


Schedule of Accreditation

issued by

United Kingdom Accreditation Service

2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

 <p>UKAS TESTING</p> <p>1604</p> <p>Accredited to ISO/IEC 17025:2017</p>	<h3>Cavendish Nuclear Limited</h3> <p>Issue No: 038 Issue date: 22 April 2021</p>	
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<p>Testing performed at the above address only</p>		

DETAIL OF ACCREDITATION

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used
AERIAL EFFLUENT MONITORING SAMPLES	<u>Radiochemical and Chemical Analysis</u>	Documented In-House Methods: (Key to Analytical Methods on Page 8)
Air (water bubblers)	³ H	QAAM 130 : LSC
	¹⁴ C	QAAM 680 : LSC
Low density granular materials Including: Charcoal granules	⁹⁰ Sr Gamma Emitters (Energy Range: 30-1460 keV)	QAAM 643 : CC QAAM 626 : GS
Zeolites	Gamma Emitters (Energy Range: 30-1460 keV) ¹²⁹ I and ¹³¹ I only	QAAM 626 : GS
Dissolved GF filter papers	Total Beta (relative to Sr ⁹⁰ /Y ⁹⁰)	QAAM 523 : PC
Filter papers (2, 4 and 6 cm diameter filter papers and High Volume air sample papers)	Gamma Emitters (Energy Range: 100-1460 keV)	QAAM 620 : GS
High volume air sample filter (borosilicate microfibre)	Total alpha (relative to Pu ²³⁹⁺²⁴⁰) Total Beta (relative to Sr ⁹⁰ /Y ⁹⁰)	QAAM 834 : ASC QAAM 834 : PC
	Uranium (U)	QAAM 834 : ICP-MS
	Total Pu Alpha ²⁴¹ Pu ²⁴¹ Am Total Am + Cm	QAAM 835 : AS /LSC



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AERIAL EFFLUENT MONITORING SAMPLES (cont'd)	<u>Radiochemical and Chemical Analysis (cont'd)</u>	Documented In-House Methods: (Key to Analytical Methods on Page 8)
Glass fibre filter papers	Total Alpha (relative to Pu ²³⁹⁺²⁴⁰) Total Beta (relative to Sr ⁹⁰ /Y ⁹⁰) ⁹⁰ Sr Total Pu Alpha ²⁴¹ Pu Total Am + Cm Alpha	QAAM 523 : ASC QAAM 523 : PC QAAM 643 : CC/PC QAAM 418 : ASC QAAM 418 : LSC QAAM 418 : ASC
Polypropylene HVAS	Pu Isotopics: ²³⁸ Pu, ²³⁹⁺²⁴⁰ Pu, ²⁴¹ Am ²⁴¹ Pu U Isotopics: ²³⁴ U, ²³⁵ U ²³⁸ U Cm Isotopes: ²⁴² Cm, ²⁴³⁺²⁴⁴ Cm ⁹⁰ Sr ¹³⁷ Cs	QAAM 831 : AS QAAM 831 : LSC QAAM 831 : AS QAAM 831 : ICP-MS QAAM 831 : AS QAAM 831/643 : CC/PC QAAM 831/620 : GS
BIOASSAY AND PERSONNEL MONITORING SAMPLES		
Faeces	Total Pu Alpha ²⁴¹ Am U Nat (assuming natural abundance with direct measurement of ²³⁸ U)	QAAM 399 : ASC/AS QAAM 399 : AS QAAM 674 : ICP-MS
Urine	Creatinine ³ H Total Pu Alpha ²⁴¹ Am ⁹⁰ Sr Uranium (²³⁸ U, ²³⁵⁺²³⁶ U, ²³⁴ U) Gamma Emitters (Energy Range: 100-1460 keV) U Nat (assuming natural abundance with direct measurement of ²³⁸ U) U Isotopics: ²³⁴ U, ²³⁵ U, ²³⁶ U, ²³⁸ U	QAAM 571 : SP QAAM 130 : LSC QAAM 398 : AS QAAM 854 : AS QAAM 398 : AS QAAM 854 : AS QAAM 643 : PC QAAM 854 : AS QAAM 627 : GS QAAM 674 : ICP-MS QAAM 674 : ICP-MS
Nose blows/wound samples/dressings	Total Pu Alpha ²⁴¹ Am Total U Alpha	QAAM 399 : ASC/AS QAAM 399 : AS QAAM 399 : ICP-MS



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<p>ENVIRONMENTAL SAMPLES AND FOODSTUFFS</p> <p>Environmental samples including: Vegetation, silt and soil Foodstuffs including: Fish and meat</p> <p>Drinking water, groundwater, surface/fresh water, trade effluent (to controlled water), trade effluent (to sewer) and leachate (from landfill)</p>	<p><u>Radiochemical and Chemical Analysis</u></p> <p>²³⁸U ²³⁴U, ²³⁵U ²³⁹⁺²⁴⁰Pu, ²³⁸Pu, ²⁴¹Am ²⁴¹Pu</p> <p>Total Alpha (relative to ²³⁹⁺²⁴⁰Pu) Total Beta (relative to ⁹⁰Sr/⁹⁰Y or ⁴⁰K) ⁹⁰Sr ⁵⁵Fe/⁶³Ni ³H ¹²⁹I ¹⁴C Total Pu Alpha ²³⁹⁺²⁴⁰Pu ²³⁸Pu ²⁴¹Pu Total Am + Cm Alpha Cm isotopes: ²⁴²Cm, ²⁴³⁺²⁴⁴Cm ⁹⁹Tc ²³⁷Np ³⁶Cl</p> <p>Uranium (assuming natural abundance with direct measurement of ²³⁸U)</p> <p>Gamma Emitters (Energy Range: 30-1460 keV) and LEPS for ¹²⁹I, ²⁴¹Am</p> <p>Fluoride Chloride Nitrite Nitrate Sulphate Phosphate</p> <p>Ammonia</p>	<p>Documented In-House Methods: (Key to Analytical Methods on Page 8)</p> <p>QAAM 819 : ICP-MS QAAM 819 : AS QAAM 819 : AS QAAM 819 : LSC</p> <p>QAAM 131 : ASC QAAM 131 : CC/PC</p> <p>QAAM 643 : CC/PC QAAM 842 : LSC QAAM 130 : LSC QAAM 80 : LSC QAAM 680 : LSC QAAM 426/QAAM 484 : AS QAAM 426 : AS QAAM 426: LSC QAAM 426/QAAM 484 : AS QAAM 426 : AS QAAM 674/QAAM679 : ICP-MS/PC QAAM 674 : ICP-MS QAAM 808 : PC</p> <p>QAAM 674 : ICP-MS</p> <p>QAAM 131 : GS QAAM 627: GS</p> <p>Documented In-House Method based on DIONEX AS11 column QAAM 837 : HPLC</p> <p>QAAM 843 : HPLC</p>



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ENVIRONMENTAL SAMPLES AND FOODSTUFFS (cont'd)	<u>Radiochemical and Chemical Analysis</u> (cont'd)	Documented In-House Methods: (Key to Analytical Methods on Page 8)
Drinking water, groundwater, surface/fresh water, trade effluent (to sewer) and trade effluent (to controlled water), leachate (from landfill) (cont'd)	Calcium (Ca) Magnesium (Mg) Potassium (K) Sodium (Na)	QAAM 843 : HPLC
	Trace elements: Li, Be, B, Al, P, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Sr, Y, Mo, Ag, Cd, Sn, Sb, Ba, Ce, Hg, Pb, Gd, Tl	QAAM 674 : ICP-MS
	Total Alkalinity COD Conductivity pH Suspended Solids	QAAM 824 QAAM 806 : Sp QAAM 827 QAAM 826 QAAM 827
Drinking water, groundwater, surface/fresh water and trade effluent (to controlled water)	²⁴¹ Am	QAAM 426 : AS
Drinking water	Colour Turbidity	QAAM 827 : HACH 8025 QAAM 827 : HACH 8237
	Total Hardness	QAAM 827
Groundwater, surface/fresh water and leachate (from landfill)	Dissolved Oxygen	QAAM 845 : DOE
Groundwater, leachate (from landfill)	Ca, Mg, K and Na	QAAM 847 : ICP-OES
Groundwater, leachate (from landfill), drinking water (non-regulatory)	Sulphate measured as Sulphur	QAAM 847 : ICP-OES
Groundwater, surface/fresh water	U Isotopics: ²³⁴ U, ²³⁵ U, ²³⁶ U, ²³⁸ U	QAAM 674 : ICP-MS
Saline/seawater	% Seawater Conductivity pH	QAAM 76 : Titration QAAM 827 QAAM 826



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ENVIRONMENTAL SAMPLES AND FOODSTUFFS (cont'd)	<u>Radiochemical and Chemical Analysis</u> (cont'd)	Documented In-House Methods: (Key to Analytical Methods on Page 8)
Saline/seawater (cont'd)	Fluoride Chloride Nitrite Nitrate Sulphate Phosphate Total Alpha: relative to ²³⁹⁺²⁴⁰ Pu Total Beta (relative to ⁴⁰ K) ¹⁴ C ⁹⁰ Sr ⁹⁹ Tc ⁵⁵ Fe/ ⁶³ Ni ²³⁷ Np ²³⁸ Pu, ²³⁹⁺²⁴⁰ Pu, ²⁴¹ Pu and ²⁴¹ Am Uranium (assuming natural abundance with direct measurement of ²³⁸ U) Gamma Emitters (Energy Range: 30-1460 keV) and LEPS for ¹²⁹ I, ²⁴¹ Am Boron ⁹⁹ Tc	Documented In-House Method based on DIONEX AS11 column QAAM 837 : HPLC QAAM 131 : ASC QAAM 131 : CC/PC QAAM 680 : LSC QAAM 822 : PC QAAM 679 : PC QAAM 842 : LSC QAAM 803 : ICP-MS QAAM 844 : AS QAAM 674 : ICP-MS QAAM 131 : GS QAAM 627 : GS QAAM 674 : ICP-MS
Milk	Gamma Emitters (Energy Range: 30-1460 keV) Carbon (Bq kg ⁻¹) by ¹⁴ C ³ H ¹²⁹ I ³⁵ S ⁹⁰ Sr ⁹⁹ Tc Total ¹⁴ C	QAAM 627 : GS QAAM 828 : LSC QAAM 130 : LSC QAAM 80 : LSC QAAM 68 : LSC QAAM 822 : PC QAAM 679 : PC QAAM 839 : Pyr/LSC
Milk, soil, potato	Total ³ H (organically bound tritium)	QAAM 838 : Pyr/LSC
Potato	Total ¹⁴ C	QAAM 839 : Pyr/LSC
Meat	⁹⁹ Tc Pu Alpha: ²³⁸ Pu, ²³⁹⁺²⁴⁰ Pu ²⁴¹ Am	QAAM 679 : PC QAAM 460 : AS QAAM 460 : AS



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ENVIRONMENTAL SAMPLES AND FOODSTUFFS (cont'd)	<u>Radiochemical and Chemical Analysis</u> (cont'd)	Documented In-House Methods: (Key to Analytical Methods on Page 8)
Fish, shellfish	⁹⁰ Sr ⁹⁹ Tc ²³⁷ Np Uranium (assuming natural abundance with direct measurement of ²³⁸ U)	QAAM 643 : PC QAAM 679 : PC QAAM 803 : ICP-MS QAAM 821 : ICP-MS
Fish	Carbon (Bq kg ⁻¹) by ¹⁴ C Total Pu Alpha ²⁴¹ Am Total ³ H (organically bound tritium) Total ¹⁴ C	QAAM 828 : LSC QAAM 460 : ASC QAAM 460 : AS QAAM 838 : Pyr/LSC QAAM 839 : Pyr/LSC
Shellfish	Total Pu Alpha, ²³⁸ Pu, ²³⁹⁺²⁴⁰ Pu ²⁴¹ Pu ²⁴¹ Am Cm isotopes: ²⁴² Cm, ²⁴³⁺²⁴⁴ Cm	QAAM 417 : LSC/AS QAAM 417 : LSC QAAM 417 : GS/AS QAAM 417 : AS
Shellfish (Alpha < 50 Bq/Kg)	Total Pu Alpha ²⁴¹ Am	QAAM 460 : ASC QAAM 460 : AS
Mollusca, crustacea, seaweed	Total ¹⁴ C	QAAM 839 : Pyr/LSC
Vegetation	Carbon (Bq kg ⁻¹) by ¹⁴ C ³ H ³⁵ S ⁹⁰ Sr Pu Alpha: ²³⁸ Pu, ²³⁹⁺²⁴⁰ Pu ²⁴¹ Am Total ³ H (organically bound tritium) Total ¹⁴ C ⁹⁹ Tc	QAAM 828 : LSC QAAM 130 : LSC QAAM 68 : LSC QAAM 643 : PC QAAM 460 : AS QAAM 460 : AS QAAM 838 : Pyr/LSC QAAM 839 : Pyr/LSC QAAM 679 : PC
Environmental samples including: vegetation, silt and soil Foodstuffs including: shellfish, fish and meat Granular materials: concrete and brick	Total Alpha: relative to ²³⁹⁺²⁴⁰ Pu Total Beta: relative to ⁴⁰ K	QAAM 482 : ASC QAAM 483 : GM



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ENVIRONMENTAL SAMPLES AND FOODSTUFFS (cont'd)	<u>Radiochemical and Chemical Analysis</u> (cont'd)	Documented In-House Methods: (Key to Analytical Methods on Page 8)
Granular materials: concrete and brick	Gamma Spectrometry (Energy Range: 100-1460 keV)	QAAM 626 : GS
Environmental samples including: silt and soil	Gamma Spectrometry (Energy Range: 30-1460 keV) on samples with densities <1	QAAM 626 : GS
Environmental samples including: vegetation	²⁴¹ Am & ¹²⁹ I Gamma Spectrometry (Energy Range: 100-1460 keV and LEPS)	QAAM 626 : GS
Foodstuffs, including: shellfish, fish, meat	²⁴¹ Am & ¹²⁹ I Gamma Spectrometry (Energy Range: 100-1460 keV and LEPS)	QAAM 626 : GS
Silts, sands and sediments	⁹⁰ Sr Total Pu Alpha ²⁴¹ Pu ²⁴¹ Am Uranium (assuming natural abundance with direct measurement of ²³⁸ U)	QAAM 643 : CC QAAM 417 : ASC QAAM 417 : LSC QAAM 417 : GS QAAM 821 : ICP-MS



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ENVIRONMENTAL SAMPLES		
Soils, silts and sediments	⁹⁹ Tc	QAAM 846 : ICP-MS
Soil (distilled)	³ H	QAAM 130 : LSC
Soil	Metals: As, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mo, Mn, Ni, Pb, Se, Sn, Sb, V, Zn	QAAM 676/674 : ICP-MS
	Metals: As, Ba, Cr, Co, Cu, Fe, Pb, Mn, Ni, V, Zn	QAAM 847 : Microwave Dissolution/ICP-OES
	⁵⁵ Fe/ ⁶³ Ni	QAAM 842 : LSC
	Total ¹⁴ C	QAAM 839 : Pyr/LSC
	Total Pu Alpha	QAAM 417 : ASC
	²⁴¹ Pu	QAAM 417 : LSC
	²⁴¹ Am	QAAM 417 : GS
Waste oil	Total Alpha	QAAM 638 : ASC
	Total Beta	QAAM 638 : CC
	Gamma Emitters (Energy Range: 30-1460 keV)	QAAM 638 : GS
END		

KEY TO ANALYTICAL METHODS / ASSOCIATED INSTRUMENTAL INSTRUCTIONS:

- AS Alpha Spectrometry/ASI9E, GSI040/43/34
- ASC Alpha Scintillation Counting/ASI5E
- CC Cerenkov Counting/ASI8E
- DOE Dissolved Oxygen Electrode
- GM Geiger-Muller Counting/ASI6E
- GS Gamma or Low Energy Photon Spectrometry/GSI047
- HPLC High Pressure Liquid Chromatography/GSI061
- ICP-MS Inductively Coupled Plasma-Mass Spectrometry/ASI82E, ASI355E
- ICP-OES Inductively Coupled Plasma-Optical Emission Spectrometry/GSI064
- ISE Ion Selective Electrode
- LSC Liquid Scintillation Counting/ASI8E
- PC Gas Flow Proportional Counting/ASI49E, GSI038
- Sp Colorimetric Technique/Spectrophotometry
- Pyr Pyrolyser