135				8	Cm 243				8
Cs 137				6	Cm 244				8
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				8	Other a				
Eu 152				8	Other b/g				
Eu 154				8	**Total a**	**0**		**0**	
Eu 155				8	**Total b/g**	**0**		**6.84E+00**	**C C 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