

Schedule of Accreditation

issued by

United Kingdom Accreditation Service

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

 <p>1016</p> <p>Accredited to ISO/IEC 17025:2017</p>	<p>Sellafield Ltd</p> <p>Issue No: 043 Issue date: 15 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
<p>HA ANALYSIS</p> <p>Dissolver Liquor HAST Liquor Aqueous Raffinates (note – specific matrices for each method are detailed in the relevant QAAM)</p>	<p><u>Radiochemical and Chemical Analysis</u></p> <p>Acidity</p> <p>Al, Fe, Mg, U&P</p> <p>Density</p> <p>Aluminium Chromium Iron Gadolinium Magnesium Molybdenum Neodymium Nickel Zirconium</p> <p>Gadolinium</p> <p>Lithium</p> <p>Pu/U Ratio</p>	<p>Documented In-House Methods</p> <p>QAAM 0310 by titrimetry</p> <p>QAAM 0361 by ICP-AES and ASI 646P</p> <p>QAAM 0682 by weight</p> <p>QAAM 0362 by ICP-AES and ASI 646P</p> <p>QAAM 0655 by ICP-AES and ASI 646P</p> <p>QAAM 0464 by ICP-AES and ASI 646P</p> <p>QAAM 0043 by TIMS ASI 46E, ASI 74E, ASI 478P for instrument operation ASI 177P for sample mounting</p>



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HA ANALYSIS (cont'd)	<u>Radiochemical and Chemical Analysis</u> (cont'd)	Documented In-House Methods
	Solids at 1000 °C	QAAM 0137 by gravimetry
	Uranium and Plutonium Pu-239, Pu-240, Pu-241, Pu-242 Pu-238 by alpha spectrometry Total Plutonium U-234, U-235, U-236, U-238	QAAM 0066 by TIMS ASI 46E, ASI 74E, ASI 478P for instrument operation ASI177P for sample mounting
	Sulphate	QAAM 0163 by LC and calculation
Dissolver Liquor HAST Liquor Aqueous Raffinates Plutonium Nitrate Solutions Plutonium Oxide Powders (note – specific matrices for each method are detailed in the relevant QAAM)	Pu and U Isotopic Composition	QAAM 0668 by TIMS and MCICP-MS ASI 46E, ASI 74E, ASI 478P for instrument operation ASI 177P for sample mounting
PLANT CONTROL	<u>Radiochemical and Chemical Analysis</u>	
Aerial Effluents (Charcoal and Zeolite matrices) Scrubber Liquors Process Liquors Degraded Solvents Plant Effluents Plant Solutions Gas Bubblers TBP/OK solutions	Acidity	QAAM 0330 by titrimetry
	Alpha Activity; relative to ²³⁹ Pu	ASI 325P Preparation and QAAM 0035 by alpha counting
	Alpha Emitting Nuclides	ASI 122P Preparation QAAM 0746 by alpha spectrometry
	Am ²⁴¹	ASI 124P, ASI 265P Preparation QAAM 0027 by LEPS (ASI 86E Gamma spec calibration)
	Am ²⁴¹ , Np ²³⁷ and I ¹²⁹	ASI 124P, ASI 265P Preparation QAAM 0053 by LEPS (ASI 86E Gamma spec calibration)



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PLANT CONTROL (cont'd)	<u>Radiochemical and Chemical Analysis (cont'd)</u>	
	Ammonium ion	QAAM 735 by cation chromatography and conductivity detector (Dionex)
	Azide	QAAM 0623 by Spectrophotometry
	Beta Activity; relative to ⁹⁰ Sr/ ⁹⁰ Y	ASI 325P Instrument Operation QAAM 0034 by Geiger Muller Ionisation detector
	C ¹⁴	QAAM 0029 by Liquid Scintillation ASI 42E for instrument operation
Aerial Effluents (Charcoal and Zeolite matrices)	C ¹⁴ + BaCO ₃ Equivalent	QAAM 0411 by Liquid Scintillation ASI 42E for instrument operation
Scrubber Liquors	Carbon	QAAM 0386 by electrolytic titration ASI 472P for instrument operation
Process Liquors	Density	QAAM 0409 by Parr densitometer
Degraded Solvents	Dissolved Solids in Aqueous samples	QAAM 0224 by titrimetry
Plant Solutions	Electrical Conductivity	QAAM 0210 by conductivity meter
Gas Bubblers	Elemental Analysis	QAAM 734 by Perkin Elmer ICP-OES
Plant Effluents	Calcium	
TBP/OK Solutions	Chromium	
	Copper	
	Iron	
	Lead	
	Magnesium	
	Nickel	
	Potassium	
	Sodium	
	Sulphur	
	Uranium	
	Zinc	



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PLANT CONTROL (cont'd) Aerial Effluents (Charcoal and Zeolite matrices) Scrubber Liquors Process Liquors Degraded Solvents Plant Solutions Gas Bubblers Plant Effluents TBP/OK Solutions	<u>Radiochemical and Chemical Analysis (cont'd)</u> Gamma Activity Gamma Emitting Nuclides (Energy range: 130 - 1886keV) Hydroxide, Carbonate and Bicarbonate I^{129} Iron MBP and DBP Moisture Ni^{63} Nitrate, Nitrite, Phosphate and Chloride Nitrite Np^{237} Oxalic Acid	ASI 265P Preparation QAAM 0295 by NaI scintillation detector QAAM 0051 by Gamma Spectrometry (ASI 86E Gamma spec calibration) QAAM 0226 by titrimetry QAAM 0103 and QAAM 53 by LEPS QAAM 0614 by Spectrophotometry QAAM 0669 by Liquid Chromatography QAAM 0116 by heating and gravimetry QAAM 0091 by Liquid Scintillation ASI 42E for instrument operation QAAM 0121 by Ion Chromatography (Dionex) QAAM 0022 by titrimetry QAAM 0590 and QAAM 53 by LEPS QAAM 0298 by titrimetry



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PLANT CONTROL (cont'd)	<u>Radiochemical and Chemical Analysis</u> (cont'd)	
Aerial Effluents Scrubber Liquors Process Liquors Degraded Solvents Plant Solutions Gas Bubblers Plant Effluents TBP/OK Solutions	pH	QAAM 0619 by pH meter
Aerial Effluents (Charcoal and Zeolite matrices) Scrubber Liquors Process Liquors Degraded Solvents	Am ²⁴¹	QAAM 0587 and QAAM 53 by LEPS for Am ²⁴¹
	Pu ²³⁸ , Pu ²³⁹⁺²⁴⁰	QAAM 0726 /QAAM 0746 by alpha spectrometry
Plant Solutions Gas Bubblers Plant Effluents TBP/OK Solutions	Pu ²⁴¹	QAAM 0726 by liquid scintillation ASI 42E for instrument operation
	Sr ⁸⁹ and Sr ⁹⁰	QAAM 0101 by Cerenkov counting ASI 42E for instrument operation QAAM 0723 gamma counting
	Suspended Solids	QAAM 0214 by gravimetry
	TBP (%)	QAAM 0410 by acid equilibrium technique
	TBP	QAAM 0711 by Gas Chromatography
	TBP and OK	QAAM 0711 by Gas Chromatography
	Tc ⁹⁹	QAAM 0102 by Liquid Scintillation ASI42E Instrument operation
	Total Alpha (large area counting-auto)	ASI 53P Preparation QAAM 0514 by Gas proportional counting
	Total Alpha Activity; relative to Pu ²³⁹	ASI 122P Preparation QAAM 0048 by scintillation



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PLANT CONTROL (cont'd) Aerial Effluents (Charcoal and Zeolite matrices) Scrubber Liquors Process Liquors Degraded Solvents Plant Solutions Gas Bubblers Plant Effluents TBP/OK Solutions (cont'd)	<u>Radiochemical and Chemical Analysis (cont'd)</u> Total Beta Activity; relative to Sr ⁹⁰ /Y ⁹⁰ Total Gamma Activity Total Organic Carbon, Inorganic Carbon, Total Carbon (in nitric acid based samples) Uranium Uranium	ASI 123P Preparation QAAM 0049 by Geiger Muller Ionisation Detector ASI 124P Preparation QAAM 0723 by Scintillation QAAM736 by Shimadzu TOC-VCHP TOC analyser QAAM 0692 by Luminescent Spectrometry QAAM 0706 by XRF ASI 390P for instrument operation
Scrubber Liquors Process Liquors Plant Solutions Gas Bubblers	Tritium as tritiated water	QAAM 0099 by Liquid Scintillation ASI 42E for instrument operation
Plant Solutions Plant Effluents	Uranium	QAAM 0755 by Energy Dispersive XRF using a PANalytical Epsilon 3XLE system



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PLANT CONTROL (cont'd) Liquid Effluent and Plant Control samples - aqueous and nitric acid matrix	<u>Radiochemical and Chemical Analysis (cont'd)</u> Aluminium Antimony Arsenic Barium Beryllium Bismuth Boron Cadmium Caesium Chromium Cobalt Copper Europium Gadolinium Indium Iron Lithium Lead Magnesium Manganese Mercury Molybdenum Neptunium Nickel Niobium Ruthenium Selenium Silver Strontium Tantalum Technetium Thorium Tin Titanium Tungsten Uranium Vanadium Zinc Zirconium	QAAM 0538 by PE Elan DRC-II ICP-MS
Aqueous Liquors from Effluent and Pond Waters	Sodium Potassium Magnesium Calcium	QAAM 0754 by ion chromatography



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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used
<p>PRODUCT SPECIFICATION</p> <p>Plutonium Nitrate Plutonium Oxides Mixed Oxide Products Uranium Oxides Uranyl Nitrate (note – specific matrices for each method are detailed in the relevant QAAM)</p>	<p><u>Radiochemical and Chemical Analysis</u></p> <p>Carbon</p> <p>Density</p> <p>Silver Aluminium Boron Barium Beryllium Bismuth Calcium Cadmium Cobalt Chromium Copper Dysprosium Europium Iron Gadolinium Indium Potassium Lithium Magnesium Manganese Molybdenum Sodium Nickel Phosphorus Lead Sulphur Samarium Tin Thorium Titanium Vanadium Tungsten Zinc Tantalum Silicon</p> <p>Free Hydrogen in Solution</p> <p>H/Pu Ratio and Total Hydrogen</p>	<p>QAAM 0300 by Coulomat titration ASI 472P for instrument operation</p> <p>QAAM 0011 by volume and gravimetry</p> <p>ASI 383P Dissolution ASI 355P Extraction QAAM 0681 by ICP-AES ASI 427P for instrument operation</p> <p>QAAM 0231 by titrimetry</p> <p>QAAM 0194 by Elliott cell</p>



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<p>PRODUCT SPECIFICATION (cont'd)</p> <p>Plutonium Nitrate Plutonium Oxides Mixed Oxide Products Uranium Oxides Uranyl Nitrate (note – specific matrices for each method are detailed in the relevant QAAM)</p>	<p><u>Radiochemical and Chemical Analysis</u> (cont'd)</p> <p>Iron</p> <p>Loss on Heating</p> <p>Nitrate</p> <p>Nitrite</p> <p>Nitrogen</p> <p>Non-Uranic Alpha Emitters</p> <p>Np²³⁷</p> <p>Phosphate</p> <p>Total Pu Alpha (Pu²³⁹⁺²⁴⁰)</p>	<p>QAAM 0113 by spectrophotometry</p> <p>QAAM 0685 by gravimetry</p> <p>QAAM 0321 by titrimetry</p> <p>QAAM 0402 by spectrophotometry</p> <p>QAAM 0700 by LECO analyser</p> <p>QAAM 0092 and QAAM 48 by alpha scintillation</p> <p>QAAM 0094 and QAAM 53 by LEPS</p> <p>QAAM 0334 by spectrometry</p> <p>QAAM 0093 and QAAM 48 by alpha scintillation</p>



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<p>PRODUCT SPECIFICATION</p> <p>(note – specific matrices for each method are detailed in the relevant QAAM)</p>	<p><u>Radiochemical and Chemical</u></p>	
	Plutonium	QAAM 0190 by Spectrophotometry
	Pu Isotopic Composition	ASI 383P Dissolution QAAM 0045 by TIMS and MCICP-MS ASI 46E, ASI 74E, ASI 478P for instrument operation ASI 177P for sample mounting
	Silicon	QAAM 0331 by spectrophotometry
	Silicon	QAAM 0105 by spectrophotometry
	Sulphate	QAAM 0323 by titrimetry
	Surface Areas of Powders	QAAM 0192 by thermal conductivity detector
	Uranium	QAAM 0671 by ICP-MS ASI 522P for instrument operation
	Uranium	QAAM 0698 by amperometric titration
	Uranium	QAAMs 543 & 557 by titration ASI 671P for Davies-Gray auto-titration
	Uranium Isotopic Abundance	QAAM 0181 by TIMS and MCICP-MS ASI 46E, ASI 74E, ASI 478P for instrument operation ASI 177P for sample mounting
Uranium Oxides Uranyl Nitrate	Uranium	QAAM 0202 by amperometric titration
Plutonium & Uranium Oxide Powders	Fluoride Chloride Bromide Iodide	QAAM 0389 by pyrohydrolysis and analysis by Ion Selective Electrode



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THORP REAGENT GALLERY (TRG) Chemical Reagents used in TRG	<u>Radiochemical and Chemical Analysis</u> Bicarbonate, Carbonate, Hydroxide Free Acidity Acidity Hydroxylamine Uranium (IV) Uranium	QAAM 0226 by titrimetry QAAM 0231 by titrimetry QAAM 0559 by MgSO ₄ method QAAM 0552 by titrimetry QAAM 0558 by spectrophotometry QAAM 0557 by titrimetry
THORP PLANT SAMPLES	<u>Radiochemical and Chemical Analysis</u> Uranium Suspended Solids	QAAM 0543 by titrimetry QAAM 0569 by gravimetry
END		