WASTE STREAM	3K33	Fuel Plug Units

SITE Hartlepool

SITE OWNER EDF Energy Nuclear Generation Ltd (EDFE NGL)

WASTE CUSTODIAN EDF Energy Nuclear Generation Ltd (EDFE NGL)

WASTE TYPE LLW

WASTE VOLUMES

		Reported (m^3)
Stocks:	At 1.4.2025	0.8
Future arisings:	1.4.2025 - 31.3.2026	0
	1.4.2026 - 31.3.2027	0
	1.4.2027 - 31.3.2030	0
Total future arisings:		**0.0**
Total waste volume:		**0.8**

OR

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

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

Comment on arising rates: -

Additional information on quantities: -

Uncertainty factors on volumes:

Stock (upper):	x 1.25	Arisings (upper):	x -
Stock (lower):	x 0.75	Arisings (lower):	x -

WASTE SOURCE

In advanced gas-cooled reactors (AGRs), the Fuel Plug Unit (FPU) is found at the top of each fuel stringer assembly in the reactor. The fuel stringer assembly and its associated FPU form a composite fuel assembly that is handled by the charge machine and loaded into the reactor as one unit. Once in the reactor, gas flow is forced up passed the fuel by gas circulators, cooling the fuel in the process. The rate of gas flow, and hence the temperature of the fuel, is controlled by a 'gag' in the FPU. The total length of an FPU is ca. 11.3m with a maximum diameter of ca. 0.3m

PHYSICAL CHARACTERISTICS

General description: The FPU is a complex module that consists of several separate assemblies (component masses are provided in parentheses):
• Closure unit (70 kg); • Sliding tube (182.5 kg); • Biological shield plug (286.5 kg); • Long extension tube (121 kg); • Additional shield (63.5 kg); • Short (flanged) extension / thermal shield / gag housing (157.6 kg); • Venturi / Insulated Tube (VIT) (175.4 kg); • Gag components (101.4 kg); • Upper tie bar

Changes since waste generated: -

Bulk density (t/m³): = 1.5

Comment on density: Density based on raw volume and weight at arising as provided in WCH.

CHEMICAL COMPOSITION

General description and components (%wt): Metal (81%), Rubber (1%), Others (18%).

Chemical state: -

Sheet metal proportion / thickness: Metal present will be in various thickness

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel……	= 15.0	Stainless steel components of FPU	
Other ferrous metals……	= 24.0	Mild steel components of FPU	
Iron……	= 36.5	Iron metal / alloy components of FPU	
Aluminium……		-	
Beryllium……		-	
Cobalt……		-	
Copper……	= 1.0	-	
Lead……		-	
Magnox/Magnesium……		-	
Nickel……	= 1.5	Nickel metal / alloy components of FPU	
Titanium……		-	
Uranium……		-	
Zinc……		-	
Zircaloy/Zirconium……		-	
Other metals……	3.0	Chromium metal / alloy components of FPU	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics		-	
Paper, cotton		-	
Wood		-	
Halogenated plastics		-	
Total non-halogenated plastics		-	
Condensation polymers		-	
Others		-	
Organic ion exchange materials		-	
Total rubber		-	
Halogenated rubber		-	
Non-halogenated rubber	= 1.0	-	
Hydrocarbons		-	
Oil or grease		-	
Fuel		-	
Asphalt/Tarmac (cont.coal tar)		-	
Asphalt/Tarmac (no coal tar)		-	
Bitumen		-	
Others		-	
Other organics		-	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials		-	
Inorganic sludges and flocs		-	
Soil		-	
Brick/Stone/Rubble	= 18.0	Serpentine rock	
Cementitious material		-	
Sand		-	
Glass/Ceramics		-	
Graphite	= 1.0	-	
Desiccants/Catalysts		-	
Asbestos		-	
Non/low friable		-	
Moderately friable		-	
Highly friable		-	
Free aqueous liquids		-	
Free non-aqueous liquids		-	
Powder/Ash		-	

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

Inorganic anions (%wt):

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

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals		-
Low flash point liquids		-
Explosive materials		-
Phosphorus		-
Hydrides		-
Biological etc. materials		-
Biodegradable materials		-
Putrescible wastes		-
Non-putrescible wastes		-
Corrosive materials		-
Pyrophoric materials		-
Generating toxic gases		-
Reacting with water		-
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		-
Boron (in Boral)		-
Boron (non-Boral)		-
Cadmium		-
Caesium		-
Selenium		-
Chromium		-
Molybdenum		-
Thallium		-
Tin		-
Vanadium		-
Mercury compounds		-
Others		-

Complexing agents (%wt): No

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

Physical components:

	Number	Type(s) and comment
Sources	= 0	-
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	Off-site	= 5.0
Recycling / reuse		
Thermal treatment, including vitrification		
Encapsulation		
Polymer encapsulation		
Other physical treatment		
Other chemical treatment		
Containerisation		
Treatment not yet determined		
None	Off-site	= 95.0

Comments on planned treatments: -

Conditioning method: -

Conditioning plants:

Plant Name	Location

Likely conditioning matrix: -

Further information on the conditioning matrix: -

Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m^3)	Payload (m^3)	Number of packages	Estimated start date for packaging
1/2 Height IP-2 Disposal/Re-usable ISO (TC01/TC02)	100.0	0.76	0.76	1	-

Range in container waste loading:

Other information on packaging and conditioning: -

Conditioned density (t/m^3): -
Conditioned density comment: -

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)			
Expected to be Non-NSD HAW managed under Scottish Government's policy			
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	= 95.0		
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	= 5.0		
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: FPU components become radioactive through 3 primary mechanisms, each of which has a differing impact on the individual components: activation through exposure to neutron flux; contamination from the coolant gas stream; and cross-contamination from plant movements. The radioactivity origin is highly dependent on the section of the FPU being examined but broadly; Lower sections of the FPU are dominated by activation; Middle sections of the FPU are dominated by contamination from the gas flow/stream; Upper sections of the FPU are dominated by cross-contamination from plant activities.

Uncertainty: Sources of uncertainty are consistent with any waste assessed through application of fingerprints. Sensitivity analysis has been conducted on the modelled activation fingerprint and is presented in the Characterisation Report C0073/TR/001 (1) along with limitations and assumptions.

Measurement of radioactivities: The total activity has been estimated by applying the fingerprint for the date of arisings. For consignments this will be decayed, but the decay time will vary depending on the storage time for the waste.

Chemical form of radionuclides:

H-3: Contamination by tritiated water
C-14: Contamination by activated graphite
Cl-36: Not assessed
Se-79: Not expected to be significant
Tc-99: Not expected to be significant
I-129: Not assessed
Ra: Not expected to be significant
Th: Not expected to be significant
U: Not assessed.
Np: Not expected to be significant
Pu: Not assessed.

WASTE STREAM **3K33** **Fuel Plug Units**

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	1.99E-04	C C 2			Gd 153				
Be 10					Ho 163				
C 14	1.24E-03	C C 2			Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36	1.42E-06	C C 2			Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54	6.99E-06	C C 2			Pb 205				
Fe 55	2.33E-03	C C 2			Pb 210				
Co 60	3.37E-04	C C 2			Bi 208				
Ni 59	1.82E-06	C C 2			Bi 210m				
Ni 63	7.15E-04	C C 2			Po 210				
Zn 65	1.18E-07	C C 2			Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90	1.45E-07	C C 2			Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232				
Nb 94	2.76E-07	C C 2			Th 234				
Mo 93	7.89E-08	C C 2			Pa 231				
Tc 97					Pa 233				
Tc 99	1.32E-08	C C 2			U 232				
Ru 106	5.26E-08	C C 2			U 233				
Pd 107					U 234	4.31E-12	C C 2		
Ag 108m	2.63E-07	C C 2			U 235	6.87E-14	C C 2		
Ag 110m	3.95E-08	C C 2			U 236	1.10E-12	C C 2		
Cd 109					U 238	1.27E-12	C C 2		
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238	3.31E-09	C C 2		
Sn 123					Pu 239	7.69E-10	C C 2		
Sn 126					Pu 240	1.83E-09	C C 2		
Sb 125	1.05E-07	C C 2			Pu 241	9.21E-08	C C 2		
Sb 126					Pu 242				
Te 125m					Am 241	5.26E-08	C C 2		
Te 127m					Am 242m				
I 129					Am 243				
Cs 134	4.87E-07	C C 2			Cm 242	1.20E-11	C C 2		
Cs 135					Cm 243				
Cs 137	1.79E-06	C C 2			Cm 244	2.63E-08	C C 2		
Ba 133	1.05E-07	C C 2			Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144	2.63E-08	C C 2			Cf 249				
Pm 145					Cf 250				
Pm 147	3.95E-08	C C 1			Cf 251				
Sm 147					Cf 252				
Sm 151					Unsp a				
Eu 152	3.95E-07	C C 2			Unsp b/g	6.94E-09	C C 2		
Eu 154	2.89E-07	C C 2			**Total a**	**8.48E-08**	*	**0**	*
Eu 155	1.71E-07	C C 2			**Total b/g**	**4.84E-03**	*	**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