WASTE STREAM 5B20 Contaminated Solvent and Oils

SITE	Dounreay
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Dounreay Site Restoration Limited
WASTE TYPE	LLW
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	0 m^3
Future arisings -	1.4.2022 - 31.3.2023.....	2.1 m^3
	1.4.2023 - 31.3.2024.....	0.1 m^3
	1.4.2024 - 31.3.2025.....	5.0 m^3
	1.4.2025 - 31.3.2026.....	20.1 m^3
	1.4.2026 - 31.3.2027.....	20.2 m^3
	1.4.2027 - 31.3.2028.....	15.3 m^3
	1.4.2028 - 31.3.2029.....	0.1 m^3
	1.4.2029 - 31.3.2030.....	0.1 m^3
	1.4.2030 - 31.3.2031.....	0.1 m^3
	1.4.2031 - 31.3.2032.....	< 0.1 m^3
	1.4.2032 - 31.3.2033.....	0.1 m^3
	1.4.2033 - 31.3.2034.....	< 0.1 m^3
	1.4.2034 - 31.3.2035.....	< 0.1 m^3
	1.4.2035 - 31.3.2036.....	< 0.1 m^3
	1.4.2036 - 31.3.2037.....	< 0.1 m^3
	1.4.2037 - 31.3.2038.....	0.1 m^3
	1.4.2038 - 31.3.2039.....	0.1 m^3
	1.4.2039 - 31.3.2040.....	0.1 m^3
	1.4.2040 - 31.3.2041.....	0.1 m^3
	1.4.2041 - 31.3.2042.....	0.2 m^3
Total future arisings:		63.9 m^3
Total waste volume:		63.9 m^3

Comment on volumes:	Arisings from oils, LLW solvents generated from cleaning of ILW wastestreams, and all other LLW liquids expected to be generated on site. This includes a small inventory of contaminated mercury. Arisings consist of a large volume of reprocessing solvents (to be washed) stored in tanks and miscellaneous oils/solvents used within facilities. Note that 2019 Stocks quatities have been consigned off-site for incineration.			
Uncertainty factors on volumes:	Stock (upper):	x	Arisings (upper)	x 1.2
	Stock (lower):	x	Arisings (lower)	x 0.8

WASTE SOURCE Fuel reprocessing and miscellaneous types of oils/solvents from machinery and experiments.

PHYSICAL CHARACTERISTICS

General description:	The waste contains a variety of solvent and oils held in various locations. The waste is likely to contain small amounts of aqueous liquids. There are no large items in the waste.
Physical components (%vol):	Chemicals (0.08%), Inorganic ion exchange materials (0.13%), Mercury (0.35%), Mild Steel (0.33%), Oil (1.08%), Other Liquid (3.14%), Plastic (0.30%), Reactive chemicals (0.35%), Rubber (0.01%), Solvent (94.00%), Sources (0.22%),
Sealed sources:	The waste contains sealed sources. Liquid sources
Bulk density (t/m^3):	0.97
Comment on density:	Based on plant washing tank density. All solvents and oils assumed to have same density.

CHEMICAL COMPOSITION

General description and components (%wt):	Chemicals (0.07%), Inorganic ion exchange materials (0.09%), Lead (0.03%), Mercury (4.39%), Mild Steel (2.41%), Oil (0.89%), Other Liquid (2.91%), Plastic (0.26%), Reactive chemicals (0.32%), Rubber (0.02%), Solvent (86.99%), Sources (1.61%),

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Chemical state: Neutral

Chemical form of radionuclides:
H-3: Likely to be present as water.
C-14: Likely to be present.
Cl-36: Not known to be present.
I-129: Likely to be present.
Ra: Not known to be present.
Th: Not known to be present.
U: Likely to be present
Np: Likely to be present
Pu: Likely to be present.

Metals and alloys (%wt): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	0		
Other ferrous metals	2.4	Mild steel containers	
Iron			
Aluminium			
Beryllium	0		
Cobalt	0		
Copper			
Lead	0.03		
Magnox/Magnesium	0		
Nickel			
Titanium			
Uranium	P		
Zinc	0		
Zircaloy/Zirconium	0		
Other metals	4.4	Mercury	

Organics (%wt): The waste consists of lightly contaminated TBP/OK reprocessing solvent, and other lightly contaminated liquids including solvents and oils.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics	0		
Paper, cotton	0		
Wood	0		
Halogenated plastics	0.26		
Total non-halogenated plastics	0		
Condensation polymers	0		
Others	0		
Organic ion exchange materials	0		
Total rubber	0.02		
Halogenated rubber	0.01		
Non-halogenated rubber	0.01		
Hydrocarbons	0.89		
Oil or grease	0.89		
Fuel			
Asphalt/Tarmac (cont.coal tar)			
Asphalt/Tarmac (no coal tar)			

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Bitumen.....		
Others.....		
Other organics.....	91.9	Chemicals; Reactive Chemicals; solvent; sources; other liquids

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0.09		
Inorganic sludges and flocs.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	0		
Sand.....	0		
Glass/Ceramics.....			
Graphite.....	0		
Desiccants/Catalysts.....	0		
Asbestos.....	0		
Non/low friable.....			
Moderately friable.....			
Highly friable.....			
Free aqueous liquids.....	P		
Free non-aqueous liquids.....	P		
Powder/Ash.....	0		

Inorganic anions (%wt): Trace quantities of inorganic anions are present.

	(%wt)	Type(s) and comment
Fluoride.....	TR	
Chloride.....	TR	
Iodide.....	TR	
Cyanide.....	0	
Carbonate.....	TR	
Nitrate.....	TR	
Nitrite.....	NE	
Phosphate.....	TR	
Sulphate.....	TR	
Sulphide.....	TR	

Materials of interest for waste acceptance criteria: Quantities of substances are not estimated.

	(%wt)	Type(s) and comment
Combustible metals.....	0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	

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Hydrides	0
Biological etc. materials	0
Biodegradable materials	0
Putrescible wastes	0
Non-putrescible wastes	0
Corrosive materials	0
Pyrophoric materials	
Generating toxic gases	
Reacting with water	0
Higher activity particles	0
Soluble solids as bulk chemical compounds	0

Hazardous substances / non hazardous pollutants: Traces of toxic metals may be present.

	(%wt)	Type(s) and comment
Acrylamide		
Benzene	NE	
Chlorinated solvents		
Formaldehyde		
Organometallics		
Phenol	NE	
Styrene		
Tri-butyl phosphate	TR	
Other organophosphates	TR	
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	TR	
Others	NE	
Electronic Electrical Equipment (EEE)		
EEE Type 1		
EEE Type 2		

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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.....		The waste contains tributyl phosphate.
Total complexing agents.....	5.0	

Potential for the waste to contain discrete items: No.

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off site	Stream volume %
Low force compaction		
Supercompaction (HFC)		
Incineration		6.0
Solidification		94.0
Decontamination		
Metal treatment		
Size reduction		
Decay storage		
Recyling / reuse		
Other / various		
None		

Comment on planned treatments: Solvents which are to be washed will produce ILW Aqueous fraction (5B360) and a LLW Solvent fraction (5B20). The aqueous fraction containing the higher activity will be processed through ADU Floc plant. The remaining "washed" solvent will be stabilised within Nochar, grouted in 200l drums, and disposed of to the LLW Disposal Facility. Other contaminated oils and solvents will be disposed using off-site routes, mainly incineration.

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		
Expected to be consigned to an On-Site Disposal Facility	94.0	
Expected to be consigned to an Incineration Facility	6.0	
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: -

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

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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: Yes

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	Incineration	~94.0	-	Low	The opportunity exists to send the LLW Solvent off site for incineration. Although the waste route is open, this opportunity is still tentative.

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 2m box (no shielding) 4m box (no shielding) Other	94.0	10	7

Other information: Washed solvent currently assume to be solidified and sent to the LLW Disposal Facility. However, there is an opportunity that this could be sent offsite for incineration providing that it is demonstrated as BPM and the resulting waste package complies with the relevant WAC.

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: The main source of activity is fission products and actinides associated with fuel

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	reprocessing.
Uncertainty:	Specific Activity is based on the sample results from all IBCs contained within DN029 (now consigned offsite). Oil and Solvent arisings is also based on these samples. The accuracy of arising activity estimates is to within a factor of 10. Specific Activity for this wastestream may be revised based on further characterisation studies.
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:	Arisings: using the same sample analysis (best available data).
Other information:	No allowance has been made for decay of 'washed' solvent. Specific activity has been derived from 2019 UKRWI data decayed to 2022.

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Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3			2.90E-04	C C 2	Gd 153				
Be 10					Ho 163				
C 14			1.51E-06	C C 2	Ho 166m				
Na 22			1.33E-10	C C 2	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			3.89E-16	C C 2
Co 60			2.30E-08	C C 2	Bi 208				
Ni 59					Bi 210m				
Ni 63			1.30E-09	C C 2	Po 210			2.35E-16	C C 2
Zn 65					Ra 223			4.85E-14	C C 2
Se 79					Ra 225			1.81E-22	C C 2
Kr 81					Ra 226			1.29E-14	C C 2
Kr 85					Ra 228			6.67E-26	C C 2
Rb 87					Ac 227			5.25E-14	C C 2
Sr 90			2.36E-07		Th 227			4.93E-14	C C 2
Zr 93					Th 228			1.50E-26	C C 2
Nb 91					Th 229			1.92E-22	C C 2
Nb 92					Th 230			1.99E-11	C C 2
Nb 93m					Th 232			6.04E-25	C C 2
Nb 94			2.39E-10	C C 2	Th 234			3.14E-07	C C 2
Mo 93					Pa 231			1.14E-12	C C 2
Tc 97					Pa 233			3.34E-13	C C 2
Tc 99					U 232				
Ru 106					U 233			2.10E-18	
Pd 107					U 234			7.21E-07	C C 2
Ag 108m					U 235			1.79E-08	C C 2
Ag 110m					U 236			8.16E-15	C C 2
Cd 109					U 238			3.15E-07	C C 2
Cd 113m					Np 237			3.46E-13	C C 2
Sn 119m					Pu 236				
Sn 121m					Pu 238			4.36E-08	C C 2
Sn 123					Pu 239			9.29E-08	C C 2
Sn 126					Pu 240			9.29E-08	C C 2
Sb 125					Pu 241			9.15E-07	C C 2
Sb 126					Pu 242				
Te 125m					Am 241			3.57E-07	C C 2
Te 127m					Am 242m				
I 129					Am 243			2.72E-17	C C 2
Cs 134					Cm 242			8.74E-13	C C 2
Cs 135					Cm 243			3.89E-11	C C 2
Cs 137			9.77E-07	C C 2	Cm 244			3.72E-11	C C 2
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248			3.8E-16	C C 2
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252			4.22E-11	C C 2
Sm 151					Other a			1.59E-08	C C 2
Eu 152					Other b/g			1.19E-06	C C 2
Eu 154			9.34E-09	C C 2	**Total a**	**0**		**1.66E-06**	**C C 2**
Eu 155			1.49E-07	C C 2	**Total b/g**	**0**		**2.96E-04**	**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