WASTE STREAM	2A306	Final Dismantling & Site Clearance : Mild Steel (Non-Reactor) LLW

SITE Calder Hall

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Sellafield Limited

WASTE TYPE LLW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	0 m³
Future arisings -	1.4.2019 - 31.3.2106.....	0 m³
	1.4.2106 - 31.3.2113.....	4235.0 m³
Total future arisings:		4235.0 m³
Total waste volume:		4235.0 m³

Comment on volumes: For inventory purposes the arisings are assumed to arise at a uniform rate over seven years. Final dismantling & site clearance is assumed to commence in 2105, with dismantling of the plant associated with this waste stream commencing in 2106, and lasting for ten years. Volumes and radioactivity have been calculated for 100 years after reactor shutdown, i.e. 2103, but the volume in this stream would not change for decommissioning in 2106.

Uncertainty factors on volumes:

Stock (upper):	x	Arisings (upper)	x 5.0
Stock (lower):	x	Arisings (lower)	x 0.5

WASTE SOURCE Mild steel from active plant dismantling of the boilers, gas ducts and other plant.

PHYSICAL CHARACTERISTICS

General description: A variety of mild steel items.

Physical components (%vol): Mild steel from dismantling of boilers (~93% vol), gas ducts (~7% vol).

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%).

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 chemical form of chlorine present has not been determined.
Se-79: The selenium content is insignificant.
Tc-99: The technetium content is insignificant.
I-129: The iodine content is insignificant.
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 chemical form of plutonium isotopes has not been determined, but may be present as oxides.

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

Stainless steel.....	0	
Other ferrous metals.....	100.0	Mild steel.
Iron.....		
Aluminium.....	0	
Beryllium.....	0	
Cobalt.....	0	

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Copper	0
Lead	0
Magnox/Magnesium	0
Nickel	0
Titanium	
Uranium	0
Zinc	0
Zircaloy/Zirconium	0
Other metals	0

Organics (%wt): None expected.
No halogenated plastics or rubbers are expected to 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): -

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): There may be trace amounts of chloride 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..... 0

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.....

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.....

EEE Type 2.....

EEE Type 3.....

EEE Type 4.....

EEE Type 5.....

Complexing agents (%wt): Not yet determined

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids……

Other organic complexants.....

Total complexing agents..... NE

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	Off-site	80.0
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		20.0

Comment on planned treatments: It has been assumed for the 2019 UK RWI that 80% of the metallic waste will be treated by the supply chain and will subsequently be 'out of scope'. The remaining 20% is assumed to be consigned to LLWR for disposal as non-compactable LLW.

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Disposal Routes:

Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository	20.0
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	80.0
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 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	20.0	10	85
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): It is not yet determined if the waste meets LLWR's Waste Acceptance Criteria (WAC).

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: -

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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:	Total Beta/Gamma is defined as the sum of the listed activities of all nuclides other than alpha emitters. Activity estimates for individual alpha emitting nuclides have not been provided but an estimate of total alpha activity has been given.
Measurement of radioactivities:	The values used were derived by calculation from available measurements and are indicative of the activities to be expected.
Other information:	The activities quoted are those at 100 years after reactor shutdown, i.e. in 2103. There may be some contamination by Cs137.

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code		Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3				6	Gd 153				8
Be 10				8	Ho 163				8
C 14				6	Ho 166m				6
Na 22					Tm 170				8
Al 26					Tm 171				8
Cl 36				6	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				8	Bi 208				8
Ni 59				6	Bi 210m				8
Ni 63				6	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				6	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				6	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				6
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			1.00E-07	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				8
Eu 152				8	Other b/g				8
Eu 154				8	**Total a**	**0**		**<1.00E-09**	**D 3**
Eu 155				8	**Total b/g**	**0**		**~1.00E-07**	**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