WASTE STREAM 9J316 Miscellaneous Metals (Reactor) ILW

SITE Hunterston A

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Magnox Limited

WASTE TYPE ILW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m³
Future arisings -	1.4.2072 - 31.3.2080.....	6.8 m³
Total future arisings:		6.8 m³
Total waste volume:		6.8 m³

Comment on volumes: Waste arisings are assumed to occur at a uniform rate over 8 years. Final Dismantling & Site Clearance is assumed to commence in 2071 lasting for 9 years. Volumes and radioactivity have been calculated for 85 years after reactor shutdown.

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 from reactor dismantling.

PHYSICAL CHARACTERISTICS

General description: Reactor components including control rods, specimen tubes and core thermocouples.

Physical components (%wt): Boron steel from control rods, shielding and emergency shutdown system (96%wt), magnox specimen tubes (3%wt), and chromel and alumel (<1%wt).

Sealed sources: -

Bulk density (t/m³): ~1.4

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

CHEMICAL COMPOSITION

General description and components (%wt): A variety of metals including Boron steel (96%wt), Magnox (3%wt), chromel (<1%wt) and alumel (<1%wt).

Chemical state: Neutral

Chemical form of radionuclides:
H-3: The tritium content is insignificant.
C-14: The chemical form of carbon 14 has not been assessed but may be graphite.
Cl-36: The chlorine 36 content is insignificant.
Se-79: The selenium content is insignificant.
Tc-99: Technetium will be incorporated in the metal. It is an activation product of Mo-98.
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): Items will be cut for packaging, but an assessment of the item dimensions has not been made.

Stainless steel.....	0	
Other ferrous metals.....	~96.0	
Iron.....		
Aluminium.....	0	
Beryllium.....	0	
Cobalt.....		
Copper.....	0	
Lead.....	0	
Magnox/Magnesium.....	~3.0	
Nickel.....	<2.0	Chromel (<1%wt) and alumel

WASTE STREAM 9J316 Miscellaneous Metals (Reactor) ILW

(<1%wt)

	Titanium	
	Uranium	
	Zinc	0
	Zircaloy/Zirconium	0
	Other metals	
Organics (%wt):	None expected. Halogenated plastics and halogenated rubbers are not expected.	
	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
	Free non-aqueous liquids	0
	Powder/Ash	0

WASTE STREAM 9J316 Miscellaneous Metals (Reactor) ILW

Inorganic anions (%wt): Not fully assessed.

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: Some Magnox is expected in the waste.

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	3.0
Active particles	
Soluble solids as bulk chemical compounds	

Hazardous substances / non hazardous pollutants: -

Acrylamide	
Benzene	
Chlorinated solvents	
Formaldehyde	
Organometallics	
Phenol	
Styrene	
Tri-butyl phosphate	
Other organophosphates	
Vinyl chloride	
Arsenic	
Barium	

WASTE STREAM 9J316 Miscellaneous Metals (Reactor) ILW

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..... NE

PACKAGING AND CONDITIONING

Conditioning method:	The waste is not expected to be supercompacted. It will be placed in baskets in the waste packages and encapsulated in 4m Stainless Steel ILW Boxes.
Plant Name:	None
Location:	Hunterston A Decommissioning Site.
Plant startup date:	2072
Total capacity (m^3/y incoming waste):	~5000.0
Target start date for packaging this stream:	2072
Throughput for this stream (m^3/y incoming waste):	~0.8
Other information:	The waste will be packaged immediately after the plant is dismantled. It will be placed in basket and encapsulated. Basket of different ILW waste may be in the same package.

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages
4m box (100mm concrete shielding)	100.0	12.3	14.3	< 1

WASTE STREAM 9J316 Miscellaneous Metals (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. Container choice may be influenced by Transport Regulations at the time of final site clearance.
Range in container waste volume:	Not yet determined. No significant variability is expected.
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 to be encapsulated.
Conditioned density (t/m³):	~3.0
Conditioned density comment:	The conditioned waste density assumes the waste will be encapsulated.
Other information on conditioning:	The waste will be cut for packaging and placed into baskets. Baskets of different Final Dismantling and Site Clearance ILW wastes may be placed in the same package. Should encapsulation not be required the density of the waste product would be about 1.2 t/m3. The volume of this stream is small and will only fill one or two boxes. It is likely that the waste will be placed in containers with other ILW.
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 specifications 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:	Total beta/gamma is defined as the sum of the listed activities of all nuclides other than alpha emitters. All alpha emitter activities are insignificant.
Measurement of radioactivities:	The specific activities were estimated from neutron activation calculations of the material and its impurities.
Other information:	There may be some contamination by Cs-137. The activities quoted are those at 85 years after reactor shutdown, i.e. in 2072.

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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			1.41E-03	C C 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26			1E-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			1.09E-09	C C 2
Mn 54				8	Pb 205				8
Fe 55			1.36E-09	C C 2	Pb 210				8
Co 60			9.1E-04	C C 2	Bi 208				8
Ni 59			9.63E-02	C C 2	Bi 210m				8
Ni 63			6.91E+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			5.91E-04	C C 2	Th 234				8
Mo 93			3.61E-05	C C 2	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99			7.45E-06	C C 2	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			2.4E-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**		**7.01E+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