

WASTE STREAM	9F43	FED Nimonic/Zirconium
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SITE Sizewell A
SITE OWNER Nuclear Decommissioning Authority
WASTE CUSTODIAN Magnox Limited
WASTE TYPE ILW
 Is the waste subject to Scottish Policy: No

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2022.....	< 0.1 m ³
Total future arisings:		0 m ³
Total waste volume:		< 0.1 m ³
Comment on volumes:	-	
Uncertainty factors on volumes:	Stock (upper): x 1.1	Arisings (upper) x
	Stock (lower): x 0.9	Arisings (lower) x

WASTE SOURCE Nimonic springs and zirconium alloy components were originally incorporated into Magnox fuel element top end fittings. These components are accumulated as waste when the fuel elements are desplittered.

PHYSICAL CHARACTERISTICS

General description: The waste consists of Nimonic springs (5g) and zirconium alloy (4g) components of the Fuel Element Top End Fittings. The inventory data is based on equal numbers of Nimonic and zirconium alloy components; however there may be fewer zirconium alloy components present. The components are expected to be intact and there may also be a small amount of Magnox attached to these components.

Physical components (%vol): Nimonic springs 63.3% Zirconium alloy Fuel Element Top end fitting 36.7%.

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m³): 2.2

Comment on density: The density is calculated from the mass of the components, and an estimate of the envelope volume of individual components.

CHEMICAL COMPOSITION

General description and components (%wt): Nimonic 55.6%, zirconium alloy 44.4%. There may be a small amount of Magnox material attached to these components.

Chemical state: Neutral

Chemical form of radionuclides: H-3: Tritium will probably be present as surface contamination, possibly as water or perhaps as other inorganic or organic compounds.
 C-14: Carbon 14 is likely to be present in the form of graphite contamination.
 Cl-36: Chlorine 36 may be present in surface contamination.
 Se-79: The selenium content is insignificant.
 Tc-99: The chemical form of technetium has not been determined.
 Ra: The radium isotope content is insignificant.
 Th: The thorium isotope content is insignificant.
 U: Chemical form of uranium isotopes may be uranium oxides if present.
 Np: The chemical form of neptunium has not been determined.
 Pu: Chemical form of plutonium isotopes may be plutonium oxides if present.

Metals and alloys (%wt): No bulk or sheet metallic items present

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	0		
Other ferrous metals.....	0		
Iron.....			
Aluminium.....	0		
Beryllium.....	0		

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Cobalt.....		
Copper.....	0	
Lead.....	0	
Magnox/Magnesium.....	TR	There may be a small amount of Magnox material attached to these components.
Nickel.....	55.6	Present as Nimonic alloy.
Titanium.....		
Uranium.....		
Zinc.....	0	
Zircaloy/Zirconium.....	44.4	
Other metals.....	0	No "other" metals present.

Organics (%wt): There may be organics present in trace quantities. There are no halogenated plastics or rubbers present.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulose.....	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.....			
Oil or grease			
Fuel.....			
Asphalt/Tarmac (cont.coal tar)...			
Asphalt/Tarmac (no coal tar)....			
Bitumen.....			
Others.....			
Other organics.....	0		

Other materials (%wt): -

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials..	0		
Inorganic sludges and flocs.....			
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	0		
Sand.....			
Glass/Ceramics.....	0		

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Graphite.....	TR
Desiccants/Catalysts.....	
Asbestos.....	0
Non/low friable.....	
Moderately friable.....	
Highly friable.....	
Free aqueous liquids.....	
Free non-aqueous liquids.....	0
Powder/Ash.....	0

Inorganic anions (%wt): Inorganic anions are not expected to be present at greater than trace concentrations.

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

Materials of interest for waste acceptance criteria: No materials likely to pose a fire or other non-radiological hazard have been identified.

	(%wt)	Type(s) and comment
Combustible metals.....		
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.....	0	
Reacting with water.....		
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

Hazardous substances /
non hazardous pollutants:

Toxic metals may be present as impurities incorporated into the Magnox.

	(%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.....		
Electronic Electrical Equipment (EEE)		
EEE Type 1.....		
EEE Type 2.....		
EEE Type 3.....		
EEE Type 4.....		
EEE Type 5.....		

Complexing agents (%wt):

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

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Potential for the waste to contain discrete items: Yes. Springs are DIs by definition

PACKAGING AND CONDITIONING

Conditioning method: The Nimonic springs and zirconium alloy components of the Fuel Element Top End Fittings will be containerised in MOSAIKs.

Plant Name: AVDS

Location: Sizewell A Site.

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 (m ³)	Payload (m ³)	Number of packages
	500 l RS drum (120mm Pb)	100.0	0.02	0.166	1

Likely container type comment: -

Range in container waste volume: -

Other information on containers: The container is expected to be made from Ductile Cast Iron (DCI).

Likely conditioning matrix:

Other information: -

Conditioned density (t/m³): ~2.2

Conditioned density comment: The conditioned density has not been assessed. The quoted value is an estimate.

Other information on conditioning: -

Opportunities for alternative disposal routing: -

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

RADIOACTIVITY

Source: The Nimonic springs and zirconium alloy components of the Fuel Element Top End Fittings will contain activation products and also fission product contamination.

Uncertainty: The values quoted are derived from the activation calculations for Nimonic and Zirconium material using the Station operation history, and are indicative of the activities expected. The volume of the waste material is an estimate.

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'.

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Measurement of radioactivities:

The Nimonic springs and zirconium alloy Fuel Element Top End Fitting components are expected to be of high specific activity. Induced activity has been calculated. Data taken from M/EF/SZA/EAN/0036/20 Issue 2 July 2021 with stock activity reference date adjusted to 2022.

Other information:

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Nuclide	Mean radioactivity, TBq/m ³				Nuclide	Mean radioactivity, TBq/m ³			
	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	5.84E-03	CC 2			Gd 153		8		
Be 10	8.51E-09	CC 2			Ho 163	1.28E-07	CC 2		
C 14	2.75E-01	CC 2			Ho 166m	2.45E-06	CC 2		
Na 22		8			Tm 170		8		
Al 26	3.25E-08	CC 2			Tm 171	8.49E-09	CC 2		
Cl 36	1.94E-04	CC 2			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n	9.01E-09	CC 2		
K 40		8			Hf 182		8		
Ca 41		8			Pt 193		8		
Mn 53	1.29E-08	CC 2			Tl 204	2.33E-05	CC 2		
Mn 54		8			Pb 205	1.20E-09	CC 2		
Fe 55	3.96E-02	CC 2			Pb 210		8		
Co 60	2.75E+01	CC 2			Bi 208		8		
Ni 59	1.44E+01	CC 2			Bi 210m		8		
Ni 63	1.34E+03	CC 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79		8			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85	2.14E-09	CC 2			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	1.96E-04	CC 2			Th 227		8		
Zr 93	8.23E-05	CC 2			Th 228	2.51E-07	8		
Nb 91	1.07E-08	CC 2			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	1.11E-04	CC 2			Th 232		8		
Nb 94	8.07E-06	CC 2			Th 234	1.82E-07	8		
Mo 93	1.07E-06	CC 2			Pa 231		8		
Tc 97		8			Pa 233		8		
Tc 99	4.50E-07	CC 2			U 232	3.74E-07	CC 2		
Ru 106		8			U 233	8.25E-07	CC 2		
Pd 107		8			U 234	7.22E-07	CC 2		
Ag 108m		8			U 235	3.50E-09	CC 2		
Ag 110m		8			U 236	1.42E-08	CC 2		
Cd 109		8			U 238	1.82E-07	CC 2		
Cd 113m		8			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m	8.67E-06	CC 2			Pu 238	5.38E-06	CC 2		
Sn 123		8			Pu 239	4.98E-06	CC 2		
Sn 126		8			Pu 240	5.85E-06	CC 2		
Sb 125	2.39E-07	CC 2			Pu 241	1.66E-04	CC 2		
Sb 126		8			Pu 242	6.14E-08	CC 2		
Te 125m	5.98E-08	8			Am 241	2.88E-05	CC 2		
Te 127m		8			Am 242m		8		
I 129		8			Am 243		8		
Cs 134	2.98E-08	CC 2			Cm 242		8		
Cs 135		8			Cm 243	2.66E-08	CC 2		
Cs 137	2.66E-04	CC 2			Cm 244	3.13E-07	CC 2		
Ba 133	1.97E-05	CC 2			Cm 245		8		
La 137	1.62E-08	CC 2			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145	1.06E-06	CC 2			Cf 250		8		
Pm 147	6.28E-07	CC 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	7.33E-05	CC 2			Other a				
Eu 152		8			Other b/g				
Eu 154		8			Total a	4.78E-05	CC 2	0	
Eu 155		8			Total b/g	1.38E+03	CC 2	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 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