

**WASTE STREAM****2C03****Miscellaneous Reactor Components Stored dry**

**SITE** Chapelcross  
**SITE OWNER** Nuclear Decommissioning Authority

**WASTE CUSTODIAN** Magnox Limited

**WASTE TYPE** ILW; SPD3

Is the waste subject to Scottish Policy: Yes

**WASTE VOLUMES**

		Reported
Stocks:	At 1.4.2022.....	13.0m <sup>3</sup>
Total future arisings:		0 m <sup>3</sup>
Total waste volume:		13.0m <sup>3</sup>

Comment on volumes: There will be no further arisings.

Uncertainty factors on volumes:	Stock (upper):	x 1.2	Arisings (upper)	x
	Stock (lower):	x 0.8	Arisings (lower)	x

**WASTE SOURCE** Miscellaneous reactor components arising from reactor defuelling operations.

**PHYSICAL CHARACTERISTICS**

General description: This waste stream comprises activated reactor components currently stored within the reactors and will arise during defuelling operations. The wet waste component of this waste stream, i.e. Miscellaneous Reactor Components wet, has been moved to waste stream 2C28, and the Reactor Mortuary Miscellaneous component has been moved to waste stream 2C38.

Physical components (%vol): Miscellaneous reactor components, including thermocouple wires, magnox capping pieces, graphite distance pieces etc..

Sealed sources: The waste does not contain sealed sources.

Bulk density (t/m<sup>3</sup>): 0.3

Comment on density: The density ranges from 0.2 to 0.6 t/m<sup>3</sup>, with an average density of 0.3 t/m<sup>3</sup>.

**CHEMICAL COMPOSITION**

General description and components (%wt): Steel (11%), Magnox (45%), graphite (44%)

Chemical state: Neutral

Chemical form of radionuclides:  
 H-3: Not determined.  
 C-14: Not determined.  
 Se-79: Not determined.  
 Tc-99: Not determined.  
 Ra: Not present.  
 Th: Not present.  
 U: Not present.  
 Np: Not present.  
 Pu: Not present.

Metals and alloys (%wt): -

	(%wt)	Type(s) / Grade(s) with proportions	% of total C14 activity
Stainless steel.....	~11.0		
Other ferrous metals.....	P	Nickel and molybdenum are present in boron steel and stainless steel.	
Iron.....			
Aluminium.....	NE		
Beryllium.....	NE		
Cobalt.....			
Copper.....	NE		

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Lead.....	NE
Magnox/Magnesium.....	45.0
Nickel.....	
Titanium.....	
Uranium.....	
Zinc.....	NE
Zircaloy/Zirconium.....	NE
Other metals.....	0

Organics (%wt):                      Organic materials present as cellulose.

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulosics.....	2.0		
Paper, cotton.....	<1.0		
Wood.....	<1.0		
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.....	0		
Soil.....	0		
Brick/Stone/Rubble.....	0		
Cementitious material.....	0		
Sand.....			
Glass/Ceramics.....	0		
Graphite.....	44.0		
Desiccants/Catalysts.....			
Asbestos.....	0		

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Non/low friable.....

Moderately friable.....

Highly friable.....

Free aqueous liquids..... P

Free non-aqueous liquids..... TR

Powder/Ash..... P

Inorganic anions (%wt): No inorganic anions are 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: Magnox (45%) is present.

	(%wt)	Type(s) and comment
Combustible metals.....	45.0	
Low flash point liquids.....	0	
Explosive materials.....	0	
Phosphorus.....	0	
Hydrides.....	0	
Biological etc. materials.....	0	
Biodegradable materials.....		
Putrescible wastes.....	0	
Non-putrescible wastes.....		
Corrosive materials.....	0	
Pyrophoric materials.....	0	
Generating toxic gases.....	0	
Reacting with water.....	45.0	
Higher activity particles.....		
Soluble solids as bulk chemical compounds.....		

Hazardous substances / non hazardous pollutants: -

	(%wt)	Type(s) and comment
Acrylamide.....		
Benzene.....		

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

Complexing agents (%wt):      No

(%wt)      Type(s) and comment

EDTA.....  
 DPTA.....  
 NTA.....  
 Polycarboxylic acids.....  
 Other organic complexants.....  
 Total complexing agents.....      0

Potential for the waste to contain discrete items:      Yes. Large Metal Items (LMIs)/"substantial" thickness items considered "durable" assumed DIs; Stainless items assumed DIs.

**PACKAGING AND CONDITIONING**

Conditioning method:      It is not intended to supercompact the waste

Plant Name:      Not yet established.

Location:      -

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Plant startup date: 2089  
 Total capacity (m<sup>3</sup>/y incoming waste): -  
 Target start date for packaging this stream: 2089  
 Throughput for this stream (m<sup>3</sup>/y incoming waste): -  
 Other information: Not yet established.

Likely container type:	Container	Waste packaged (%vol)	Waste loading (m <sup>3</sup> )	Payload (m <sup>3</sup> )	Number of packages
	4m box (no shielding)	100.0	16.2	18.9	< 1

Likely container type comment: -  
 Range in container waste volume: -  
 Other information on containers: -  
 Likely conditioning matrix: Not specified  
 Other information: -  
 Conditioned density (t/m<sup>3</sup>): 2.0  
 Conditioned density comment: -  
 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 main sources of activity are activated steels from reactor components containing Co-60.  
 Uncertainty: The banding and code of the stock activities are best estimate limit values, within a factor of 3 (upper limit) and 100 (lower limit).  
 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: The activities of the stocks have been estimated from limited information.  
 Other information: -

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Nuclide	Mean radioactivity, TBq/m <sup>3</sup>				Nuclide	Mean radioactivity, TBq/m <sup>3</sup>			
	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			Gd 153		8		
Be 10		8			Ho 163		8		
C 14		6			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	1E-04	BB 2			Lu 174		8		
Ar 39		8			Lu 176		8		
Ar 42		8			Hf 178n		8		
K 40		8			Hf 182		8		
Ca 41		8			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54	5.37E-08	BD 2			Pb 205		8		
Fe 55	9.46E-02	BD 2			Pb 210		4		
Co 60	8.27E-02	BD 2			Bi 208		8		
Ni 59	4E-04	BD 2			Bi 210m		8		
Ni 63	3.68E-02	BD 2			Po 210		4		
Zn 65	1.59E-08	BD 2			Ra 223		8		
Se 79		4			Ra 225		8		
Kr 81		8			Ra 226		4		
Kr 85		8			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90		4			Th 227		8		
Zr 93		4			Th 228		8		
Nb 91		8			Th 229		4		
Nb 92		8			Th 230		4		
Nb 93m		4			Th 232		4		
Nb 94		5			Th 234		8		
Mo 93		5			Pa 231		4		
Tc 97		8			Pa 233		8		
Tc 99		5			U 232		8		
Ru 106		5			U 233		8		
Pd 107		5			U 234		8		
Ag 108m		5			U 235		8		
Ag 110m		8			U 236		8		
Cd 109		8			U 238		8		
Cd 113m		8			Np 237		8		
Sn 119m		8			Pu 236		8		
Sn 121m		5			Pu 238		8		
Sn 123		8			Pu 239		8		
Sn 126		5			Pu 240		8		
Sb 125		8			Pu 241		8		
Sb 126		8			Pu 242		8		
Te 125m		8			Am 241		8		
Te 127m		8			Am 242m		8		
I 129		5			Am 243		8		
Cs 134		5			Cm 242		8		
Cs 135		5			Cm 243		8		
Cs 137		5			Cm 244		8		
Ba 133		8			Cm 245		8		
La 137		8			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		5			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147		5			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151		5			Other a				
Eu 152		5			Other b/g				
Eu 154		5			<b>Total a</b>	<b>0</b>			<b>0</b>
Eu 155		5			<b>Total b/g</b>	<b>2.15E-01</b>	<b>BD 2</b>		<b>0</b>

**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