WASTE STREAM 9B315 Mild Steel (Non-Reactor) LLW

SITE Bradwell

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 m³
Future arisings -	1.4.2087 - 31.3.2090.....	3404.0 m³
Total future arisings:		3404.0 m³
Total waste volume:		3404.0 m³

Comment on volumes: Final Dismantling & Site Clearance is assumed to commence in 2083 with reactor dismantling commencing in 2087 and lasting for three years. Volumes and radioactivity have been calculated for 85 years after reactor shutdown, i.e. 2087.

Uncertainty factors on volumes:

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

WASTE SOURCE Mild steel items from the boilers and the reactor ancillary plant.

PHYSICAL CHARACTERISTICS

General description: A variety of mild steel items.

Physical components (%wt): Mild steel items (100%).

Sealed sources: The waste does not contain 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): Mild steel (100%). Composition is >98% iron

Chemical state: Neutral

Chemical form of radionuclides: H-3: The tritium is incorporated in the steel.
C-14: The carbon 14 is incorporated in the steel. There also may be some contamination as graphite.
Cl-36: The chlorine 36 is incorporated in the steel.

Metals and alloys (%wt): All of the waste will be bulk metal items which have been cut for packaging. Metal thicknesses will probably range from a few mm to about 100 mm.

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	100.0	All of the waste included in this waste stream is mild steel including BS 970 EN2/3	100.0
Iron.....			
Aluminium.....	0		
Beryllium.....	0		
Cobalt.....	~0.01	Greatest measured value from the various components.	
Copper.....	0		
Lead.....	0		
Magnox/Magnesium.....	0		

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Nickel	~0.07	Greatest measured value from the various components.
Titanium		
Uranium		
Zinc	0	
Zircaloy/Zirconium	0	
Other metals	TR	Silver and niobium

Organics (%wt): None expected.

	(%wt)	Type(s) and comment	% of total C14 activity
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): Traces of graphite expected.

	(%wt)	Type(s) and comment	% of total C14 activity
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			

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Highly friable	
Free aqueous liquids	0
Free non-aqueous liquids	0
Powder/Ash	0

Inorganic anions (%wt): -

	(%wt)	Type(s) and comment
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.

	(%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		
Putrescible wastes	0	
Non-putrescible wastes		
Corrosive materials	0	
Pyrophoric materials	0	
Generating toxic gases	0	
Reacting with water	0	
Higher activity particles		
Soluble solids as bulk chemical compounds		

Hazardous substances / non hazardous pollutants: None expected

	(%wt)	Type(s) and comment
Acrylamide		
Benzene		
Chlorinated solvents		
Formaldehyde		

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Organometallics.....	
Phenol.....	
Styrene.....	
Tri-butyl phosphate.....	
Other organophosphates.....	
Vinyl chloride.....	
Arsenic.....	
Barium.....	
Boron.....	
Boron (in Boral).....	
Boron (non-Boral).....	
Cadmium.....	
Caesium.....	
Selenium.....	
Chromium.....	
Molybdenum.....	TR
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): Yes

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids…….		
Other organic complexants.....		
Total complexing agents.....	TR	

Potential for the waste to contain discrete items: Yes. Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs. NB If recycled then DI Limits n/a

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		
Supercompaction (HFC)		
Incineration		
Solidification		
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		100.0

Comment on planned treatments: 100% of the waste expected to go to landfill

Disposal Routes:

Disposal Route	Stream volume %	Disposal density t/m3
Expected to be consigned to the LLW Repository		
Expected to be consigned to a Landfill Facility	100.0	1.4
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		

Classification codes for waste expected to be consigned to a landfill facility: 17 04 05

Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):

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: (Not applicable to this waste stream)

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Container	Stream volume %	Waste loading m³	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: -

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: Contamination, and activation of the mild steel and its impurities.

Uncertainty: The values quoted were derived by calculation from available data and are indicative of the activities that are to 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 were estimated from gamma spectrometry measurements in the boilers.

Other information: The activities quoted are those at 85 years after reactor shutdown, i.e. in 2087. There may be some contamination by Cs137.

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	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			3.9E-07	C C 2	Gd 153				8
Be 10				8	Ho 163				8
C 14			3.9E-06	C C 2	Ho 166m			<2.8E-08	C 3
Na 22				8	Tm 170				8
Al 26				8	Tm 171				8
Cl 36			3.9E-07	C C 2	Lu 174				8
Ar 39				8	Lu 176				8
Ar 42				8	Hf 178n				8
K 40				8	Hf 182				8
Ca 41			1.2E-08	C C 2	Pt 193				8
Mn 53				8	Tl 204				8
Mn 54				8	Pb 205				8
Fe 55				8	Pb 210				8
Co 60				8	Bi 208				8
Ni 59			1.2E-07	C C 2	Bi 210m				8
Ni 63			7.9E-06	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			2.4E-08	C C 2	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			<1.6E-08	C 3	Th 234				8
Mo 93				8	Pa 231				8
Tc 97				8	Pa 233				8
Tc 99				8	U 232				8
Ru 106				8	U 233				8
Pd 107				8	U 234				8
Ag 108m			2.4E-08	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			1.6E-09	C C 2
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			2E-08	C C 2	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**		**1.6E-09**	**C C 2**
Eu 155				8	**Total b/g**	**0**		**1.28E-05**	**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