

WASTE STREAM	9J310	Stainless Steel (Reactor) Recycle LLW
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SITE Hunterston A
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 -	1.4.2072 - 31.3.2080.....	5.2 m ³
Total future arisings:		5.2 m ³
Total waste volume:		5.2 m ³

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 Stainless steel items from reactor dismantling.

PHYSICAL CHARACTERISTICS

General description: A variety of stainless steel items.
 Physical components (%wt): Stainless steel items (100%).
 Sealed sources: -
 Bulk density (t/m³): ~1.4
 Comment on density: The density is of the waste as cut for packaging.

CHEMICAL COMPOSITION

General description and components (%wt): Stainless steels (100%).
 Chemical state: Neutral
 Chemical form of radionuclides: H-3: The tritium content is insignificant.
 C-14: Carbon 14 will be incorporated in the steel. There may also be some graphite contamination.
 Cl-36: Chlorine 36 will be incorporated in the steel.
 Se-79: The selenium content is insignificant.
 Tc-99: Technetium will be incorporated in the steel. 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 have been be cut for packaging. Metal thicknesses will probably range from a few mm to about 25 mm.

Stainless steel.....	100.0	All of the waste included in this waste stream is stainless steel.
Other ferrous metals.....	0	
Iron.....		
Aluminium.....	0	
Beryllium.....	0	
Cobalt.....		
Copper.....	0	
Lead.....	0	
Magnox/Magnesium.....	0	

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	Nickel.....	
	Titanium.....	
	Uranium.....	
	Zinc.....	0
	Zircaloy/Zirconium.....	0
	Other metals.....	0
		There are no "other" metals present.
Organics (%wt):	None expected. No halogenated plastics or rubbers will be present.	
	Total cellulose.....	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

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	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:	No materials likely to pose a fire or other non-radiological hazard have been identified.	
	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:	None expected.	
	Acrylamide.....	
	Benzene.....	
	Chlorinated solvents.....	
	Formaldehyde.....	
	Organometallics.....	
	Phenol.....	
	Styrene.....	
	Tri-butyl phosphate.....	
	Other organophosphates.....	
	Vinyl chloride.....	
	Arsenic.....	

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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

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction Supercompaction (HFC) Incineration Solidification Decontamination Metal treatment Size reduction Decay storage Recycling / reuse Other / various None		100.0

Comment on planned treatments:

This waste stream is expected to be sent for Metal Recycle.

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Disposal Route	Stream volume %
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	100.0

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: (Not applicable to this waste stream)

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 2m box (no shielding) 4m box (no shielding) Other			

Other information: -

Waste Planned for Disposal at the LLW Repository: (Not applicable to this waste stream)

Container voidage: -

Waste Characterisation Form (WCH): -

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

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Source:	Activation of the stainless steel and impurities.
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:	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:	The activities quoted are those at 85 years after reactor shutdown, i.e. in 2072. There may be some contamination by Cs137.

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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				8	Gd 153				8
Be 10				8	Ho 163				8
C 14			2.27E-05	C C 2	Ho 166m				8
Na 22				8	Tm 170				8
Al 26				8	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				8
Mn 54				8	Pb 205				8
Fe 55				8	Pb 210				8
Co 60			1.21E-07	C C 2	Bi 208				8
Ni 59			3.88E-05	C C 2	Bi 210m				8
Ni 63			2.31E-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				8	Th 227				8
Zr 93				8	Th 228				8
Nb 91				8	Th 229				8
Nb 92				8	Th 230				8
Nb 93m				6	Th 232				8
Nb 94			1.83E-07	C C 2	Th 234				8
Mo 93			2.74E-07	C C 2	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99			6.36E-08	C C 2	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			8.57E-09	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	2.37E-03	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