

REQUIREMENT SPECIFICATIONS

1) General Requirements

- 1.1 The Requirement Specifications shall be read in conjunction with the Conditions of Contract and all other documents included in this Contract. The Contractor shall be bound by all Contract Documents referred to in the Tender and shall be deemed to have made himself acquainted with all such documents before tendering for the Contract, as no claims for lack of knowledge in this respect will be entertained.

2) Contract Specifications

- 2.1 This Contract is called for the supply, delivery, installation and commissioning, including training, of the following chemical analytical equipment to the Environmental Health Institute (EHI). The Contract shall commence tentatively in January 2020. Actual date of commencement and duration of the Contract shall be stated in the electronic Letter of Acceptance.

S/N	Item Description	Quantity	Post-Warranty Comprehensive Service
Firm Requirement			
1	Equipment 1 GC-QHRAMS comprising: • Gas Chromatography; • Quadrupole High Resolution Accurate Mass Spectrometer Hybrid System; • Autosampler; • Olfactometry Detector (ODP); • Thermal Desorption (TD) Unit; and • all necessary accessories	1 unit	3 years
2	Equipment 2 GC-MS comprising: • Gas Chromatography; • Liquid Autosampler; • Headspace & SPME Autosampler; • Mass Spectrometer; • Flame Ionisation Detector System; and • all necessary accessories	1 unit	3 years
3	Equipment 3 LC-QHRAMS comprising: • Liquid Chromatography; • Liquid Autosampler; • Quadrupole High Resolution Accurate Mass Spectrometer Hybrid System; and • all necessary accessories	1 unit	3 years
4	Equipment 4	1 unit	3 years

Part 2: Requirement Specifications

S/N	Item Description	Quantity	Post-Warranty Comprehensive Service
	ICP-MS/MS comprising: - Inductively Coupled Plasma Tandem Mass Spectrometer System; and - all necessary accessories		
Optional Requirement			
5	Nitrogen Phosphorous Detector for GC-MS equipment	1 unit	Not applicable
6	Thermostatted autosampler for LC-QHRAMS equipment	1 unit	Not applicable

- 2.2 The price quoted shall include all expenses such as labour, materials and transport cost necessary to complete the Contract. Any additional claims from the Contractor will not be entertained.
- 2.3 The Contract shall be awarded in full to one successful Tenderer. Tenderer shall quote for all items (including the optional requirement) to be considered for award.
- 2.4 Tenderer shall comply with Clause 5 of Part 1 Section A: Instructions to Tenderers. The Agency will not consider terms and conditions different from what was stipulated in the Agency's tender documents.
- 2.5 In the event that a tenderer quotes third parties' peripheral products, the tenderer supplying this hybrid system shall be the contact point for all matters. The Contractor is responsible for any matter for this tender and after sales service, support and maintenance. This is to ensure proper communication among all parties.
- 2.6 The awarded tenderer for this contract shall work together with the Agency's appointed contractor for the facility renovation to ensure that all necessary site preparation is carried out to facilitate proper operation and maintenance of the four analytical equipment to be installed under this contract.
- 2.7 The four analytical equipment shall be delivered, installed and commissioned within four months from the issuance of the Purchase Order (PO).
- 2.8 The Contractor shall provide a printer and set up a local network to establish the connection of the desktops of the four analytical equipment to the printer for double-sided printing and provision of at least one set of toner cartridge for the printer.
- 2.9 Tenderers shall provide the completed Compliance Tables from Section 3 (Equipment Requirements) of the Requirement Specifications. Published brochures and/ or certified technical specifications of the quoted equipment shall be provided in tender submission to substantiate claims to compliance with tender specifications. **The Agency reserves the right to reject any tender submitted without the completed Compliance Table.**

a) "Yes"

Where the proposal is in complete conformance with the explicit requirements of the Equipment Requirements

b) “No”

Where the proposal varies from the explicit requirements of the Equipment Requirements.

3) Equipment Compliance Tables

3.1 COMPLIANCE TABLE FOR EQUIPMENT 1: GC-QHRAMS

Equipment 1: GAS CHROMATOGRAPHY – QUADRUPOLE HIGH RESOLUTION ACCURATE MASS SPECTROMETER, OLFACTOMETRY DETECTOR AND THERMAL DESORPTION UNIT HYBRID SYSTEM (GC-QHRAMS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	The GC-QHRAMS shall be supplied and installed with the following modules and services: 1. Column Oven 2. Split/Splitless Inlet 3. Autosampler 4. Quadropole High Resolution Accurate Mass Spectrometer Hybrid system 5. Olfactory Detector (ODP) 6. Thermal Desorption (TD) 7. Nitrogen Generator (if required) 8. Data Management System 9. Installation, Warranty and Maintenance 10. Training 11. Other Requirements		
1.	Column Oven with the following specifications:		
	1. Operating temperature range shall be minimally in the range of 5 °C to 450 °C.		
	2. Shall allow at least 20 oven ramps and 21 plateaus. Negative ramps shall be allowed.		
	3. Oven shall be able to cool down from 450 °C to 50 °C in less than 250s.		
2.	Split/Splitless Inlet with the following specifications:		
	1. Pressure range shall be between 0 to 100 psi or larger.		

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Equipment 1: GAS CHROMATOGRAPHY – QUADRUPOLE HIGH RESOLUTION ACCURATE MASS SPECTROMETER, OLFACTOMETRY DETECTOR AND THERMAL DESORPTION UNIT HYBRID SYSTEM (GC-QHRAMS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	2. Auto pressure regulation for Split/Splitless Inlet shall be adjustable from 0.001 psi with septum purge.		
	3. Inlet shall have backflush capabilities.		
	4. Inlet shall be suitable for all capillary columns (50 µm to 530 µm internal diameter) and accommodate a split ratio of up to 7500:1 or better.		
	5. Maximum operating temperature shall be at least 400 °C and above.		
	6. Timed closure and opening of the purge line shall be allowed.		
	7. Inlet shall have a gas saver mode to reduce gas consumption without affecting performance.		
	8. The electronic pneumatic control for Inlet and Detectors of the GC shall have selectable pressure units (psi, kPa or bar), carrier and makeup gas types, such as Helium, Hydrogen, Nitrogen or Argon/Methane.		
3.	Autosampler with the following specifications: 1. The capacity of the sampler shall be able to hold at least 160 sample vials.		
	2. The syringe shall support up to 100 µL with standard syringe carriage.		
4.	Quadrupole High Resolution Accurate Mass Spectrometer Hybrid System with the following specifications: 1. Electron Ionization (EI) source shall be supplied.		
	2. Ion source temperature shall have an adjustable range of at least 100 to 350 °C.		
	3. Quadrupole mass axis stability shall be at ±0.1 Da or better over 12 hours.		
	4. Quadrupole isolation mass shall have a range of at least 20 to 1,050 m/z		
	5. The mass range and spectral acquisition range shall be at least m/z 30-3,000 (inclusive).		

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Equipment 1: GAS CHROMATOGRAPHY – QUADRUPOLE HIGH RESOLUTION ACCURATE MASS SPECTROMETER, OLFACTOMETRY DETECTOR AND THERMAL DESORPTION UNIT HYBRID SYSTEM (GC-QHRAMS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	6. The system shall have a spectral acquisition rate that is selectable from at least 1 –18 spectra/sec.		
	7. System shall have dynamic range of at least 10 ⁵ .		
	8. System shall be able to detect 60 fg or less of octofluoronaphthalene (OFN) that is statistically derived at a 99% confidence level of 8 sequential splitless injections of 1 µL, 100 fg/µL OFN at m/z 271.9867.		
	9. System shall have a resolution (full width at half height) of at least 25,000 at m/z 271.9867 from a splitless injection of 1 pg OFN.		
	10. System shall have an average mass error of <3 ppm RMS m/z at 271.9867 from 8 sequential splitless injections of 1 pg OFN.		
5.	Olfactory Detector (ODP) with the following specifications:		
	1. The olfactometer module shall be able to communicate with the other modules of GC-QHRAMS system.		
	2. The ODP shall allow simultaneous detection of compounds at the nose and at the MS detector. Any accessory that is needed to achieve simultaneous detection shall be included.		
	3. Recorder software shall be integrated into the GC-QHRAMS system software for the identification of components by superimposing olfactograms and MS chromatograms.		
	4. Olfactory pad shall be integrated to allow recording of olfactory events at different odour intensity levels with voice recording and allows voice to text processing.		
	5. ODP shall be capable of meeting these requirements minimally: i. Humidifier to provide humidified gas to avoid condensation; ii. Transfer line temperature: not exceeding 325 °C; iii. Temperature control from GC.		
	6. Olfactory recorder software shall be installed, which is compatible with the ODP, GC-QHRAMS operating software and Windows operating system.		

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Equipment 1: GAS CHROMATOGRAPHY – QUADRUPOLE HIGH RESOLUTION ACCURATE MASS SPECTROMETER, OLFACTOMETRY DETECTOR AND THERMAL DESORPTION UNIT HYBRID SYSTEM (GC-QHRAMS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
6.	Thermal Desorption (TD) with the following specifications:		
	1. The TD unit shall be able to communicate with the other modules of the GC-QHRAMS system and be compatible with the entire TD application range.		
	2. It shall be possible to analyse compounds ranging in volatility from C ₂ to n-C ₄₄ hydrocarbons plus labile compounds, such as mercaptan and CS gas (which require low flow path temperatures) on the same system, without modification.		
	3. Fully automated sequencing shall be allowed for tubes and canisters/bags.		
	4. Multi-tube (up to 100) automated desorption with automated re-collection of trap desorption (outlet) split flow using a single autosampler.		
	5. The TD unit shall allow the automatic sampling of canister/bag, to be able to sample up to 14 canisters/bags for the monitoring of C ₂ -C ₁₄ . Manual re-collection of outlet split from canister/bag samples shall be allowed.		
	6. The single-tube thermal desorber shall be capable of desorption of single tubes, monitoring of C ₂ -C ₄₄ and reactive species, and manual re-collection of inlet and outlet split flows.		
	7. The cold trap shall be made of quartz, with 2 mm i.d. where packed and 0.9 mm i.d. at the sample input/output end.		
	8. The system shall allow the trap to be independently heated for conditioning purposes and for obtaining a sample blank.		
	9. The sample flow path shall be adjustable in minimally 1 °C increments, with the temperature range of the valve ranging from 50 °C to 210 °C and the transfer line shall be in the range of 50 °C to 250 °C.		
	10. The sample flow path shall support uniform heating, and be constructed entirely of inert materials such as, PTFE, quartz, inert-coated stainless steel and uncoated, deactivated fused silica.		

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		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	11. The tube desorption oven shall be able to be heated at a range of 35 °C to 425 °C, adjustable in minimally 1 °C increments.		
	12. Desorption time shall be in the range of 0 to 600 minutes, adjustable in minimally 0.1 min increments.		
	13. The TD unit shall be compatible with 3.5 inch and 4.5-inch long sorbent tubes.		
	14. Trap heating rates shall reach up to 100 °C/s and backflush desorption combine to facilitate operation at flows below 2 mL/min.		
	15. Single and double splitting options shall be available and <0.1% carryover is tolerated to ensure compatibility with samples over a wide concentration range.		
	16. Quantitative re-collection of both tube and trap desorption split flow to allow repeat analysis.		
	17. The TD system shall offer the option of an elevated temperature tube and trap purge during standard 2-stage tube desorption for selective elimination of water and unwanted volatiles prior to analysis.		
	18. The TD unit shall be compatible with water management accessory.		
	19. The water management accessory shall be included with the following features: i. Water removal trap shall be able to operate from -30 °C to 50 °C with uniform electrical cooling. ii. Water removal trap shall be able to trap high temperature from 35 °C to 425 °C with uniform heating. iii. Compatible with gas-phase samples ranging in pressure from below atmospheric pressure to 50 psig iv. Seamless integration with thermal desorption unit and GC-QHRAMS system.		
	20. The TD unit shall be connected to the GC inlet that has a back pressure-regulated electronic pneumatic module. This can be used to provide electronic carrier gas control through the entire GC-QHRAMS analyser.		

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Equipment 1: GAS CHROMATOGRAPHY – QUADRUPOLE HIGH RESOLUTION ACCURATE MASS SPECTROMETER, OLFACTOMETRY DETECTOR AND THERMAL DESORPTION UNIT HYBRID SYSTEM (GC-QHRAMS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	21. GC remote cable connections shall be able to support automatic start of the entire analytical system when the cold trap desorbs, and allows the system to check the “ready” status of the analyser and associated data handling. The cold trap will not desorb unless and until it receives a ‘ready’ signal from the GC-QHRAMS system.		
	22. A canister rack shall be included, which can accommodate up to 15 canisters of volumes 1 L to 6 L with necessary tubings and fittings.		
7.	Nitrogen Generator with the following specifications:		
	1. A nitrogen generator shall be included if the nitrogen gas usage during sample analysis is greater than 6 L/min. The nitrogen generator shall be compatible with the GC-QHRAMS equipment.		
	2. The nitrogen generator shall be capable of supporting a flow rate of 70 L/min at 8 bar for the smooth operation of GC-QHRAMS equipment.		
	3. Nitrogen purity shall be greater than 98.5% to ensure the smooth operation of GC-QHRAMS system.		
8.	Data Management System		
	System control, data acquisition and operating software		
	1. Equipment 1, 2 and 3 shall share the same operating and data analysis software.		
	2. Full software control on the operation of the GC, QHRAMS, TD, and ODP and autosampler for method and run control, online signal display, data handling, evaluation, reporting and system diagnostics.		
	3. There shall be a unified software platform for data acquisition and data analysis.		
	4. The latest edition of the National Institute of Standards and Technology (NIST) spectral library shall be installed with capability to install other libraries if necessary.		
	5. Software shall support small molecule unknown screening with the following features: theoretical fragmentation of parent to annotate daughter ions, finding transformed		

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		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	compounds, sub-structure search against Mass Spectral (MS) library.		
	6. Software to support quantitative analysis and compound identification by accurate mass, and isotope pattern		
	7. Able to acquire data, integrate, review and report on an actively running sample with snapshot or real-time monitoring function.		
	8. Shall include the following features: i. User-defined flags for different parameters ii. Automatically generate reports iii. Extract chromatograms iv. Supports single analysis and batch analysis v. View and extract peak spectra vi. Auto and manual integration of the peaks vii. Identify compounds through library search		
	9. Shall have the ability to create accurate mass libraries.		
	10. Computer: The computer controlling and operating the system shall minimally consist of the following configuration or its equivalent or better, with standard warranty. i. Installed with Windows Operating System. ii. Shall include at least one monitor (at least 21" display). iii. Shall include a 10 gigabit Ethernet (10GbE) connection for MS data. iv. Shall include program software and at least 1 TB hard drives for data storage. v. Shall include a Graphic Card and Sound Card. vi. Shall come with US/International (QWERTY) USB Keyboard and USB optical mouse. vii. Microsoft Office – latest version pre-installed with installation CD included viii. Shall have all computer interfaces, cables and software drivers.		

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		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
9.	Installation, Warranty and Maintenance		
	A) Installation:		
	1. A factory test specification to be accompanied with equipment delivery. Declaration of conformity shall be provided to certify the equipment has passed electrical and safety tests.		
	2. Installation and commissioning of all the equipment supplied shall be performed by qualified and factory certified service engineers to the satisfaction of the Agency.		
	3. Performance acceptance test of all the supplied equipment commissioning shall be based on reproducibility of factory test specification and equipment performance validation report.		
	B) Warranty and Maintenance:		
	<u>During the Warranty Period, the following shall apply:</u>		
	1. All the equipment and accessories supplied including the GC-QHRAMS system shall come with at least 12-month warranty after successful commissioning.		
	2. All user queries during the warranty period shall be attended to by certified service engineers within two working days.		
	3. During the warranty period, minor repairs that do not require part replacement shall be resolved within three working days. Major repairs requiring part replacement shall be completed within 10 working days upon receipt of replacement parts. All repairs shall be carried out by certified service engineers to the satisfaction of the Agency.		
	4. There shall be at least one or more full Preventive Maintenance (PM) as recommended by the manufacturer before the end of the warranty period. PM kit shall be deemed to be included in the tendered price.		

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Equipment 1: GAS CHROMATOGRAPHY – QUADRUPOLE HIGH RESOLUTION ACCURATE MASS SPECTROMETER, OLFACTOMETRY DETECTOR AND THERMAL DESORPTION UNIT HYBRID SYSTEM (GC-QHRAMS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	<u>Comprehensive Service Package:</u> 1. The Tenderer shall quote for a post-warranty three-year comprehensive service to be provided by certified service engineers. The service shall include all the equipment and accessories in the GC-QHRAMS system. The service shall cover PM as recommended by the manufacturer, unlimited service support inclusive of repairs and parts replacement.		
	2. The PM service, inclusive of the PM kit, shall be carried out at least once a year and shall, consist of: i. Routine maintenance of the Equipment, including but not limited to the testing of functions and inspecting of the condition of the Equipment to keep the Equipment safe for use and in good working order; and ii. Adjustment and/or repair of any defect in or malfunction of the Equipment discovered by the Contractor's representatives during the course of routine maintenance checks.		
	3. The comprehensive maintenance shall include: i. Hardware and software telephone support; ii. At least one annual onsite PM; iii. Unlimited onsite repair visits (travel & labour) at no extra costs to the Agency.		
	4. Consumables/Supplies required for repairs including liners, seals, tubing, assemblies, and multipliers shall be provided at no extra costs to the Agency.		
	5. The comprehensive service shall cover the cost of manpower, supply of replacement parts, if required, and installation of the replacement parts.		
	6. All user queries during the comprehensive service contract period shall be attended to by certified service engineers within two working days.		
	7. PM shall be scheduled within two weeks from the date of purchase order (PO). The PM service shall be completed within three working days .		

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Equipment 1: GAS CHROMATOGRAPHY – QUADRUPOLE HIGH RESOLUTION ACCURATE MASS SPECTROMETER, OLFACTOMETRY DETECTOR AND THERMAL DESORPTION UNIT HYBRID SYSTEM (GC-QHRAMS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	8. During the Contract period, minor repairs that do not require part replacement shall be resolved within 3 working days . Major repairs requiring part replacement shall be completed within 10 working days on receipt of the replacements parts. All repairs shall be carried out by certified service engineers to the satisfaction of the Agency.		
	9. Parts and repair services for the associated computer and printer: In the scenario that the associated computer and printer are faulty and parts are obsolete/ no longer available, the Contractor shall be responsible to provide replacements at no additional cost to the Agency during the warranty period and post-warranty PM period.		
10.	Training 1. The Contractor shall provide onsite application support and consultation for up to 10 days within a year after successful commissioning of the Equipment.		
	2. The Contractor shall provide at least three days of onsite customised training to at least five personnel within a year after successful commissioning of the Equipment.		
11.	Other Requirements: 1. Tenderer shall submit product brochures/catalogues for evaluation upon request.		
	2. Tenderer shall submit training certificates of service engineers upon request.		
	3. Tenderer shall comply with Clause 5 of Part 2 – Instructions to Tenderers. The Agency will not consider terms and conditions different from what was stipulated in the Agency's tender documents.		

Part 2: Requirement Specifications

3.2) COMPLIANCE TABLE FOR EQUIPMENT 2: GC-MS

Equipment 2: GAS CHROMATOGRAPHY, LIQUID AUTOSAMPLER, HEADSPACE & SPME AUTOSAMPLER, MASS SPECTROMETER, AND FLAME IONISATION DETECTOR HYBRID SYSTEM (GC-MS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	The GC-MS shall be supplied and installed with the following modules and services: 1. Column Oven 2. Split/Splitless Inlet 3. Liquid, Headspace and SPME Autosampler 4. Mass Spectrometer 5. Flame Ionization Detector (FID) 6. Hydrogen Generator 7. Data Management System 8. Installation, Warranty and Maintenance 9. Training 10. Other Requirements 11. Option to Purchase		
1.	Column Oven with the following specifications:		
	1. Operating temperature range shall be minimally from 5°C to 450 °C		
	2. Shall allow at least 20 oven ramps and 21 plateaus.		
	3. Oven shall be able to cool down from 450 °C to 50 °C in less than 250 s.		
	4. The GC shall have a hydrogen safety shutdown system that monitors the hydrogen flow and shuts down the gas flows if a leak is detected.		
2.	Split/Splitless Inlet with the following specifications:		
	1. Dual injector ports shall be equipped for independent dual column usage.		
	2. The following injection modes shall be available: Split, Splitless.		

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Equipment 2: GAS CHROMATOGRAPHY, LIQUID AUTOSAMPLER, HEADSPACE & SPME AUTOSAMPLER, MASS SPECTROMETER, AND FLAME IONISATION DETECTOR HYBRID SYSTEM (GC-MS)		Compliance Status	
		Tick box if Yes	Tick box if No
	3. Auto pressure regulation for Split/Splitless Inlet shall be at least 0.001 psi with septum purge.		
	4. Pressure range shall be within the range of 0 to 100 psi or larger.		
	5. Inlet shall have backflush capabilities.		
	6. Inlet shall be suitable for all capillary columns (50 µm to 530 µm id).		
	7. Inlet shall be able to accommodate split ratio of up to 7500:1 or above.		
	8. Electronic pressure/flow control shall be integrated.		
	9. Maximum operating temperature shall be 400 °C or above.		
	10. Timed closure and opening of the purge line shall be allowed.		
	11. Gas saver mode shall be integrated to reduce gas consumption without affecting performance.		
	12. The electronic pneumatic control for Inlet and Detectors of the GC shall have selectable pressure units (psi, kPa or bar), carrier, and makeup gas types, such as Helium, Hydrogen, Nitrogen or Argon/methane.		
3.	Liquid, Headspace and Solid-Phase Microextraction (SPME) Autosampler with the following specifications:		
	1. The autosampler shall have the capability to perform liquid injection, headspace injection and SPME injection within a single autosampler.		
	2. The autosampler shall be able to handle large volume injection of up to 10 mL.		
	3. The autosampler shall allow configurations capable of multiple injection modes; switching from one configuration to the other shall be automatic and fully unattended.		
	4. Exchange of tool modules such as syringe modules shall be automatic.		

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Equipment 2: GAS CHROMATOGRAPHY, LIQUID AUTOSAMPLER, HEADSPACE & SPME AUTOSAMPLER, MASS SPECTROMETER, AND FLAME IONISATION DETECTOR HYBRID SYSTEM (GC-MS)		Compliance Status	
		Tick box if Yes	Tick box if No
5.	The autosampler shall be able to automatically perform the following operations: i. Sample dilution, with a different liquid present in a vial or solvent reservoir installed on the autosampler; ii. Standard dilution, to prepare a calibration curve; iii. Standard addition to add internal standards to a sample; iv. Liquid standard addition to headspace vials, prior the injection; and v. Sample derivatization, prior to injection, including incubation steps.		
	6. The autosampler shall allow installation of two different needle length syringes.		
	7. The autosampler shall be capable of achieving multiple solvent washing of at least four different solvents.		
	8. The incubation oven or agitator module shall have at least six vial positions capable of heating from 40 °C to 200 °C with agitation.		
	9. For SPME, the autosampler shall have a fiber conditioning station with conditioning temperature up to 350 °C or above.		
	10. The autosampler shall be controlled from software system installed in the PC.		
	11. The autosampler shall be able to house at least 45 samples for headspace vials of 10 or 20 mL.		
	12. The autosampler shall be able to house at least 162 of 2 mL liquid sample vials.		
4.	Mass Spectrometer with the following specifications:		
	1. The system shall offer non-coated, and inert electron ionization (EI) source. The EI source shall be capable of operating in 70 eV.		
	2. Ion source temperature shall have a range of at least 150-350 °C.		
	3. The system shall be equipped with a quadrupole mass filter.		
	4. The system shall have a minimum mass range of m/z 2.0 – 1050.0.		
	5. The system shall have an electronic scan rate of up to 20,000 u/sec or better.		

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Equipment 2: GAS CHROMATOGRAPHY, LIQUID AUTOSAMPLER, HEADSPACE & SPME AUTOSAMPLER, MASS SPECTROMETER, AND FLAME IONISATION DETECTOR HYBRID SYSTEM (GC-MS)		Compliance Status	
		Tick box if Yes	Tick box if No
	6. Mass axis stability shall be better than 0.10 amu/48 h.		
	7. The system shall have at least the following scan modes: Full scan (FS), single ion monitoring (SIM), alternating Full Scan/SIM (simultaneous within a single injection).		
	8. 2 filaments shall be available in ion source to allow automatic switching when one fails to minimize downtime.		
	9. Electron ionization scan sensitivity: 1 pg OFN gives > 300:1 signal-to-noise ratio scanning from 50 – 300 amu at nominal m/z 272 ion.		
	10. Mass accuracy: 1 µL injection of a 100 pg/µL (OFN) standard scanning from 50-300 amu will give its monoisotope at m/z 272.0 with accuracy within ± 0.1.		
	11. Electron ionization instrument detection limit not more than 10 fg (at 99% confidence level based from area of precision of eight sequential splitless injections of OFN).		
	12. A splitter shall be installed to connect one injector inlet to two detectors.		
5.	1. Flame Ionization Detector (FID) with the following specifications: Minimum detectable level shall be <1.4 pg C/s (tridecane)		
	2. Maximum operating temperature shall be at least 450 °C.		
	3. The FID shall provide flameout detection and automatic re-ignition which can be controlled by the keypad or operating software.		
	4. Data acquisition speed shall be at least 300 Hz.		
	5. Linear dynamic range shall be at least 10 ⁷ .		
	6. The FID shall have electronic flow control for gases, i.e. Air, hydrogen and makeup gas: Air flow rate of 0 – 500 mL/min or better Hydrogen gas flow rate of 0 – 100 mL/min or better Makeup gas (Nitrogen or Helium) flow rate of 0 – 50 mL/min or better		
6.	Hydrogen Generator with the following specifications: 1. The hydrogen generator shall be compatible with the GCMS equipment.		

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Equipment 2: GAS CHROMATOGRAPHY, LIQUID AUTOSAMPLER, HEADSPACE & SPME AUTOSAMPLER, MASS SPECTROMETER, AND FLAME IONISATION DETECTOR HYBRID SYSTEM (GC-MS)		Compliance Status	
		Tick box if Yes	Tick box if No
	2. The generator shall be able to operate at a maximum flow rate of at least 300 cc/min for the smooth operation of GCMS equipment.		
	3. The generator shall be able to supply hydrogen gas at >99.9995% purity for the smooth operation of GCMS-equipment.		
	4. The electronic pressure shall be adjustable to at least 100 psi.		
	5. The hydrogen generator shall be integrated with an internal leak detection with automatic shutdown features.		
7.	Data Management System System control, data acquisition and operating software 1. Equipment 1, 2 and 3 shall share the same operating and data analysis software.		
	2. Full software control on the operation of the FID, MS, auto liquid sampler, headspace sampler and SPME, for method and run control, online signal display, data handling, evaluation, reporting and system diagnostics.		
	3. The latest edition of the NIST spectral library shall be installed, with capability to install other libraries if necessary.		
	4. There shall be a unified software platform for data acquisition and data analysis.		
	5. Supports single analysis and batch analysis, batch table wizard, add or insert analyses.		
	6. Able to acquire data, integrate, review and report on an actively running sample with snapshot or real-time monitoring function.		
	7. Shall include the following features: i. User-defined flags for different parameters ii. Automatically generate reports iii. Extract chromatograms iv. View and extract peak spectra v. Auto and manual integration of the peaks vi. Identify compounds through library search		

Part 2: Requirement Specifications

Equipment 2: GAS CHROMATOGRAPHY, LIQUID AUTOSAMPLER, HEADSPACE & SPME AUTOSAMPLER, MASS SPECTROMETER, AND FLAME IONISATION DETECTOR HYBRID SYSTEM (GC-MS)		Compliance Status	
		Tick box if Yes	Tick box if No
8.	Computer: The computer controlling and operating the system shall minimally consist of the following configuration or its equivalent or better, with standard warranty. - Installed with Windows Operating System. - Shall include one monitor (At least 21"). - Shall include program software and at least 512 GB hard drive for storage space. - Shall have an Intel Core processor with at least 3.1 GHz processing speed. - Shall come with US/International (QWERTY) USB Keyboard and USB optical mouse. - Microsoft Office – latest version pre-installed with installation CD included - Shall come with graphic card and sound card - Shall have all computer interfaces, cables and software drivers.		
8.	Installation, Warranty and Maintenance A) Installation: A factory test specification to be accompanied with equipment delivery. Declaration of conformity shall be provided to certify the equipment has passed electrical and safety tests.		
	Installation and commissioning of all the equipment supplied shall be performed by qualified and factory certified service engineers to the satisfaction of the Agency.		
	Performance acceptance tests of all the supplied equipment commissioning shall be based on reproducibility of factory test specification and equipment performance validation reports.		
	B) Warranty and Maintenance: <u>During the Warranty Period, the following apply:</u> All the equipment and accessories supplied shall come with at least 12-month warranty after successful commissioning.		
	All user queries during the warranty period shall be attended to by certified service engineers within two working days.		

Part 2: Requirement Specifications

Equipment 2: GAS CHROMATOGRAPHY, LIQUID AUTOSAMPLER, HEADSPACE & SPME AUTOSAMPLER, MASS SPECTROMETER, AND FLAME IONISATION DETECTOR HYBRID SYSTEM (GC-MS)	Compliance Status	
	Tick box if Yes	Tick box if No
3. During the warranty period, minor repairs that do not require part replacement shall be resolved within three working days. Major repairs requiring part replacement shall be completed within 10 working days upon receipt of replacement part. All repairs shall be carried out by certified service engineers to the satisfaction of the Agency.		
4. There shall be at least one or more full PM as recommended by the manufacturer before the end of the warranty period. PM kit shall be deemed to be included in the tendered price.		
<u>Comprehensive Service Package:</u> 5. The Tenderer shall quote for a post-warranty three-year comprehensive service to be provided by certified service engineers. The service shall include all the equipment and accessories in the GC-MS system. The service shall cover PM as recommended by the manufacturer, unlimited service support inclusive of repairs and parts replacement.		
6. The PM price shall include the PM kit, and be carried out at least once a year. PM service shall consist of: i. Routine maintenance of the Equipment, including but not limited to the testing of functions and inspecting of the condition of the Equipment to keep the Equipment safe for use and in good working order; and ii. Adjustment and/or repair of any defect in or malfunction of the Equipment discovered by the Contractor's representatives during the course of routine maintenance checks.		
7. The comprehensive service shall include: i. Hardware and software telephone support. ii. At least one annual onsite preventive maintenance; iii. Unlimited onsite repair visits (travel & labour) at no extra costs to the Agency.		
8. Consumables/Supplies required for repair including liners, seals, tubing, assemblies, and multipliers shall be provided at no extra costs to the Agency.		
9. The comprehensive service shall cover the cost of manpower, supply of replacement parts and installation of the replacement parts.		

Part 2: Requirement Specifications

Equipment 2: GAS CHROMATOGRAPHY, LIQUID AUTOSAMPLER, HEADSPACE & SPME AUTOSAMPLER, MASS SPECTROMETER, AND FLAME IONISATION DETECTOR HYBRID SYSTEM (GC-MS)		Compliance Status	
		Tick box if Yes	Tick box if No
	10. All user queries during the comprehensive service contract period shall be attended to by certified service engineers within 2 working days .		
	11. PM shall be scheduled within 2 weeks from the date of PO. The PM service shall be completed within 3 days .		
	12. During the Contract period, minor repairs that do not require part replacement shall be resolved within 3 working days . Major repairs requiring part replacement shall be completed within 10 working days on receipt of the replacements parts. All repairs shall be carried out by certified service engineers to the satisfaction of the Agency.		
	13. In the event that the instrument malfunction for more than one month during the Contract period, a replacement instrument shall be made available at the Tenderer's designated lab for sample analysis by the Agency.		
	14. Parts and repair services for the associated computer and printer; in the scenario that the associated computer and printer are faulty and parts are obsolete / no longer available, the Contractor shall be responsible to provide replacements at no additional cost to the Agency during the warranty period and post-warranty PM period.		
9.	Training: 1. The Contractor shall provide onsite application support and consultation for 10 days within a year after successful commissioning of the equipment.		
	2. The Contractor shall provide at least three days of onsite customized training for at least five personnel within a year after successful commissioning of the equipment.		
10.	Other Requirements: 1. Tenderer shall submit product brochures/catalogues for evaluation upon request		
	2. Tenderer shall submit training certificates of service engineers upon request.		
	3. Tenderer shall comply with Clause 5 of Part 2 – Instructions to Tenderers. The Agency will not consider terms and conditions different from what was stipulated in the Agency's tender documents.		

Part 2: Requirement Specifications

Equipment 2: GAS CHROMATOGRAPHY, LIQUID AUTOSAMPLER, HEADSPACE & SPME AUTOSAMPLER, MASS SPECTROMETER, AND FLAME IONISATION DETECTOR HYBRID SYSTEM (GC-MS)		Compliance Status	
		Tick box if Yes	Tick box if No
11	Option to Purchase (To be activated when needed during the contract period): 1. Nitrogen Phosphorus Detector with the following specifications: a) Detector shall have a minimum detectable limit of 100 fg N/s and 20 fg P/s or better. b) Detector shall have a selectivity of gP/gC of at least 200,000. c) Detector shall have a selectivity of gN/gC to be at least 25,000. d) Detector shall have a linear dynamic range of at least 10⁴. e) Detector shall have a maximum temperature of at least 400 °C.		

3.3) COMPLIANCE TABLE FOR EQUIPMENT 3: LC-QHRMAS

Equipment 3: LIQUID CHROMATOGRAPHY, LIQUID AUTOSAMPLER, QUADRUPOLE HIGH RESOLUTION ACCURATE MASS SPECTROMETER HYBRID SYSTEM (LC-QHRAMS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	The LC-QHRAMS shall be supplied and installed with the following modules and services: 1. Pump 2. Auto-Sampler 3. Thermostatted Column Compartment 4. Quadrupole High Resolution Accurate Mass System 5. Nitrogen Generator 6. Data Management System 7. Installation, Warranty and Maintenance 8. Training 9. Other Requirements		

Part 2: Requirement Specifications

Equipment 3: LIQUID CHROMATOGRAPHY, LIQUID AUTOSAMPLER, QUADRUPOLE HIGH RESOLUTION ACCURATE MASS SPECTROMETER HYBRID SYSTEM (LC-QHRAMS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	10. Option to Purchase		
1.	Pump with the following specifications: 1. Gradient pump that offers at least 2 solvent channels. 2. Pump shall enable high pressure gradient proportioning and the following conditions shall be met: i. Proportioning accuracy of $\pm 0.4\%$. ii. Proportioning precision of $<0.15\%$ RSD 3. Flow-rate range settable from at least 0.001 to 5 mL/min, 4. Maximum operating pressure of at least 800 Bar. 5. Solvent degassing system shall be built in the system. 6. The pump shall be suitable for operation in the pH range of at least 2.0 to 12.0. 7. Safety features to detect leaks shall be included.		
2.	Auto-Sampler with the following specifications: 1. The sample capacity shall be at least 132 x 2 mL vials. 2. The injection range shall be in the range of at least 0.1 – 25 μL . 3. Injection precision volume shall be less than 0.25% RSD of peak areas. 4. Carryover shall not exceed 0.005% with needle wash.		
3.	Thermostatted Column Compartment with the following specifications: 1. The column compartment shall be capable of operating at temperature range at least 5 °C to 80 °C. 2. Temperature stability of the column compartment shall be within ± 0.1 °C. 3. Temperature accuracy of the column compartment shall be within ± 0.5 °C. 4. Heating rate shall be less than 15 minutes from 20°C to 40°C.		

Part 2: Requirement Specifications

Equipment 3: LIQUID CHROMATOGRAPHY, LIQUID AUTOSAMPLER, QUADRUPOLE HIGH RESOLUTION ACCURATE MASS SPECTROMETER HYBRID SYSTEM (LC-QHRAMS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	5. Cooling rate shall be within 15 minutes from 40°C to 20°C.		
	6. The column compartment shall be able to accommodate at least 2 x 30 cm columns or 4 x 15 cm columns.		
4.	Quadrupole High Resolution Accurate Mass Spectrometer Hybrid System with the following specifications:		
	1. System shall include an Electron Spray Ionization (ESI) source.		
	2. System shall be able to switch between both positive and negative ionization mode.		
	3. Mass resolution shall be equal or better than 30,000 FWHM.		
	4. Mass accuracy: <3 ppm RMS without internal calibration.		
	5. The sensitivity of the system shall satisfy either of the following: a) ESI MS full scan sensitivity of 1 pg injection of reserpine gives a S/N of greater than 250:1 when measured at m/z 609.2807; or b) ESI MS full scan sensitivity of 500 fg injection of buspirone gives a S/N of >100:1 at m/z 386.2551.		
	6. Mass range shall be at least 50-6,000 m/z for HRAMS.		
	7. The system shall have a spectral acquisition rate that is of at least 12 spectra/sec.		
	8. The system shall be capable of performing the following scan functions: i. Acquire and display Full Scan mass spectra ii. Acquire and display Full Scan MS/MS spectra iii. Timed MS/MS for scheduled data acquisition of target compound fragment spectra		
5.	Nitrogen Generator with the following specifications:		
	1. The nitrogen generator shall be compatible with the LC-QHRAMS equipment.		

Part 2: Requirement Specifications

Equipment 3: LIQUID CHROMATOGRAPHY, LIQUID AUTOSAMPLER, QUADRUPOLE HIGH RESOLUTION ACCURATE MASS SPECTROMETER HYBRID SYSTEM (LC-QHRAMS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	2. The nitrogen generator shall be capable of supporting a flow rate of at least 32 L/min at 8 bar to support the smooth operation of the LC-QHRAMS equipment.		
	3. Nitrogen purity shall be greater than 98.5% for the smooth operation of the LC-QHRAMS equipment.		
6.	Data Management System with the following specifications:		
	1. Equipment 1, 2 and 3 shall share the same operating and data analysis software.		
	2. Software shall support small molecule unknown screening with the following features: theoretical fragmentation of parent to annotate daughter ions, finding transformed compounds, sub-structure search against MS library.		
	3. Software to provide LC-HRAMS equipment control, including batch acquisition.		
	4. Software to support quantitative analysis and compound identification by accurate mass, and isotope pattern.		
	5. Computer: The computer controlling and operating the system shall minimally consist of the following configurations or its equivalent or better, with standard warranty: i. Installed with Windows Operating System. ii. Shall include at least one monitor (at least 21" display) iii. Shall include a 10 gigabit Ethernet (10GbE) connection for MS data. iv. Shall include program software and at least 1 TB hard drives for data storage. v. Shall include a Graphic Card and Sound Card. vi. Shall come with US/International (QWERTY) USB Keyboard and USB optical mouse. vii. Microsoft Office – latest version pre-installed with installation CD included. viii. Shall have all computer interfaces, cables and software drivers.		

Part 2: Requirement Specifications

Equipment 3: LIQUID CHROMATOGRAPHY, LIQUID AUTOSAMPLER, QUADRUPOLE HIGH RESOLUTION ACCURATE MASS SPECTROMETER HYBRID SYSTEM (LC-QHRAMS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
7.	Installation, Warranty and Maintenance		
	A) Installation: 1. A factory test specification to be accompanied with equipment delivery. Declaration of conformity shall be provided to certify the equipment has passed electrical and safety tests.		
	2. Installation and commissioning of all the equipment supplied shall be performed by qualified and factory certified service engineers to the satisfaction of the Agency.		
	3. Performance acceptance test of all the supplied equipment commissioning shall be based on reproducibility of factory test specification and equipment performance validation report.		
	B) Warranty and Maintenance: <u>During the Warranty Period, the following apply:</u>		
	1. All the equipment and accessories supplied including the LC-QHRAMS system shall come with at least 12-month warranty after successful commissioning.		
	2. All user queries during the warranty period shall be attended to by certified service engineers within 2 working day .		
	3. During the warranty period, minor repairs that do not require part replacement shall be resolved within 3 working days . Major repairs requiring part replacement shall be completed within 10 working days upon receipt of replacement part. All repairs shall be carried out by certified service engineers to the satisfaction of the Agency.		
	4. There shall be at least one or more full PM as recommended by the manufacturer before the end of the warranty period. PM kit shall be deemed to be included in the tendered price.		

Part 2: Requirement Specifications

Equipment 3: LIQUID CHROMATOGRAPHY, LIQUID AUTOSAMPLER, QUADRUPOLE HIGH RESOLUTION ACCURATE MASS SPECTROMETER HYBRID SYSTEM (LC-QHRAMS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	<u>Comprehensive Service Package:</u> 5. The Tenderer shall quote for a post-warranty three-year comprehensive service to be provided by certified service engineers. The service shall cover all the equipment and accessories in the LC-QHRAMS system. The service shall cover PM as recommended by the manufacturer, unlimited service support inclusive of repairs and parts replacement.		
	6. The PM price shall include the PM kit, and be carried out at least once a year. PM service shall consist of: i. Routine maintenance of the Equipment, including but not limited to the testing of functions and inspecting of the condition of the Equipment to keep the Equipment safe for use and in good working order; and ii. Adjustment and/or repair of any defect in or malfunction of the Equipment discovered by the Contractor's representatives during the course of routine maintenance checks.		
	7. The comprehensive service shall include: i. Hardware and software telephone support; ii. At least one annual onsite preventive maintenance; iii. Unlimited onsite repair visits (travel & labour) at no extra costs to the Agency.		
	8. Consumables/Supplies required for repair including liners, seals, tubing, assemblies, and multipliers shall be provided at no extra costs to the Agency.		
	9. The comprehensive service shall cover the cost of manpower, supply of replacement parts and installation of the replacement parts.		
	10. All user queries during the comprehensive service contract period shall be attended to by certified service engineers within 2 working days.		
	11. PM shall be scheduled within 2 weeks from the date of PO. The PM service shall be completed within 3 days .		

Part 2: Requirement Specifications

Equipment 3: LIQUID CHROMATOGRAPHY, LIQUID AUTOSAMPLER, QUADRUPOLE HIGH RESOLUTION ACCURATE MASS SPECTROMETER HYBRID SYSTEM (LC-QHRAMS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	12. During the contract period, minor repairs that do not require part replacement shall be resolved within 3 working days . Major repairs requiring part replacement shall be completed within 10 working days on receipt of the replacements parts. All repairs shall be carried out by certified service engineers to the satisfaction of the Agency.		
	13. In the event that the instrument malfunction for more than one month during the Contract period, a replacement instrument shall be made available at the Tenderer's designated lab for sample analysis by the Agency.		
	14. Parts and repair services for the associated computer and printer; in the scenario that the associated computer and printer are faulty and parts are obsolete / no longer available, the Contractor shall be responsible to provide replacements at no additional cost to the Agency during the warranty period and post-warranty PM period.		
8.	Training: 1. Onsite Application support and consultation shall be provided for 10 days within a year after successful commissioning of the Equipment by the Contractor.		
	2. The Contractor shall provide onsite customised training for at least five personnel for at least three days within a year after successful commissioning of the Equipment.		
9.	Other Requirements: 1. Tenderer shall submit product brochures/catalogues for evaluation upon request		
	2. Tenderer shall submit training certificates of service engineers upon request.		
	3. Tenderer shall comply with Clause 5 of Part 2 – Instructions to Tenderers. The Agency will not consider terms and conditions different from what was stipulated in the Agency's tender documents.		
10	Option to Purchase (To be activated when needed during the contract period)*:		

Part 2: Requirement Specifications

Equipment 3: LIQUID CHROMATOGRAPHY, LIQUID AUTOSAMPLER, QUADRUPOLE HIGH RESOLUTION ACCURATE MASS SPECTROMETER HYBRID SYSTEM (LC-QHRAMS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	1) Thermostatted autosampler with the following specifications: a) Temperature shall be settable in the range of at least 4 to 30 °C with sample temperature stability of ± 1 °C or better. *If the autosampler described in para 2 comes with the in-built temperature control function, then Tenderer need not quote for this item.		

3.4) COMPLIANCE TABLE FOR EQUIPMENT 4: ICP-MS/MS

Equipment 4: INDUCTIVELY COUPLED PLASMA TANDEM MASS SPECTROMETER SYSTEM (ICP-MS/MS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	The ICP-MS/MS shall be supplied and installed with the following modules and services: 1. Sample Introduction System 2. Plasma and Ion Optics 3. ICP-MS Interface 4. Mass Analyzer 5. Detector 6. Vacuum and Cooling System 7. Consumables and Accessories 8. Data and Management System 9. Installation, Warranty and Maintenance 10. Training 11. Other Requirements		

Part 2: Requirement Specifications

Equipment 4: INDUCTIVELY COUPLED PLASMA TANDEM MASS SPECTROMETER SYSTEM (ICP-MS/MS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
1.	Sample Introduction System shall have the following specifications:		
	1. The ICP-MS/MS shall come with an autosampler to accommodate a total capacity of at least 80 vials of samples.		
	2. The sample probe shall be metal-free, anti-corrosion and acid resistant materials and able to return to an integral rinse port where it is continuously rinsed by fresh wash solution between samples.		
	3. Reinitializing the autosampler in case of an emergency shall be allowed.		
	4. The sample introduction system shall come with a Peltier cooled spray chamber.		
	5. A high performance, concentric nebulizer shall be included.		
	6. The spray chamber capable of operating at a controlled temperature range of at least -5 °C to 20 °C shall be included.		
	7. The ICP-MS/MS system shall come with a peristaltic pump with at least three channels with 10 inert rollers, offering low pulsation and high precision.		
	8. The ICP-MS/MS shall have an integrated system to extend matrix tolerance.		
2.	Plasma and Ion Optics shall have the following specifications:		
	1. The torch of ICP-MS/MS system shall preferably be a single-piece quartz for high matrix tolerance, and for fast and easy replacement.		
	2. Torch position shall be adjustable and fully controllable to enable the plasma position to be optimised.		
	3. All adjustments between including radio frequency (RF) power, argon gas flow and plasma position shall be computer controlled with the ability to be implemented manually or completely automatically.		
	4. The system shall be equipped with at least three gas lines for the operation of plasma.		

Part 2: Requirement Specifications

Equipment 4: INDUCTIVELY COUPLED PLASMA TANDEM MASS SPECTROMETER SYSTEM (ICP-MS/MS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	5. The quadrupole rods in a quadrupole mass analyser shall be truly hyperbolic in cross section to generate a theoretically correct hyperbolic field.		
3.	ICP-MS Interface shall have the following specifications: 1. The sampling and skimmer cones shall be constructed from high purity Ni with apertures between 1.0 to 1.1 mm and 0.45 to 0.50 mm diameter respectively.		
4.	Mass Analyzer and Collision Reaction Cell (CRC) with the following specifications: 1. A tandem mass analyser system shall be supplied. Each mass analyser system shall consist of fully functional quadrupole rods capable of discriminating ionic masses based on mass-to-charge ratios (Q1 and Q3) and collision reaction cell (Q2) located in between Q1 and Q3. 2. The mass analyser system shall be capable of operation in either single quad and/or triple quad modes, which shall be automatically selected by the software or can be pre-selected by the end-user. 3. Mass scan ranges for the final quadrupole shall be in the range of at least 2-275 amu when analysing in both single and triple quad modes. 4. Scan speed of the mass spectrometer shall be at least 3,700 amu/s (Li to U), with acquisition points at 40 interval masses. 5. Mass resolution shall be <1.0 amu at 10% peak height across the mass range or better. 6. The typical mass calibration stability shall be within $\pm 0.05u$ per day. 7. The sensitivity of the system shall fulfil either of the following: a) Abundance sensitivity measured at ^{133}Cs in single quad mode to be at 1×10^{-7} or better, or b) Sensitivity measured at ^{115}In is 300 kcps/ppb in single quad mode, with detection limit of <0.1 ppt.		

Part 2: Requirement Specifications

Equipment 4: INDUCTIVELY COUPLED PLASMA TANDEM MASS SPECTROMETER SYSTEM (ICP-MS/MS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	8. The CRC shall be equipped with at least four independent gas supply channels, each controlled by an independent mass flow controller. Two of the cell gas lines shall be able to carry He and H ₂ gases, and corrosive resistant, whilst the other two cell gas lines shall be corrosive resistant for the supply of other cell gases.		
	9. The CRC shall be able to promote chemical reactions with selected reactive gas for targeted mass-shift formation.		
	10. The design of the CRC shall include a feature to minimise matrix contamination e.g. off-axis ion lens design.		
5.	Detector with the following specifications:		
	1. The detector shall be a discrete dynode electron multiplier with a linear dynamic range of at least 10 orders of magnitude.		
	2. Minimum dwell time of 100 µs for data acquisition.		
	3. Stability: % RSD at Li (7 amu), Y (89 amu), and Tl (205 amu) shall be: a) No more than 3%, for short term (10 min); and b) No more than 4%, for long term (2 hr).		
6.	Vacuum and Cooling system with the following specifications:		
	1. The ICP-MS/MS system shall be equipped with heat exchanger/chiller to ensure consistent cooling of all components of ICP-MS/MS system throughout the operation.		
	2. The pumping system shall have an vacuum system to reduce random background.		
7.	Consumables and Accessories with the following specifications:		
	1. The ICP-MS/MS system shall come with the necessary accessories for the complete installation of the equipment in good working condition. This shall include all connecting units, tubings, cutter, wall mounting brackets, standard solutions and all other necessary accessories for the proper installation.		

Part 2: Requirement Specifications

Equipment 4: INDUCTIVELY COUPLED PLASMA TANDEM MASS SPECTROMETER SYSTEM (ICP-MS/MS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	One extra set of the following items shall minimally be included for self-maintenance and replacement of consumables: i. ICP-MS sampler and skimmer cone ii. Graphite gasket iii. Torch iv. Sample tubes		
8.	Data Management System with the following specifications: 1. The system controller shall monitor for the system status, RF power, gas supplies, equipment temperatures, electrical systems, vacuum system and cooling systems.		
	2. As minimum requirements, the following functions shall be available: i. Spectrum mode: The normal acquisition mode used to acquire intensity vs. mass data from continuous signals. ii. Time resolved mode: For fast, multi-element analysis of transient signals. Multi-element data is acquired in user defined time slices, and a time vs. intensity plot is generated for every mass. iii. Isotopic analysis: Employs fast scanning to optimise precision on isotope ratio measurements and isotope dilution studies. iv. Nanoparticles analysis: Acquire and analyse nanoparticles in single particle mode and field flow fractionation (FFF) mode. In all modes, the acquisition display screen shall show the data being required in real time.		

Part 2: Requirement Specifications

Equipment 4: INDUCTIVELY COUPLED PLASMA TANDEM MASS SPECTROMETER SYSTEM (ICP-MS/MS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	3. The ICP-MS/MS software shall include the following features: i. Fully automated system start-up and shutdown options ii. Provision for automated, unattended shutdown after sample analysis iii. Storage of electronic record of the tuning report (including all meter values and tuning parameter values) iv. Storage of results and data which can be linked seamlessly with third party applications such as Excel. v. Acquire and process time-resolved data; and vi. Include basic peak integration and calibration facilities for time resolved analysis and data processing.		
	4. Computer: The computer controlling and operating the system shall minimally consist of the following configuration or its equivalent or better, with standard warranty. i. Installed with Windows Operating System. ii. Shall include one monitor (At least 21"). iii. Shall include program software and at least 1 TB hard drive. iv. Shall have an Intel Core processor with 3.1 GHz of processing speed and at least 8 GB RAM. v. Shall come with US/International (QWERTY) USB Keyboard and USB optical mouse. vi. Microsoft Office – latest version pre-installed with installation CD included. vii. Shall come with graphic card and sound card. viii. Shall have all computer interfaces, cables and software drivers.		
9.	Installation, Warranty and Maintenance A) Installation: 1. A factory test specification shall be accompanied with equipment delivery. Declaration of conformity shall be provided to certify the equipment has passed electrical and safety tests.		
	2. Installation and commissioning of all the equipment supplied shall be performed by certified service engineers to the satisfaction of the Agency.		

Part 2: Requirement Specifications

Equipment 4: INDUCTIVELY COUPLED PLASMA TANDEM MASS SPECTROMETER SYSTEM (ICP-MS/MS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	3. Performance acceptance test of all the supplied equipment commissioning shall be based on reproducibility of factory test specification and equipment performance validation report.		
	B) Warranty and Maintenance: <u>During the Warranty Period, the following apply:</u>		
	1. All the equipment and accessories supplied including the ICP-MS/MS system shall come with at least 12-month warranty after successful commissioning.		
	2. All user queries during the warranty period shall be attended to by certified service engineers within 2 working days.		
	3. During the warranty period, minor repairs that do not require part replacement shall be resolved within 3 working days . Major repairs requiring part replacement shall be completed within 10 working days upon receipt of replacement part. All repairs shall be carried out by certified service engineers to the satisfaction of the Agency.		
	4. There shall be at least one or more full Preventive Maintenance (PM) as recommended by the manufacturer before the end of the warranty period. PM kit shall be deemed to be included in the tendered price.		
	<u>Comprehensive Service Contract Package:</u> 5. The Tenderer shall quote for a post-warranty three-year comprehensive service to be provided by certified service engineers. The service shall include all the equipment and accessories in the ICP-MS/MS system. The service shall cover PM as recommended by the manufacturer, unlimited service support inclusive of repairs and parts replacement.		

Part 2: Requirement Specifications

Equipment 4: INDUCTIVELY COUPLED PLASMA TANDEM MASS SPECTROMETER SYSTEM (ICP-MS/MS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	6. The PM price shall include the PM kit, and be carried out at least once a year. PM service shall consist of: i. Routine maintenance of the Equipment, including but not limited to the testing of functions and inspecting of the condition of the Equipment to keep the Equipment safe for use and in good working order; and ii. Adjustment and/or repair of any defect in or malfunction of the Equipment discovered by the Contractor's representatives during the course of routine maintenance checks.		
	7. The comprehensive service shall include: i. Hardware and software telephone support; ii. At least one annual onsite preventive maintenance; iii. Unlimited onsite repair visits (travel & labour) at no extra costs to the Agency.		
	8. Consumables/Supplies required for repair including liners, seals, tubing, assemblies, and multipliers shall be provided at no extra costs to the Agency.		
	9. The comprehensive service shall cover the cost of manpower, supply of replacement parts and installation of the replacement parts.		
	10. All user queries during the comprehensive service contract period shall be attended to by certified service engineers within 48 h upon raising the query or the next working day in case of weekends and public holidays.		
	11. During the contract period, minor repairs that do not require part replacement shall be resolved within 3 working days. Major repairs requiring part replacement shall be completed within 10 working days on receipt of the replacements parts. All repairs shall be carried out by certified service engineers to the satisfaction of the Agency.		
	12. In the event that the down time of the instrument is more than one month during the Contract period, a replacement instrument shall be made available at the Tenderer's designated lab for sample analysis by the Agency.		

Part 2: Requirement Specifications

Equipment 4: INDUCTIVELY COUPLED PLASMA TANDEM MASS SPECTROMETER SYSTEM (ICP-MS/MS)		Compliance Status	
		Tick box if Yes	Tick box if No
S/N	TECHNICAL SPECIFICATIONS		
	13. Parts and repair services for the associated computer and printer; in the scenario that the associated computer and printer are faulty and parts are obsolete / no longer available, the Contractor shall be responsible to provide replacements at no additional cost to the Agency during the warranty period and post-warranty PM period.		
10.	Training 1. Shall provide application support and consultation for 10 days within a year after successful commissioning of the Equipment.		
	2. Onsite customised training for at least three days shall be provided to at least five personnel within a year after successful commissioning of the Equipment.		
11.	Other Requirements: 1. Tenderer shall submit product brochures/catalogues for evaluation upon request		
	2. Tenderer shall submit training certificates of service engineers upon request.		
	3. Tenderer shall comply with Clause 5 of Part 2 – Instructions to Tenderers. The Agency will not consider terms and conditions different from what was stipulated in the Agency's tender documents.		