

**WASTE STREAM****2P05****BTC Rig Hall****SITE**

Sellafield NNL

**SITE OWNER**

Nuclear Decommissioning Authority

**WASTE CUSTODIAN**

National Nuclear Laboratory

**WASTE TYPE**

LLW

**WASTE VOLUMES**

Reported

Stocks:	At 1.4.2019.....	22.7 m <sup>3</sup>
Future arisings -	1.4.2019 - 31.3.2025.....	6.5 m <sup>3</sup>
Total future arisings:		6.5 m <sup>3</sup>
Total waste volume:		29.2 m <sup>3</sup>

**Comment on volumes:**

Disposals to date are not representative of long-term operations. Once the plant has been operational for a number of years a better estimate of arisings can be made.

**Uncertainty factors on volumes:**

Stock (upper):	x 1.5	Arisings (upper)	x 1.5
Stock (lower):	x 0.5	Arisings (lower)	x 0.5

**WASTE SOURCE**

Waste generated from the Rig Hall is from the manufacture, operation and POCO of the 'Geomelt' and other associated test rigs researched by NNL. Geomelt is a rig to demonstrate ability to convert a series of waste forms into durable vitrified product. This consists of a vitrified monolith, contained within a cast refractory box. These incorporate the waste form (eg soil, sand, sludges) and some radiological inventory. The majority of the blocks will be classified as LA-LLW as they are below 200 Bq/g, containing either Cs-137 or Sr-85. Two of the blocks will contain natural uranium and be classified as LLW. Typical associated waste arisings will be in the majority steel and metal work arising from the dismantling of rigs as well as gloves, paper, PVC, rubber and plastics from general operations.

**PHYSICAL CHARACTERISTICS****General description:**

There will be 34 product boxes containing Cs-137 or Sr-85 which will be classified as LA-LLW. There will be 2 product boxes containing natural Uranium, classified as LLW. Typical associated waste arisings are in the majority steel and metal work arising from the dismantling of rigs as well as rubbers and plastics from general operations. This mixed general waste is able to fit within a skip. Larger items may arise but this is thought to be infrequent. Various test waste forms are incorporated into the vitrified product boxes as part of the experimental Geomelt rig, to demonstrate the capability.

**Physical components (%wt):**

Vitrified product boxes (32%). Also: Paper, tissues, paper towels, cardboard, wood, tacky mats, polythene bottles, rubber, gloves, cable, metal sheets, pipe, rubble and glassware. Typical waste arisings by percentage weight are metal (7%), concrete/rubble (53%), soil (1%), plastics (halogenated) (4%), plastics (non-halogenated) 1%, rubber (1%) and wood (1%).

**Sealed sources:**

The waste does not contain sealed sources.

**Bulk density (t/m<sup>3</sup>):**

~1.38

**Comment on density:**

This is based on the the density of the product boxes, the rig, and the operating waste.

**CHEMICAL COMPOSITION****General description and components (%wt):**

Concrete/rubble 53%, Vitrified product boxes 32%, Metal 7%, halogenated plastics 4%, non-halogenated plastics, soil, rubber, wood - 1% each.

**Chemical state:**

Neutral

**Chemical form of radionuclides:**

H-3: Not anticipated to be present.  
 C-14: Not anticipated to be present.  
 Cl-36: Not anticipated to be present.  
 Se-79: Not anticipated to be present.  
 Tc-99: Not anticipated to be present.  
 I-129: Not anticipated to be present.  
 Ra: Not anticipated to be present.  
 Th: Not anticipated to be present.  
 U: U234, U235, and U238  
 Np: Not anticipated to be present.  
 Pu: Not anticipated to be present.

**Metals and alloys (%wt):**

Sheet metal 50% - typical thickness 5 mm. Bulk items 50% - typical dimensions 1000 mm

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	x 300 mm x 300 mm.	
	Stainless steel.....	4.0
	Other ferrous metals.....	2.0
	Iron.....	
	Aluminium.....	0.10
	Beryllium.....	
	Cobalt.....	0.20
	Copper.....	0.30
	Lead.....	
	Magnox/Magnesium.....	
	Nickel.....	0.30
	Titanium.....	
	Uranium.....	
	Zinc.....	0.10
	Zircaloy/Zirconium.....	
	Other metals.....	Unspecified metals.
Organics (%wt):	-	
	Total cellulose.....	1.0
	Paper, cotton.....	
	Wood.....	1.0
	Halogenated plastics .....	4.0
	Total non-halogenated plastics.....	1.0
	Condensation polymers.....	
	Others.....	
	Organic ion exchange materials....	
	Total rubber.....	1.0
	Halogenated rubber .....	
	Non-halogenated rubber.....	1.0
	Hydrocarbons.....	
	Oil or grease .....	
	Fuel.....	
	Asphalt/Tarmac (cont.coal tar)...	
	Asphalt/Tarmac (no coal tar)....	
	Bitumen.....	
	Others.....	
	Other organics.....	Unspecified amounts of plastic and rubber.
Other materials (%wt):	Concrete, rubble accounts for 53% of the waste.	
	Inorganic ion exchange materials.	
	Inorganic sludges and flocs.....	
	Soil.....	1.0
	Brick/Stone/Rubble.....	
	Cementitious material.....	53.0
		Concrete from refractory boxes

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	Sand.....		
	Glass/Ceramics.....	32.0	Vitrified product
	Graphite.....		
	Desiccants/Catalysts.....		
	Asbestos.....		
	Non/low friable.....		
	Moderately friable.....		
	Highly friable.....		
	Free aqueous liquids.....		
	Free non-aqueous liquids.....		
	Powder/Ash.....		
Inorganic anions (%wt):	None of these items are anticipated to be present.		
	Fluoride.....		
	Chloride.....		
	Iodide.....		
	Cyanide.....		
	Carbonate.....		
	Nitrate.....		
	Nitrite.....		
	Phosphate.....		
	Sulphate.....		
	Sulphide.....		
Materials of interest for waste acceptance criteria:	Metals (aluminium, zinc), within geomelt blocks, rendering them non-reactive with water.		
	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.....	0	
	Corrosive materials.....	0	
	Pyrophoric materials.....	0	
	Generating toxic gases.....	0	
	Reacting with water.....	0.20	Aluminium, zinc vitrified in Geomelt blocks
	Active particles.....	0	
	Soluble solids as bulk chemical compounds.....	0	

**WASTE STREAM****2P05****BTC Rig Hall**Hazardous substances /  
non hazardous pollutants:

May be small amounts, assumed to be &lt; 0.1% wt.

Acrylamide.....

Benzene..... 0

Chlorinated solvents.....

Formaldehyde.....

Organometallics.....

Phenol..... 0

Styrene.....

Tri-butyl phosphate..... 0

Other organophosphates.....

Vinyl chloride..... 0

Arsenic..... 0

Barium.....

Boron..... 0

Cadmium..... 0

Caesium.....

Selenium..... 0

Chromium..... 0.10

Within alloy metals

Molybdenum..... 0

Thallium.....

Tin..... 0

Vanadium..... 0

Mercury compounds.....

Others..... 0

Electronic Electrical Equipment (EEE)

EEE Type 1..... 50.0

EEE Type 2..... 100.0

EEE Type 3..... 50.0

EEE Type 4.....

EEE Type 5..... 5.0

Complexing agents (%wt):

Yes

EDTA..... &lt;0.01

0.00013kg per 1.08t soft waste;  
nil in blocks.

DPTA.....

NTA.....

Polycarboxylic acids..... 0

Other organic complexants..... 0

Total complexing agents..... &lt;0.01

**TREATMENT, PACKAGING AND DISPOSAL**

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	On-site	18.0
Supercompaction (HFC)		18.0
Incineration	Off-site	14.0
Solidification		
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recycling / reuse		
Other / various	50.0	
None		

Comment on planned treatments:

The vitrified product boxes will be suitable for direct disposal either to specified landfill (for the LA-LLW boxes) or to the LLWR repository (for the 2 x Uranium blocks). The soft bagged waste may be suitable for incineration depending on monitoring levels.

**Disposal Routes:**

Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository	~21.0
Expected to be consigned to a Landfill Facility	~47.0
Expected to be consigned to an On-Site Disposal Facility	
Expected to be consigned to an Incineration Facility	~18.0
Expected to be consigned to a Metal Treatment Facility	~14.0
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 m <sup>3</sup>	Number of packages
1/3 Height IP-1 ISO			
2/3 Height IP-2 ISO			
1/2 Height WAMAC IP-2 ISO	18.0	59.28	< 1
1/2 Height IP-2 Disposal/Re-usable ISO	3.0	10	< 1
2m box (no shielding)			
4m box (no shielding)			
Other			

Other information: -

**Waste Planned for Disposal at the LLW Repository:**

Container voidage: NNL do not load containers. NNL waste is mixed with Sellafield Ltd waste on

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Sellafield site. Voidage and packaging efficiency is determined by Sellafield Ltd.

Waste Characterisation Form (WCH):

The waste meets the LLWR's Waste Acceptance Criteria (WAC).  
The waste has a current WCH.  
Inventory information is consistent with the current WCH.

Waste consigned for disposal to LLWR in year of generation:

No. A number of bags of soft waste and geomelt blocks have accumulated. It is anticipated this will start to be removed in the first half of 2019.

Potential for the waste to contain discrete items:

Yes. The 2 x Uranium Geomelt blocks will be deemed 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**

Source:

Uranium, Cs137 and Sr-85 is used in the Rig Hall as inventory within the Geomelt blocks. Contaminated process waste will be generated (such as gloves/ paper etc.) from the Geomelt rig and other associated rigs.

Uncertainty:

This waste stream became fully operational in Dec 2017. This waste stream is based on known plans for the experimental make up of the Geomelt blocks.

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 activity is a known amount based on the planned experimental make up of each Geomelt block. The activity of the soft bagged waste is based on Activity Conversion Factors derived from the make up the blocks and an assumption of the activity that may migrate via the off-gas system, and the portion of that which may contaminate the soft bagged waste.

Other information:

The soft bagged waste will be LLW. The Uranium Blocks will be LLW. All other blocks will be LA-LLW.

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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					Gd 153				
Be 10					Ho 163				
C 14					Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36					Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54					Pb 205				
Fe 55					Pb 210				
Co 60					Bi 208				
Ni 59					Bi 210m				
Ni 63					Po 210				
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90					Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232				
Nb 94					Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106					U 233				
Pd 107					U 234	9.43E-09	3	1.03E-05	AA 2
Ag 108m					U 235	5.81E-08	3	4.71E-07	AA 2
Ag 110m					U 236				
Cd 109					U 238	1.76E-04	3	3.51E-07	AA 2
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238				
Sn 123					Pu 239				
Sn 126					Pu 240				
Sb 125					Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241				
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137	5.45E-05	3	3.15E-05	AA 2	Cm 244				
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a				
Eu 152					Other b/g	5.85E-05	3	1.00E-04	AA 2
Eu 154					<b>Total a</b>	<b>1.76E-04</b>	<b>3</b>	<b>1.11E-05</b>	<b>AA 2</b>
Eu 155					<b>Total b/g</b>	<b>1.13E-04</b>	<b>3</b>	<b>1.32E-04</b>	<b>AA 2</b>

**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