WASTE STREAM	7D34	Ion Exchange R Decontaminatio	esin from Primary Circuit n	
SITE	HMNB De	evonport		
SITE OWNER	Ministry o	f Defence		
WASTE CUSTODIAN	Babcock I	nternational Group		
WASTE TYPE	LLW			
Is the waste subject to Scottish Policy:	No			
WASTE VOLUMES				
Stocks	At 1 4 202	22	Reported	
Slocks.	AL 1.4.202	24.0.0005	12.011	
Future arisings -	1.4.2023	· 31.3.2025 · 31.3.2028	~-2.0 m³ ~-2.8 m³	
	1.4.2028	- 31.3.2031	~-4.0 m ³	
	1.4.2031 ·	- 31.3.2034	~-3.1 m ³	
Total future arisings:			-12.0 m ³	
Total waste volume:			0 m ³	
	major mai future aris future con form awai conditioni remove C which incl arisings' r converted by treame and condi involved in	intenance periods. Po ings generation rate iditioning of current st ting treatment. Waste ng/treatment campaig 14 & chelates. Camp ude C-14 as well as o epresent the program into conditioned was ent /conditioning of 7D tioning option for all r in this initiative.	CD operations have now ceased at Devo s based on decay from ILW wastestrea ock. Current Stocks declared are for wa disposal due to commence c. 2024 wh gn as part of a MoD driven Resin Dispos aign expected to include all other DRDL shelate content. Reported negative volut of work in which this wastestream will b testream: 7D26/C. Arising rate is expec 40 arisings. Currently awaiting commer esins containing chelates (and/or high C	onport therefore m and expectation o aste stored in raw hich will follow a sal Project (RDP) to resin waste streams mes in 'future be reduced and ted to be influenced nocement of treatment C14). NWS are
Uncertainty factors on volumes:	Stock (up	per): x 1.1	Arisings (upper) x	1.3
WASTE SOURCE	Stock (low The prima chemical generated	ver): x 0.9 ary circuit of the reactor process. Resin is use I when the magnetite	Arisings (lower) x or power plant is decontaminated using d to remove soluble metal activation pro layer is removed from the primary plant	0.7 a multi-stage oducts that are
PHYSICAL CHARACTER	ISTICS			
General description:	The waster resin is a cation act Storage V storage po organic ch require to will be end	e consists of uniform s mixture of anion and ive sites. When resin 'essel (RSV). Resin is eriod. Due to the cher nelating agents. There be pre-treated to rem capsulated into either	spheroids of approximately 1.0 mm size cation resin mixed to ensure an even nu is shown to be exhausted it is discharge headed by an amount of water and ren nical process used the resin will also co are no large items present. The conditi love the chelate (and C-14) concentration drums or other approved containers (e.	. The ion exchange umber of anion / ed into a Resin nains wet during its ontain an amount of oned waste will ons and the product .g. THISO).
Physical components (%vol)	: Raw wast	e ion exchange resin	(75%), water (25%).	
Sealed sources:	The waste	e does not contain se	aled sources.	
Bulk density (t/m ³):	1.1			
Comment on density:	The waste anion and spheroids state and decontam	e contains organic bas cation sites. The res of approximately 1m is 'headed' by a quan ination process being	sed ion exchange resin. There are equa in is a polystyrene based bead consistir m diameter. Pre-conditioned resin is alw tity of demineralised water. Due to the o used the resin will contain appreciable	I numbers of active ng of uniform vays held in a wet chemical quantities of

CHEMICAL COMPOSITION

General description and Raw waste ion exchange resin (75%), water (25%). components (%wt):

chelating agents (>>1 % by weight). There are no large items present. The density will be in the region of 1-1.1 t/m³. Once conditioned for disposal the density will increase as the

waste will be encapsulated into an appropriate concrete matrix.

WASTE STREAM	7D34	lon Exchange Decontamina	Resin from Primary Circuit tion	
Chemical state:	Acid			
Chemical form of radionuclides:	H-3: HT(C-14: A ı Pu: Poss	D predominantly. number of potential sibility of Pu-241, for	forms. Most significant carbonate. m not known. Present in extremely low co	incentration.
Metals and alloys (%wt):	Not appl	icable.		
		(%wt)	Type(s) / Grade(s) with proportions	% of total C14
Stainless stor	el	, 		activity
Other ferrous	metals	0		
Iron		0		
Aluminium		0		
Beryllium		0		
Cobalt		0		
Copper		0		
Lead		0		
Magnox/Mag	nesium	0		
Nickel		0		
Titanium				
Uranium		0		
Zinc		0		
Zircaloy/Zircc	onium	0		
Other metals		0		
Organics (%wt):	-			
		(%wt)	Type(s) and comment	% of total C14
Total cellulos	ics	0		ασανιίγ
Paper, cott	on	0		
Wood		0		
Halogenated	plastics	0		
Total non-hal	logenated pla	stics 0		
Condensat	tion polymers.	0		
Others		0		
Organic ion e	exchange mat	erials 75.0		100.0
Total rubber.		0		
Halogenate	ed rubber	0		
Non-haloge	enated rubber	r0		
Hydrocarbon	S	0		
Oil or great	se			
Fuel				
Asphalt/Ta	rmac (cont.cc	oal tar)		
Asphalt/Ta	rmac (no coal	I tar)		
Bitumen				
Others				
Other organic	CS	0		
Other materials (%wt)	-			

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Ion Exchange Resin from Primary Circuit **Decontamination**

	(%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	0		
Desiccants/Catalysts	0		
Asbestos	0		
Non/low friable			
Moderately friable			
Highly friable			
Free aqueous liquids	25.0		
Free non-aqueous liquids	0		
Powder/Ash	0		
Inorganic anions (%wt): -			
	(%wt)	Type(s) and comment	
Fluoride	0		
Chloride	0		
lodide	0		
Cyanide	0		
Carbonate	0		
Nitrate	0		
Nitrite	0		
Phosphate	0		
Sulphate	0		
Sulphide	0		
Materials of interest for There are no hazard	lous materi	als present in the waste apart from those a	already identified

N waste acceptance criteria: (e.g. picolinate and formate).Chelating agents will be present within the raw waste (adhered to the resin surface) and are declared for current stocks in raw state. Chelates will be removed, and C-14 removed/reduced following successful conditioning/treatment as part of the MoD driven Resin Disposal Project (RDP) in which this waste will move to the 7D26/C stream.

	(%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	

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Ion Exchange Resin from Primary Circuit Decontamination

Putrescible wastes	0
Non-putrescible wastes	0
Corrosive materials	0
Pyrophoric materials	0
Generating toxic gases	0
Reacting with water	0
Higher activity particles	0
Soluble solids as bulk chemical compounds	0

-

Hazardous substances / non hazardous pollutants:

(%wt)

< 0.02

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)	0
Boron (non-Boral)	<0.02
Cadmium	
Caesium	
Selenium	
Chromium	
Molybdenum	
Thallium	
Tin	
Vanadium	
Mercury compounds	
Others	
Electronic Electrical Equipment (EEE)	
EEE Type 1	
EEE Type 2	
EEE Type 3	

Present in the some resin packages. Average concentration over full 7D34 inventory: ~ 9.73 mg/l. Average over boronated packages only: 68.1 mg/l. Maximum conc in any single RSV: 160 mg/l

2022 Inventory

WASTE STREAM 7D34	lon Exchange Decontaminati	Resin from Primary Circuit on
EEE Type 4 EEE Type 5 Complexing agents (%wt): Yes		
	(%wt)	Type(s) and comment
EDTA		
DPTA		
NTA		
Polycarboxylic acids		
Other organic complexar	nts <1.8	Averaged over entire invenory: Picolinate (~1.22 %mass) and Averaged Formate (~0.04 %mass). Average over chelated inventory: Picolinate: 1.83 %wt, Formate: 0.09 %wt. Max chelate in any RSV: Picolinate: 4.7 %wt, Formate: 0.3 %wt
Total complexing agents	< <1.8	
Potential for the waste to No. contain discrete items:		

TREATMENT, PACKAGING AND DISPOSAL

Planned on-site / off-site treatment(s):	Treatment	On-si Off s	te / site	Stream volume %
	Low force compaction Supercompaction (HFC)			
	Incineration			
	Solidification	Off-	site	100.0
	Decontamination			
	Metal treatment			
	Size reduction			
	Decay storage			
	Recyling / reuse			
	Other / various			
	None			
Comment on planned treatments:	Due to the chelate and C14 concentrations, it is in treated/conditioned prior to disposal to destroy the remove significant proportions of C-14 from the wa Treatment/conditioning process is due to commer product will be encapsulated for final disposal at the	tended th organic o aste strea nce c. 202 he NWS.	at the res chelates a m. 4/2025. T	in will be and also he resulting
Disposal Routes:	Disposal Route		Stream volume %	Disposal 6 density t/m3
	Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be consigned to an On-Site Disposa Expected to be consigned to an Incineration Faci Expected to be consigned to a Metal Treatment F Expected to be consigned as Out of Scope Expected to be recycled / reused Disposal route not known	, I Facility lity Facility	100.0) ~1.9

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

Upcoming (2022/23-2024/25) Waste Routing (if expected to change from above):

-

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Ion Exchange Resin from Primary Circuit Decontamination

Disposal Route	Stream volume %			
	ty	2024/25		
Expected to be consigned to the LLW Repository Expected to be consigned to a Landfill Facility Expected to be consigned to an On-Site Disposal Facility Expected to be consigned to an Incineration Facility Expected to be consigned to a Metal Treatment Facility Expected to be consigned as Out of Scope Expected to be recycled / reused Disposal route not known				

Opportunities for alternative disposal routing:

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

Waste Packaging for Disposal:

Container	Stream volume	Waste loading	Number of
	%	m ³	packages
 1/3 Height IP-1 ISO 2/3 Height IP-2 ISO 1/2 Height WAMAC IP-2 ISO 1/2 Height IP-2 Disposal/Re-usable ISO 2m box (no shielding) 4m box (no shielding) Other 			

Other information:

Encapsulated resin direct into HHISO. If not, within standard 200 litre drums loaded into HHISO containers for disposal to LLWR. Alternative may be considered depending on the conditioning/treatment option used.

Waste Planned for Disposal at the LLW Repository:

Container voidage:	<10%.				
Waste Characterisation Form (WCH):	The waste does not meet the LLWR's Waste Acceptance Criteria (WAC).				
	Development work has been carried out to determine the most appropriate way to manage the waste, e.g. C-14 removal and chelate destruction. Final product will meet NWS WAC.				
Waste consigned for disposal to LLWR in year of generation:	No. It is presently envisaged that this waste will be treated/conditioned prior to disposal to NWS (to remove C-14 and chelate content). Waste will be batched wit other resins with the aim that disposal will take place within the next 2-5 yrs i.e. before 2027.				

Non-Containerised Waste for	(Not applicable to this waste stream)			
Stream volume (%):	-			
Waste stream variation:	-			
Bounding cuboidal volume:				
Inaccessible voidage:	-			
Other information:	-			

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Ion Exchange Resin from Primary Circuit Decontamination

RADIOACTIVITY

Source:	Activation products that have been removed from the primary plant during the decontamination process. The activity is collected and retained on ion exchange resin.
Uncertainty:	All activities will be accurately determined through sampling and analysis. Future treatment of the waste may signifcantly reduce C-14 content.
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:	Core samples are taken from each resin container. The sample is prepared and analysed to determine the major nuclides by gamma spectroscopy and other selective chemical techniques for other beta/gamma nuclides. Gross alpha and gross beta measurements are also taken. If certain trigger nuclides (e.g. Cs-137) are detected then additional analysis will be undertaken for other nuclides (e.g. I-129).
Other information:	A core sample of the resin is taken from the RSV. This sample is subject to full radiochemical analysis for alpha and beta/gamma activities. The chelate concentration is also determined. The H-3 within the overstanding water is also assessed along with pH, conductivity and chloride analysis.

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Ion Exchange Resin from Primary Circuit **Decontamination**

	Mean radioactivity, TBq/m ³				Mean radioactivity, TBq/m ³				
Nuclide	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code	Nuclide	Waste at 1.4.2022	Bands and Code	Future arisings	Bands and Code
H 3	1.31E-04	AA 1	~1.31E-04	BB 2	Gd 153				
Be 10					Ho 163				
C 14	2.81E-05	AA 1	~2.81E-05	BB 2	Ho 166m				
Na 22					Im 170 Tm 171				
AI 26					1m 171 Lu 174				
Ar 39					Lu 174				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					TI 204				
Mn 54	1.71E-07	AA 1	~1.71E-07	BB 2	Pb 205				
Fe 55	8.97E-04		~8.97E-04	BB 2	PD 210 Bi 208				
C0 60	2.02E-03	AAI	~2.02E-03	DD 2	Bi 200 Bi 210m				
Ni 63	4 06F-04	AA 1	~4 06F-04	BB 2	Po 210				
Zn 65	5.12E-10	AA 1	~5.12E-10	BB 2	Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90					Th 228				
ZI 93 Nh 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				
Pd 107					U 234				
Ag 108m					U 235				
Ag 110m	2.63E-10	AA 1	~2.63E-10	BB 2	U 236				
Cd 109					U 238				
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 239				
Sn 125					Pu 240				
Sb 125	1.34E-06	AA 1	~1.34E-06	BB 2	Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241				
Te 127m					Am 242m				
I 129					Am 243 Cm 242				
Cs 134					Cm 243				
Cs 135 Cs 137	6 90E-08	AA 1	~6.90F-08	BB 2	Cm 244				
Ba 133	0.002 00		0.002 00	55 1	Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 251				
Sm 147					Cf 252				
Sm 151					Other a	3.43E-07	AA 1	~3.43E-07	BB 2
Eu 152					Other b/g	6.76E-11	AA 1	~6.76E-11	BB 2
Eu 154					Total a	~3.43E-07	AA 1	~3.43E-07	BB 2
Eu 155	7.32E-08	AA 1	~7.32E-08	BB 2	Total b/g	~4.08E-03	AA 1	~4.08E-03	BB 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

Bands quantify uncertainty in Note: mean radioactivity.

Code

1 Measured activity

2 Derived activity (best estimate) 3 Derived activity (upper limit)

4 Not present

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