WASTE STREAM	9J21	Bunker Waste

SITE Hunterston A

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE ILW

WASTE VOLUMES

	Reported (m^3)
Stocks: At 1.4.2025	= 488.4
Future arisings:	
Total future arisings:	**0.0**
Total waste volume:	**488.4**

OR

Conditioned (m^3)	Packaged (m^3)

Number of waste packages in stock: At 1.4.2025…… - packages

Comment on arising rates: There will be no future arisings from this stream. The waste is containerised but not yet conditioned. The total waste volume is made up of the sum of FED graphite 447.2 m3, MCI 17.9 m3 and FED Fuel Channel Components 23.3 m3

Additional information on quantities: -

Uncertainty factors on volumes:

Stock (upper):	x 1.20	Arisings (upper):	x -
Stock (lower):	x 0.80	Arisings (lower):	x -

WASTE SOURCE FED Graphite: Fuel element debris from the removal of graphite sleeves from discharged fuel elements plus reflector sleeves from each fuel channel.
MCI: The source of the waste is redundant contaminated equipment and materials.
FED Fuel Channel Components: The waste consists of components from reactor fuel assemblies.

PHYSICAL CHARACTERISTICS

General description: FED Graphite: Each fuel channel comprised 10 fuel elements (with associated graphite sleeves) and a disposable bottom reflector graphite sleeve. The fuel element sleeve and the reflector have been removed from the fuel and reduced in size in a cracking unit. The resultant graphite pieces have a maximum size of 300 mm and weight of 5.5 kg. Dust from the cracking operation has been accumulated in polythene bags or bottle. There are no large items that may require special handling.
MCI: The waste consists mainly of filter dust bags with some filters and general wastes. Items must have a dimension less than 1.3 metres to pass through a bunker loading hole. Wastes may be in polythene bags or 180 litre drums. No large items have been identified.
FED Fuel Channel Components: Fuel channel components are metallic and consist of one cast iron support member and ten zirconium D bars per fuel channel. There are no large items that may require special handling.

Changes since waste generated: -

Bulk density (t/m^3): ~ 1.4

Comment on density: Mean Density of waste calculated assuming a packing efficiency of 1.4 (packing fraction of 0.71). Density may be greater than the given value towards the bottom of the bunker, where the graphite may be crushed.

CHEMICAL COMPOSITION

General description and components (%wt): FED Graphite; Graphite (100%), graphite impurities. The waste consists almost entirely of graphite with only trace amounts of activated impurities fission products, actinide contaminants and trace quantities of polythene.
MCI: The waste consists of metals such as stainless steel, mild steel and aluminium, entrapped graphite dust and other dust and ceramic material.
FED Fuel Channel Components: The waste consists of cast iron and zirconium metal. Cast iron (~67%), zirconium (~33%).

Chemical state: Neutral

Sheet metal proportion / thickness: FED Graphite: No sheet or bulk metal present in this waste stream.
MCI: No sheet metal is expected.
FED Fuel Channel Components: Support members (~67% wt) are 200 mm length by 150 mm diameter.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel	= 0	-	
Other ferrous metals	= 4.0	-	
Iron		-	
Aluminium	= 0	-	
Beryllium	= 0.01	-	
Cobalt		-	
Copper	= 0	-	
Lead	= 0	-	
Magnox/Magnesium	TR	-	
Nickel		-	
Titanium		-	
Uranium		-	
Zinc	= 0	-	
Zircaloy/Zirconium	= 1.6	FED Fuel Channel Components: Zirconium D-bars.	
Other metals	TR	Only trace amounts of "other" metals may be present.	

Organics (%wt):

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

Other materials (%wt):

	(%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		-	
Glass/Ceramics	= 0	-	
Graphite	= 94.4	-	100.0
Desiccants/Catalysts		-	
Asbestos	= 0	-	
Non/low friable		-	
Moderately friable		-	
Highly friable		-	
Free aqueous liquids	TR	-	
Free non-aqueous liquids	= 0	-	
Powder/Ash	< 1.0	-	

COMPONENTS OF MATERIALS, WASTE PROPERTIES, MATERIALS NOT CONTRIBUTING TO MASS

Inorganic anions (%wt):

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

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals	TR	-
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		-
Corrosive materials	= 0	-
Pyrophoric materials	= 0	-
Generating toxic gases	NE	-
Reacting with water	TR	-
Higher activity particles		-
Soluble solids as bulk chemical compounds		-

Hazardous substances / non hazardous pollutants: -

	(%wt)	Type(s) and comment
Acrylamide		-
Benzene		-
Chlorinated solvents		-
Formaldehyde		-
Organometallics		-
Phenol		-
Styrene		-
Tri-butyl phosphate		-
Other organophosphates		-
Vinyl chloride		-
Arsenic		-
Barium		-
Boron	0	-
Boron (in Boral)		-
Boron (non-Boral)		-
Cadmium		-
Caesium		-
Selenium		-
Chromium		-
Molybdenum		-
Thallium		-
Tin		-
Vanadium		-
Mercury compounds		-
Others		-

Complexing agents (%wt): Yes

	(%wt)	Type(s) and comment
EDTA		-
DPTA		-
NTA		-
Polycarboxylic acids		-
Other organic complexants		-
Total complexing agents	TR	-

Physical components:

	Number	Type(s) and comment
Sources		-
Electronic & Electrical Equipment (EEE)		-
EEE Type 1		-
EEE Type 2		-
EEE Type 3		-
EEE Type 4		-
EEE Type 5		-

TREATMENT, PACKAGING AND DISPOSAL

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

Treatment	On-site / Off-site	Stream volume %
Size reduction Decay storage Low force compaction Supercompaction (HFC) Incineration Drying/dewatering/liquid separation Tie down/fixatives/strippable coating/painting application Decontamination Metal treatment Recycling / reuse Thermal treatment, including vitrification Encapsulation Polymer encapsulation Other physical treatment Other chemical treatment Containerisation Treatment not yet determined None	On-site	100.0

Comments on planned treatments: -

Conditioning method: The current proposal is to process the waste during Initial Decommissioning Works. All wastes in the bunker will be encapsulated together, excluding any dusts (9J62). The waste will be grouted in 3m3 stainless steel boxes.

Conditioning plants:

Plant Name	Location
HNA SILWE	Hunterston A

Likely conditioning matrix: Unknown

Further information on the conditioning matrix: The waste is expected to be encapsulated in BFS/OPC. PFA/OPC is another matrix that may be adopted.

Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m^3)	Payload (m^3)	Number of packages	Estimated start date for packaging
3 m^3 box (side lifting)	100.0	1.8	2.9	274	-

Range in container waste loading: No significant variability is expected.

Other information on packaging and conditioning: The 3m3 box is expected to be made from stainless steel. The current proposal is to retrieve and condition wastes held in the SAWB Bunkers during Initial Decommissioning Works.

Conditioned density (t/m^3): ~ 2.0

Conditioned density comment: The density of conditioned waste will probably be about 2 t/m3.

Management Routes:

Disposal Route	Stream volume %	Raw density t/m^3	Start date
Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland)	NE		
Expected to be Non-NSD HAW managed under Scottish Government's policy	NE		
Expected to be disposed to LLW Vaults NRS Dounreay Expected to be consigned to the Geological Disposal Facility Expected to be consigned to a Near Surface Disposal Facility Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be disposed On-Site Expected to be managed by In-Situ Disposal Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be Out of Scope Expected to be recycled / reused Disposal route not known			

Classification codes for waste expected to be consigned to a landfill facility:

Opportunities for alternative disposal routing: No

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
-	-	-	-	-

RADIOACTIVITY

Source: Predominantly activation products with possible contamination by fission products and actinides.

Uncertainty: The values quoted are indicative of the activities that might be expected.

Measurement of radioactivities: Activities have been estimated from activation calculations with assumptions for contamination.

Chemical form of radionuclides:

H-3: The chemical form of tritium has not been assessed but will probably be present as surface contamination.
C-14: Carbon 14 will be present as graphite.
Cl-36: The chemical form of chlorine 36 has not been determined but will probably be present as surface contamination.

Se-79: The selenium content is insignificant.
Tc-99: The chemical form of Technetium has not been determined.
I-129: -
Ra: The radium isotope content is insignificant.
Th: The thorium isotope content is insignificant.
U: The chemical form of uranium isotopes may be uranium oxides.
Np: The neptunium content is insignificant.
Pu: The chemical form of plutonium isotopes has not been determined but may be present as plutonium oxides.

WASTE STREAM **9J21** **Bunker Waste**

Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3	1.61E-01	C C 2			Gd 153		8		
Be 10	4.77E-06	C C 2			Ho 163		8		
C 14	7.51E-03	C C 2			Ho 166m	9.07E-06	C C 2		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	2.72E-04	C C 2			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40		8			Hf 182		8		
Ca 41	2.26E-05	C C 2			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	4.22E-03	C C 2			Pb 210		8		
Co 60	1.33E-01	C C 2			Bi 208		8		
Ni 59	1.43E-04	C C 2			Bi 210m		8		
Ni 63	3.01E-02	C C 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79		8			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85		8			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	5.58E-04	C C 2			Th 227		8		
Zr 93	4.77E-04	C C 2			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92	9.54E-09	C C 2			Th 230		8		
Nb 93m	4.85E-04	C C 2			Th 232		8		
Nb 94	4.73E-06	C C 2			Th 234	1.34E-08	C C 2		
Mo 93	4.75E-04	C C 2			Pa 231		8		
Tc 97		8			Pa 233	1.87E-09	C C 2		
Tc 99	1.43E-04	C C 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	1.45E-08	C C 2		
Ag 108m	9.32E-05	C C 2			U 235		8		
Ag 110m		8			U 236	1.80E-09	C C 2		
Cd 109		8			U 238	1.34E-08	C C 2		
Cd 113m	6.85E-05	C C 2			Np 237	1.87E-09	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m	2.37E-03	C C 2			Pu 238	7.51E-06	C C 2		
Sn 123		8			Pu 239	4.80E-06	C C 2		
Sn 126	1.59E-09	C C 2			Pu 240	9.02E-06	C C 2		
Sb 125	2.19E-06	C C 2			Pu 241	7.65E-05	C C 2		
Sb 126		8			Pu 242	4.62E-09	C C 2		
Te 125m	5.48E-07	C C 2			Am 241	1.23E-05	C C 2		
Te 127m		8			Am 242m	4.46E-08	C C 2		
I 129		8			Am 243	1.34E-08	C C 2		
Cs 134	1.56E-09	C C 2			Cm 242	3.68E-08	C C 2		
Cs 135	3.67E-09	C C 2			Cm 243	9.83E-09	C C 2		
Cs 137	5.68E-04	C C 2			Cm 244	9.85E-08	C C 2		
Ba 133	6.81E-07	C C 2			Cm 245		8		
La 137		8			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145	1.08E-04	C C 2			Cf 250		8		
Pm 147	1.57E-08	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	8.66E-04	C C 2			Unsp a		8		
Eu 152	6.75E-03	C C 2			Unsp b/g		8		
Eu 154	5.71E-02	C C 2			**Total a**	**3.38E-05**	*	**0**	*
Eu 155	3.98E-04	C C 2			**Total b/g**	**4.07E-01**	*	**0**	*

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 the 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
* Total calculated from the 114 declared radionuclides