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Springfields Fuels Limited

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Testing performed at the above address only

DETAIL OF ACCREDITATION

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used
ENVIRONMENTAL SAMPLES	Chemical/Radiochemical Analysis	Documented In-House Methods designated as Laboratory Manual Methods (LMM)
Atmospheric contaminants on filters	Uranium	LMM2124 by inductively coupled plasma - mass spectrometry LMM7023 for operation of instrument
Filter papers	Alpha and beta activity (relative to Natural Uranium)	LMM2121 by liquid scintillation counting
		LMM 2231 Using a HIDEX 300SL
Groundwater, Surface water/fresh water, Trade effluent (to controlled water)	Uranium	LMM1993 and LMM2016 by X-ray fluorescence spectrometry
	Uranium-235	LMM2176 by mass spectrometry, LMM7024 for operation of instrument
	Low level uranium	LMM2115 by inductively coupled plasma - mass spectrometry LMM7023 for operation of instrument
	Alpha Emitters: Thorium Isotopes: Th232, Th230 and Th228, Plutonium and Americium Isotopes: Pu-238, Pu239, Pu240, Am241, Uranium Isotopes: U238, U235 and U234 and Total Sum of Alpha Activity from nuclides listed	LMM1960 by alpha spectrometry LMM2206 for Electrodeposition

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used
ENVIRONMENTAL SAMPLES (cont'd)	Chemical/Radiochemical Analysis (cont'd)	Documented In-House Methods designated as Laboratory Manual Methods (LMM)
Groundwater, Surface water/fresh water, Trade effluent (to controlled water) (cont'd)	Total alpha/beta activity (relative to Natural Uranium)	LMM2121 by liquid scintillation counting
	Polonium-210	LMM1955 by alpha spectrometry
	Protactinium-231, Thorium-234 & Protactinium-234m, or other Gamma emitters 59.5-1836 keV	LMM2171 by gamma spectrometry LMM2195 for QC procedure LMM2196 for background measurement
	*Trace metals (excludes Na, Mg, Al, K and Ca in trade effluents) Technetium-99 Neptunium-237 Gadolinium (only in trade effluents)	LMM2158 for sample preparation and analysis by inductively coupled plasma - mass spectrometry and LMM7023 or LMM7040 for operation of instrument
	Fluorine	LMM2042 by ion selective electrode
	Ammonia	LMM2088 by ion selective electrode
	pH	LMM2186 by ion selective electrode
	Suspended solids	LMM1209 by gravimetry
	Chemical Oxygen Demand (COD)	LMM2181 by chemical method (palintest)
	Fluoride, Bromide, Chloride, Nitrite, Nitrate, Phosphate and Sulphate	LMM2228 by ion chromatography

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used
ENVIRONMENTAL SAMPLES (cont'd)	Chemical/Radiochemical Analysis (cont'd)	Documented In-House Methods designated as Laboratory Manual Methods (LMM)
Grass, soil, sediment, leafy vegetables, shellfish	Uranium	LMM2129 by inductively coupled plasma - mass spectrometry (including freeze-dried samples) LMM7023 for operation of instrument
	Gamma emitters Energy Range: (59.5 keV to 1836 keV)	LMM1979 by gamma spectrometry LMM2195 for QC procedure LMM2196 for background measurement
	Alpha emitters: Thorium isotopes: Th232, Th230 and Th228	LMM2090 by alpha spectrometry LMM2206 for Electrodeposition
Stack emissions	Fluorine	LMM2042 by ion selective electrode
MEDICAL SAMPLES Urine (human)	Uranium	LMM2136 by inductively coupled plasma - mass spectrometry LMM7023 for operation of instrument
	Creatinine	LMM2001 by colorimetry
	Mercury and nickel	LMM2158 for sample preparation and analysis by inductively coupled plasma - mass spectrometry and LMM7023 or LMM7040 for operation of instrument
	Fluorine	LMM2042 by ion selective electrode

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used
METALS, ALLOYS and CERAMICS	Metallurgical, Mechanical and Physical Tests	Documented In-House Methods designated as Laboratory Manual Methods (LMM)
AGR Daily Destruction Pin	Grain size, weld condition and dimensions, surface condition, hardness	LMM2149, ASTM E112-13 by metallography, and Vickers hardness testing to BS EN ISO 6507-1:2005
AGR Recovery welds	Weld condition and dimensions	LMM2197 by metallography
The examination of AGR RSW samples	Weld condition and dimensions	LMM2190 by metallography
Zirconium Alloys (Typically fuel rod girth, seal welds and control coupons)	Corrosion Assessment	LMM2097 and LMM7030, ASTM G2/G2M-06 (2019) by autoclave and stereomicroscopy
Zirconium Alloys (Typically 'upper' and 'lower' girth welds and seal weld samples)	Preparation and metallurgical examination	LMM2096 by microscopy
Non-routine samples	Grain size	LMM2207, ASTM E112-13 by metallography
AGR End caps	Depth and position of laser marks	LMM2187 by metallography and depth measurement by differential focussing
AGR grid to lug welds	Weld condition and dimensions	LMM2184 by metallography
Uranium dioxide fuel pellets	Grain size	LMM1862, ASTM E112-13 for examination by metallography LMM2072 for preparation
Uranium dioxide fuel pellets	Porosity by comparison (AGR) and image analysis	LMM2053 by metallography and image analysis
	Inclusions	LMM2211 by microscopy
Uranium dioxide powder U_3O_8 powder	Particle size	LMM2201 by laser diffraction (Malvern Mastersizer 2000E)
OTHERS Metal samples	Vickers hardness HV0.2, HV0.3, HV0.5, HV1, HV2, HV10 and HV30	LMM2068 by Vickers hardness test to BS EN ISO 6507-1:2005

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used
PLANT PRODUCTS/RAW MATERIALS (GENERAL)	Chemical/Radiochemical Analysis	Documented In-House Methods designated as Laboratory Manual Methods (LMM)
Dilute hydrofluoric acid	Uranium	LMM2016 by X-ray fluorescence spectrometry
Dilute hydrofluoric acid	Hydrofluoric acid	LMM1719 by titrimetry
Dilute hydrofluoric acid	Residue at 800°C	LMM1515 by gravimetry
RAW MATERIAL SPECIFICATION AND URANIUM PRODUCT	Chemical/Radiochemical Analysis	
Uranium Compounds/Oxides	Uranium isotopes U-233, U-234, U-235, U-236 and U-238	LMM2176 by mass spectrometry LMM7024 for operation of instrument
Uranium Compounds/Oxides Uranium Liquors (Uranium Nitrate and Uranium Hexafluoride)	*Trace metals	LMM2180 for sample preparation and analysis by inductively coupled plasma - mass spectrometry and LMM7023 or LMM7040 for operation of instrument
Uranium Compounds/Oxides Uranium Hexafluoride (UF6)	Uranium assay	LMM1996, by X-ray fluorescence spectrometry
Uranium Liquors (Uranium Nitrate and Uranium Hexafluoride)Uranium Oxide Powders/Pellets Pure Uranium Metal	*Trace metals	LMM2221 for analysis by inductively coupled plasma - mass spectrometry and LMM7023 or LMM 7040 for operation of instrument
	Silicon Technetium-99	LMM2222 for sample preparation and analysis by inductively coupled plasma - mass spectrometry and LMM7023 or LMM 7040 for operation of instrument
	Sodium Potassium	LMM2223 for sample preparation and analysis by inductively coupled plasma - mass spectrometry and LMM7023 or LMM 7040 for operation of instrument

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used
RAW MATERIAL SPECIFICATION AND URANIUM PRODUCT (cont'd)	Chemical/Radiochemical Analysis (cont'd)	Documented In-House Methods designated as Laboratory Manual Methods (LMM)
Uranium Oxides/Pellets	Aluminium	LMM2106 for sample preparation and analysis by inductively coupled plasma - mass spectrometry and LMM7023 or LMM 7040 for operation of instrument
Uranium Compounds/Oxides Uranium Liquors (Uranium Nitrate and Uranium Hexafluoride)	Thorium-230	LMM2180 for sample preparation and analysis by inductively coupled plasma - mass spectrometry and LMM7023 or LMM7040 for operation of instrument
	Neptunium-237	LMM2120 for sample preparation and analysis by inductively coupled plasma - mass spectrometry and LMM7023 or LMM7040 for operation of instrument
Uranium Compounds/Oxides Uranium Hexafluoride (UF6)	Carbon	LMM2146 by combustion
	Sulphur	LMM2146 by combustion
	Water content	LMM2049 by Karl Fischer titration
Uranium Compounds/Oxides	Nitrogen	LMM2094 by combustion
Sintered Uranium Dioxide Pellets	Uranium	LMM2205 by gravimetry
Sintered Uranium Dioxide Pellets	Hydrogen	LMM2212 by combustion
Uranium Compounds/Oxides	Particle size analysis	LMM1622 by gravimetric method
Uranium Compounds/Oxides	Specific surface area (powders)	LMM2172 by Nitrogen absorption employing the BET model
Uranium Compounds/Oxides Uranium Metals	Fluoride	LMM2042 by ion selective electrode

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used
RAW MATERIAL SPECIFICATION AND URANIUM PRODUCT (cont'd)	Chemical Analysis/Physical Tests (cont'd)	Documented In-House Methods designated as Laboratory Manual Methods (LMM)
Uranium Oxides Uranium Metals Uranium Hexafluoride (UF_6)	Phosphorus	LMM2103 by absorptiometry
Uranium Oxides Uranium Metals	Chloride	LMM2080 by turbidimetry
Uranium Oxide sintered pellets and powders	Oxygen/Uranium ratio	LMM2141 by amperometry
Uranium Oxide powders	Oxygen/Uranium ratio	LMM2081 by amperometry
Uranium Compounds/Oxides	Pour and tap density	LMM1385, LMM1576 by physical tests
Uranium Hexafluoride	Hydrocarbon and halocarbon impurities	LMM1463 by infra-red spectroscopy
Uranium Hexafluoride Uranium Nitrate Liquors	Non-Uranic Isotopes: Plutonium and Americium isotopes: Pu239, Pu240, Pu238, Am241	LMM2125 by alpha spectrometry LMM2206 for Electrodeposition
Uranium Hexafluoride	Plutonium-241	LMM2093 by liquid scintillation counting LMM2125 for sample preparation
	Uranium-232	LMM2153 by alpha spectrometry
	Fission product isotopes: Nb95, Zr95, Ru103, Ru106, Sb125, Cs134, Cs137, Ce141, Ce144, Co60 and Pa233	LMM2061 by High resolution gamma spectrometry LMM2195 for QC procedure LMM2196 for background measurement
Uranium Oxides, Dried Organic Matter and Plastics	Fluoride	LMM2227 by Combustion Ion Chromatography
Uranium oxides and plastics	Chloride	LMM2227 by Combustion Ion Chromatography

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used
INORGANIC and ORGANIC MATERIAL WASTE MATERIALS and RESIDUES	Chemical Analysis/Physical Tests	Documented In-House Methods designated as Laboratory Manual Methods (LMM)
Nitric acid soluble Uranium from waste materials/residues	Uranium	LMM2003 by X-ray fluorescence spectrometry
Uranium from waste materials/residues by fusion	Uranium	LMM2056 by X-ray fluorescence spectrometry
Uranium in solvents and oils	Uranium	LMM1993 & LMM2016 by X-ray fluorescence spectrometry
Uranium from waste materials/residues Uranium in solvents and oils Nitric acid soluble Uranium	Uranium-234, Uranium-235, Uranium-236	LMM2176 by mass spectrometry, LMM7024 for operation of instrument
END		

APPENDIX 1

*Trace metals and rare earth elements covered by these methods

Analyte	2158	2180	2221
Aluminium	√		√
Antimony		√	
Arsenic	√	√	
Barium		√	
Beryllium		√	
Bismuth		√	
Boron		√	
Cadmium	√	√	
Caesium			
Calcium	√		√
Cerium			
Chromium	√		√
Cobalt	√		√
Copper	√		√
Dysprosium		√	
Erbium			
Europium		√	
Gadolinium		√	
Gallium			
Germanium			
Gold			
Hafnium		√	

Holmium			
Indium		√	
Iridium			
Iron	√		√
Lanthanum			
Lead	√	√	
Lithium		√	
Lutetium			
Magnesium	√		√
Manganese	√		√
Mercury	√		
Molybdenum			√
Neodymium			
Neptunium	√		
Nickel	√		√
Niobium		√	
Osmium			
Palladium			
Phosphorus			
Platinum			
Potassium	√		
Praseodymium			
Rhenium		√	
Rhodium			
Rubidium			
Ruthenium		√	
Samarium		√	
Scandium			
Selenium			
Silicon			
Silver		√	
Sodium	√		
Strontium		√	
Tantalum		√	
Technetium	√		
Tellurium			
Terbium			
Thallium		√	
Thorium	√	√	
Thulium			
Tin		√	
Titanium		√	
Tungsten		√	
Uranium			
Vanadium	√	√	
Ytterbium			
Yttrium			
Zinc	√		√
Zirconium		√	