

<b>WASTE STREAM</b>	<b>5B359</b>	<b>Contaminated Soil ILW</b>
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**SITE** Dounreay  
**SITE OWNER** Nuclear Decommissioning Authority  
**WASTE CUSTODIAN** Dounreay Site Restoration Limited  
**WASTE TYPE** ILW  
 Is the waste subject to Scottish Policy: Yes

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2022.....	0 m <sup>3</sup>
Future arisings -	1.4.2035 - 31.3.2036.....	6.8 m <sup>3</sup>
	1.4.2036 - 31.3.2037.....	7.8 m <sup>3</sup>
	1.4.2037 - 31.3.2038.....	7.8 m <sup>3</sup>
	1.4.2038 - 31.3.2039.....	7.8 m <sup>3</sup>
	1.4.2039 - 31.3.2040.....	7.8 m <sup>3</sup>
	1.4.2040 - 31.3.2041.....	7.8 m <sup>3</sup>
	1.4.2041 - 31.3.2042.....	7.8 m <sup>3</sup>
	1.4.2042 - 31.3.2043.....	7.8 m <sup>3</sup>
	1.4.2043 - 31.3.2044.....	7.8 m <sup>3</sup>
	1.4.2044 - 31.3.2045.....	7.8 m <sup>3</sup>
	1.4.2045 - 31.3.2046.....	7.8 m <sup>3</sup>
	1.4.2046 - 31.3.2047.....	7.8 m <sup>3</sup>
	1.4.2047 - 31.3.2048.....	7.8 m <sup>3</sup>
	1.4.2048 - 31.3.2049.....	1.2 m <sup>3</sup>
Total future arisings:		101.6 m <sup>3</sup>
Total waste volume:		101.6 m <sup>3</sup>

Comment on volumes: It should be noted that the DSRL is using a provisional site programme and that arisings dates are subject to change. It should be noted that the site strategy for removal of soil is under revision and therefore future arisings will need to be reassessed. Volumes are based on limited sampling data.

Uncertainty factors on volumes: Stock (upper): x Arisings (upper) x 1.2  
 Stock (lower): x Arisings (lower) x 0.8

**WASTE SOURCE** Concrete foundation slabs and sub-slab soils for active buildings. Also contaminated soil which has arisen from accidental releases of activity from historical operations. The soil will be excavated during new build or site remediation operations.

**PHYSICAL CHARACTERISTICS**

General description: Mainly soil with smaller amounts of rubble (broken up sub-slab pieces). There are no large items to influence package choice.  
 Physical components (%vol): Cementitious material (e.g. concrete) (35.82%), Soil/Stone (64.18%),  
 Sealed sources: The waste does not contain sealed sources.  
 Bulk density (t/m<sup>3</sup>): ~0.42  
 Comment on density: Density should roughly match 5B323 (same waste type)

**CHEMICAL COMPOSITION**

General description and components (%wt): The soils (59.89%) contains clay, silt, sand and stones together with some organic matter but is too variable to give breakdown data. The building foundations (40.11%) will be concrete.  
 Chemical state: Neutral  
 Chemical form of radionuclides: Cl-36: Possibly present as general contamination.  
 I-129: Possibly present as general contamination.  
 Th: Possibly present as general contamination.  
 U: Possibly present as discrete particles or general contamination.  
 Pu: Possibly present as general contamination.  
 Metals and alloys (%wt): Likely to be present as small pieces in soil.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	NE		
Other ferrous metals.....	NE		
Iron.....			
Aluminium.....	TR		
Beryllium.....			
Cobalt.....	0		
Copper.....	TR		
Lead.....	TR		
Magnox/Magnesium.....	TR		
Nickel.....			
Titanium.....			
Uranium.....			
Zinc.....	TR		
Zircaloy/Zirconium.....	TR		
Other metals.....	TR	Traces of other metals may be present.	

Organics (%wt): Small quantities of organic material will be present as flora and fauna. Hydrocarbons and trichloroethylene are known to be present.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	P		
Paper, cotton.....	P		
Wood.....	P		
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.....	NE		
Oil or grease .....			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	TR	Trichloroethylene	

Other materials (%wt): -

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	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....	0		
Soil.....	59.9		
Brick/Stone/Rubble.....	NE		
Cementitious material.....	40.1		
Sand.....	P		
Glass/Ceramics.....			
Graphite.....	0		
Desiccants/Catalysts.....	0		
Asbestos.....	NE		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	0		
Free non-aqueous liquids.....	0		
Powder/Ash.....	0		

Inorganic anions (%wt):            Inorganic anions are present in the soil but their concentrations have not been estimated.

	(%wt)	Type(s) and comment
Fluoride.....	P	
Chloride.....	P	
Iodide.....	P	
Cyanide.....	NE	
Carbonate.....	P	
Nitrate.....	P	
Nitrite.....	NE	
Phosphate.....	P	
Sulphate.....	P	
Sulphide.....	P	

Materials of interest for waste acceptance criteria:            The presence of hazardous materials is to be determined.

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....		
Biodegradable materials.....		
Putrescible wastes.....		
Non-putrescible wastes.....		

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Corrosive materials.....	0
Pyrophoric materials.....	0
Generating toxic gases.....	
Reacting with water.....	0
Higher activity particles.....	NE
Soluble solids as bulk chemical compounds.....	0

Hazardous substances / non hazardous pollutants: Toxic metals may be present in trace quantities. Soil may contain listed substances in trace quantities.

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

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Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA.....		
DPTA.....		
NTA.....		
Polycarboxylic acids.....		
Other organic complexants.....		There may be natural complexing agents in the organic matter, concentrations unknown.
Total complexing agents.....	NE	

Potential for the waste to contain discrete items: Not yet determined. Potential for sub slabs to come out as blocks.

**PACKAGING AND CONDITIONING**

Conditioning method: Contaminated soil and sub slab will most likely be encapsulated within 6m<sup>3</sup> boxes for long term storage. However, this waste route is not finalised.

Plant Name: Mobile Conditioning Plant - TBC

Location: Dounreay

Plant startup date: TBC

Total capacity (m<sup>3</sup>/y incoming waste): ~8.0

Target start date for packaging this stream: 2035

Throughput for this stream (m<sup>3</sup>/y incoming waste): ~8.0

Other information: Assume throughputs will be unconstrained.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	6m <sup>3</sup> concrete box (SD)	100.0	3.75	5.76	28

Likely container type comment: Strategy being developed.

Range in container waste volume: Not yet estimated.

Other information on containers: -

Likely conditioning matrix: Cement

Other information: -

Conditioned density (t/m<sup>3</sup>): ~2.5

Conditioned density comment: The density is likely to be around 2 - 3 t/m<sup>3</sup>.

Other information on conditioning: -

Opportunities for alternative disposal routing: Not yet determined

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Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
Disposal at a Near Surface / Near Site Disposal Facility	Onsite disposal	100.0	-	Low	It is possible that further characterisation will show that this waste can be consigned at a lower waste category and will be suitable for disposal at the Low Level waste Disposal Facility.

### RADIOACTIVITY

Source:	The source of the activity is accidental releases of a historic nature.
Uncertainty:	-
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:	Specific Activity determined from UKRWI decayed down to 2022
Other information:	-

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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					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			3.26E-04	CC 2	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			7.84E-02	CC 2	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		9.86E-06	CC 2	
Ag 108m					U 235		1.79E-07	CC 2	
Ag 110m					U 236		7.16E-07	CC 2	
Cd 109					U 238				
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238		3.59E-04	CC 2	
Sn 123					Pu 239		6.83E-04	CC 2	
Sn 126					Pu 240		5.02E-08	CC 2	
Sb 125					Pu 241		1.67E-04	CC 2	
Sb 126					Pu 242				
Te 125m					Am 241		4.05E-04	CC 2	
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137			9.41E-02	CC 2	Cm 244		3.11E-04	CC 2	
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>1.77E-03</b>	<b>CC 2</b>	
Eu 155					<b>Total b/g</b>	<b>0</b>	<b>1.73E-01</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