

SECTION III**SCOPE OF REQUIREMENT****(A) REQUIREMENT SPECIFICATION FOR ANALYTICAL EQUIPMENT****1. GENERAL DESCRIPTION**

This scope of requirement covers the minimum requirements for the supply and post-warranty maintenance for the following Equipment:

Lot No.	Description
1	Firm 2 units of X-Ray Fluorescence Spectrometer (XRF) with options for another 1 unit
2	Firm 3 units of Ion Chromatography (IC) with options for another 1 unit
3	Firm 2 units of Liquid Handler
4	Firm 1 unit of Contamination Monitor, comprising 1 unit of hand foot monitoring system with 6 units of radiation contamination survey meters.
5	Firm 1 unit of Gas Chromatography Mass Spectrometry/ Mass Spectrometer (GCMS/MS) with options for another 1 unit
6	Firm 3 units Liquid Chromatography Mass Spectrometry/Mass Spectrometer (LCMS/MS) with options for another 1 unit
7	Firm 1 unit of Inductively Coupled Plasma Mass Spectrometer (ICP-MS)
8	Firm 2 units of Rapid DNA Analyser
9	Firm 10 units of Biological Air Sampling System with options for another 5 units
10	Firm 10 units of Bio-aerosol Sampling System
11	Firm 3 units of Becquerel (BQ) monitor

2. SPECIFICATIONS

Please refer to the following appendices for the technical specifications and related maintenance requirements:

- a) Appendix 1: XRF
- b) Appendix 2: IC
- c) Appendix 3: Liquid Handler
- d) Appendix 4: Contamination Monitor
- e) Appendix 5: GCMS/MS
- f) Appendix 6: LCMS/MS
- g) Appendix 7: ICP-MS
- h) Appendix 8: Rapid DNA Analyser
- i) Appendix 9: Biological Air Sampling System
- j) Appendix 10: Bio-aerosol Sampling System
- k) Appendix 11: BQ Monitor

3 WARRANTY

- a) All Goods shall come with warranty period of at least twelve (12) months against defect from the date of delivery or upon successful completion of the acceptance test or commissioning, whichever is later. The Contractor shall be responsible for providing maintenance services during the warranty period.
- b) Where during the warranty period, any part or unit is found to be defective or malfunction, the Tenderer shall at his own expense make good or repair the same within the specified turn-around-time. He shall provide and supply labour, transport, materials, tools and replacement parts necessary for the execution of the repair services during the warranty period at no additional cost to the Authority.

4 DELIVERY SCHEDULE

- a) For firm purchase quantities:

Lot No.	Equipment	Firm Qty	Delivery date
1	XRF	2	1 Nov-17
2	IC	3	1 Nov-17
3	Liquid Handler	2	1 Nov-17
4	Contamination Monitor	1	2 Jul-18
5	GCMS/MS	1	2 Jul-18
6	LCMS/MS	3	2 Jul-18
7	ICP-MS	1	2 Jul-18
8	Rapid DNA Analyser	2	2 Jul-18
9	Bio-air sampling	10	2 Jul-18
10	Bio-aerosol sampling	10	2 Jul-18
11	BQ	3	1 Jul-19

- b) For optional purchase quantities :

Lot No.	Equipment	Optional Qty	Delivery date
1	XRF	1	: Within 24 weeks from date of exercise of option(s)
2	IC	1	
5	GCMS/MS	1	
6	LCMS/MS	1	
9	Bio-air sampling	5	

5 SUBMISSION OF DOCUMENTS

- a) Tenderer is required to submit the following documents for evaluation purposes:
 - a. Form of Tender (Appendix 1 of Section I)
 - b. Price Schedule (Appendix 1.1 of Section I)
 - c. Compliance to Conditions of Contract (Appendix 1.2 of Section I)
 - d. Compliance to Scope of Requirements (Appendix 1.3 of Section I)
 - e. All other parts of the Tenderer's tender
 - f. Supporting Documents which include:

- i. Information on Particulars of Company Directors/Partners,
 - ii. Tenderer's experience and proven track records of the company in supplying of the product
 - iii. Product brochures specifications,
 - iv. Etc
- b) For IC, GCMS/MS, LCMS/MS, ICP-MS – tenderer must collect one sample from the lab for each instrument after 5 working days from the close of the tender and submit all results to the lab within 14 days from the receipt of samples from the Authority.

6 EVALUATION CRITERIA

The evaluation criteria shall be based on price competitiveness, i.e. only offers meeting the tender requirements as set out in Section III and addition criteria stated below will be considered for selection of award:

- a. Registration with the Government Registration Authority (GRA) for the supply head and financial category:
 - EPU/LTE/10 – Laboratory Testing and Survey Equipment and Laboratory Testing Services
 - EPU/LAB/30 – Laboratory Equipment and Accessories
 - Financial grade of \$250,000 (S3)
- b. Compliance with Conditions of Contract
- c. Submission of analysed results within the stipulated duration as stated in the detailed specifications.
- d. Except for Lot 11 (BQ Monitor), tenderers who are interested to participate in the tender for Lot 1 to 10 are required to attend the mandatory tender briefing cum Lab Visits (if required).

7 TENDER BRIEFING

a) Except for Lot 11 (BQ Monitor), tenderers who are interested to participate in the tender for Lot 1 to 10 are required to attend the mandatory tender briefing cum Lab Visits (if required). Details of Tender Briefing/Lab Visit are as follows:

Event	Applicable for:	Date	Time
Tender Briefing at Tuas Auditorium	- Lot 1 (XRF) - Lot 2 (IC) - Lot 5 (GCMS/MS) - Lot 6 (LCMS/MS) - Lot 7 (ICP-MS)	24 Oct 16	1000 hrs
Tender Briefing at Tuas Auditorium	- Lot 3 (Liquid handler) - Lot 4 (Contamination Monitor) - Lot 8 (Rapid DNA) - Lot 9 (Biological Air Sampling System) - Lot 10 (Bio-aerosol Sampling System)	24 Oct 16	1500 hrs
Tuas Site visit	- Lot 5 (GCMS/MS) - Lot 6 (LCMSMS)	24 Oct 16	1100 hrs
Woodlands Site Visit	- Lot 5 (GCMS/MS) - Lot 6 (LCMSMS)	26 Oct 16	1000 hrs
Pasir Panjang Site Visit	Lot 4 (Contamination Monitor)	26 Oct 16	1400 hrs
Pasir Panjang Site Visit	Lot 7 (ICP-MS)	26 Oct 16	1500 hrs
Pasir Panjang Site Visit	- Lot 5 (GCMS/MS) - Lot 6 (LCMSMS)	26 Oct 16	1600 hrs

Venue1: Pasir Panjang Scanning Station
21/23 Harbour Drive
S(117502)

Venue2: Old Woodlands Checkpoint
11 Woodlands Crossing Road
Singapore 738103

Venue3: Tuas Checkpoint Complex
501 Jalan Ahmad Ibrahim
Singapore 639937

Contact: peter_chua@mha.gov.sg (Tel: 6897 7467)

To register attendance for briefing, interested Tenderers are to submit the following details to Peter Chua **at least 3 working days before the tender briefing** for security clearance.

- Full Name as in NRIC
- NRIC/FIN No.
- Name of organisation
- Designation
- Vehicle No. (if applicable)

8 TRAINING

- a. The successful Tenderer shall conduct user training on the operation, trouble shooting and general maintenance of the equipment. The estimated number of users to be trained is 10.
- b. The training session shall be conducted only on Mondays to Fridays (excluding Singapore public holidays), 9 am to 5 pm.
- c. The training location shall be at MHA laboratory and/or at the vendor's company.

Appendix 1 to Section III

(1) REQUIREMENT SPECIFICATION FOR X-RAY FLUORESCENCE SPECTROMETER (XRF)

(A) SPECIFICATIONS

1.1 General Description

- a. The weight of the spectrometer shall not exceed 100 kg.
- b. The dimensions of the spectrometer shall not exceed 100 cm width, 65 cm depth and 65 cm height.
- c. The system should be an equivalent if not better capability than the specifications stated from 1.2 to 1.15.
- d. Each unit shall include item 1.2 to 1.15.

1.2 X-Ray Fluorescence Spectrometer

- a. The spectrometer shall be an energy dispersive X-rays fluorescence spectrometer.
- b. The spectrometer shall be able to analyze elements from sodium (Na) to uranium (U).
- c. The spectrometer shall be able to carry out qualitative and quantitative elemental analysis of both solid and liquid samples. The spectrometer shall also be able to carry out thickness analysis.
- d. The spectrometer shall be able to analyze samples in air, vacuum and helium environment.
- e. The spectrometer shall have at least five primary X-ray filters which can be interchangeable via the software on the computer.
- f. The spectrometer shall have at least four collimators with diameters ranging from 1 to 10 mm. Interchanging of these collimators shall be controlled on the computer.
- g. The X-ray filters and collimators shall be controlled independently of each other to enable different combinations of X-ray filter and collimator.
- h. The spectrometer shall incorporate a CCD camera with lighting for the imaging and capturing of sample target spot.
- i. The spectrometer shall come with a vacuum unit for sensitive analysis of light elements in solid samples. A vacuum pump with rotary pump unit shall be provided.
- j. The spectrometer shall come with a helium purge unit for light elements analysis for liquid samples. A dual-holder stainless steel rack for 10 liter helium gas cylinders shall be provided.
- k. The spectrometer shall have an external indicator that lights up when the X-ray source is turned on. The indicator light shall be clearly visible from a distance of at least 2.5 m.
- l. The spectrometer shall have a switch to disable irradiation when necessary

1.3 Sample Chamber

- a. The sample chamber shall be of at least 28 cm width, 26 cm depth and 8 cm height.
- b. The sample chamber shall be able to accommodate an additional sample tray with a capacity of at least 10 samples, which can be mounted when required.
- c. The spectrometer shall be able to carry out continuous analysis of multiple samples in a single run.

1.4 X-ray Generator

- a. The X-ray generator shall have a power of at least 50 W.
- b. The X-ray tube shall use rhodium or equivalent as target.
- c. The X-ray tube shall be air-cooled.
- d. The X-ray tube shall have a voltage range of at least 5 to 45 kV with 1kV increment.
- e. The X-ray tube shall have a current range of at least 1 to 900 μ A, with 1 μ A increment.
- f. The X-ray generator shall have a stability of at most $\pm 0.5\%$.
- g. The system shall be able to protect itself from a surge in voltage or current while preventing irradiation when necessary.

1.5 Detector

- a. The detector shall be a high performance silicon drift detector or equivalent.
- b. The detector shall be Peltier-cooled, liquid nitrogen free.

1.6 Pulse Processor

- a. The counting unit shall have a digital signal processing system.
- b. The signal measurement energy range shall be at least 0.5 to 40 keV.
- c. It shall have at least 2048 channels of counting.

1.7 Hydraulic Press

- a. A manual hydraulic press shall be provided for the pressing of powdered samples.
- b. The press shall be able to operate at a maximum pressure of at least 15 tons.
- c. The press shall have a safety screen.
- d. The plate diameter shall be at least 60 mm.
- e. The press shall come with a pair of stainless steel compression plates of 50 mm diameter or equivalent.

1.8 Software

- a. The software shall have the capability to perform both qualitative and quantitative analysis.
- b. The software shall be able to carry out quantitative analysis using calibration curves derived from standards.
- c. The software shall be able to perform quantitative analysis using fundamental parameters when standards are not available. This shall also be applicable for analysis of film thickness and composition.
- d. The quantitative analysis software shall incorporate a variety of correction methods.
- e. The software shall have a wide selection of user-defined options such as data selection and display.
- f. The software shall be able to generate printable reports with various editable report templates which incorporate data such as sample image spot, calibration curve and analytical results.
- g. The software shall have an editable library which can allow for the adding and removal of content.
- h. Software upgrades (if any) shall be provided at no extra cost.

1.9 Computer and Printer

- a. The computer shall have a Intel® Core™ i7-6700 Processor (Quad Core, 8MB, 8T, 3.4GHz) Intel® Integrated Graphics 8GB (1x8GB) 1600MHz DDR3L Memory (Max 4 DIMM slots; up 16GB) 1TB 7200 RPM 3.5" SATA Hard Drive 8x DVD+/-RW, at least 22" LCD wide monitor, keyboard, , wireless mouse & mouse pad.
- b. The computer shall be pre-installed with the latest and compatible Windows operating system and Microsoft office software (Word, Excel® and PowerPoint)
- c. A colour laser printer with duplex printing function and a spare set of colour toner cartridge shall be provided.

1.10 Accessories

- a. Each system provided shall come with the full suite of the following accessories, or their equivalent. The accessories shall consist of the following items or their equivalent. The items are as shown in the table:

S/no.	Items	Quantity (For each unit of XRF)
i.	Mylar films for sample cell (500 sheets/set)	12
ii.	Ultralene XRF window film for sample cell (300 feet)	12
iii.	Microporous Teflon film (17 feet)	12
iv.	Polyethylene sample cell cups (31mm) (100 pieces/set)	12

S/no.	Items	Quantity (For each unit of XRF)
v.	Filter paper for analysis of liquid samples in vacuum (50 sheets/set)	12
vi.	Moulding ring used for the manual press (100 pieces per set)	12

1.11 Regulatory Licenses for Ionizing Radiation Irradiating Apparatus

- a. Application of licenses (i.e. L3, L5) required to possess and use of the X-ray fluorescence spectrometer shall be provided. The licenses shall be for use of the system in 2 Laboratories situated at 2 locations (Tuas Checkpoint and Woodlands Checkpoint).
- b. Application of R1 worker licenses. At least seven R1 Licenses per Laboratory.
- c. Any other Licenses.
- d. The Tenderer shall include the costs for application of the Licenses including required medical examination tests and TLD badges for R1 workers.

1.12 Training

- a. Training shall be provided for 10 users for each spectrometer. Operation, troubleshooting and general maintenance of the system shall be covered during the training session.
- b. There shall at least be one other training session within a year of installation of the instrument, given by the supplier's application specialist which can be customized to the users' requirements.
- c. Training shall be provided for the users of the instruments at site, as well as at the Tenderer's application laboratory, after installation and commissioning.
- d. The training session shall be conducted only on Mondays to Fridays (excluding Singapore public holidays), 9 am to 5 pm.

1.13 Warranty and Technical Support

- a. On-site installation, commissioning and training by factory-trained engineer is required.
- b. The Tenderer shall have a local dedicated team, consisting of sales, engineers and application engineers from direct factory/manufacturer for optimum support of the system.
- c. The Tenderer shall be committed to provide after sales service efficiently and effectively. The Tenderer shall have in his facility a similar system proposed in this tender for training purposes.
- d. Back up equipment support for testing shall be available at the supplier's facility during equipment breakdown.
- e. The Tenderer shall assist in the application of all required regulatory licenses.
- f. Comprehensive support must be provided for the equipment for a period of 12 months which will consist of the following at no extra cost:
 - i. Unlimited service calls
 - ii. Travel and labour expenses of the engineer

iii. Service parts used for repairs

g. The warranty shall commence only upon successful completion of the acceptance test or commissioning. The service engineer must respond 24 hours for service calls and within 48 hours for on-site service.

1.14 Others

- a. All modules must be GLP/GMP compliant or a declaration of conformity certificate must be provided.
- b. The tenderer shall deliver the spectrometers to separate locations. Refer to para 4 of Section III for delivery schedule. Lab staff shall be notified of the exact delivery at least one week before
- c. The tenderer shall take note that there is no lift available at the two sites of the delivery. The price quoted shall include hoisting charges of the instrument, if necessary.
- d. Prices quoted shall include all administrative, delivery, installation and freight charges.

(B) NON-COMPREHENSIVE MAINTENANCE FOR X-RAY FLUORESCENCE SPECTROMETER

2.1 The successful Tenderer shall provide a seven (7) years Non-comprehensive Maintenance package for spectrometers. The Non-comprehensive Maintenance shall be exercised after the expiry of the warranty period.

2.2 The scope of activities for the Non-Comprehensive Maintenance package shall include the followings:

- a. Preventive Maintenance (PM)
 - i. The tenderer shall perform PM at least twice per year.
 - ii. The scope of PM is as specified in **Appendix 1.1** to Section III.
- b. Corrective Maintenance (CM)
 - i. The tenderer shall perform CM within the stated turnaround time.
 - ii. The scope of CM is as specified in **Appendix 1.2** to Section III.
- c. Technical Support during office hours from 0800 to 1800hrs.
- d. 2-Way Transportation of the equipment if maintenance is done off-site.

Appendix 1.1 to Section III

PREVENTIVE MAINTENANCE (PM) FOR OF X-RAY FLUROSCENCE SPECTROMETER (XRF)

2.3 The tenderer shall performed preventive maintenance at least twice a year.

2.4 The tenderer shall provide the detailed proposed scope of works for the PM upon submission of tender. The general scope of work for the PM shall be as follows:

- a) General system inspection
- b) Interior cleaning
- c) Lubrication
- d) Electrical and mechanical testing (adjustments, if necessary)
- e) Calibration with standard samples, if applicable
- f) Perform integrity tests for the system
- g) A service report and maintenace report shall be submitted after each PM

Appendix 1.2 to Section III

CORRECTIVE MAINTENANCE (CM) FOR OF X-RAY FLUROSCENCE SPECTROMETER (XRF)

2.5 The general scope of work for the Corrective Maintenance shall be as follows:

- a) Respond to service calls. To be performed as per request by the Laboratories. The response time upon receipt of fault call is within next business day of fault call from Mondays to Fridays (0800 to 1800hrs).
- b) Unlimited breakdown call. The Tenderer has to respond to all breakdown calls.
- c) Service Report. After each corrective maintenance or repair works, the Tenderer shall submit a report on the corrective maintenance works done and the recommendation parts to change (if any) within 5 working days.
- d) Labour and tools. During the corrective maintenance or repair works, the Tenderer shall provide all labour, tools, equipment etc. that are required to carry out the work. The price of the labour and tolls required will be based on the Price Schedule for CM. The Tenderer shall submit the price schedule together with the quotation for bidding.
- e) Repair the breakdown. The Tenderer has to provide solution to the breakdown and recommendation of parts to change. The price of the parts to change will be based on the Price schedule for CM. The Tenderer shall submit the price schedule together with the quotation for bidding.
- f) Technical support. The Contactor has to provide technical support during the office hours (0800 to 1800hrs).
- g) Warranty of repair and parts. All repairs of parts and servicing works carried out shall carry a warranty period of 6 months. Parts that are replaced shall come with a minimum 1 year warranty.

Appendix 2 to Section III**(2) REQUIREMENT SPECIFICATION FOR ION CHROMATOGRAPHY (IC)****(B) SPECIFICATIONS****1.1 General Description**

- a. The dimensions of the system shall not be more than 65W x 57D x 97H (cm).
- b. The weight of the system shall not be more than 150 kg.
- c. The system shall comprise of conductivity detectors for cations and anions analysis, suppressors, columns, eluent pumps and data handling system for the analysis of cations and anions.
- d. The system shall be able to detect cations and anions simultaneously.
- e. The system shall have equivalent if not better capability than the specifications stated from 1.2 to 1.13.
- f. Each system shall include item 1.2 to 1.13.

1.2 Ion Chromatography System

- a. The system shall comprise two modules (Module I & Module II).
- b. The system shall have inert, non-metallic PEEK (polyetheretherketone) components throughout the system to ensure solvent compatibility, corrosion and resistance.
- c. The 2 modules shall be configured as two separate systems with separation and detection functions with one computer and data analysis system. The two modules shall be able to run simultaneously for two samples and acquire data concurrently.
- d. Module I shall be able to run sample separation for detection of anions.
- e. Module II shall be able to run sample separation for detection of cations.
- f. Eluent generation shall be available as an option.
- g. The system shall be suitable for the usage of carbonate, hydroxide or organic solvent as eluent.
- h. The system shall have the ability to perform gradients with either low pressure mixing or electrolytically produced with the addition of an eluent generator.
- i. The system shall have a suppressor which operates in continuous suppression mode. Suppressor regeneration shall be via either chemical or electrolytic.
- j. The system shall permit field installation of an optional automation manager consisting of up to two 6-port or 10-port high pressure.

1.3 Pump

- a. The system shall have two high pressure pumps, one pump for Module I and another for Module II.
- b. The system shall have a pressure from 0-35MPa.
- c. The pump housing shall be able to incorporate at least two independent pumping systems.

- d. Pumps shall be made of non-metallic material to reduce possibility of corrosion.
- e. Pump shall be capable of running 2 mm and 4 mm i.d. columns without modification of the pump heads.

1.4 Suppressor

- a. The system shall have two suppressors, each for Module I and Module II.
- b. Both chemical and electrolytic suppression are acceptable.
- c. Suppressor device shall be able to suppress carbonate, hydroxide, and methanesulfonic acid eluents.
- d. The suppressors shall operate in a continuous suppression mode to reduce background noise.
- e. The suppressor shall not have any moving parts and consumables.
- f. The cost of all operating parts of suppression and maintenance cost associated with suppression inclusive of suppressor, peristaltic pumps, tubing, filters, rotors, and chemicals required for functional operation of suppressor shall be covered for one year.

1.5 Conductivity Detector

- a. The system shall have two conductivity detectors, each for Module I and Module II.
- b. The detector shall have measuring range from 0-15000 μ S.

1.6 Eluent Generator

- a. The eluent generator shall be available as an option and must be available in either a single channel or dual channel configuration. The single channel shall be field upgradeable to dual and both channels shall be contained in the same enclosure.
- b. Eluent generation is an electrolytic process by which eluent is produced and purified at the same time and various concentration can be prepared automatically.
- c. Eluent generation should not be prepared through the dilution of concentrate using a burette device to produce eluent of various concentrations. The concentration of the eluent must be possible throughout a run without the use of additional mechanical devices such as valves.
- d. Eluent Concentration shall be in the range from 0.1 to 100mM for hydroxide eluent.
- e. Flow rates shall be at least 0.1 mL/min to 3.000 mL/min for analytical system.

1.7 Auto Sampler

- a. The auto sampler shall be shared by Module I and Module II.
- b. The auto sampler shall be made from non-metallic fluid pass components.
- c. The auto sampler shall be able to perform both full loop and partial loop injection.
- d. The auto sampler shall be capable of modifying a run sequence anywhere within the sampler during the run without interrupting analysis.
- e. The auto sampler shall be capable of handling vials sizes of 1.5ml.
- f. All functions are controlled by the instrument software.
- g. The auto sampler shall be capable of sequential or simultaneous injection.

- h. The auto sampler shall have a variable volume range of 1-100 μL in 0.1 μL increments or 100-7500 μL in 1 μL increments.

1.8 Software

- a. The software shall be able to provide full automatic control of the process of analysing samples.
- b. Standard curves shall be generated using a variety of curve fitting functions.
- c. The software shall be able to automate integration updates without time consuming batch reprocessing of changes to integration in a data set.
- d. The software shall allow real time integration monitoring in order for an instrument operator to monitor real time progress.
- e. The instrument software shall include self-diagnostic functions.

1.9 Computer and Printer

- a. The computer shall have a Intel® Core™ i7-6700 Processor (Quad Core, 8MB, 8T, 3.4GHz) Intel® Integrated Graphics 8GB (1x8GB) 1600MHz DDR3L Memory (Max 4 DIMM slots; up 16GB) 1TB 7200 RPM 3.5" SATA Hard Drive 8x DVD+/-RW, at least 22" LCD wide monitor, keyboard, , wireless mouse & mouse pad.
- b. The computer shall be pre-installed with the latest and compatible Windows operating system and Microsoft office software (Word, Excel® and PowerPoint)
- c. A colour laser printer with duplex printing function and a spare set of colour toner cartridges shall be provided.

1.10 Accessories

- a. **Each system** provided shall come with the full suite of the following accessories, or their equivalent. The accessories are as follow:
 - i. 100 mL of a mixture of 7 anions (50 ppm fluoride, 30 pm chloride, 100 ppm nitrite, 100 ppm bromide, 100 ppm nitrate, 150 ppm phosphate and 150 ppm sulphate).
 - ii. 2 columns for the detection of anions stated in 1.10ai. The dimension of the column shall be 150 mm x 2 mm id x 4 μm .
 - iii. 2 guard columns compatible with the column in 1.10a ii.
 - iv. 1 column for the detection of chlorate and perchlorate. The dimension of the column shall be 250 mm x 2 mm id x 4 μm .
 - v. 1 guard column compatible with the column in 1.10a iv.
 - vi. 4000 pieces of 0.45 μm polyvinylpyrrolidone filter to remove organic acids.
 - vii. 100 mL of a mixture of 7 cations (50 ppm lithium, 200 ppm sodium, 400 ppm ammonium, 400 ppm potassium, 400 ppm magnesium and 1000 ppm calcium).
 - viii. 2 columns for the detection of anions stated in 1.10a vii. The dimension of the column shall be 250 mm x 2 mm id x 4 μm .
 - ix. 2 guard columns compatible with the column in 1.10a viii.
 - x. 3500 pieces of 1 to 10 mL pipette tips.

- xi. 3500 pieces of 1.5 mL polypropylene vials and vial caps (must be compatible for use in autosampler).
- xii. 3500 pieces of 10 mL polypropylene vials and vial caps (must be compatible for use in autosampler).

1.11 Others

- a. Tenderer shall collect standards and/or samples, provided by the Authority, to analyse at no additional costs. The hardcopy of the chromatograms and analysis results shall be provided within 14 days upon receipt of the samples. All samples must be returned to the Authority after submission of report. The analysis results cannot be published in any form or revealed to a third party.
- b. All modules must be GLP/GMP compliant or a declaration of conformity certificate must be provided.
- c. The tenderer shall deliver the IC to separate locations. Refer to para 4 of Section III for delivery schedule. Lab staff shall be notified of the exact delivery date at least 1 week before.
- d. The tenderer shall take note that there is no lift available at two of the sites of the delivery. The price quoted shall include hoisting charges of the instrument, if necessary.
- e. Prices quoted must include all administrative, delivery, installation and freight charges.

1.12 Training

- a. Training shall be provided on the operation of the system and software after installation of the system.
- b. Training shall be provided for at least 10 users for the operation of each system and software, trouble shooting and general maintenance of the system.
- c. There shall be at least one training session from the supplier's application specialist which can be customized to the users' needs within a year of installation of each instrument.
- d. Training shall be provided for the users of the instruments at site, as well as at the tenderer's application laboratory, after installation and commissioning.

1.13 Warranty and Support

- a. On-site installation, commissioning and training by factory-trained engineer is required.
- b. The tenderer shall have a local dedicated team, consisting of sales, engineers and application engineers from direct factory/manufacturer for optimum support of the system.
- c. The tenderer shall provide after-sales service efficiently and effectively. The tenderer shall have in his/her facility a similar system to that proposed in this tender for training purposes.
- d. Back up equipment support for testing must be available at the tenderer's facility during equipment breakdown.

- e. Comprehensive support shall be provided for the equipment for a period of **12 months** which will consist of the following **at no extra cost**:
 - i. Unlimited service calls
 - ii. Travel and labour expenses of the engineer
 - iii. Service parts used for repairs
- f. The warranty shall commence only upon successful completion of the acceptance test or commissioning. The service engineer shall respond within 24 hours for service calls and within 48 hours for on-site service.

(B) COMPREHENSIVE MAINTENANCE FOR ION CHROMATOGRAPHY SYSTEM

- 2.1 The Contractor shall provide a seven (7) year Preventive Maintenance and Corrective Maintenance after the expiry of the warranty period.
- 2.2 The scope of activities for the Comprehensive Maintenance package shall include the following:
 - a. Preventive Maintenance (PM)
 - ii. The Contractor shall perform PM twice per year.
 - iii. The scope of PM is as specified in **Appendix 2.1** to Section III.
 - b. Corrective Maintenance (CM)
 - i. The Contractor shall perform CM within the stated turnaround time.
 - ii. The scope of CM is as specified in **Appendix 2.2** to Section III.
 - c. Technical Support during office hours from 0800 to 1800hrs.
 - d. 2-Way Transportation of the equipment if maintenance is done off-site.

Appendix 2.1 to Section III

PREVENTIVE MAINTENANCE (PM) FOR ION CHROMATOGRAPHY SYSTEM

2.3 The Contractor shall provide the detailed proposed scope of works for the PM upon submission of tender. The general scope of work for the PM of IC shall be as follows:

- a) Inspect and clean the pumps.
- b) Install new seals and check valves for the pumps.
- c) Replace the tubing connections if necessary.
- d) Inspect the pressure valves. Rebuilt and reconnect the valves and liquid lines inside the pressure valves.
- e) Verify the fittings of the system. Ensure that there is no leakage.
- f) Provide a PM kit for the PM.
- g) Perform maintenance for the system
- h) A service report and maintenance report shall be submitted after each PM.

Appendix 2.2 to Section III

CORRECTIVE MAINTENANCE (CM) FOR ION CHROMATOGRAPHY SYSTEM

2.4 The general scope of work for the CM of the IC shall be as follows:

- a) To be performed as per request by the laboratories. The response time (RT) upon receipt of fault call is within next business day of fault call from Mondays to Fridays (0800 to 1800hrs).
- b) To include all parts and labour used.
- c) The charges for the corrective maintenance are to be covered under the comprehensive maintenance plan.
- d) To provide technical support during office hours (0800 to 1800hrs).
- e) If corrective maintenance is done off-site, the price quoted shall include 2-way transportation of the equipment.
- f) The Contractor shall make arrangements with the Authority to collect the defective system within 3 business days of fault call.
- g) A service report shall be submitted after each corrective maintenance.
- h) On-Site Turn-Around-Time (i.e., the time period between the time the Contractor arrives at the Site to the time the repaired Equipment and/or Services are successfully completed and accepted on site by the Authority) required is 7 calendar days.
- i) Workshop Repair Turn-Around-Time (i.e. the time period between the receipt of a defective Equipment by the Contractor and the receipt and acceptance of the repaired Equipment by the Authority) required is 21 calendar days.
- j) All repairs of parts and servicing works carried out shall carry a warranty period of 6 months. Parts that are replaced shall come with a minimum 1 year warranty.

Appendix 3 to Section III

(3) REQUIREMENT SPECIFICATION FOR AUTOMATED LIQUID HANDLING SYSTEM

(A) SPECIFICATIONS

1.1 General Description

- a. The proposed system shall be a single table top instrument that is able to automatically dispense a selected quantity of liquids to designated container according to the programmed protocol.
- b. The system shall have a mobile arm holding a pipette head and also a tray system such that they are able to cover motion in the X, Y and Z axis.
- c. The system shall be enclosed with a cover that can be opened to access the operating surface of the system.
- d. The external dimension of the instrument shall not exceed 700 mm x 700 mm x 600 mm (W x D x H).
- e. The weight of the instrument shall not exceed 80 kg.
- f. The system's operating environment shall cover the temperature of 20°C to 25°C, inclusive, with a relative humidity of 40% to 70%, inclusive.
- g. The system shall be compatible with a power supply of 220-240V, AC, 50Hz.
- h. The system shall have at least two (2) USB 2.0 ports for the transfer of data.
- i. The system should be an equivalent if not better capability than the specifications stated from 1.2 to 1.9
- j. Each system shall include item 1.2 to 1.9.

1.2 Pipette

- a. The pipette head shall utilize a motorized pipette for the drawing and dispensing of liquids and does not require additional accessories such as an air compressor to operate.
- b. The pipette shall dispense liquid volume between 1 µL to 200 µL, inclusive, without having to change the pipette head.
- c. The pipette shall be able to handle single channel and 8-channel pipetting.
- d. When doing single channel pipetting, the pipette shall work such that it only picks up one pipette tip at a time.
- e. There shall be a mechanism allowing liquid to not stay on the external surface of the tips when dispensing minute volume of liquid.

- f. The pipetting errors of the pipette shall not be more than the following:

Volume (µL)	Systematic Error (%)	Random Error (%)
For 1 – 20 µL		
1	10.0	5
10	2.0	1
20	1.5	1
For 20 – 200 µL		
20	2.5	1
100	1	0.5
200	1	0.25

1.3 Pipette tips

- The pipette tips supplied shall be compatible for use on the pipette head.
- The pipette tips supplied shall cover the volume liquid volume between 1 µL to 200 µL, inclusive.
- The pipette tips supplied shall be filtered tips, sterilized, DNase/RNase-free and come in individual packs of 96-tips.
- There shall be two hundred (200) packs/racks of 96-pipette tips for each volume range of tips proposed to be supplied for each unit of system.

Eg. If there are two (2) volume ranges proposed:

Number of 96-tips packs for volume range #1 for Instrument #1	Number of 96-tips packs for volume range #2 for Instrument #1	Number of 96-tips packs for volume range #1 for Instrument #2	Number of 96-tips packs for volume range #2 for Instrument #2
200	200	200	200

1.4 Tray System

- The tray system shall be such that it will allow the attachment of customized racks/adaptors, each for holding different types of consumables such as tubes and pipette tips.
- The different types of customized racks/adaptors proposed shall hold the following consumables:
 - 1.5 mL flip-cap micro-centrifuge tubes, non-passive cooling;
 - 1.5mL/2.0 mL screw-cap micro-centrifuge tubes, non-passive cooling;
 - 2.0 mL screw-cap micro-centrifuge tubes, requiring passive cooling;
 - 0.5 mL skirted, screw-cap micro-centrifuge tubes, requiring passive cooling (external dimensions is similar to that of a 2.0mL screw-cap micro-centrifuge tube);

- v. 0.2 mL flip-cap PCR tubes and strip-tubes, non-passive cooling;
 - vi. 0.2 mL flip-cap PCR tubes and strip-tubes, requiring passive cooling;
 - vii. 0.2 mL half-skirted, 96-well optical microplate, requiring passive cooling;
 - viii. Pipette tips rack for the proposed volume range;
 - ix. Waste bin;
- c. 1 unit of each customized racks/adaptors (non- passive cooling) listed above shall be supplied for each instrument.
 - d. 2 units of each customized racks/adaptors (passive cooling) listed above shall be supplied for each instrument.
 - e. There shall be sufficient slots on the tray to attach one unit of each type of the required customized racks/adaptors stated above in a single tray, in a single run.

1.5 Software and user interface

- a. The system shall come with a touch-screen tablet on a supporting stand, installed with the necessary software to operate and communicate with the instrument.
- b. The software shall be easy to use, allowing the selection of pre-defined protocols and the changing variables such as the number of reactions to prepare.

1.6 Protocol

- a. Each system shall come with at least two (2) protocols customized as per user's request.
- b. The protocol for each system will differ slightly but will generally include the following:
 - i. Preparing a master-mix in a new tube by drawing from two (2) stock tubes in a specific ratio;
 - ii. Preparing a dilution series from a stock tube and a tube of dilution buffer/water;
 - iii. Dispensing the master-mix into wells of a 96-well plate followed by the dilution series and samples.

1.7 Training

- a. A comprehensive training shall be included after the installation of the system, with the following requirements:
 - i. The training shall accommodate fifteen (15) persons for each system;
 - ii. The training shall cover the operation and maintenance of the system;
 - iii. The training shall be conducted at two separate user's facility, on a date to be arranged with the user.

1.8 Warranty and support

- a. On-site installation, commissioning and training by factory-trained engineer is required.
- b. The tenderer shall have a local dedicated team, consisting of sales, engineers and application engineers from direct factory/manufacturer for optimum support of the system.
- c. The tenderer shall provide after-sales service efficiently and effectively. The tenderer shall have in his/her facility a similar system to that proposed in this tender for training purposes.
- d. Back up equipment support for testing must be available at the tenderer's facility during equipment breakdown.
- e. Comprehensive support shall be provided for the equipment for a period of **12 months** which will consist of the following **at no extra cost**:
 - i. Unlimited service calls
 - ii. Travel and labour expenses of the engineer
 - iii. Service parts used for repairs
- f. The warranty shall commence only upon successful completion of the acceptance test or commissioning. The service engineer shall respond within 24 hours for service calls and within 48 hours for on-site service.

1.9 Others

- a. The tenderer shall deliver the system to separate locations. Refer to para 4 of Section III for delivery schedule. Lab staff shall be notified of the exact delivery date at least 1 week before.
- b. The prices quoted for the system shall include all charges, inclusive of overseas freight charges, licensing, testing and commissioning.

(B) COMPREHENSIVE MAINTENANCE FOR AUTOMATED LIQUID HANDLING SYSTEM

- 2.1 The Contractor shall provide a seven (7) year Comprehensive Maintenance after the expiry of the warranty period.
- 2.2 The scope of activities for the Comprehensive Maintenance package shall include the following:
 - a. Preventive Maintenance (PM)
 - i. The frequency of the maintenance is to be proposed by the Tenderer in accordance to the requirement of the model.
 - ii. The scope of the PM is as specified in **Appendix 3.1 to Section III**
 - b. Corrective Maintenance (CM)
 - i. The Contractor shall perform CM within the stated turnaround time.
 - ii. The scope of the CM is as specified in **Appendix 3.2 to Section III**
- 2.3 Technical support shall be provided during office hours from 0800 to 1800hrs.
- 2.4 Two-way transportation of the equipment shall be provided if the maintenance is done off-site.

Appendix 3.1 to Section III

PREVENTIVE MAINTENANCE FOR AUTOMATED LIQUID HANDLING SYSTEM

- 2.5 The Contractor shall provide the detailed proposed scope of works for the PM upon submission of tender. The general scope of work for the PM shall be as follows:
- a) General inspection of the system.
 - b) Interior cleaning and lubrication of the instrument.
 - c) Calibration of the pipette head for its coordinate motion.
 - d) Calibration of the pipette's accuracy and precision.
 - e) Operate the system and check that there are no abnormal noises.
 - f) Software updates when necessary.
 - g) A service report shall be submitted immediately after each PM.

Appendix 3.2 to Section III

CORRECTIVE MAINTENANCE FOR AUTOMATED LIQUID HANDLING SYSTEM

2.6 The general scope of work for the CM of automated liquid handling system shall be as follows:

- a) The CM shall be performed as per request by the Authority. The response time upon receipt of fault call is within the next business day of the fault call from Mondays to Fridays (0800 to 1800hrs).
- b) The CM shall include all parts and labor used.
- c) All charges for the CM are to be covered under the comprehensive maintenance plan.
- d) The Contractor shall make arrangements with the Authority to collect the defective system within 3 business days of the fault call.
- e) A service report shall be submitted after each CM.
- f) On-site Turn-Around-Time (i.e. the time period between the time the Contractor arrives at the Site to the time the repaired Equipment and/or Services are successfully completed and accepted on-site by the Authority) required is seven (7) calendar days.
- g) Workshop Repair Turn-Around-Time (i.e. the time period between the receipt of the defective Equipment by the Contractor and the receipt and acceptance of the repaired Equipment by the Authority) required is twenty-one (21) calendar days.
- h) All repairs of parts and servicing works carried out shall carry a warranty period of six (6) months. Parts that are replaced shall come with a minimum one (1) year warranty.

Appendix 4 to Section III

(4) REQUIREMENT SPECIFICATIONS FOR CONTAMINATION MONITOR

(A) SPECIFICATIONS

1.1 General Description

- a. The item consists of 1 (one) unit of hand and foot monitoring system with 6 (six) units of radiation contamination survey meters.
- b. The hand and foot monitor shall be compact due to the space constraint. The dimension of the monitor shall not exceed 700mm (W) and 850mm (D).

1.2 Hand and foot monitoring system

- a. The monitor shall be a gasless system, without the need to have external continuous gas supply.
- b. The monitor shall be used for simultaneous measurement of alpha, beta and gamma radiation.
- c. The monitor shall be able to check for background fluctuations before the start of each contamination measurement.
- d. The monitor shall be able to compensate contamination measurement with background value by continuously monitoring the ambient radiation.
- e. The monitor shall have a sensitive/effective area for hand detector of not less than 300cm².
- f. The monitor shall have a sensitive/effective area for foot detector of not less than 450cm².
- g. The monitor shall be able to provide both palm and back of hand measurement.
- h. The measuring results can be represented in the units Bq/cm² or in cps.
- i. The monitor shall come with a removable hand probe for frisker measurement and for detection of contamination on clothing.
- j. The monitor shall have 4 foot stand for safety purpose.
- k. The monitor shall have operation done via a touch panel on the graphical display.
- l. The monitor shall have a permanent data memory of more than 1700 measuring data that can be transferred via USB to an external computer.

1.3 Operating Conditions of the Hand and foot monitoring system

- a. The monitor shall function in the following conditions:
 - i. From 10⁰C to 35⁰C
 - ii. Maximum humidity of more than 90% relative humidity without degradation in performance
- b. The monitor shall be compatible with power 220-240 VAC, 47-65 Hz.
- c. The Tenderer shall supply all the cables, connectors and accessories necessary

for proper operation of the monitor.

1.4 Calibration

- a. The Tenderer shall provide service for calibration locally.
- b. The monitor shall come with calibration sources with appropriate activities, dimensions and with homogenous distribution of radionuclides for the alpha, beta and gamma detectors in the monitor.

1.5 Survey Meter

- a. The monitor shall come with 6 units of radiation contamination survey meter.
- b. The Survey meter shall have features :
 - i. Dimension not exceeding 11cm (L) x 30cm (W) x 7cm (H)
 - ii. Weight (with probe) not exceeding 1.2kg
 - iii. With shoulder strap or carry casing for ease of carrying
 - iv. Can detect alpha, beta and gamma or X-ray radiation
 - v. Data logging survey mode feature that allows user to store up measurements
 - vi. Quick start up of less than 1 min
 - vii. Auto-power down feature

1.6 Training

- a. The successful Tenderer shall conduct onsite training sessions at 5 different sites for the monitor and the survey meters and at least 10 trainees per session. The training shall be provided by factory trained engineer. The training shall include but not be limited to the followings:
 - i. Operating instructions
 - ii. Operating level maintenance (inclusive of troubleshooting)
 - iii. The training session shall be conducted only on Monday to Friday, 0900 to 1700hr.
- b. The monitor and survey meter shall come with operating manuals (hard and softcopies).

1.7 Delivery and Commissioning

- a. The Tenderer shall schedule the delivery and installation events to meet the stipulated commissioning date.
- b. The Tenderer shall deliver the one Hand Foot Monitor and six survey meters to 5 separate sites.
- c. The Tenderer shall provide commission the monitor and survey meter by factory trained engineer.
- d. The Tenderer shall provide the tools and equipment which are necessary for the installation of the monitor.
- e. Refer to para 4 of Section III for delivery schedule. Lab staff shall be notified of the exact delivery at least one week before.

1.8 Warranty and Support

- a. The Tenderer shall have a local dedicated team, consisting of sales, engineers for optimum after sales support.
- b. Comprehensive support shall be provided for the equipment for a period of 12 months which will consist of the following at no extra cost:
 - i. Unlimited service calls (Service engineer shall respond within 24 hrs for service calls and within 48 hrs for on-site service)
 - ii. Travel and labour expenses of the engineer
 - iii. Service parts used for repairs
- c. The warranty (at least 1 year) shall commence only upon successful completion of commissioning.

1.9 Others

- a. Prices quoted shall include all administrative (i.e. import and export licences, custom and import duties), delivery and freight charges.

(B) COMPREHENSIVE MAINTENANCE FOR SPECIFICATIONS FOR HAND AND FOOT MONITORING AND RADIATION CONTAMINATION SURVEY METERS

- 2.1 The Tenderer shall provide a seven (7) years Preventive Maintenance (PM) and Corrective Maintenance (CM) after the expiry of the warranty period.
- 2.2 The scope of activities for Comprehensive Maintenance package shall include the following:
- a. Preventive Maintenance (PM)
 - i. The Successful Tenderer shall perform PM; the frequency of the PM shall be **3 monthly for the Hand and Foot Monitor** and **yearly for the survey meter.**
 - ii. The scope of PM is as specified in **Appendix 4.1** to Section III.
 - b. Corrective Maintenance (CM)
 - i. The Successful Tenderer shall perform CM within the stated turnaround time.
 - ii. The scope of CM is as specified in **Appendix 4.2** to Section III..
 - c. Technical Support during office hours from 0800 to 1800hrs.
 - d. 2-Way Transportation of the equipment if maintenance is done off-site.

Appendix 4.1 to Section III

PREVENTIVE MAINTENANCE (PM) FOR HAND AND FOOT MONITORING WITH RADIATION CONTAMINATION SURVEY METERS

2.3 The Contractor shall provide the detailed proposed scope of works for the PM upon submission of tender. The general scope of work for the PM of Hand and Foot Monitor and survey meter shall be as follows:

- a) The frequency of maintenance is 3 monthly for the Hand and Foot Monitor and yearly for the survey meter.
- b) The Tenderer shall provide the **detailed proposed scope of works** for PM upon Tender submission. The general scope for the PM is as follows:
 - i. Inspection of the hardware
 - ii. Conduct integrity test for the monitor to ensure its functionality
 - iii. Calibration of the monitor with test sources
 - iv. A service report shall be submitted after each PM

Appendix 4.2 to Section III

**CORRECTIVE MAINTENANCE (CM) FOR HAND AND FOOT MONITORING
WITH RADIATION CONTAMINATION SURVEY METERS**

2.4 The general scope of work for the CM of the IC shall be as follows:

- a) CM shall be performed as per request by the Authority. The response time upon receipt of fault call is within 24 hr from Mondays to Friday (0800 to 1800hrs).
- b) Tenderer to provide technical support during office hours (0800 to 1800hrs).
- c) The faulty part(s) is to be collected within next working day of fault call.
- d) All parts and labour cost shall be covered under the comprehensive maintenance package.
- e) A service report shall be submitted after each corrective maintenance.
- f) On-Site Turn Around Time required is 7 days (i.e., the period between the time the Contractor arrives at the Site to the time the repaired Equipment and/or Services are successfully completed and accepted by the Authority).
- g) Workshop Repair Turn-Around-Time required is 60 days (i.e., the time period between the receipt of a defective Equipment by the Contractor and the receipt and acceptance of the repaired Equipment by the Authority)
- h) If corrective maintenance is to be performed off-site, the price quoted shall include 2 way transportation of the equipment.
- i) All repairs of parts and servicing works carried out shall carry a warranty period of 6 months. Parts that are replaced shall come with a minimum 1 year warranty.

Appendix 5 to Section III

(5) REQUIREMENT SPECIFICATION FOR GAS CHROMATOGRAPHY MASS SPECTROMETRY/MASS SPECTROMETER (GCMS/MS)

(A) SPECIFICATION

1.1 General Description

- a. The main frame of the GCMS/MS shall not weigh be more than 120 kg.
- b. The dimensions shall not exceed 100 cm (L) x 90 cm (W) x 50 cm (H).
- c. The system shall have equivalent if not better capability than the specifications stated from 1.2 to 1.14.

1.2 Gas Chromatography (GC)

- a. The software that monitors gas chromatography counters and provides graphic display shall be offered. A real-time notification via indicator/ advisor when a counter limit has been reached must also be provided.
- b. The display of primary pressure shall be available to indicate the remaining gas in carrier cylinder to avoid disruptions in analysis.
- c. The pre-programmed leak tests shall be available from the keyboard or monitoring software for safety purposes.
- d. The system shall provide a run time deviation log created for each analysis.
- e. Built-in column bleed, standard atmospheric pressure and temperature compensation shall be available.
- f. The gas chromatography system can reduce carrier gas consumption after injection or on stand-by.

1.3 Column Oven

- a. The column oven shall have an operating temperature range of +4 °C to 450°C.
- b. A built-in automatic carrier gas shutoff is required if inlet pressure drops to a threshold level set.

1.4 Injector

- a. Two units of independently temperature controlled injector units shall be supplied.
- b. A split ratio range of 0 to 9999.9 shall be available to avoid column overload.
- c. The split/splitless injector shall be able to operate for temperatures up to a maximum of 450 °C.
- d. The pressure programming method must employ constant linear velocity mode as separation ability is determined by linear velocity speed.

1.5 Mass Analyzer

- a. The mass spectrometer shall have the Electron Ionization (EI) mode supplied as standard. The Positive Chemical Ionization (PCI) and Negative Chemical Ionization (NCI) modes must be available for changing the ionization modes for the analysis of various compounds.
- b. The mass spectrometer must be equipped with an ultra high sensitivity ion source that has an ion optical system with high transport efficiency and excellent temperature homogenization of the ion source box to prevent the formation of adsorption sites inside the ion source due to cold spots.
- c. The collision cell must allow for efficient ion acceleration, ensuring zero cross talk.
- d. The mass spectrometer shall have a mass range of 10 to 1050 amu with unit mass resolution over the entire mass range. The mass spectrometer must also be able to measure at least 600 MRM/sec. The collision cell must be capable of performing MRM analysis with dwell time of less than 1 msec.
- e. The MS-MS capability must be available in Quadrupole 2 via Collision Induced Dissociation (CID).
- f. The mass spectrometer must have the capability to allow for the installation of two narrow-bore capillary columns simultaneously in order to eliminate the need to swap columns when switching applications.
- g. The mass spectrometer must have high performance synchronous Scan/MRM, Scan/SIM and Product Scan/MRM with automated SIM or MRM set up that can convert a full scan method to a SIM or MRM or Scan/SIM or Scan/MRM or Product Scan/MRM method. The software must automatically configure the number of SIM or MRM group, SIM or MRM cycles across the peak and the ions added to each group.
- h. The automated MRM optimization and method creation for the MRM measurement must be available.
- i. The system shall have built-in capability to adjust the retention times of target compounds even for simultaneous MRM analysis of multiple components.
- j. The signal-to-noise for 1 pg of octafluoronaphthalene in EI scan at m/z 272 must be greater than 300. The signal-to-noise for 100 fg of octafluoronaphthalene in EI MRM must be greater than 7000. Analysis report shall be provided upon request.
- k. The vacuum system must be able to accommodate flow rates up to 8.0 ml/min of helium enabling highly effective evacuation speeds which increases allowable column flow rates.
- l. A vacuum pump that is compatible with the GCMS/MS system shall be provided to supply the vacuum required for the GCMS/MS system.
- m. The scanning speed shall be variable up to 20, 000 amu/sec.
- n. There shall be an automatic interrupt system which provides protection against damage such as filament failure. In case of power failure, vacuum integrity and cleanliness should be maintained by not venting to atmospheric pressure automatically.
- o. There must be two filaments available for both EI and CI ionization mode allowing switching to another when one fails.
- p. Fully automatic start-up and shut-down of the system by simply clicking one button on the computer screen shall be available when replacing columns or repairing ion sources.

1.6 Auto Sampler

- a. The auto sampler shall be installed easily without the need for alignment. It should allow random access in sample sequencing. It must also accommodate up to 150 samples.

1.7 Flame Ionization Detector

- a. The system must be equipped with a detector splitting system to split elution from the analytical column to the flame ionization detector and mass spectrometer. The detector splitting device must employ low dead volume hardware with an inert coating throughout the sample pathway in combination with a high precision digital flow controller.
- b. The detector splitting device must be supplied with software capable of method loading or saving, calculation of detector flow rate and split ratio and high flow warning indicator at setting overflow value.
- c. The flame ionization detector must provide fast flame out detection and efficient automatic re-ignition with a temperature range of up to 450°C. The detector must be able to detect at levels below 1.5 pg C/s.
- e. There shall be electronic flow controller for three gases – hydrogen, make-up gas and air.
- f. A hydrogen generator compatible with the system shall be provided.

1.8 Gas Lines

- a. Installation of gas lines including regulator and switch over manifold, from the source of the gas to the system. All materials and labour shall be provided by tenderer
- b. Regulators shall be provided for the all gases required for analysis.

1.9 Software

- a. The system software must fully control the instrument using pre-stored methods of all operating parameters. This software must be fully GLP/GMP compliant. Strong security function, validation function for hardware and software, and audit trail function for data traceability must be built-in as a standard.
- b. The library search software provided as a standard shall be capable of searching through several libraries simultaneously including the user defined private library. The library search mode should be either by similarity search or index search.
- c. The NIST Mass Spectral Library (latest version) and the Wiley Mass Spectral Library (latest version) shall be provided.
- d. Libraries on food, environmental and forensic for single quadrupole and triple quadrupole shall be provided.
- e. There shall be simultaneous Scan/SIM or Scan/MRM capability.
- f. Software and libraries upgrades (if any) shall be provided without any additional costs.

1.10 Computer and Printer

- a. The computer shall have a Intel® Core™ i7-6700 Processor (Quad Core, 8MB, 8T, 3.4GHz) Intel® Integrated Graphics 8GB (1x8GB) 1600MHz DDR3L Memory (Max 4 DIMM slots; up 16GB) 1TB 7200 RPM 3.5" SATA Hard Drive 8x DVD+/-RW, at least 22" LCD wide monitor, keyboard, , wireless mouse & mouse pad.
- b. The computer shall be pre-installed with the latest and compatible Windows operating system and Microsoft office software (Word, Excel® and PowerPoint)
- c. A colour laser printer with duplex printing function and a spare set of colour toner cartridges shall be provided.

1.11 Uninterrupted Power Supply (UPS)

- a. One set of UPS with output power supply shall be provided together with batteries that are sufficient to serve a backup time of at least 30 minutes.
- b. The package shall include the installation and commissioning of the UPS with the GCMS/MS supplied.

1.12 Accessories

- a. The system shall be supplied with a set of GC start-up kit, consisting of at least septum, liners, o-rings, one unit of gas trap for hydrocarbons, moisture and oxygen, oil mist filter and 2 ceramic scoring wafers as well as a tool kit and consumables kit (for GC and MS) for basic maintenance of the GCMS/MS system.
- b. The system shall be supplied with one additional EI ion source.
- c. The system shall be supplied with two capillary column, RTX-5MS or equivalent. The dimensions of the columns are as such - 30 m x 0.25 mm id x 0.25 μ m.
- d. The system shall be supplied with two pieces of RTX-5Sil MS or equivalent. The dimensions of the columns are as such - 30 m x 0.25 mm id x 0.25 μ m supplied.
- e. The system shall be supplied with a hydrogen generator that can generate hydrogen with purity greater than 99.9995% and a 200 cc/min output flow rate.
- f. A stainless steel rack shall be provided to contain two gas tanks, with a volume of 10 litres each.
- g. The system provided shall come with the full suite of the following accessories, or their equivalent. The accessories are as follow:
 - i. 25 pieces of microliter syringe for autosampler (10 μ L)
 - ii. 4 pieces of ceramic insulator (if necessary)
 - iii. 100 pieces of O-ring for the glass insert
 - iv. 500 pieces of septum for injector port
 - v. 2 pieces of molecular sieve filter
 - vi. 100 pieces of deactivated splitless glass insert
 - vii. 100 pieces of deactivated split glass insert
 - viii. 2 pieces of triple gas filter
 - ix. 4 pieces of EI filament

1.12 Others

- a. Tenderer shall collect samples, provided by the Authority, to analyse at no additional costs. The chromatograms and analysis results shall be provided within 14 days upon receipt of the samples. All samples must be returned to the Authority after submission of report. The analysis results cannot be published in any form or revealed to a third party.
- b. All modules must be GLP/GMP compliant or a declaration of conformity certificate must be provided.
- c. The tenderer shall deliver the system to separate locations. Refer to para 4 of Section III for delivery schedule. Lab staff shall be notified of the exact delivery at least one week before.
- d. The tenderer shall take note that there is no lift available at site of the delivery. The price quoted shall include hoisting charges of the instrument, if necessary.
- e. Prices quoted must include all administrative, delivery, installation and freight charges.

1.13 Training

- a. Training shall be provided for at least 10 users for the operation, trouble shooting and general maintenance of the system.
- b. There shall be at least another training session from the supplier's application specialist which can be customized to the users' needs within a year of installation of the instrument.
- c. Training shall be provided for the users of the instruments at site, as well as at the tenderer's application laboratory, after installation and commissioning.

1.14 Warranty and Support

- a. On-site installation, commissioning and training by factory-trained engineer is required.
- b. The tenderer shall have a local dedicated team, consisting of sales, engineers and application engineers from direct factory/manufacturer for optimum support of the system.
- c. The supplier shall provide after-sales service efficiently and effectively. The supplier shall have in his/her facility a similar system to that proposed in this tender for training purposes.
- d. Back up equipment support for testing shall be available at the supplier's facility during equipment breakdown.
- e. Comprehensive support must be provided for the equipment (inclusive of GCMS/MS, hydrogen generator and UPS) for a period of **12 months** which will consist of the following **at no extra cost**:
 - i. Unlimited service calls
 - ii. Travel and labour expenses of the engineer
 - iii. Service parts used for repairs
- f. The warranty shall commence only upon successful completion of the acceptance test or commissioning. The service engineer must respond within 24 hours for service calls and within 48 hours for on-site service.

(B) COMPREHENSIVE MAINTENANCE FOR GCMS/MS SYSTEM

- 2.1 The Contractor shall provide a seven (7) year Preventive Maintenance and Corrective Maintenance after the expiry of the warranty period.
- 2.2 The scope of activities for the Comprehensive Maintenance package shall include the following:
- a. Preventive Maintenance (PM)
 - i. The Contractor shall perform PM twice per year for the GCMS/MS.
 - ii. The Contractor shall perform PM once per year for the hydrogen generator and UPS.
 - iii. The scope of PM is as specified in **Appendix 5.1** to Section III.
 - b. Corrective Maintenance (CM)
 - i. The Contractor shall perform CM within the stated turnaround time.
 - ii. The scope of CM is as specified in **Appendix 5.2** to Section III.
 - c. Technical Support during office hours from 0800 to 1800hrs.
 - d. 2-Way Transportation of the equipment if maintenance is done off-site.

Appendix 5.1 to Section III

PREVENTIVE MAINTENANCE (PM) FOR GCMS/MS SYSTEM

2.3 The Contractor shall provide the detailed proposed scope of works for the PM upon submission of tender.

2.4 The general scope of work for the PM for the **GCMS/MS** shall be as follows:

- a) Clean the ion source box and lens system. Rotate or clean the pre-rod.
- b) Check if heaters, sensors and GC remote signal cables are securely connected at their positions.
- c) Provide a complete PM kit and change the parts in the PM kit for the PM.
- d) Provide and replace the oil for the rotary pump.
- e) Check the level of PFTBA and replenish if necessary.
- f) Ensure that there is no leak in the MS system by verifying the intensity of m/z 18 and 69 is more than twice of m/z 28. Furthermore, ensure that there is no leak at the injector port.
- g) Inspect that both filaments are working normally and replace when necessary.
- h) Clean the injector unit and ensure that the syringe and turret are not damaged.
- i) Check condition of carrier gas filter and replace when necessary.
- j) Operate the autosampler and check that there are no abnormal noises.
- k) Perform necessary PM checks for GCMS/MS.
- l) A service report and PM report shall be submitted after each PM.

2.5 The general scope of work for the PM for **hydrogen generator** shall be as follows:

- a) Provide a complete PM kit for the PM.
- b) Replace with a new PM kit.
- c) Verify the proper functioning of the hydrogen generator.
- d) Perform necessary PM.
- e) A service report and PM report shall be submitted after each PM.

2.6 The general scope of work for the PM for **UPS** shall be as follows:

- a) Verify the proper functioning of the UPS.
- b) Check the battery of the UPS and replace if necessary
- c) A service report shall be submitted after each PM.

Appendix 5.2 to Section III

CORRECTIVE MAINTENANCE (CM) FOR GCMS/MS SYSTEM

2.4 The general scope of work for the CM of GCMS/MS shall be as follows:

- a) The Contractor shall provide the detailed proposed scope of works for the CM upon submission of tender. The general scope of work for the CM for the GCMS/MS (inclusive of pump overhaul), hydrogen generator and UPS (inclusive of battery) is as follows:
- b) To be performed as per request by the laboratories for the GCMS/MS, hydrogen generator and UPS. The response time (RT) upon receipt of fault call is within next business day of fault call from Mondays to Fridays (0800 to 1800hrs).
- c) To include all parts and labour used.
- d) The charges for the corrective maintenance are to be covered under the comprehensive maintenance plan
- e) To provide technical support during office hours (0800 to 1800hrs).
- f) If corrective maintenance is done off-site, the price quoted shall include 2-way transportation of the equipment.
- g) The Contractor shall make arrangements with the Authority to collect the defective system within 3 business days of fault call.
- h) A service report shall be submitted after each corrective maintenance
- i) On-Site Turn-Around-Time (i.e., the time period between the time the Contractor arrives at the Site to the time the repaired Equipment and/or Services are successfully completed and accepted on site by the Authority) required is 7 calendar days.
- j) Workshop Repair Turn-Around-Time (i.e. the time period between the receipt of a defective Equipment by the Contractor and the receipt and acceptance of the repaired Equipment by the Authority) required is 21 calendar days.
- k) All repairs of parts and servicing works carried out shall carry a warranty period of 6 months. Parts that are replaced shall come with a minimum 1 year warranty.

Appendix 6 to Section III**(6) REQUIREMENT SPECIFICATION FOR LIQUID CHROMATOGRAPHY MASS SPECTROMETRY/MASS SPECTROMETER (LCMS/MS)****(A) SPECIFICATIONS****1.1 General Description**

- a. The system shall be an ultra high performance liquid chromatography coupled to a triple quadrupole mass spectrometer.
- b. The LCMS/MS shall be a bench-top version.
- c. The dimensions of the system shall not be more than 150 cm (L) by 70 cm (W) by 70 cm (H).
- d. The weight of the system shall not be more than 150 kg.
- e. The system shall have equivalent if not better capability than the specifications stated from 1.2 to 1.15.
- f. Each system shall include item 1.2 to 1.15.

1.2 Ultra High Pressure Binary Solvent Delivery System

- a. The pump shall be a high pressure binary gradient pump
- b. Each pump shall be installed with a solvent selector valve to automatically switch between two solvents.
- c. The flow rate shall be adjustable between 0.001 to 5 mL/min in 0.0001 mL/min increments.
- d. The flow rate precision shall be less than $\pm 0.07\%$ RSD.
- e. The composition accuracy shall be less than 0.1% (1 mL/min, 100MPa).
- f. The pump shall be able to withstand an operating pressure of at least 120 MPa for flow rate of up to 2 mL/min and 80 MPa for flow rate up to 5 mL/min
- g. The composition precision shall be less than 0.15 % RSD at constant room temperature.
- h. Wash kit shall be included.

1.3 Degassing Unit

- a. The degassing unit shall have at least four flow lines.
- b. The maximum operating flow rate shall be up to 10 mL/min per flow line.
- c. The error status shall be transferred to the operating software.
- d. The unit shall include a leak sensor and a drain-pan.

1.4 Auto Sampler

- a. The auto sampler shall use a direct injection method as standard. However, the system shall allow flexibility to change the injection method to the loop injection with adjustable or fixed volume injection, when required.
- b. The auto sampler shall have a leak sensor, automatic rack and vial recognition.
- c. The injection system shall be of variable injection volume type with zero sample loss during injection.

- d. The auto sampler shall perform customised continuous analyses according to the conditions specified for each sample. Priority samples may be inserted in the queue during automated run.
- e. The system shall have the function of rinsing the flow line before and after sampling.
- f. The auto sampler shall have functions for maintenance and validation which are accessible by dedicated operating buttons.
- g. The auto sampler shall be able to accommodate at least 100 2 mL vials in 1 tray.
- h. The maximum operating pressure shall not be less than 80 MPa.
- i. The sample injection volume shall be variable from 0.1 μ L to 40 μ L.
- j. The injection volume precision shall not be more than 0.25 % from 5 to 40 μ L.
- k. The injection volume accuracy shall be within $\pm 1\%$ (at 10 μ L injection, n = 10).
- l. The system shall allow temperatures to be set from 4 to 40 $^{\circ}$ C.
- m. The carry over shall be below 0.004 % without rinsing.

1.5 Column Oven

- a. The column oven shall have a temperature limit device and temperature fuse. It must also have solvent and gas leak sensors as safety features.
- b. The column oven shall be capable of complex temperature programming in linear and step programs. The temperature range shall be ambient 10 $^{\circ}$ C to 80 $^{\circ}$ C.
- c. Complex temperature programming in linear and step programs shall be possible.

1.6 Ion Source

- a. The system must be equipped with the following:
 - i. One set of Electro Spray Ionisation (ESI) assembly
 - ii. One set of Atmospheric Pressure Chemical Ionisation (APCI) assembly
- b. The source temperature should be settable by user up to 750 $^{\circ}$ C.
- c. A syringe and syringe pump shall be available for direct infusion of samples.
- d. The instrument must have an active source exhaust for the removal of gases within the ionization source.

1.7 Mass Analyzer

- a. The mass analyzer shall consist of two, high standard, fast scanning quadrupoles and one efficient collision cell. The mass range is from at least 10 to 1000 m/z.
- b. The instrument should be able to carry out positive and negative mode scans in one single experiment at a polarity switching time of 50 msec.
- c. The maximum scanning speed of the mass analyzer should be 20,000 amu/s.
- d. For sensitivity in positive ESI, the measured signal-to-noise ratio obtained from the MRM transition m/z 609 to 195 for an injection of 1 pg of Reserpine should be more than or equal to 90,000:1. For sensitivity in negative ESI, the measured signal-to-noise ratio obtained from the MRM transition m/z 321 to 152 for an injection of 1 pg of chloramphenicol should be more than or equal to 90,000:1. S/N measurements are calculated based on 1 standard deviation of at least 3 points of noise which produce the smallest standard deviation, after applying up to 3 Gaussian smooths.

- a. Mass spectrometry-mass spectrometry (MS-MS) capability shall be available in quadrupole 2 via collision induced dissociation.
- b. The collision cell shall have a minimum dwell time of 2 milliseconds.
- c. Auto-tuning shall be standard with a syringe pump that delivers accurate injection under full workstation control in both positive and negative modes. Manual tuning shall also be allowed. At least one set of standard sample for auto-tuning shall be supplied.
- d. The vacuum system shall be a differential type with triple inlet turbo-molecular pump and one rotary pump.
- e. There shall be a shutter to cut-off nitrogen when no mobile-phase flows or during stand-by mode.
- f. Stainless steel piping for carrier gas shall be provided.
- g. The detector shall capable of very fast switching between positive and negative ion detection.
- h. A unit of nitrogen generator shall be supplied for each LCMS/MS system. The nitrogen generator shall be compatible with the system.

1.8 Gas Lines

- a. Installation of gas lines if necessary (including regulator and semi-automatic switch over manifold), from the source of the gas to the system. All materials and labour shall be provided by tenderer
- b. Regulators shall be provided for the all gases required for analysis.

1.9 Software

- a. Software shall be the latest version and provide for a seamless control of all the modules of the LC and MS. Software upgrades, if necessary, shall be provided without any additional costs.
- b. MS/MS acquisition mode must have various modes apart from MRM, for instance full scan, selected ion monitoring (Q1 and Q3), product ion scan, precursor ion scan and neutral ion scan.
- c. Auto start-up and shutdown of the MS shall be possible using a single key operation.

1.10 Computer and Printer

- d. The computer shall have a Intel® Core™ i7-6700 Processor (Quad Core, 8MB, 8T, 3.4GHz) Intel® Integrated Graphics 8GB (1x8GB) 1600MHz DDR3L Memory (Max 4 DIMM slots; up 16GB) 1TB 7200 RPM 3.5" SATA Hard Drive 8x DVD+/-RW, at least 22" LCD wide monitor, keyboard, , wireless mouse & mouse pad.
- e. The computer shall be pre-installed with the latest and compatible Windows operating system and Microsoft office software (Word, Excel® and PowerPoint)
- f. A colour laser printer with duplex printing function and a spare set of colour toner cartridges shall be provided.

1.11 Uninterrupted Power Supply (UPS)

- a. One set of UPS with output power supply shall be provided together with batteries that are sufficient to serve a backup time of at least 30 minutes.
- b. The package shall include the installation and commissioning of the UPS with the LCMS/MS supplied.

1.12 Accessories

- a. **Each system** provided shall come with the full suite of the following accessories, or their equivalent. The accessories are as follow:
 - i. 2 C18 columns. The dimension of the column is 100 mm x 2.1 mm id x 1.7 um.
 - ii. 2 guard columns compatible with the column in 1.11a i.
 - iii. 2 guard column holders compatible with the guard column in 1.11a ii.
 - iv. 1 piece of ESI probes assy.
 - v. 1 piece of APCI probes assay
 - vi. 2 piece of ESI electrode
 - vii. 1 piece of APCI electrode

1.13 Others

- a. Tenderer shall collect samples, provided by the Authority, to analyse at no additional costs. The chromatograms and analysis results shall be provided within 14 days upon receipt of the samples. All samples must be returned to the Authority after submission of report. The analysis results cannot be published in any form or revealed to a third party.
- b. All modules must be GLP/GMP compliant or a declaration of conformity certificate must be provided.
- c. The tenderer shall deliver the LCMS/MS to separate locations. Refer to para 4 of Section III for delivery schedule. Lab staff shall be notified of the exact delivery date at least 1 week before.
- d. The tenderer shall take note that there is no lift available at two of the sites of the delivery. The price quoted shall include hoisting charges of the instrument, if necessary.
- e. Prices quoted must include all administrative, delivery, installation and freight charges.

1.14 Training

- a. A briefing shall be provided on the operation of the system and software after installation of the system.
- b. Training shall be provided for at least 10 users for the operation, trouble shooting and general maintenance for each system.
- c. There shall be at least one training session from the supplier's application specialist which can be customized to the users' needs within a year of installation of the instrument.
- d. Training shall be provided for the users of the instruments at site, as well as at the tenderer's application laboratory, after installation and commissioning.

1.15 Warranty and Support

- a. On-site installation, commissioning and training by factory-trained engineer is required.
- b. The tenderer shall have a local dedicated team, consisting of sales, engineers and application engineers from direct factory/manufacturer for optimum support of the system.
- c. The tenderer shall provide after-sales service efficiently and effectively. The tenderer shall have in his/her facility a similar system to that proposed in this tender for training purposes.
- d. Back up equipment support for testing must be available at the tenderer's facility during equipment breakdown.
- e. Comprehensive support shall be provided for the equipment (inclusive of LCMS/MS, nitrogen generator and UPS) for a period of **12 months** which will consist of the following **at no extra cost**:
 - i. Unlimited service calls
 - ii. Travel and labour expenses of the engineer
 - iii. Service parts used for repairs
- f. The warranty shall commence only upon successful completion of the acceptance test or commissioning. The service engineer shall respond within 24 hours for service calls and within 48 hours for on-site service.

(B) COMPREHENSIVE MAINTENANCE FOR LCMS/MS SYSTEM

- 2.1 The Contractor shall provide a seven (7) year Preventive Maintenance and Corrective Maintenance after the expiry of the warranty period.
- 2.2 The scope of activities for the Comprehensive Maintenance package shall include the following:
 - a. Preventive Maintenance (PM)
 - i. The Contractor shall perform PM twice per year on the LCMS/MS
 - ii. The Contractor shall perform PM once per year for the nitrogen generator and UPS.
 - iii. The scope of PM is as specified in **Appendix 6.1** to Section III.

- b. Corrective Maintenance (CM)
 - i. The Contractor shall perform CM for LCMSMS, nitrogen generator and UPS (inclusive of the battery) within the stated turnaround time.
 - ii. The scope of CM is as specified in **Appendix 6.2** to Section III.
- c. Technical Support during office hours from 0800 to 1800hrs.
- d. 2-Way Transportation of the equipment if maintenance is done off-site.

Appendix 6.1 to Section III

PREVENTIVE MAINTENANCE (PM) FOR LCMS/MS SYSTEM

- 2.3 The Contractor shall provide the detailed proposed scope of works for the PM upon submission of tender.

The general scope of work for the PM for **LCMS/MS** shall be as follows:

- a) Verify the pulsation of flow from the LC pump and ensure that there is correct output flow.
- b) Inspect the system for leakage, cable problems, tubing problems, water issues and chemical residue. Repair and/or replace the parts if necessary.
- c) Verify the proper functioning of the temperature sensor inside the column oven.
- d) Verify the proper functioning of the mass spectrometer Q1 and Q3 in both positive and negative mode.
- e) Conduct tuning results check on the Q1 and Q3 scan mode. A tuning check on the MS/MS mode shall also be done.
- f) Inspect and ensure that the vacuum pump is operating well.
- g) Cleaning of the ionization probe/ assembly. Change the ionization probe if necessary.
- h) Inspect and ensure that the rotary pump is operating well.
- i) To provide and change the oil for the rotary pump.
- j) Perform necessary PM checks.
- k) A service report and PM report shall be submitted after each PM.

The general scope of work for the PM for **nitrogen generator** shall be as follows:

- a) Inspect and ensure that the nitrogen generator is operating well
- b) Perform the following test - leak checks, system logs, relief valve testing.
- c) Inspect the compressor. If the compressor is beyond the third refit, it shall be replaced during the PM without any cost.
- d) Supply and replace annual service kit for every PM
- e) Turn on the generator to build up set point pressure

The general scope of work for the PM for **UPS** shall be as follows:

- a) Verify the proper functioning of the UPS.
- b) Check the battery of the UPS and replace if necessary.
- c) A service report shall be submitted after each PM.

Appendix 6.2 to Section III

CORRECTIVE MAINTENANCE (CM) FOR LCMS/MS SYSTEM

2.4 The Contractor shall provide the detailed proposed scope of works for the CM upon submission of tender. The general scope of work for the CM for the LCMS/MS (inclusive of pump overhaul), nitrogen generator and UPS (inclusive of battery) is as follows:

- a) To be performed as per request by the laboratories for the LCMS/MS, nitrogen generator and UPS. The response time (RT) upon receipt of fault call is within next business day of fault call from Mondays to Fridays (0800 to 1800hrs).
- b) To include all parts and labour used.
- c) To include all the necessary system upgrade without additional cost.
- d) The charges for the corrective maintenance are to be covered under the comprehensive maintenance plan.
- e) To provide technical support during office hours (0800 to 1800hrs).
- f) If corrective maintenance is done off-site, the price quoted shall include 2-way transportation of the equipment.
- g) The Contractor shall make arrangements with the Authority to collect the defective system within 3 business days of fault call.
- h) A service report shall be submitted after each corrective maintenance
- i) On-Site Turn-Around-Time (i.e., the time period between the time the Contractor arrives at the Site to the time the repaired Equipment and/or Services are successfully completed and accepted on site by the Authority) required is 7 calendar days.
- j) Workshop Repair Turn-Around-Time (i.e. the time period between the receipt of defective Equipment by the Contractor and the receipt and acceptance of the repaired Equipment by the Authority) required is 21 calendar days.
- k) All repairs of parts and servicing works carried out shall carry a warranty period of 6 months. Parts that are replaced shall come with a minimum 1 year warranty.

Appendix 7 to Section III**(7) REQUIREMENT SPECIFICATION FOR INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY (ICP-MS)****(A) SPECIFICATIONS****1.1 General Description**

- a. The spectrometer shall be a bench-top system.
- b. The spectrometer shall not exceed a footprint of $< 0.65 \text{ m}^2$.
- c. The system shall be equipped with a collision reaction cell with gas inlets in addition to the argon gas line.

1.2 Components of ICP

- a. The standard spray chamber shall be thermoelectric (Peltier) cooled.
- b. The torch for general use shall have an injector diameter $> 2\text{mm}$.
- c. The system shall have a frequency matching RF Generator, operating a 27MHz and with no consumable parts required.
- d. All the gases flow rate including the nebulizer, plasma and auxiliary gases shall be fully and independently variable and under controlled under mass flow control.
- e. In addition to the plasma and auxiliary gas supplies, at least two further gas supplies shall be available to allow independent optimisation of the nebuliser gas flow and the total gas flow through the plasma.
- f. All mass flow controllers shall be completely integrated into the system and under full software control (on/off and gas flow rates).
- g. The sample introduction system must support introduction of high matrix samples of up to at least 10% total dissolved solids without the requirement of manual sample dilution.

1.3 ICP-MS Interface

- a. The system shall use the same cone interface for both high sensitivity and high matrix tolerance.
- b. The sampling cone orifice shall be $< 1.1\text{mm}$.
- c. The skimmer cone orifice shall be $< 0.5\text{mm}$.

1.4 Ion Focusing System

- a. The ion lens or lenses shall be fully computer controlled and auto-tuning available for optimization of voltages via system software. Once optimized, the ion lens must operate at fixed voltages to ensure good matrix tolerance.
- b. The ion deflecting lens system shall be located between the skimmer cone and slide valve.
- c. The ion deflecting lens shall be removable for cleaning without breaking the main analyser vacuum.

1.5 Mass Analyzer System

- a. A tandem mass analyzer system shall be available with each mass analyzer system comprising of a set of fully functional quadrupole rods capable of discriminating ionic masses based on mass-to-charge ratios.
- b. The mass analyzer system shall be capable of operation in either single quad and/or MS/MS modes, which can be pre-selected by the end-user.
- c. The quadrupole rods shall be hyperbolic or equivalent, in cross section.
- d. For optimum performance the quadrupole mass analyzer shall operate at high RF frequency >2.9 MHz is required for optimum resolution of overlapping matrix peaks.
- e. The following specifications must be met when analyzing in single quad mode:
 - i) Mass range:
Q1: 2 – 260 amu
Q2: 2 – 275 amu
 - ii) Mass scan speed:
Scan speed (Li to U, plus data collection at 40 intervening masses): > 5,000 amu/sec
 - iii) Abundance sensitivity (measured at ^{133}Cs):
Single quad mode, Low mass side (M-1): 5×10^{-7}
Single quad mode, High mass side (M+1): 1×10^{-7}
MS/MS mode: 1×10^{-10}

1.6 Collision/ Reaction Cell (CRC)

- a. The system shall come with a thermally-stabilized collision/reaction cell (CRC) device for removal of polyatomic interferences.
- b. The collision/reaction cell shall operate effectively in collision mode, using pure helium gas.
- c. At least 4 independent cell gas mass flow controllers shall be provided on the CRC.
- d. All the different cell gases must be acquired sequentially in a single analysis.
- e. The time for the cell gas to change from one gas mode to another shall be < 5 secs.
- f. The ICP-MS shall be capable of analyzing all interference prone elements on mass.
- g. The ICP_MS must be able to analyze arsenic at mass 75 in high matrix samples.
- h. The collision/reaction cell shall be protected from contamination by either an off-axis ion lens design.

1.7 Vacuum System

- a. The ICP-MS shall have a four-stage differential vacuum system or equivalent, consisting of two units of high efficiency turbomolecular pumps, to achieve good operating vacuum and to reduce random background. The turbomolecular pump should be backed up by mechanical rotary pumps. The vacuum shall be continuously monitored by the data system, using at least two independent

vacuum gauges.

- b. The vacuum system shall have an isolation gate valve between interface and high vacuum area, to allow rapid routine maintenance, sample and skimmer cone changes, etc., with no loss of high vacuum. During full system shutdown or power failure, the analyzer vacuum chamber shall be completely protected from oil backstreaming from the backing pump by an automatic isolation valve in the backing line.
- c. The system must be able to automatically recover the system vacuum following an overnight power outage.

1.8 Detection system

- a. The ion detector assembly shall consist of a solid state, discrete dynode electron multiplier (DDEM) simultaneously operating in both pulse counting and analog modes (dual mode). Critical detector electronics must be temperature controlled to ensure stability.
- b. The minimum time required for data acquisition by the detector must be 100 µsecs in both the pulse and analog modes, to ensure no loss of analytical signal when measuring fast transient signals, such as those from laser ablation or chromatographic analysis
- c. Detector mode selection for each mass must be fully automatic and transparent to the user, and not require any prior knowledge of the sample composition.
- d. The detector shall be automatically protected against damage due to high ion flux.
- e. The detector shall support fast measurement of transient signals with a 0.1 millisecond integration time for Time Resolved Analysis (TRA) acquisitions, typically used for single nanoparticle analysis.
- f. The system shall be capable of measuring concentrations of elements such as Na, K and Ca up to 1000ppm, to minimize sample dilutions, and elements like Zn, Mn, Be and Hg at low ppt levels, using the standard sample introduction system.

1.9 Chiller System

- a. The chiller system (floor model) shall be provided with the cooling capacity to cool all components of the ICP-MS system.

1.10 Autosampler

- a. An integrated high precision and flexible autosampler shall be provided. The autosampler shall be mounted to the ICP-MS mainframe with short distant of sample tubing to reduce the sample up taking time and reduce possible carry over from the tubing.
- b. The autosampler shall have a tray cover to minimize contamination from the environment.
- c. It shall have flexible rack configurations, allowing up to 89 of sample vials (6 mL x 79 positions and 18 mL x 10 positions), and 3 x100ml bottles for wash, tuning and internal standard solutions. Different tray size and configuration must be available, such as tray for 2ml, 15ml and 50ml vials.
- d. A reset switch shall be available to reinitialize the autosampler in the case of an emergency.

1.11 Uninterrupted Power Supply (UPS)

- a. One set of UPS with output power supply shall be provided together with batteries that are sufficient to serve a backup time of at least 30 minutes.
- b. The package shall include the installation and commissioning of the UPS with the ICP-MS system.

1.12 Microwave Digestor

- a. The ICP-MS shall come with a easy to use microwave sample preparation system for closed pressure vessel acid digestion of broad range of sample for subsequent inorganic analysis.
- b. The microwave digestor shall be stainless steel housing, have a built in pre-set digestion methods and a touch screen panel display.
- c. The microwave shall have safety features such as an automatic door locking system and independent door safety interlocks to prevent microwave emission in event of improper door closure or misalignment.
- d. The package shall include a rolling bench (stainless steel) designed for the Microwave digestor.

1.13 Hydrogen Generator and exhaust vent

- a. Tenderer shall provide a Hydrogen generator that is suitable for use to the proposed ICP-MS system.
- b. Tenderer shall install a stainless steel exhaust vent from the top of the instrument to the exterior exhaust. An exhaust fan must be included for the vent.

1.14 System Controller and Data Acquisition

- a. The system shall feature an on-board microprocessor (system controller) to control the instrument independently of the data system, so that instrument control and safety interlocks are not compromised should the data system fail. The system controller shall monitor system status, RF power, gas supplies, instrument temperatures, electrical systems, vacuum system and cooling systems.
- b. The acquisition display screen shall show the data being acquired in real time.
- c. The software shall include a method development assistance to guide new users to generate high-quality data consistently.

1.15 Computer and Software

- a. The PC shall be an IBM compatible PC featuring an Intel processor or equivalent. To maximize instrument productivity, the PC must feature a CPU of at least 3.0GHz clock speed, 4GB (or greater) RAM, 500GB (or greater) SATA hard drive, and a DVD+RW drive, a wireless mouse and mouse pad. An integrated 10/100/1000 Base-T LAN interface must also be provided. It would be advantageous if no custom communication interface is required, so that the PC hardware configuration is as standard and widely available as possible. All cables and interfaces necessary for operation must be provided.
- b. The PC shall be pre-installed with the Microsoft Office software (Word, Excel® and PowerPoint).
- c. The PC shall be come with at least a 22" LCD flat panel display
- d. A colored LaserJet printer with duplex printing function with a set of colored toner cartridges.
- e. The ICP-MS software shall run under the Windows 7 (64-bit) operating system, for maximum compatibility with third-party programs.
- f. The system software shall include the following features and capabilities:
 - i. The ICP-MS WorkStation shall control the ICP-MS during the acquisition and processing of data. Full integration between the ICP-MS and any peripheral components (such as Autosampler, chromatography or laser ablation sample introduction) is essential.
 - ii. A facility to store an electronic record of the tuning report, including all meter values and tuning parameter values. An optional facility to run the Tune Check as a QC sample during a sample sequence, allowing QC actions to be taken in the event of tuning checks not being met shall also be available.
 - iii. A table of results must be available for the user to view during the sequence acquisition, and the user must be able to select the information displayed in the table (e.g. header information, counts, concentration, etc). This table must be updated with each new data file as it is acquired. The data table shall be linked seamlessly with 3rd party applications such as Excel, using simple copy and paste commands.
 - iv. A facility must be available to add a rush sample or otherwise modify an automated sequence at any time during the run, without having to restart the sequence.
 - v. Calibration modes must include external calibration, method of standard additions, isotope ratio, isotope dilution, and semi-quantitative analysis, where analytes are calibrated by reference to other analytes. Correction options must include background subtraction, blank subtraction and internal standard correction.

- vi. Comprehensive context sensitive help including hypertext links, an index and an on-line applications manual. Full system maintenance documentation must also be available on DVD-ROM.
- vii. The software must be written in an open architecture format to allow user customization of menu lists and the ability to use user-defined macros and scripts to customize the software operation.
- g. A provision must exist to add an optional chromatography software interface to allow fully automated, real time data analysis with comprehensive data handling capabilities such as retention time recalibration, internal standard correction, integration, calibration, quantitation, and compound or species identification routines.
- h. A provision must also exist to add an optional single nanoparticle application module with built-in method setup assistance. This application module must include comprehensive data analysis tools for processing single nanoparticle signals.

1.16 Accessories

- a. The system provided shall come with the full suite of consumables that are compatible to be run on the system. The consumables shall be for a 1 year supply with a guiding number of processing of 10 samples per day.
- b. The tenderer shall list in details the required consumables to process and analysis of the sample. These include:
 - i. Consumables for the ICP-MS (including tubings, sample cone, accessories which required to be changed after sample run)
 - ii. Digestion vessels for microwave digester.

1.17 System Installation, Training, Service Support and Implementation

- a. All materials and labour shall be provided for full system installation, modification works (i.e. installation of exhaust outlet, piping work, power supply points etc) at site and gas lines installation. Gas lines shall include Argon gas, helium gas etc). All gas regulators shall be provided for all gases required for analysis. Lab staff shall be notified of the exact delivery date at least one week before
- b. The Tenderer shall provide stainless steel rack for holding small gas cylinders (10 Litre or less).
- c. Prices quoted shall include all administrative (inclusive Licenses, permits etc), delivery and freight charges.
- d. The system shall include full installation qualification/performance verification and on-site familiarization. A 4-day operator-training course for 10 persons at the vendor site or On-site shall be provided. Trained application consultants must be available for customized on-site or on-line applications support and good user support and communication through regular newsletters, website updates and user group meetings will be considered favourably.
- e. Back up equipment support for testing shall be available at the tenderer's facility

during system breakdown.

- f. Comprehensive support shall be provided for a period of **12 months** which will consist of the following **at no extra cost**:
 - i. Unlimited service calls
 - ii. Travel and labour expenses of the engineer
 - iii. Service parts used for repair

1.18 Warranty Period

- a. At least 12 months comprehensive warranty with maintenance package shall be provided. The warranty shall cover service parts of the system, UPS, Chiller and the microwave digester.
- b. The warranty shall commence only upon successful completion of the acceptance test or commissioning. The service engineer must respond within 24 hours for service calls and within 48 hours for on-site service.

(B) COMPREHENSIVE MAINTENANCE FOR ICP-MS SYSTEM

2.1 The Tenderer shall provide seven (7) years Preventive Maintenance and Corrective Maintenance after the expiry of the warranty period.

2.2 The scope of activities for the Comprehensive Maintenance package shall include the followings:

- a. Preventive Maintenance (PM)
 - i. The Tenderer shall perform PM once per year on the ICP-MS system, microwave digester, UPS and Chiller.
 - ii. The scope of PM is as specified in **Appendix 7.1** to Section III.
- b. Corrective Maintenance (CM)
 - i. The Tenderer shall perform CM within the stated turnaround time.
 - ii. The scope of CM is as specified in **Appendix 7.2** to Section III.
- c. Technical Support during office hours from 0800 to 1800hrs.
- d. 2-Way Transportation of the equipment if maintenance is done off-site.

Appendix 7.1 to Section III

PREVENTIVE MAINTENANCE (PM) FOR ICP-MS SYSTEM

2.3 The Tenderer shall provide the detailed proposed scope of works for the PM upon submission of tender. The general guide for the scope of work for the PM for the ICP-MS (including Autosampler), Chiller, microwave digester, Hydrogen Generator and UPS shall be as follows:

- a) Performed functionality check on the ICP-MS system
- b) Clean the sample introduction area of the ICP-MS
- c) Check for tubing replacements
- d) Operate the auto sampler and check that there are no abnormal noises.
- e) Check the functionality of the microwave digester
- f) Check the functionality of the vacuum pump and also to replace the oil for the rotary pump
- g) Check condition of the UPS
- h) A service report shall be submitted after each PM.

Appendix 7.2 to Section III

CORRECTIVE MAINTENANCE (CM) FOR ICP-MS SYSTEM

2.4 The Tenderer shall provide the detailed proposed scope of works for the CM upon submission of tender. The general scope of work for the CM for ICP-MS (including Autosampler & rotary pump), Chiller, microwave digester, Hydrogen Generator and UPS is as follows:

- a) To be performed as per request by the Authority for the ICP-MS (including autosampler), Chiller, microwave digester and UPS. The response time (RT) upon receipt of fault call is within next business day of fault call from Mondays to Fridays (0800 to 1800hrs).
- a) To include all parts and labour cost
- b) The charges for the corrective maintenance are to be covered under the comprehensive maintenance package
- c) To provide technical support during office hours (0800 to 1800hrs)
- d) If corrective maintenance is done off-site, the price quoted shall include 2-way transportation of the equipment
- e) The Contractor shall make arrangements with the Authority to collect the defective system within 3 business days of fault call.
- f) A service report shall be submitted after each corrective maintenance
- g) On-Site Turn-Around-Time (i.e., the time period between the time the Contractor arrives at the Site to the time the repaired Equipment and/or Services are successfully completed and accepted on site by the Authority) required is 7 calendar days.
- h) Workshop Repair Turn-Around-Time (i.e. the time period between the receipt of a defective Equipment by the Contractor and the receipt and acceptance of the repaired Equipment by the Authority) required is 21 calendar days.
- i) All repairs of parts and servicing works carried out shall carry a warranty period of 6 months. Parts that are replaced shall come with a minimum 1 year warranty.

Appendix 8 to Section III

(8) REQUIREMENT SPECIFICATION FOR RAPID DNA ANALYSIS SYSTEM

(C) SPECIFICATIONS

1.1 General Description

- a. The proposed system shall be a single tabletop unit that is able to automatically analyze DNA samples and produce an electropherogram for each sample in less than 2 hours.
- b. The system shall utilize disposable sample and reagent cartridges such that there will be no direct contact between the chemical reagents and the samples and that there is no need for flushing and cleaning of sample inlet area.
- c. The system shall allow the processing of at least 4 samples simultaneously.
- d. The system shall be capable of processing the following sample types, but not limited to:
 - i. Blood;
 - ii. Buccal Swab;
 - iii. Cigarette Butt;
 - iv. Semen;
 - v. Touch and Trace (eg. swabs from bottles, handled objects, etc.)

1.2 Sample and Reagent Cartridges

- a. The sample and reagent cartridges shall be disposable after every use.
- b. All liquids and waste shall be fully contained in the cartridges without any leakages before and after each run.
- c. Each of the sample cartridges shall be able to process at least 4 samples in each run.
- d. The design of the sample cartridge shall allow the removal of the sample media (eg. swabs) even after the run has completed.
- e. Each of the cartridges shall be pre-loaded with all the required reagents and materials for Cell Lysis, DNA Extraction and Purification, PCR Amplification and Capillary Electrophoresis.
- f. The amplification chemistry shall target the following loci: D3S1358, D5S818, D7S820, D8S1179, D13S317, D16S539, D18S51, D21S11, CSF1PO, FGA, TH01, TPOX, vWA, D1S1656, D2S441, D2S1338, D10S1248, D12S391, D19S433, D22S1045, SE33, DYS391 and Amelogenin.

- g. An Allelic Ladder which is compatible with the amplification chemistry and containing the known alleles for each locus shall be included in the cartridge for each run.
- h. There shall also be an Internal Lane Standard or Sizing Standard compatible with the amplification chemistry in each lane of the cartridge.
- i. The cartridges shall have a shelf-life of at least 6 months upon delivery.
- j. There shall be a supply of sample and reagent cartridges for **350 samples each year for each instrument unit**. The supply shall cover a period of **three (3) years**.

	Number of Samples for Instrument #1	Number of Samples for Instrument #2
Firm Purchase		
Year 1	350	350
Year 2	350	350
Year 3	350	350

- l. The delivery of the sample and reagent cartridges shall be staggered and based on a schedule to be arranged with the user and it shall be made to two (2) separate locations.
- m. There shall be a replacement of sample and reagent cartridges upon hardware failure during a run process.

1.3 Software and User Interface

- a. Any software licenses required by the system shall cover at least eight (8) years of instrument usage and shall be included in the quotation.
- b. The system shall contain a data interpretation software which is able to interpret electropherograms and generate STR profiles, based on allele designation.
- c. The system shall have a resolution of single base pair.
- d. The system shall have at least three (3) levels of encrypted access rights.
- e. The system shall have a user-friendly touch-screen instrument control software, with step-by-step guide throughout the whole operational process.

1.4 Physical

- a. The external dimensions of the system shall not exceed 800mm x 800mm x 500mm (W x D x H).
- b. The weight of the system shall not exceed 100kg.
- c. The system's operating environment shall cover the temperature of 20°C to 25°C, inclusive, with a relative humidity of 40% to 70%, inclusive.

- d. The system shall be compatible with a power supply of 220-240V, AC, 50Hz.
- e. The system shall have at least two (2) USB 2.0 ports and at least one (1) Ethernet (RJ45 10/100/1000 megabit data rates) port.

1.5 Training

- a. A comprehensive training shall be included after the installation of the system, with the following requirements:
 - i. The training shall accommodate fifteen (15) persons;
 - ii. The training shall cover the operation and maintenance of the system, including the transfer of the analysis data to an analysis software on an externally connected computer;
 - iii. The necessary reagents and consumables shall be provided for during the training;
 - iv. The training shall be conducted at the user's facility, on a date to be arranged with the user.

1.5 Accessories

- a. **Each system** shall come with **one (1) laptop** installed with a genotyping analysis software for manual review and interpretation of the electropherogram generated from the system.
- b. The laptop shall minimally have the following:
 - i. Intel Core I5-2400 processor, or equivalent;
 - ii. 4GB RAM;
 - iii. 500GB SSD;
 - iv. Windows 7 pre-installed, or otherwise compatible for the software;
 - v. Microsoft Office (Word, Excel, PowerPoint) pre-installed;
 - vi. One (1) additional 23" LCD Monitor Display;
- c. The genotyping analysis software installed in the laptop shall have the same interpretation algorithms and settings as those in the system's interpretation software such that the run results can be imported from the instrument into the laptop for immediate analysis.
- d. Any licenses required for the software shall cover at least eight (8) years of instrument usage and shall be included in the quotation.

1.6 Warranty and Support

- a. On-site installation, commissioning and training by certified engineer is required.
- b. The warranty shall commence only upon the successful completion of the acceptance test or commissioning.

- c. The Contractor shall have a local dedicated team, consisting of sales, engineers and application engineers from direct factory/manufacturer for optimum support of the system.
- d. Comprehensive support must be provided for a period of twelve (12) months and shall consist of the following at no extra cost:
 - i. Unlimited service calls with response within 24 hours;
 - ii. On-site service within 48 hours;
 - iii. Travel and labor expenses of the engineers;
 - iv. Service parts and tools used for repairs.

1.7 Others

- a. The delivery and installation of the system shall be made in the Singapore to two (2) separate locations. Refer to para 4 of Section III for delivery schedule. Lab staff shall be notified of the exact delivery date at least 1 week before.
- b. The prices quoted for the system shall be in Singapore Dollar, and shall include all charges, inclusive of overseas freight charges, licensing, testing and commissioning.

(D) COMPREHENSIVE MAINTENANCE FOR RAPID DNA ANALYSIS SYSTEM

2.1 The Contractor shall provide a seven (7) year Comprehensive Maintenance after the expiry of the warranty period.

2.2 The scope of activities for the Comprehensive Maintenance package shall include the following:

- a. Preventive Maintenance (PM)
 - i. The frequency of the maintenance is to be proposed by the Tenderer in accordance to the requirement of the model.
 - ii. The scope of the PM is as specified in **Appendix 8.1 to SectionIII**
- b. Corrective Maintenance (CM)
 - i. The Contractor shall perform CM within the stated turnaround time.
 - ii. The scope of the CM is as specified in **Appendix 8.2 to SectionIII**

2.3 Technical support shall be provided during office hours from 0800 to 1800hrs.

2.4 Two-way transportation of the equipment shall be provided if the maintenance is done off-site.

Appendix 8.1 to Section III

PREVENTIVE MAINTENANCE (PM) FOR RAPID DNA ANALYSIS SYSTEM

2.5 The Contractor shall provide the detailed proposed scope of works for the PM upon submission of tender. The general scope of work for the PM shall be as follows:

- a) General inspection of the system.
- b) Replacement of the capillary array.
- c) Calibration of the instrument.
- d) Operate the system and check that there are no abnormal noises and that the system is in good and proper working condition.
- e) Software updates when necessary.
- f) A service report shall be submitted immediately after each PM.

Appendix 8.2 to Section III

CORRECTIVE MAINTENANCE (CM) FOR RAPID DNA ANALYSIS SYSTEM

- 2.6 The Corrective Maintenance (CM) shall be performed as per request by the Authority. The response time upon receipt of fault call shall be within the next business day of the fault call from Mondays to Fridays (0800 to 1800hrs).
- a) The CM shall include all parts and labor used.
 - b) The CM shall include the replacement of reagents upon hardware failure.
 - c) All charges for the CM are to be covered under the comprehensive maintenance plan.
 - d) The Contractor shall make arrangements with the Authority to collect the defective system within 3 business days of the fault call.
 - e) A service report shall be submitted after each CM.
 - f) On-site Turn-Around-Time (i.e. the time period between the time the Contractor arrives at the Site to the time the repaired Equipment and/or Services are successfully completed and accepted on-site by the Authority) required is seven (7) calendar days.
 - g) Workshop Repair Turn-Around-Time (i.e. the time period between the receipt of the defective Equipment by the Contractor and the receipt and acceptance of the repaired Equipment by the Authority) required is twenty-one (21) calendar days.
 - h) All repairs of parts and servicing works carried out shall carry a warranty period of six (6) months. Parts that are replaced shall come with a minimum one (1) year warranty.

Appendix 9 to Section III

(9) REQUIREMENT SPECIFICATION FOR BIOLOGICAL AIR SAMPLING SYSTEM

(A) SPECIFICATIONS

1.1 General Description

- a. The weight of each unit of Biological Air Sampling System shall not be more than 7kg.
- b. The external dimensions of each unit shall not exceed 400 x 250 x 250mm.
- c. Each unit noise level shall not be more than 70 dB (A) when fully operational.
- d. Each unit electrical requirement must be 230V (60Hz).

1.2 Biological Air Sampling Unit

- a. Ten units of Biological Air Sampling system shall be supplied.
- b. Each unit shall be able to perform qualitative detection of airborne organisms.
- c. Each unit shall be stationary via membrane filter method.
- d. Each unit air throughput shall be able to set between 2.0m³/h to 8.0m³/h in increments of 0.1m³/h.
- e. Each unit maximum variation of air throughput shall not be more than $\pm 5\%$ within the temperature range of 15 °C to 35 °C.
- f. Each unit timer range shall be between 1-99 minutes, adjustable in increments of 1 minute.
- g. Each unit operation mode shall be at least membrane-covered keypad with 6 keys.
- h. Each unit shall have membrane-covered keypad with six keys and liquid crystal display that shows at least 2 x 16 characters.
- i. Each unit shall be able to show error messages when filter is clogged or when filter is defective.
- j. Each unit air inlet connector shall be of Bayonet-type quick connect or equivalent.
- k. Each unit shall have an adapter to fit into 80mm gelatin membrane filter.
- l. Each unit shall be capable of being controlled via PLC interface or PC.

- m. Each unit shall be able to supply the customizable function via PLC as required.
- n. Each unit shall come with all other accessories for the air sampler to be fully functional.

1.3 Programmable Logic Controller (PLC)

- a. Ten units of Programmable Logic Controller shall be supplied.
- b. Each unit must be of part number COSP MB or equivalent.
- c. Each unit of PLC shall be able to provide relay, timer, counter and time switch function.
- d. Each unit of PLC must be able to perform multiple-day operation and pulse output operation.
- e. The PLC programs must be easily written, saved, and monitored by personal computer and can be simulated on the personal computer.
- f. Each PLC unit shall have memory cassette to copy and save programs easily.
- g. Each PLC unit shall be able to set password to protect user setting.

1.4 Accessories

- a. The system shall be supplied with 10 pieces of open filter holders of part number 17656 or equivalent. The filter holder must be able to hold an 80mm gelatin member filter.
- b. The system shall be supplied with 10 units of connectors for the MD8 unit of part number 17657 or equivalent.
- c. The system shall be supplied with 10 units of 2 metres length flexible PVC tubing of part number 17085 or equivalent.

1.5 Others

- a. The tenderer shall deliver the system to separate locations. Refer to para 4 of Section III for delivery schedule. Lab staff shall be notified of the exact delivery date at least 1 week before.
- b. Delivery shall be made to three separate locations (Tuas Checkpoint, Pasir Panjang Scanning Station and Woodlands Checkpoint).
- c. The tenderer shall provide and delivered to Tuas Checkpoint samples of the accessories parts within 5 working days upon request for compatibility evaluation by the authority.

- d. Supporting documents must be provided and delivered to Tuas Checkpoint within 5 working days upon request for compatibility evaluation by the authority.
- e. Prices quoted must include all administrative, delivery and freight charges.

1.6 Training

- a. Training shall be provided for at least 15 users for the operation for the operating, trouble shooting and general maintenance of the system including PLC software operation.
- b. Training shall be provided for the users of the instruments at site, as well as at the tenderer's application laboratory, after installation and commissioning.

1.7 Warranty and Support

- a. Each of the Biological Air Sampling Unit shall come with a 12- month on-site warranty, inclusive of all replacement parts, transport/courier and labour cost.
- b. The tenderer must have a local dedicated team, consists of sales, engineers and application engineers from direct factory/manufacturer for optimum support of the system.
- c. Back up equipment support for testing shall be available at the supplier's facility during equipment breakdown.
- d. The successful vendor shall complete the testing and commissioning of the system within 2 weeks from date of delivery.
- e. The warranty shall commence only upon successful completion of the acceptance test or commissioning. The service engineer must respond within 24 hours for service calls and within 48 hours for on-site service.

(B) NON-COMPREHENSIVE MAINTENANCE FOR BIOLOGICAL AIR SAMPLING SYSTEM

- 2.1 The Contractor shall provide a seven (7) year Preventive Maintenance after the expiry of the warranty period.
- 2.2 The scope of activities for the Preventive Maintenance package shall include the following:
- a. Preventive Maintenance (PM)
 - iii. The Contractor shall perform PM once a year.
 - iv. The scope of PM is as specified in **Appendix 9.1** to Section III.
 - b. Corrective Maintenance
 - i. The Contractor shall perform CM within the stated turnaround time.
 - ii. The scope of PM is as specified in **Appendix 9.2** to Section III.
 - iii. The Authority shall pay for each arising of ad-hoc CM at the rates specified in **Appendix 9.3** of this Invitation to Tender.
 - c. Technical Support during office hours from 0800 to 1800hrs.
 - d. 2-Way Transportation of the equipment if maintenance is done off-sit

Appendix 9.1 to Section III

PREVENTIVE MAINTENANCE (PM) FOR BIOLOGICAL AIR SAMPLING SYSTEM

2.3 The Contractor shall provide the detailed proposed scope of works for the PM upon submission of tender. The general scope of work for the PM shall be as follows:

- a) Conduct visual inspection for damages and completeness. All foot mount must be present. There must be no crack and damage of the casing, keypad, display, on/off switch and power cord cable.
- b) Perform maintenance check for the system once a year. The maintenance check includes:
 - i) Cleaning up of system
 - ii) Fasten all fastener
 - iii) Checking electrical wiring and electronic board connection
 - iv) Inspection of motor
 - v) Replacement of filter pad
- c) Perform system functional check for the system once a year. The system check includes:
 - i) Verification of Timer at 60seconds, 120 seconds and 300 seconds. The maximum deviation allowed is ± 5 seconds.
 - ii) Checking of Error message. Error message must be displayed when filter is clogged.
- d) Calibrate the flow rate sensor once a year. Flow rate must be calibrated at 3 points - 3.0m³/hr, 5.0m³/hr and 7.0m³/hr. The maximum deviation allowed is ± 0.2 m³/h or ± 3.3 l/min.
- e) Provide transportation to collect and return the units.
- f) Provide maintenance checklist and service labels after servicing.
- g) A service report and maintenance report shall be submitted after each PM.

Appendix 9.2 to Section III

CORRECTIVE MAINTENANCE FOR BIOLOGICAL AIR SAMPLING SYSTEM

2.4 The general scope of work for the Corrective Maintenance shall be as follows:

- a) To be performed as per request by the laboratories. The response time (RT) upon receipt of fault call is within 24 hours from Mondays to Fridays (0800 to 1800hrs).
- b) To provide technical support during office hours (0800 to 1800hrs).
- c) If corrective maintenance is done off-site, the price quoted must include 2-way transportation of the equipment.
- d) The faulty part(s) is to be collected within next business day of fault call.
- e) A service report should be submitted after each Corrective Maintenance.
- f) On-Site Turn-Around-Time (i.e., the time period between the time the Contractor arrives at the Site to the time the repaired Equipment and/or Services are successfully completed and accepted on site by the Authority) required is 7 days.
- g) Workshop Repair Turn-Around-Time (i.e. the time period between the receipt of defective Equipment by the Contractor and the receipt and acceptance of the repaired Equipment by the Authority) required is 60 days.
- h) All repairs of parts and servicing works carried out shall carry a warranty period of 6 months. Parts that are replaced should come with a minimum 1 year warranty.
- i) The tenderer shall fill in the price schedule for corrective maintenance and submit it together with the quotation for bidding.

Appendix 10 to Section III

(10) REQUIREMENT SPECIFICATION FOR BIO-AEROSOL SAMPLER

(A) SPECIFICATIONS

1.1 General Description

- a. The external dimension of the bio-aerosol sampler shall not exceed a dimension of 22 x 33 x 36 cm.
- b. The total weight of the bio-aerosol sampler shall not be more than 5 kg.
- c. The bio-aerosol sampler shall have equivalent if not better capability than the specifications stated from 1.2 to 1.9.
- d. Each unit shall include item 1.2 to 1.9.

1.2 Sampler

- a. The bio-aerosol sampler shall operate based on wet-walled cyclone.
- b. The bio-aerosol sampler shall be ready for use within 2 minute from cold start.
- c. The bio-aerosol sampler shall be able to sample for at least 1 minute for short operation and for at least 5 hours for continuous operation.
- d. The bio-aerosol sampler shall be able to set the air flow rate from the range 100L/min to 300L/min at an interval of 50L/min.
- e. The bio-aerosol sampler shall be able to capture and concentrate particles size of 0.5 µm to 20 µm in the liquid sample.
- f. The bio-aerosol sampler shall be able to obtain a volume ranging from 5ml to 15ml of liquid sample at the end of sampling.
- g. The collected sample shall be suitable for use for different types of analysis methods listed as follows:
 - i. Culture in agar-plates
 - ii. Polymerase Chain Reaction (PCR)
 - iii. Immuno-assay

1.3 Operating conditions

- a. The bio-aerosol sampler shall be operational in a temperature ranging from 4°C to 40°C and storage temperature ranging from -20 °C to 70 °C.

- b. The power plug shall be a 3-pin plug and must be suitable for direct use in Singapore.
- c. The battery shall be 24V with NiMh technology and able to operate for at least 45 minutes of sampling.
- d. The bio-aerosol sampler's spare parts (exclude electronic parts) shall be able to autoclave and decontaminated by using Hydrogen Peroxide vapour.

1.4 Start-Up Kit

- a. The bio-aerosol sampler shall come with a Start-Up kit which includes all necessary consumables to be used for analysis.

1.5 Accessories

- a. The bio-aerosol sampler provided shall come with a transportation case which includes the full suite of the following accessories, or their equivalent. The accessories are as follow:
 - i. 2 units of Internal Batteries
 - ii. 1 unit of Battery Charger
 - iii. 1 unit of Air Intake
 - iv. 1 unit of Tripod
 - v. 1 unit of Power cord (240V; 3-pin plug for direct without adaptor)
 - vi. 1 set of Operator's Manual – English version
 - vii. 5 packs of Cones & Caps (50 sets/pack)
 - viii. 30 bottle of Collection liquid in bottle (250ml/bottle)
 - ix. 12 sets of Tubing Kit
 - x. 1 set of Air Intake

1.6 Others

- a. The tenderer shall deliver the bio-aerosol samplers to 3 separate locations. Refer to para 4 of Section III for delivery schedule. Lab staff shall be notified of the exact delivery date at least 1 week before.
- b. Prices quoted shall include all administrative, delivery and freight charges.

1.7 Training

- a. At least three training sessions shall be provided for the operation, trouble shooting and general maintenance of the system.
- b. Each training session shall accommodate at least 10 people.
- c. The training session shall be conducted only on Monday to Friday, 9 am to 5 pm.

1.8 Commissioning and acceptance test

- a. Commissioning and acceptance test of the equipment shall be included.

1.9 Warranty and Support

- a. On-site installation, commissioning and training by factory-trained engineer is required.
- b. The tenderer shall have a local dedicated team, consisting of sales, engineers and application engineers from direct factory/manufacturer for optimum support of the system.
- c. The tenderer shall provide after-sales service efficiently and effectively. The tenderer shall have in his/her facility a similar system to that proposed in this tender for training purposes.
- d. Back up equipment support for testing must be available at the tenderer's facility during equipment breakdown.
- e. Comprehensive support shall be provided for the equipment for a period of **12 months** which will consist of the following **at no extra cost**:
 - i. Unlimited service calls
 - ii. Travel and labour expenses of the engineer
 - iii. Service parts used for repairs
- f. The warranty shall commence only upon successful completion of the acceptance test or commissioning. The service engineer shall respond within 24 hours for service calls and within 48 hours for on-site service.

(B) NON-COMPREHENSIVE MAINTENANCE FOR BIO-AEROSOL SAMPLER SYSTEM

- 2.1 The Tenderer shall provide a seven (7) year non-comprehensive Preventive Maintenance and Corrective Maintenance after the expiry of the warranty period.
- 2.2 The scope of activities for the Preventive Maintenance package shall include the following:
 - a. Preventive Maintenance (PM)
 - i. The Successful Tenderer shall perform PM twice per year.
 - ii. The scope of PM is as specified in **Appendix 10.1** to Section III.
 - b. Corrective Maintenance (CM)
 - i. The Successful Tenderer shall perform CM within the stated turnaround time.
 - ii. The scope of CM is as specified in **Appendix 10.2** to Section III.
 - c. Technical Support during office hours from 0800 to 1800hrs.
 - d. 2-Way Transportation of the equipment if maintenance is done off-site.

Appendix 10.1 to Section III

PREVENTIVE MAINTENANCE FOR BIO-AEROSOL SAMPLER SYSTEM

2.3 The Contractor shall provide the detailed proposed scope of works for the PM upon submission of tender. The general scope of work for the PM shall be as follows:

- a) Conduct visual inspection for damages and completeness.
- b) Carry out functional test of bio-aerosol sampler and long-time monitoring unit.
- c) To check the internal to ensure all Electronic cards and screws are locked in place. Ensure all connectors are seated properly.
- d) To clean the internal to ensure no deposit inside the bio-aerosol sampler to prevent corrosion and short circuits.
- e) To calibrate the motor speed and flow rate of the bio-aerosol sampler once a year.
- f) Final inspection and functional checks.
- g) Provide transportation to collect and return the units.
- h) Provide maintenance checklist and service labels after servicing.
- i) A service report shall be submitted after each PM.

Appendix 10.2 to Section III

CORRECTIVE MAINTENANCE (CM) FOR BIO-AEROSOL SAMPLER SYSTEM

2.4 The general scope of work for the CM shall be as follows:

- a) Respond to service calls. To be performed as per request by the Laboratories. The response time upon receipt of fault call is within next business day of fault call from Mondays to Fridays (0800 to 1800hrs).
- b) Unlimited breakdown call. The contractor has to respond to all breakdown calls.
- c) Service Report. After each corrective maintenance or repair works, the contractor shall submit a report on the corrective maintenance works done and the recommendation parts to change (if any) within 5 working days.
- d) Labour and tools. During the corrective maintenance or repair works, the Contractor shall provide all labour, tools, equipment etc that are required to carry out the work. The price of the labour and tolls required will be based on the Price Schedule for CM in **Appendix 1.1 to Section I.**
- e) Repair the breakdown. The Contractor has to provide solution to the breakdown and recommendation of parts to change. The price of the parts to change will be based on the Price schedule for CM in **Appendix 1.1 to Section I.**
- f) Technical support. The Contactor has to provide technical support during the office hours (0800 to 1800hrs).
- g) Warranty of repair and parts. All repairs of parts and servicing works carried out shall carry a warranty period of 6 months. Parts that are replaced shall come with a minimum 1 year warranty.

Appendix 11 to Section III

(11) REQUIREMENT SPECIFICATION FOR BECQUEREL MONITOR

(A) SPECIFICATIONS

1.1 General Description

- a. Each monitor shall consist of a detector unit and a measuring unit.
- b. The monitor shall be suitable for measurement of liquids and solid samples.
- c. The system should be an equivalent if not better capability than the specifications stated from 1.2 to 1.13.
- d. Each unit shall include item 1.2 to 1.13.

1.2 Monitor

- a. The monitor shall use scintillation measuring system for assessment of gamma activity in food, materials and soil samples with respect to radioactive contaminants.
- b. The monitor shall have a gamma probe that contains a 2" x 2" Na (TI) detector, a photomultiplier, a high voltage supply and the electronic circuits for signal conditioning.
- c. The monitor shall come with an integrated scale that provides the weight to calculate weight based activity in Bq/kg.
- d. The monitor shall consist of a probe with built-in threshold amplifier and high-voltage generator; 1.5 m cable fixed to the instrument.
- e. The monitor shall contain at least the following self-monitoring features:
 - i. Automatic self-test is activated and background measurement is performed to estimate the detection limits when the monitor is powered up.
 - ii. Detector failure, range overflow is displayed if the fault(s) occur.
- f. The monitor shall have an audible alarm to signal detected activity is above the warn level or the alert limit.
- g. The detection data shall be saved after counting of each sample.
- h. The Tenderer shall provide the following specifications for I-129 , Cs137:
 - i. Counting efficiency
 - ii. Resolution
- i. The monitor shall have a detection limit for Cs-137 of 100 Bq/kg or less.
- j. The sample volume shall be at least 500ml or less.

1.3 Shielding

- a. The monitor shall have a lead shielding (20 mm to 55mm) to reduce the background radiation.
- b. The lead shield shall cover the whole probe as well as the sample containment completely.

1.4 Isotopes

- a. The monitor shall detect gamma emitters up to 2000 keV.
- b. The monitor shall have the capability to identify up to 16 nuclide peaks from the library. Additional nuclides can be added by the user.

1.5 Operating Conditions

- a. The monitor shall function in the following conditions:
 - i. 10⁰C to 35⁰C; maximum humidity of 80% without degradation in performance
 - ii. A normal laboratory environment with ambient laboratory illumination
- b. The System shall be compatible with AC power rating of 230V at 50Hz.
- c. The Tenderer shall supply all the cables, connectors and accessories necessary for proper operation of the system.

1.6 Computer and Printer

- a. Tenderer shall provide a laptop with the following minimal specifications:
 - i. Dual-Core processor
 - ii. At least 15” HD LED display,
 - iii. 8GB RAM, 500 GB Hard drive
 - iv. Pre-loaded Software Windows 7
 - v. Pre-installed Window Office (Words, Excel, PowerPoint)
 - vi. Able to communicate with the monitor via a USB interface
- b. Tenderer shall provide the software for analysis of the data. Analysis of data shall include features such as automatic calculation of activity, normalization of results, background subtraction, precision, error of measurement, etc.
- c. Results shall be saved permanently in a folder in computer memory after counting of each sample.
- d. Software upgrades (if any) shall be provided at no extra cost.

1.7 Accessories

- a. The Tenderer shall include calibration sources.
- b. The calibration sources shall be stored in lead lined container if it is gamma emitting.
- c. The Tenderer shall provide a total of 100 units of Marinelli beakers that is compatible for use with the monitor.

1.8 Trainings

- a. The successful Tenderer shall conduct at least 3 training sessions, up to 10 trainees per session in laboratories in Singapore specified by the Authority to enable complete operation of the monitors.
- b. The training shall be provided by factory trained engineer.
- c. The training shall include but not be limited to the followings:
 - i. Hardware and software installation and setup instructions
 - ii. Software configuration instructions and Data analysis
 - iii. Operating instructions
 - iv. Operating level maintenance (inclusive of troubleshooting)
 - v. The training session shall be conducted only on Monday to Friday, 0900 to 1700hr.
- d. The monitor shall come with operating manuals (hard and softcopies).

1.9 Warranty and Technical Support

- a. On-site installation, commissioning and training by factory-trained engineer is required.
- b. The Tenderer shall have a local dedicated team, consisting of sales, engineers and application engineers from direct factory/manufacturer for optimum support of the system.
- c. The Tenderer shall be committed to provide after-sales services efficiently and effectively.
- d. Comprehensive support must be provided for the equipment for a period of 12 months which will consist of the following at no extra cost:
 - i. Unlimited service calls
 - ii. Travel and labour expenses of the engineer
 - iii. Service parts used for repairs
- e. The warranty shall commence only upon successful completion of the acceptance test For commissioing. The service engineer must respond within 24 hours for service call within 48 hours for on-site service.

1.10 Others

- a. The tenderer shall deliver the system to separate locations. Refer to para 4 of Section III for delivery schedule. Lab staff shall be notified of the exact delivery date at least 1 week before.
- b. The Tenderer shall take note that there is no lift available at the two sites of the delivery. The price quoted shall include hoisting charges of the instrument, if necessary.
- c. Prices quoted shall include all administrative (including import and export licences, custom and import duties), delivery, installation and freight charges.

(B) NON-COMPREHENSIVE MAINTENANCE FOR OF BECQUEREL MONITOR

- 2.1 The Tenderer shall provide a seven (7) years Preventive Maintenance (PM) and Ad-hoc Corrective Maintenance (CM) after the expiry of the warranty period
- 2.2 The scope of activities for Non-Comprehensive Maintenance package shall include the following:
 - a. Preventive Maintenance (PM)
 - i. The Successful Tenderer shall perform PM; the frequency of the PM shall be proposed by the Tenderer.
 - ii. The scope of PM is as specified in Appendix 11.1 to Section III.
 - b. Corrective Maintenance (CM)
 - i. The Successful Tenderer shall perform ad-hoc CM within the stated turnaround time.
 - ii. The scope of CM is as specified in Appendix 11.2 to Section III.
 - c. Technical Support during office hours from 0800 to 1800hrs.
 - d. 2-Way Transportation of the equipment if maintenance is done off-site.

Appendix 11.1 to Section III

PREVENTIVE MAINTENANCE (PM) FOR BECQUEREL MONITORS

- 2.3 The Tenderer shall provide the detailed proposed scope of works for the PM upon submission of tender. The general scope of work for the PM shall be as follows:
- 2.4 The frequency of maintenance is to be proposed by the Tenderer in accordance to the requirement of the model.
- 2.5 The Tenderer shall provide the detailed proposed scope of works for PM upon Tender submission. The general scope for the PM is as follows:
 - a) Inspection of the hardware
 - b) Conduct integrity test (including detector calibrations) for the monitor to ensure its functionality.
 - c) A service report shall be submitted after each PM
- 2.6 The submitted costing shall include any freight charges, administration charges.

Appendix 11.2 to Section III

CORRECTIVE MAINTENANCE (CM) FOR BECQUEREL MONITORS

2.7 The general scope of work for the Corrective Maintenance shall be as follows:

- a) Respond to service calls. To be performed as per request by the Laboratories. The response time upon receipt of fault call is within next business day of fault call from Mondays to Fridays (0800 to 1800hrs).
- b) Unlimited breakdown call. The contractor has to respond to all breakdown calls.
- c) Service Report. After each corrective maintenance or repair works, the contractor shall submit a report on the corrective maintenance works done and the recommendation parts to change (if any) within 5 working days.
- d) Labour and tools. During the corrective maintenance or repair works, the Contractor shall provide all labour, tools, equipment etc. that are required to carry out the work. The price of the labour and tolls required will be based on the Price Schedule for CM. The Tenderer shall fill in the price schedule and submit together with the quotation for bidding.
- e) Repair the breakdown. The Tenderer has to provide solution to the breakdown and recommendation of parts to change. The price of the parts to change will be based on the Price schedule for CM .The Tenderer shall fill in the price schedule and submit together with the quotation for bidding.
- f) Technical support. The Tenderer has to provide technical support during the office hours (0800 to 1800hrs).
- g) Warranty of repair and parts. All repairs of parts and servicing works carried out shall carry a warranty period of 6 months. Parts that are replaced shall come with a minimum 1 year warranty.