WASTE STREAM 9A69 Miscellaneous Contaminated Items from Post Irradiation Examination

SITE	Berkeley
SITE OWNER	Nuclear Decommissioning Authority
WASTE CUSTODIAN	Magnox Limited
WASTE TYPE	ILW

WASTE VOLUMES

		Reported
Stocks:	At 1.4.2019.....	27.5 m³
Total future arisings:		0 m³
Total waste volume:		27.5 m³

Comment on volumes: The last arising of this waste was in 1982. There will be no further arisings of this waste stream.

Uncertainty factors on volumes:				
	Stock (upper):	x 1.1	Arisings (upper)	x
	Stock (lower):	x 0.9	Arisings (lower)	x

WASTE SOURCE The waste is miscellaneous contaminated items arising at Berkeley Nuclear Laboratories (now Berkeley Technology Centre), principally from the examination of irradiated fuel, steel and graphite.

PHYSICAL CHARACTERISTICS

General description: The waste consists principally of non-fuel element debris from the post irradiation examination work carried out on fuel, steel and graphite in the BC caves and cells. This waste will also comprise combustible and non-combustible wastes, metals, glass and cave refurbishment wastes. There will be a small amount of fire suppressant powders and vermiculite. The waste is contained within mild steel black can liners and paint tin liners. Current plans are that the mild steel waste containers described in former stream 9A926 will not be separated from the waste in this stream. Originally, this waste stream included part of the 3m³ of dried ion exchange material that was used as an infill for approximately 175 of the MCI black cans between 1975 and 1987. This mobile waste has now got a separate identifier (9A82) and therefore, the volumes for 9A69 and 9A70 have been reduced by 1.5m³ each. As the waste is containerised, it is unlikely that there will be any large items that will require special handling.

Physical components (%vol): The waste will include steel items such as tools, plastic items, tissues and swabs used for cleaning, fire suppressant powders and the absorber vermiculite. There may be small quantities of ion exchange material, but this is described in stream 9A82 and will be treated with stream 9A25. % Breakdown, ~25% ferrous metals, ~25% glass, ~20% plastics, ~15% paper, ~ 5% each of organic and inorganic Ion Exchange resins and ~5% of ternary eutectic chloride.

Sealed sources: -

Bulk density (t/m³): 0.5

Comment on density: Densities calculated using weights and external volumes of containers.

CHEMICAL COMPOSITION

General description and components (%wt): The waste will include steel, plastics, paper and graphite. There may be small amounts of ternary eutectic chloride (sodium chloride, barium chloride and potassium chloride) which was used as fire extinguishant, and incinerator ash. Fission products, actinides and other activation products will be present as contaminants.

Chemical state: Alkali

Chemical form of radionuclides: H-3: Most tritium is expected to be present as water but some may be in the form of other inorganic compounds or as organic compounds.
C-14: Chemical form of carbon 14 has not been determined but may be graphite.
Cl-36: The chemical form of chlorine 36 in these wastes is not known.
U: Chemical form of uranium isotopes has not been determined but may be uranium oxides.
Pu: Chemical form of plutonium isotopes has not been determined but may be plutonium oxides.

Metals and alloys (%wt): Much of the metal will be of only 1-2 mm thickness but there will be items of greater thickness.

WASTE STREAM	9A69	Miscellaneous Contaminated Items from Post Irradiation Examination

	Stainless steel	NE	
	Other ferrous metals	~25.0	
	Iron		
	Aluminium	NE	
	Beryllium	NE	
	Cobalt		
	Copper	NE	
	Lead	NE	
	Magnox/Magnesium	NE	
	Nickel		
	Titanium		
	Uranium		
	Zinc	NE	
	Zircaloy/Zirconium	NE	
	Other metals	NE	"Other" metals have not been identified.
Organics (%wt):	There will be a number of organic materials present in the waste, including plastics, Perspex, polythene, PVC and paper. Specific organic chemical compounds identified as possibly present are: hexamine, methanol, Perklone D, acetone and epoxy resin. These compounds may adversely affect radionuclide mobility. No quantitative estimates of the various types or quantities of organics have been assessed. There may also be small quantities of liquid organic oils, e.g. oil on swabs and in hydraulic equipment.		
	Total cellulosics	~15.0	
	Paper, cotton	~15.0	
	Wood	NE	
	Halogenated plastics	NE	
	Total non-halogenated plastics	NE	
	Condensation polymers	NE	
	Others	NE	
	Organic ion exchange materials	~5.0	
	Total rubber	NE	
	Halogenated rubber	NE	
	Non-halogenated rubber	NE	
	Hydrocarbons		
	Oil or grease		
	Fuel		
	Asphalt/Tarmac (cont.coal tar)		
	Asphalt/Tarmac (no coal tar)		
	Bitumen		
	Others		
	Other organics	NE	
Other materials (%wt):	-		

WASTE STREAM	9A69	Miscellaneous Contaminated Items from Post Irradiation Examination

Inorganic ion exchange materials.	~5.0
Inorganic sludges and flocs.....	0
Soil.....	0
Brick/Stone/Rubble.....	0
Cementitious material.....	0
Sand.....	
Glass/Ceramics.....	~25.0
Graphite.....	NE
Desiccants/Catalysts.....	
Asbestos.....	0
Non/low friable.....	
Moderately friable.....	
Highly friable.....	
Free aqueous liquids.....	0
Free non-aqueous liquids.....	NE
Powder/Ash.....	NE

Inorganic anions (%wt): The inorganic anion content of the waste has not been quantified.

Fluoride.....	0
Chloride.....	~5.0
Iodide.....	0
Cyanide.....	0
Carbonate.....	NE
Nitrate.....	NE
Nitrite.....	NE
Phosphate.....	NE
Sulphate.....	NE
Sulphide.....	0

Materials of interest for waste acceptance criteria: Ternary eutectic chloride (TEC) fire extinguishant is of potential concern owing to the corrosive effect of sodium chloride (one third of total contents of TEC) on the waste container. The toxic chemical chromium trioxide has been identified as possibly present.

Combustible metals.....	TR
Low flash point liquids.....	0
Explosive materials.....	0
Phosphorus.....	0
Hydrides.....	TR
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.....	TR

WASTE STREAM	9A69	Miscellaneous Contaminated Items from Post Irradiation Examination

Active particles.....

Soluble solids as bulk chemical compounds.....

Hazardous substances / non hazardous pollutants: None expected,

Acrylamide.....

Benzene.....

Chlorinated solvents.....

Formaldehyde.....

Organometallics.....

Phenol.....

Styrene.....

Tri-butyl phosphate.....

Other organophosphates.....

Vinyl chloride.....

Arsenic.....

Barium.....

Boron.....

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): Yes

EDTA.....

DPTA.....

NTA.....

Polycarboxylic acids……

Other organic complexants.....	TR	Organic complexing agents may be present in small quantities.
Total complexing agents.....	~1.0	

WASTE STREAM 9A69 Miscellaneous Contaminated Items from Post Irradiation Examination

PACKAGING AND CONDITIONING

Conditioning method: This stream is to be co-packaged with 9A36, 9A37, 9A38, 9A57, 9A58, 9A59, 9A65, 9A68, 9A70, 9A71, 9A72, 9A75, 9A77, 9A78, 9A82. Packages are assigned to 9A68, 9A71 & 9A75.

Plant Name: -

Location: Berkeley Site

Plant startup date: -

Total capacity (m^3/y incoming waste): -

Target start date for packaging this stream: -

Throughput for this stream (m^3/y incoming waste): -

Other information: -

Likely container type:

Container	Waste packaged (%vol)	Waste loading (m^3)	Payload (m^3)	Number of packages

Likely container type comment: -

Range in container waste volume: .

Other information on containers: -

Likely conditioning matrix:

Other information: -

Conditioned density (t/m^3): -

Conditioned density comment: -

Other information on conditioning: -

Opportunities for alternative disposal routing:

Treatment	Stream volume (%)	Comment
-	-	-

RADIOACTIVITY

Source: The waste has become contaminated from the processes concerned with the examination of irradiated fuel, steel and graphite at Berkeley Nuclear Laboratories (now Berkeley Technology Centre).

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

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 specific activities were derived by estimation based upon available information.

WASTE STREAM	9A69	Miscellaneous Contaminated Items from Post Irradiation Examination

Other information: Specific activity is a function of operating history.

WASTE STREAM 9A69 Miscellaneous Contaminated Items from Post Irradiation Examination

Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code	Nuclide	Mean radioactivity, TBq/m³ Waste at 1.4.2019	Bands and Code	Future arisings	Bands and Code
H 3	1.02E-03	C C 2			Gd 153		8		
Be 10		8			Ho 163		8		
C 14	1.00E-05	C C 2			Ho 166m		8		
Na 22		8			Tm 170		8		
Al 26		8			Tm 171		8		
Cl 36	7E-07	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		8			Pt 193		8		
Mn 53		8			Tl 204		8		
Mn 54		8			Pb 205		8		
Fe 55	9.40E-06	C C 2			Pb 210		8		
Co 60	6.18E-05	C C 2			Bi 208		8		
Ni 59	1E-06	C C 2			Bi 210m		8		
Ni 63	7.36E-05	C C 2			Po 210		8		
Zn 65		8			Ra 223		8		
Se 79	1.21E-08	C C 2			Ra 225		8		
Kr 81		8			Ra 226		8		
Kr 85		8			Ra 228		8		
Rb 87		8			Ac 227		8		
Sr 90	5.26E-03	C C 2			Th 227		8		
Zr 93	6E-07	C C 2			Th 228		8		
Nb 91		8			Th 229		8		
Nb 92		8			Th 230		8		
Nb 93m	3.57E-07	C C 2			Th 232		8		
Nb 94		8			Th 234	3E-07	C C 2		
Mo 93		8			Pa 231		8		
Tc 97		8			Pa 233	4.12E-08	C C 2		
Tc 99	3E-06	C C 2			U 232		8		
Ru 106		8			U 233		8		
Pd 107		8			U 234	3.08E-07	C C 2		
Ag 108m	<2.96E-06	C 3			U 235	7E-09	C C 2		
Ag 110m		8			U 236	4.00E-08	C C 2		
Cd 109		8			U 238	3E-07	C C 2		
Cd 113m		8			Np 237	4.12E-08	C C 2		
Sn 119m		8			Pu 236		8		
Sn 121m		8			Pu 238	1.82E-04	C C 2		
Sn 123		8			Pu 239	1.00E-04	C C 2		
Sn 126	4.35E-08	C C 2			Pu 240	2.00E-04	C C 2		
Sb 125		8			Pu 241	1.69E-03	C C 2		
Sb 126	6.09E-09	C C 2			Pu 242	1E-07	C C 2		
Te 125m		8			Am 241	3.38E-04	C C 2		
Te 127m		8			Am 242m	8.48E-07	C C 2		
I 129	6E-09	C C 2			Am 243	3.00E-07	C C 2		
Cs 134	1.78E-09	C C 2			Cm 242	7E-07	C C 2		
Cs 135	1E-07	C C 2			Cm 243	1.51E-07	C C 2		
Cs 137	5.30E-03	C C 2			Cm 244	1.89E-06	C C 2		
Ba 133		8			Cm 245		8		
La 137		8			Cm 246		8		
La 138		8			Cm 248		8		
Ce 144		8			Cf 249		8		
Pm 145		8			Cf 250		8		
Pm 147	2.09E-07	C C 2			Cf 251		8		
Sm 147		8			Cf 252		8		
Sm 151	1.82E-05	C C 2			Other a				
Eu 152	1.62E-07	C C 2			Other b/g				
Eu 154	1.14E-05	C C 2			**Total a**	**8.24E-04**	**C C 2**	**0**	
Eu 155	5.51E-07	C C 2			**Total b/g**	**1.35E-02**	**C C 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