

<b>WASTE STREAM</b>	<b>2E101</b>	<b>Decommissioning LLW</b>
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**SITE** Springfield

**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Springfield Fuels Limited

**WASTE TYPE** LLW

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2019.....	0 m <sup>3</sup>
Future arisings -	1.4.2019 - 31.3.2021.....	~6.0 m <sup>3</sup>
	1.4.2021 - 31.3.2030.....	~100.0 m <sup>3</sup>
	1.4.2030 - 31.3.2040.....	~0 m <sup>3</sup>
	1.4.2040 - 31.3.2050.....	~182.0 m <sup>3</sup>
	1.4.2100 - 31.3.2110.....	~700.0 m <sup>3</sup>
Total future arisings:		988.0 m <sup>3</sup>
Total waste volume:		988.0 m <sup>3</sup>

Comment on volumes: The waste arisings are generated by the Springfield Decommissioning Model, which assesses each building on the seen volume and the predicted level of contamination inside the building. The model data is periodically reviewed, the stock volumes within this waste stream were fully reviewed for the 2019 inventory, as the work to re-evaluating material against the new disposal authorisation at Clifton Marsh Landfill Site (CMLFS) occurred between the 2010 and 2013 inventory updates. The waste arisings are generated by the Springfield Decommissioning Model, which assesses each building on the seen volume and the predicted level of contamination inside the building. The model data is periodically reviewed and has proved prudent.

Uncertainty factors on volumes: Stock (upper): x 1.0 Arisings (upper) x 1.5  
 Stock (lower): x 1.0 Arisings (lower) x 0.5

**WASTE SOURCE** The waste arises from decommissioning of uranium processing and fabrication facilities.

**PHYSICAL CHARACTERISTICS**

General description: Waste comprises plant, equipment, structural and building materials and soil. The waste includes compactable and non compactable waste. All waste material will have been subject to decontamination, with minor exceptions which include those materials not suitable for decontamination, such as asbestos and other building lagging.

Physical components (%wt): Metal (40%), rubble / concrete (40%), plastics / rubber (5%), asbestos (5%), wood (<0.5%), soft organics (5%) and others (4.5%).

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): ~1.8

Comment on density: Estimated average bulk density of raw decommissioning waste.

**CHEMICAL COMPOSITION**

General description and components (%wt): Metal (40%), rubble / concrete (40%), plastics / rubber (5%), asbestos (5%), wood (<0.5%), soft organics (5%) and others (4.5%).

Chemical state: Neutral

Chemical form of radionuclides: H-3: Not expected to be present.  
 C-14: Not expected to be present.  
 Cl-36: Not expected to be present.  
 Se-79: Not expected to be present.  
 Tc-99: Older facilities that had this Nuclide present have been Decommissioned but each project has a new fingerprint validated to ensure it is not present  
 I-129: Not expected to be present.  
 Ra: Not expected to be present.  
 Th: Not expected to be present.  
 U: Oxides, fluorides and nitrates of uranium.  
 Np: Older facilities that had this Nuclide present have been Decommissioned but each project has a new fingerprint validated to ensure it is not present  
 Pu: Not expected to be present.

Metals and alloys (%wt): Decontamination processes incorporate size reduction of larger items to a size which allows handling, hence no large dimension sheets or bulk materials are anticipated for

**WASTE STREAM****2E101****Decommissioning LLW**

disposal as part of this stream.

Stainless steel.....	~5.0
Other ferrous metals.....	~21.2
Iron.....	~5.0
Aluminium.....	~4.0
Beryllium.....	0
Cobalt.....	0
Copper.....	<1.5
Lead.....	~1.0
Magnox/Magnesium.....	0
Nickel.....	0
Titanium.....	0
Uranium.....	~0.30
Zinc.....	~2.0
Zircaloy/Zirconium.....	0
Other metals.....	0

## Organics (%wt):

-	
Total cellulose.....	4.0
Paper, cotton.....	~3.5
Wood.....	<0.50
Halogenated plastics .....	3.0
Total non-halogenated plastics.....	1.0
Condensation polymers.....	
Others.....	~1.0
Organic ion exchange materials....	0
Total rubber.....	1.0
Halogenated rubber .....	~0.50
Non-halogenated rubber.....	~0.50
Hydrocarbons.....	0
Oil or grease .....	0
Fuel.....	0
Asphalt/Tarmac (cont.coal tar)...	0
Asphalt/Tarmac (no coal tar)....	0
Bitumen.....	0
Others.....	0
Other organics.....	2.0

## Other materials (%wt):

-	
Inorganic ion exchange materials.	0
Inorganic sludges and flocs.....	2.0
Soil.....	0
Brick/Stone/Rubble.....	~4.0
Cementitious material.....	~36.0
Sand.....	

**WASTE STREAM****2E101 Decommissioning LLW**

Glass/Ceramics.....	1.5
Graphite.....	0.50
Desiccants/Catalysts.....	
Asbestos.....	~5.0
Non/low friable.....	~5.0
Moderately friable.....	0
Highly friable.....	0
Free aqueous liquids.....	0
Free non-aqueous liquids.....	0
Powder/Ash.....	0

Mostly old lagging from process vessels and may be either Amosite, Chrysotile or Crocidolite.

## Inorganic anions (%wt):

Trace amounts only after the decontamination process.

Fluoride.....	0
Chloride.....	0
Iodide.....	0
Cyanide.....	0
Carbonate.....	0
Nitrate.....	0
Nitrite.....	0
Phosphate.....	0
Sulphate.....	0
Sulphide.....	0

## Materials of interest for waste acceptance criteria:

Asbestos is present. Historical (buried) waste will contain beryllium contaminated filters in concreted drums (132 off).

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
Active particles.....	0
Soluble solids as bulk chemical compounds.....	0

**WASTE STREAM****2E101****Decommissioning LLW**Hazardous substances /  
non hazardous pollutants:

Asbestos (~5%).	
Acrylamide.....	0
Benzene.....	0
Chlorinated solvents.....	0
Formaldehyde.....	0
Organometallics.....	0
Phenol.....	0
Styrene.....	0
Tri-butyl phosphate.....	0
Other organophosphates.....	0
Vinyl chloride.....	NE
Arsenic.....	0
Barium.....	0
Boron.....	0
Cadmium.....	0
Caesium.....	0
Selenium.....	0
Chromium.....	0
Molybdenum.....	0
Thallium.....	0
Tin.....	0
Vanadium.....	0
Mercury compounds.....	0
Others.....	NE
Electronic Electrical Equipment (EEE)	
EEE Type 1.....	0
EEE Type 2.....	0
EEE Type 3.....	0
EEE Type 4.....	0
EEE Type 5.....	0

Complexing agents (%wt):

Not yet determined	
EDTA.....	
DPTA.....	
NTA.....	
Polycarboxylic acids.....	
Other organic complexants.....	
Total complexing agents.....	

**WASTE STREAM****2E101****Decommissioning LLW****TREATMENT, PACKAGING AND DISPOSAL**

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

Treatment	On-site / Off site	Stream volume %
Low force compaction	On-site	~80.0
Supercompaction (HFC)		
Incineration		
Solidification		
Decontamination	On-site	~10.0
Metal treatment	On-site	~5.0
Size reduction		
Decay storage		
Recycling / reuse	On-site	~5.0
Other / various		
None		~5.0

Comment on planned treatments:

All waste material will have been subject to decontamination, with minor exceptions which include those materials not suitable for decontamination, such as asbestos and other building lagging. This can include jet washing and acid pickling.

**Disposal Routes:**

Disposal Route	Stream volume %
Expected to be consigned to the LLW Repository	100.0
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	
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	~15.0	NE	NE
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	~85.0	NE	

Other information: -

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

Container voidage: Expected to be 10% or less.

**WASTE STREAM****2E101****Decommissioning LLW**

Waste Characterisation Form (WCH):

The waste does not meet the LLWR's Waste Acceptance Criteria (WAC).  
The waste does not have a current WCH.

Future wastes generated will require characterisation to ensure that it meets the LLWR disposal acceptance criteria.

Waste consigned for disposal to LLWR in year of generation:

No. Wastes are stored pending work on decontamination methods or the development of waste stream characterisation fingerprints. The timescales for qualifying waste types for disposal may mean that some wastes are not disposed of in the year of arising.

Potential for the waste to contain discrete items:

No

**Non-Containerised Waste for In-Vault Grouting:**

Stream volume (%):

-

Waste stream variation:

-

Bounding cuboidal volume:

Inaccessible voidage:

-

Other information:

-

**RADIOACTIVITY**

Source:

The main source of activity is contamination by uranium and its daughters. The waste becomes contaminated from contact with intermediate uranium compounds during the fuel manufacturing process.

Uncertainty:

Activities are estimated on the basis that site processes a mixture of natural and enriched material.

Definition of total alpha and total beta/gamma:

The waste stream is contaminated by coming in contact with Uranium and its intermediate products (oxides). The uranium is from a series of enrichments with a Site mean of 3.2%U235, it is assumed that the uranium is not irradiated therefore contains no reactor products and is aged to a point of equilibrium. This waste stream typically has an activity concentration of 2000Bq/g therefore this is split equally between alpha and beta/ gamma activity.

Measurement of radioactivities:

Chemical analysis and direct monitoring.

Other information:

Radiological activity of decommissioning waste varies from area to area depending on operations within the area. Hence the composition of this waste stream is not expected to be the same for each area and characterisation of will be required, including independent chemical analysis and confirmation monitoring.

**WASTE STREAM 2E101 Decommissioning LLW**

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				
Ag 108m					U 235				
Ag 110m					U 236				
Cd 109					U 238				
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					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				
Eu 154					<b>Total a</b>	<b>0</b>	<b>1.8E-03</b>	<b>BB 2</b>	
Eu 155					<b>Total b/g</b>	<b>0</b>	<b>1.8E-03</b>	<b>CC 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