WASTE STREAM 7V24 Metallic ILW from Vulcan

SITE	Dounreay (Vulcan)
SITE OWNER	Ministry of Defence
WASTE CUSTODIAN	Ministry of Defence
WASTE TYPE	ILW; SPD1
Is the waste subject to Scottish Policy:	No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	1.3 m^3
Future arisings -	1.4.2025 - 31.3.2030.....	83.2 m^3
Total future arisings:		83.2 m^3
Total waste volume:		84.5 m^3

Comment on volumes: As the plant has ceased critical operation there will no further activation of existing metallic components. The timescales for decommissioning will be tailored to the decommissioning strategy that is being developed for the site. The ILW inventory will be confirmed through future characterisation work. The waste volumes are based on the assumption that the Reactor 1 RPV & Closure Head will be LLW by the time of decommissioning.

Uncertainty factors on volumes:

Stock (upper):	x 1.1	Arisings (upper)	x 1.4
Stock (lower):	x 0.9	Arisings (lower)	x 0.6

WASTE SOURCE Reactor decommissioning ILW comprising irradiated steel components. Only the internals of the Reactor 1 Pressure Vessels and the Primary Circuit IX column are expected to be ILW, the RPV itself and all surrounding reactor components are expected to be categorised as LLW.

PHYSICAL CHARACTERISTICS

General description:	Activated reactor components and metallic scrap/swarf. Waste has undergone no chemical or physical transformation processes.
Physical components (%wt):	The components comprise the stainless steel thermal shields, core barrels, cladding, motor support tubes and metal scrap/swarf. Activated metals 100%wt.
Sealed sources:	The waste does not contain sealed sources.
Bulk density (t/m^3):	~7.85
Comment on density:	Quoted density is that of stainless steel. Bulk density still to be determined.

CHEMICAL COMPOSITION

General description and components (%wt):	The estimated waste arising is stainless steel (94%wt), Iron (5%), zirconium swarf (<1%wt).
Chemical state:	Neutral
Chemical form of radionuclides:	H-3: Likely to be present C-14: Likely to be present Cl-36: Not known to be present Se-79: Not known to be present Tc-99: May be present I-129: Likely to be present Ra: Likely to be present Th: Likely to be present U: Likely to be present Np: Likely to be present Pu: Likely to be present
Metals and alloys (%wt):	Proportions of metal to be determined. % of total C14 activity of the waste stream material components to be determined.

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	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel	~94.0	To be determined.	
Other ferrous metals	NE	Mild steel may be present if the cladding cannot be separated from the LLW RPV.	
Iron	~5.0	As magnetite.	
Aluminium	P		
Beryllium	0		
Cobalt	P		
Copper	P		
Lead	0		
Magnox/Magnesium	0		
Nickel	P		
Titanium	0		
Uranium	P		
Zinc	P		
Zircaloy/Zirconium	~1.0		
Other metals	P		

Organics (%wt): No organic materials are present

	(%wt)	Type(s) and comment	% of total C14 activity
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	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	0		

Other materials (%wt): Other materials are not present

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

Inorganic anions (%wt): There are no inorganic ions present

	(%wt)	Type(s) and comment
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: It is known that zirconium alloys are present.

	(%wt)	Type(s) and comment
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	

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Corrosive materials.....	0	
Pyrophoric materials.....	~1.0	As zirconium alloys
Generating toxic gases.....	0	
Reacting with water.....	0	
Higher activity particles.....	NE	
Soluble solids as bulk chemical compounds.....	0	

Hazardous substances / non hazardous pollutants: There are no known toxic metals contaminants associated with the waste other than components of stainless steel alloy.

	(%wt)	Type(s) and comment
Acrylamide.....	0	
Benzene.....	0	
Chlorinated solvents.....	0	
Formaldehyde.....	0	
Organometallics.....	0	
Phenol.....	0	
Styrene.....	0	
Tri-butyl phosphate.....	0	
Other organophosphates.....		
Vinyl chloride.....	0	
Arsenic.....	P	Component of stainless steel alloy.
Barium.....	0	
Boron.....	0	
Boron (in Boral).....	0	
Boron (non-Boral).....	0	
Cadmium.....	0	
Caesium.....	0	
Selenium.....	0	
Chromium.....	P	Component of stainless steel alloy.
Molybdenum.....	P	Component of stainless steel alloy.
Thallium.....	0	
Tin.....	P	Component of stainless steel alloy.
Vanadium.....	P	Component of stainless steel alloy.
Mercury compounds.....		
Others.....	P	
Electronic Electrical Equipment (EEE)		
EEE Type 1.....	0	
EEE Type 2.....	0	
EEE Type 3.....	0	
EEE Type 4.....	0	
EEE Type 5.....	0	

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Complexing agents (%wt): No

	(%wt)	Type(s) and comment
EDTA.....	0	
DPTA.....	0	
NTA.....	0	
Polycarboxylic acids…….	0	
Other organic complexants.....	0	
Total complexing agents.....	0	

Potential for the waste to contain discrete items: Not yet determined.

PACKAGING AND CONDITIONING

Conditioning method: The conditioning method is still to be confirmed.

Plant Name: -

Location: -

Plant startup date: -

Total capacity (m³/y incoming waste): -

Target start date for packaging this stream: -

Throughput for this stream (m³/y incoming waste): -

Other information: -

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m³)	Payload (m³)	Number of packages
Not specified	100.0	NE	NE	NE

Likely container type comment: The container type is still to be confirmed.

Range in container waste volume: -

Other information on containers: -

Likely conditioning matrix: Not Specified

Other information: -

Conditioned density (t/m³): -

Conditioned density comment: -

Other information on conditioning: Future packaging and conditioning not yet determined.

Opportunities for alternative disposal routing: Not yet determined

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Estimated Date that Opportunity will be realised	Opportunity Confidence	Comment
-	-	-	-	-	-

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RADIOACTIVITY

Source:	The waste will consist of predominantly stainless steel components irradiated during reactor operations.
Uncertainty:	Activities calculated from area fingerprint. This will be refined following further sampling.
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:	Activities calculated from area fingerprint.
Other information:	Estimates are based on a knowledge of similar arisings from PWR reactors.

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Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	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	2.39E-04	DD 2	2.83E-04	DD 2	Gd 153				
Be 10					Ho 163				
C 14	2.39E-02	DD 2	2.39E-02	DD 2	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	5.79E-06	DD 2	6.59E-05	DD 2	Pb 205				
Fe 55	2.03E-02	DD 2	4.34E-02	DD 2	Pb 210				
Co 60	2.35E-02	DD 2	3.49E-02	DD 2	Bi 208				
Ni 59					Bi 210m				
Ni 63	5.99E-03	DD 2	6.12E-03	DD 2	Po 210				
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90	1.71E-03	DD 2	1.84E-03	DD 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				
Ag 108m					U 235				
Ag 110m	4.50E-06	DD 2	9.42E-05	DD 2	U 236				
Cd 109					U 238				
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238	7.36E-05	DD 2	7.54E-05	DD 2
Sn 123					Pu 239	3.14E-07	DD 2	3.14E-07	DD 2
Sn 126					Pu 240				
Sb 125	1.95E-04	DD 2	4.14E-04	DD 2	Pu 241	1.88E-04	DD 2	2.17E-04	DD 2
Sb 126					Pu 242				
Te 125m	4.88E-05				Am 241	2.22E-06	DD 2	1.26E-06	DD 2
Te 127m					Am 242m				
I 129					Am 243				
Cs 134	7.56E-05	DD 2	2.07E-04	DD 2	Cm 242				
Cs 135					Cm 243				
Cs 137	2.08E-03	DD 2	2.23E-03	DD 2	Cm 244	1.4E-06	DD 2	1.57E-06	DD 2
Ba 133					Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144	2.75E-05	DD 2	3.96E-04	DD 2	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	6.29E-04	DD 2	8.01E-04	DD 2	**Total a**	**7.76E-05**	**DD 2**	**7.85E-05**	**DD 2**
Eu 155	3.44E-04	DD 2	5.28E-04	DD 2	**Total b/g**	**7.93E-02**	**DD 2**	**1.15E-01**	**DD 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