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| <b>Equipment 1: High Performance Liquid Chromatography/ Inductively Coupled Plasma-Mass Spectrometer (HPLC/ICP-MS) System</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <b>Location: Chemical Metrology Laboratory (CML)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Quantity: 1</b> |                                                                                            |
| <b><u>General</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                    |                                                                                            |
| <ul style="list-style-type: none"> <li>- The system shall consist of a computer-controlled, high performance liquid chromatography (HPLC) hyphenated to inductively coupled plasma mass spectrometer (ICP-MS) for the analysis of trace metals in a wide range of sample types. The system should allow for the option to operate the ICP-MS unit alone. The system shall include all equipment necessary for the maintenance of high vacuum and the introduction of samples by conventional solution nebulization.</li> </ul>                                                                                                                         |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The HPLC/ICP-MS mainframe must be bench top (not floor standing) with single floor mounted rotary pump, due to limitations in lab space. The instrument mainframe dimensions must not be larger than 800 mm width, 750 mm depth, and 1000 mm height in order to fit into the cleanroom material "shower". The instrument must have a stainless steel chassis to ensure durability when exposed to acid fumes or organic solvent vapors. The HPLC/ICP-MS system (including autosampler) and computer should be able to fit on the laboratory existing bench top (2900 mm length, and 800 mm width).</li> </ul> |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The system must have safety interlocks to allow safe shutdown, so that the instrument will not be damaged in the case of loss of power, gas supply, water cooling, or other system malfunction. In addition, all events must be automatically logged to a user-retrievable electronic error file and must include event description, time and date.</li> </ul>                                                                                                                                                                                                                                                |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The instrument must operate from one 30-32A single phase electrical supply. All other components, including the chiller must run from standard 110/240V power outlet.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                              |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The ICP-MS must employ a single exhaust vent with flow <math>\leq 7.0 \text{ m}^3/\text{min}</math>. This is important to keep a positive air pressure in the cleanroom laboratory without overloading the existing air handling system.</li> </ul>                                                                                                                                                                                                                                                                                                                                                           |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The HPLC/ICP-MS must maintain optimum performance under the following conditions: Temperature: between 18 °C and 30 °C inclusive (maximum rate of change 2 °C /hr).<br/>Humidity (non-condensing): between 40% and 70 % inclusive.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                 |                    | Yes/ No                                                                                    |
| <b><u>Major hardware and software components (ICP-MS)</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                    |                                                                                            |
| The ICP-MS system shall minimally consist of, but not be limited to, the following major components, complete with all software/hardware and                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                    | Yes/ No                                                                                    |

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| <b>Equipment 1: High Performance Liquid Chromatography/ Inductively Coupled Plasma-Mass Spectrometer (HPLC/ICP-MS) System</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       |                    | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------------------------------------------------------------------------------|
| <b>Location: Chemical Metrology Laboratory (CML)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Quantity: 1</b> |                                                                                            |
| <ul style="list-style-type: none"> <li>- The standard Sample Introduction Kit must be able to analyse up to at least 3% total dissolved solid matrix sample, such as undiluted sea water sample. This direct analysis must also be automatically tuned for robustness depending on solid content via the integrated software.</li> </ul>                                                                                                                                                                                                                            |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The ICP-MS system must include dedicated sample introduction kit for the analysis of samples dissolved in HF (Hydrofluoric Acid).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                               |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The instrument must have a frequency matching RF Generator, operating at 27 MHz and with no consumable parts required. A generator operating at a frequency of 27 MHz is more efficient as an ion source, resulting in low oxides.</li> </ul>                                                                                                                                                                                                                                                                              |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The RF generator must have output power continuously variable from 500 to 1600 watts, and must be digitally controlled to ensure the RF frequency does not drift outside the allowed frequency range.</li> </ul>                                                                                                                                                                                                                                                                                                           |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The RF generator must be a solid-state design (no power amplifier tubes, ceramic or otherwise) and water-cooled for better cooling efficiency. It should require no/minimal maintenance.</li> </ul>                                                                                                                                                                                                                                                                                                                        |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- All gas flows including the nebulizer, plasma and auxiliary gases must be fully and independently variable and under mass flow control, to ensure consistent operation and enable the plasma to be optimized for the widest range of applications. The use of simple needle valves or fixed orifices on these critical gas flows is unacceptable due to the imprecise nature of these devices and their incompatibility with some sample introduction devices that increase the carrier gas line back pressure.</li> </ul> |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- In addition to the plasma and auxiliary gas supplies, the system must have the option for two additional gas supplies to allow independent optimisation of the nebuliser gas flow and the total gas flow through the plasma.</li> </ul>                                                                                                                                                                                                                                                                                    |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The system must have the option for a fifth gas supply (mass flow controller) for advanced applications, such as the analysis of organic solvents. All mass flow controllers must be completely integrated into the instrument and under full software control (on/off and gas flow rates).</li> </ul>                                                                                                                                                                                                                     |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The interface (sampling cone and skimmer cone) must be easily accessed for routine maintenance and does not require any o-ring for assembly.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                    |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The system must use the same interface (sampling cone and skimmer cone) for both high sensitivity and high matrix tolerance. It is not</li> </ul>                                                                                                                                                                                                                                                                                                                                                                          |                    | Yes/ No                                                                                    |

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| <b>Location: Chemical Metrology Laboratory (CML)</b>                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Quantity: 1</b> |                                                                                            |
| acceptable to have to use different interface cones to achieve high sensitivity specifications and high matrix sample analysis capability separately.                                                                                                                                                                                                                                                                                                           |                    |                                                                                            |
| - In order to improve the analyzer vacuum and reduce the transfer of matrix material into the high vacuum region, interface cones orifice sizes should be as small as possible. The sampling cone orifice should be $\leq 1.1$ mm and skimmer cones orifice should be $\leq 0.5$ mm.                                                                                                                                                                            |                    | Yes/ No                                                                                    |
| - The ICP-MS system must include 2 sampling cones (1 nickel and 1 platinum) and 2 skimmer cone (1 nickel and 1 platinum). The mounting kit should be included.                                                                                                                                                                                                                                                                                                  |                    | Yes/ No                                                                                    |
| - The ion lens or lenses must be fully computer controlled and auto-tuning available for optimization of voltages via system software.                                                                                                                                                                                                                                                                                                                          |                    | Yes/ No                                                                                    |
| - The ion lens design must be based on an off-axis configuration.                                                                                                                                                                                                                                                                                                                                                                                               |                    | Yes/ No                                                                                    |
| - To reduce downtime, the ion lenses should be located between the skimmer cone and slide valve, so that they can be removed for cleaning without breaking the main vacuum seal. This also keeps the vacuum components clean and free from moisture, and prevents accidental damage of the mass analyser during maintenance. The lens assembly must not be a consumable item (i.e. simple cleaning should restore the lenses to full performance in all cases). |                    | Yes/ No                                                                                    |
| - The mass spectrometer rods (quadrupole, hexapole or octapole) must be truly hyperbolic in cross section to generate a theoretically correct hyperbolic field. Round cross-section rods have poorer transmission at increased resolution than hyperbolic cross section rods.                                                                                                                                                                                   |                    | Yes/ No                                                                                    |
| - For optimum performance the mass analyzer must operate at high RF frequency $\geq 2.7$ MHz for optimum resolution of overlapping matrix peaks.                                                                                                                                                                                                                                                                                                                |                    | Yes/ No                                                                                    |
| - The system must be capable of analysing mass ranging from at least 2 – 260 amu.                                                                                                                                                                                                                                                                                                                                                                               |                    | Yes/ No                                                                                    |
| - Scan speed (Li to U, plus data collection at 40 intervening masses): $\geq 3000$ amu/sec or better.                                                                                                                                                                                                                                                                                                                                                           |                    | Yes/ No                                                                                    |
| - Mass calibration stability of $\leq 0.05$ amu over eight hours of continuous operation must be sustained.                                                                                                                                                                                                                                                                                                                                                     |                    | Yes/ No                                                                                    |
| - Safety interlocks shall shut off power to the mass analyser under any instrument conditions that could cause damage to the mass analyser and detector assembly.                                                                                                                                                                                                                                                                                               |                    | Yes/ No                                                                                    |

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| <b>Location: Chemical Metrology Laboratory (CML)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Quantity: 1</b> |                                                                                            |
| <ul style="list-style-type: none"> <li>- The system must feature a collision/reaction cell (CRC) device for removal of polyatomic interferences.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The instrument must be able to operate in CRC mode for all analytes, not only a small set of 3-4 analytes. It is essential that collision/reaction cell must be simple to setup for routine operation, using consistent conditions for multi-element analysis in variable sample matrices containing Cl, SO<sub>4</sub>, organic content, without the need for any mathematical interference correction equations.</li> </ul>                                                                                                                                                                                                                                                                                                |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The instrument must also be able to operate in CRC mode for semi-quantitative analysis of all analytes in unknown samples without the need for correction equations.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The ICP-MS must be capable of analyzing all interference prone elements. The instruments must be able to analyse Selenium isotopes in variable high matrix samples without the need of interference correction equations. Tenderers will be provided with samples for testing. The protocol for the analysis of the sample will be provided upon sample collection.</li> </ul> <p><b>Sample Collection Details:</b></p> <p>Suppliers are required to collect the samples <b>between 0830 to 1200 within the first week from the tender opening date</b> at:</p> <p>Venue (Address): 1 Science Park Road, #01-05/06, The Capricorn, Singapore Science Park II, Singapore 117528.</p> <p>Contact number: 6775 1605 ext 103</p> |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The sample must be analysed on the system proposed in this tender. The sample result (raw data) shall be submitted via email (in an EXCEL file) <b>not later than 2 weeks from the tender closing date.</b></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                    |                                                                                            |
| <ul style="list-style-type: none"> <li>- To reduce routine maintenance when analyzing high matrix samples, the collision/reaction cell must be protected from contamination by either an off-axis ion lens or photon stop. It is not acceptable for the reaction cell to be located in line with the skimmer cone orifice, without a physical barrier to prevent deposition of sample matrix.</li> </ul>                                                                                                                                                                                                                                                                                                                                                              |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The collision/reaction cell must include at least 1 cell gas line with the option of adding up to a total of 3 cell gas line to cover all possible applications. It is not acceptable to use an external gas manifold for the</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                    | Yes/ No<br>Collision/reaction cell gas required:                                           |

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| addition of a 3rd cell gas as dead volume is increased and changeover between externally-controlled cell gases cannot be automated within a run (please indicate which collision/reaction cell gasses are required). Tenderer is also required to quote for the option to add an additional cell gas line.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                    |                                                                                            |
| <ul style="list-style-type: none"> <li>- The ICP-MS shall have a three-stage vacuum system consisting of a high efficiency pump, to achieve the required operating vacuum to help reduce random background. A mechanical rotary pump must back the pump. The vacuum must be continuously monitored by the data system, using at least three independent vacuum gauges. The expansion vacuum must be monitored so that the software can alert the operator if the interface pressure becomes higher due to interface degradation. The mechanical pump shall be outside the system cabinet, able to be located at least 3 m away from the instrument and mounted on wheels to facilitate routine oil changes. Ideally, the system should remain under vacuum even when it is in standby mode.</li> </ul> |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The vacuum system must 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. The valve must be solenoid operated so that it will close in the event of a power failure during operation, and not be dependent on sufficient gas supply pressure to protect the system in the event of failure. 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 or similar features in the backing line.</li> </ul>                                                                                                |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The ion detector assembly shall minimally consist of a solid state, discrete dynode electron multiplier simultaneously operating in both pulse counting and analog modes (dual mode). Critical detector electronics must be temperature controlled to ensure stability.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The minimum time required for data acquisition by the detector must be 100 <math>\mu</math>s or better in both the pulse and analog mode, to ensure no loss of analytical signal when measuring fast transient signals, such as those from laser ablation or chromatographic analysis. Detector systems which require significantly longer acquisition times in either mode are not acceptable, since this will compromise the acquisition of data when both high and low concentrations are measured at the same time.</li> </ul>                                                                                                                                                                                                                            |                    | Yes/ No                                                                                    |

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------------------------------------------------------------------------------|
| <b>Location: Chemical Metrology Laboratory (CML)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Quantity: 1</b> |                                                                                            |
| <ul style="list-style-type: none"> <li>- The detector shall cover at least a full 11 orders of linear dynamic range (real concentration measurement range, not detector electronic response range) automatically measuring analog and pulse counting signals for multiple elements over the entire mass range in a single scan. 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.</li> </ul>                                                                                               |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Cross calibration of detector modes must be fully automated and performed by the software. To minimize instrument setup time, detector response in both counting modes should be linear, enabling detector cross calibration to be performed by measurement at only one signal intensity, using only one multi-element standard. This speeds up the calibration process, enabling cross calibration to be performed automatically for all required analytes. The detector must be automatically protected against damage due to high ion flux.</li> </ul> |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The instrument must be capable of measuring concentrations of elements such as Na, K and Ca up to at least 1000 ppm, to minimize sample dilutions, and elements like Zn, Cu, Mn, Be and Hg at low ppt levels, using the standard sample introduction system and standard interface without the need to reduce mass analyzer resolution from the normal setting, or changing the detector setting or calibration.</li> </ul>                                                                                                                               |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The system must include a recirculating water chiller or heat exchanger with the cooling capacity to cool all components of the ICP-MS system. The system spray chamber temperature must be independently controlled from that of the water chiller system.</li> </ul>                                                                                                                                                                                                                                                                                    |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The ICP-MS system must come with a fast and high precision autosampler, including an acrylic enclosure with HEPA filter (to reduce the risk of environmental contamination).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                   |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The autosampler must be close to the ICP-MS mainframe to reduce the sample up taking time, reduce possible carry over from the tubing and allow sample uptake by peristaltic pump.</li> </ul>                                                                                                                                                                                                                                                                                                                                                             |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The sample probe must be metal-free and must return to an integral rinse port, where it is continuously rinsed by fresh wash solution between samples.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                         |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The autosampler must have flexible rack configurations, allowing loading of at least 120 sample vials (15 mL), and 42 sample vials (50 mL) at the same time.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                   |                    | Yes/ No                                                                                    |

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| <b>Location: Chemical Metrology Laboratory (CML)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Quantity: 1</b> |                                                                                            |
| <ul style="list-style-type: none"> <li>- A Reset/Stop Switch shall be available to prevent sample wastage in the case of an emergency.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The instrument should 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 must monitor system status, RF power, gas supplies, instrument temperatures, electrical systems, vacuum system and cooling systems.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- A high-speed on-board multi-channel analyzer must perform data acquisition, so that data acquisition is never compromised during multi-tasking of the data system. At minimum the system must have the demonstrated ability to acquire data from a sample sequence, run a separate data processing session, automatically update a sample data table, create control charts and be communicating via LAN/cable all at the same time.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The on-board multi-channel analyzer must be fast enough to enable the multi-element acquisition of fast transient signals. Data acquisition should be flexible to allow for the widest range of applicability, including the handling of fast transient signals such as those arising from chromatography and laser ablation.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- As a minimum, the following modes should be available: <ul style="list-style-type: none"> <li>a. Mode 1 - the normal acquisition mode, used to acquire intensity vs. mass data from continuous signals.</li> <li>b. Mode 2 - for fast, multi-element analysis of transient signals. Multi-element data is acquired in user defined time slices, and a time vs. intensity plot is generated for every mass. This mode must be able to handle any transient signal, with no limit on the number of masses acquired. The software must be able to display several masses on the monitor at the same time, during the acquisition.</li> <li>c. Mode 3 - to handle data from complex chromatography applications. Allows operating parameter and analyte selection changes to be programmed during a time resolved acquisition for full flexibility and to handle ICP-MS data collection from gradient elution chromatography.</li> </ul> </li> </ul> |                    | Yes/ No                                                                                    |

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| Location: Chemical Metrology Laboratory (CML)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Quantity: 1                                       |                                                                              |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| d. Mode 4 - for both isotope ratio and isotope dilution studies. This mode employs very fast scanning to optimize precision on isotope ratio measurements.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                   |                                                                              |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| - In all modes, the acquisition display screen should show the data being acquired in real time. The capability to perform real-time manipulation of the data during acquisition would be advantageous, such as the capability to save and process partially completed time resolved data acquisitions for laser or chromatography.                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                   | Yes/ No                                                                      |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| - The system must meet the following performance specification:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                   |                                                                              |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| <table><tr><th colspan="2">Performance Specification</th></tr><tr><td>Sensitivity</td><td></td></tr><tr><td>Li ( 7 )</td><td>≥ 50 Mcps/ppm</td></tr><tr><td>Y ( 89 )</td><td>≥ 300 Mcps/ppm</td></tr><tr><td>Tl ( 205)</td><td>≥ 200 Mcps/ppm</td></tr><tr><td>Oxide ( CeO<sup>+</sup>/ Ce<sup>+</sup> )</td><td>≤ 1.5%</td></tr><tr><td>Doubly charged: (Ce<sup>2+</sup>/ Ce<sup>+</sup> ) or (Ba<sup>2+</sup>/Ba<sup>+</sup>)</td><td>≤ 3.0%</td></tr><tr><td>Background (9 amu)</td><td>≤ 1 cps (no gas mode)<br/>≤ 0.5cps (cell gas mode)</td></tr><tr><td>Short term stability (RSD)</td><td>≤ 2%</td></tr><tr><td>Long term stability (RSD)</td><td>≤ 3% (2 h)</td></tr><tr><td>Isotope Ratio precision (RSD)</td><td>≤ 0.1%</td></tr></table> |                                                   | Performance Specification                                                    |  | Sensitivity |  | Li ( 7 ) | ≥ 50 Mcps/ppm | Y ( 89 ) | ≥ 300 Mcps/ppm | Tl ( 205) | ≥ 200 Mcps/ppm | Oxide ( CeO <sup>+</sup> / Ce <sup>+</sup> ) | ≤ 1.5% | Doubly charged: (Ce <sup>2+</sup> / Ce <sup>+</sup> ) or (Ba <sup>2+</sup> /Ba <sup>+</sup> ) | ≤ 3.0% | Background (9 amu) | ≤ 1 cps (no gas mode)<br>≤ 0.5cps (cell gas mode) | Short term stability (RSD) | ≤ 2% | Long term stability (RSD) | ≤ 3% (2 h) | Isotope Ratio precision (RSD) | ≤ 0.1% | Yes/ No |
| Performance Specification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                   |                                                                              |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| Sensitivity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                   |                                                                              |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| Li ( 7 )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ≥ 50 Mcps/ppm                                     |                                                                              |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| Y ( 89 )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | ≥ 300 Mcps/ppm                                    |                                                                              |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| Tl ( 205)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ≥ 200 Mcps/ppm                                    |                                                                              |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| Oxide ( CeO <sup>+</sup> / Ce <sup>+</sup> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ≤ 1.5%                                            |                                                                              |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| Doubly charged: (Ce <sup>2+</sup> / Ce <sup>+</sup> ) or (Ba <sup>2+</sup> /Ba <sup>+</sup> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ≤ 3.0%                                            |                                                                              |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| Background (9 amu)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ≤ 1 cps (no gas mode)<br>≤ 0.5cps (cell gas mode) |                                                                              |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| Short term stability (RSD)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ≤ 2%                                              |                                                                              |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| Long term stability (RSD)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ≤ 3% (2 h)                                        |                                                                              |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| Isotope Ratio precision (RSD)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ≤ 0.1%                                            |                                                                              |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| Major hardware and software components (HPLC)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                   |                                                                              |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| - The HPLC system must be capable of delivering at least 4 different solvents.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                   | Yes/ No                                                                      |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| - The solvent composition (controlled by the pump) should be customizable according to the user and the composition precision should be ≤0.2% (RSD).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                   | Yes/ No                                                                      |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| - The flow precision should be ≤ 0.1% (RSD)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                   | Yes/ No                                                                      |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| - The flow accuracy should be within ±1%.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                   | Yes/ No                                                                      |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| - A solvent degassing unit must be provided.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                   | Yes/ No                                                                      |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |
| - The materials in contact with the solvents should be resistant to acids, bases and organics and should be constructed of metal-free material such as Vespel, ceramics and/or PEEK.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                   | Yes/ No                                                                      |  |             |  |          |               |          |                |           |                |                                              |        |                                                                                               |        |                    |                                                   |                            |      |                           |            |                               |        |         |

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| <b>Equipment 1: High Performance Liquid Chromatography/ Inductively Coupled Plasma-Mass Spectrometer (HPLC/ICP-MS) System</b>                                                                                                          |                    | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <b>Location: Chemical Metrology Laboratory (CML)</b>                                                                                                                                                                                   | <b>Quantity: 1</b> |                                                                                            |
| - Sample injection volume must be variable between 0.1 µL to 100 µL with zero sample loss during injection.                                                                                                                            |                    | Yes/ No                                                                                    |
| - Injection precision must be ≤ 0.25% of RSD value.                                                                                                                                                                                    |                    | Yes/ No                                                                                    |
| - Must have a leak sensor, automatic rack and vial recognition as safety feature.                                                                                                                                                      |                    | Yes/ No                                                                                    |
| - Sample cooler shall have a cooling capability with temperature range covering 4 °C to at least ambient temperature.                                                                                                                  |                    | Yes/ No                                                                                    |
| - The sample holder should be able to hold at least 100 x 2 mL vials.                                                                                                                                                                  |                    | Yes/ No                                                                                    |
| - The rinsing of sample injector by solvent (for washing) must be automated.                                                                                                                                                           |                    | Yes/ No                                                                                    |
| - The rinsing of sample injector by sample prior to analysis should be programmable from the software.                                                                                                                                 |                    | Yes/ No                                                                                    |
| - The oven for HPLC must have an operating temperature range that covers 5 °C above the environment to at least 80 °C.                                                                                                                 |                    | Yes/ No                                                                                    |
| - The oven should be able to house commercially available columns having dimensions of 30 cm in length or shorter.                                                                                                                     |                    | Yes/ No                                                                                    |
| - The oven should have a temperature stability which shall not exceed ±0.1 °C (inclusive).                                                                                                                                             |                    | Yes/ No                                                                                    |
| - The oven should have a temperature accuracy which shall not exceed ±0.5 °C (inclusive).                                                                                                                                              |                    | Yes/ No                                                                                    |
| - Capable of temperature programming in linear and step programmes.                                                                                                                                                                    |                    | Yes/ No                                                                                    |
| - The warm up time should ideally be ≤ 5 mins.                                                                                                                                                                                         |                    | Yes/ No                                                                                    |
| <b><u>System Software and Computer</u></b>                                                                                                                                                                                             |                    |                                                                                            |
| - Minimum configuration: Intel i5-2400 processor or equivalent, 4GB RAM, 500 GB hard drives, wireless modem 802.11a/b/g/n/ac , USB 3.0, DVD RW (CD RW capable), mouse and keyboard, high resolution 19 inch flat screen color monitor. |                    | Yes/ No                                                                                    |
| - Window 7 Prof. Operating System and Microsoft Office.                                                                                                                                                                                |                    | Yes/ No                                                                                    |
| - The software should provide real time graphics during analysis                                                                                                                                                                       |                    | Yes/ No                                                                                    |
| - The software should have a built-in database with which the system selects/recommends the best isotope mass for analysis for each sample.                                                                                            |                    | Yes/ No                                                                                    |

| <b>Equipment 1: High Performance Liquid Chromatography/ Inductively Coupled Plasma-Mass Spectrometer (HPLC/ICP-MS) System</b>                                                                                                                                                                                                                                                                                                                                                                   |                    | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------------------------------------------------------------------------------|
| <b>Location: Chemical Metrology Laboratory (CML)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Quantity: 1</b> |                                                                                            |
| <ul style="list-style-type: none"> <li>- The software shall minimally allow creation of analytical methods using parameters such as choice of prominent isotope mass, RF power, nebulizer argon flow, integration/sampling time, and background correction. One set of operating parameters can be set for all elements in the method or for individual elements in the method for optimum results. These parameters shall be adjusted automatically, without operator intervention.</li> </ul> |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software must be capable of internal standard correction, background correction, drift correction, weight correction and dilution correction automatically, or similar features that address possible interferences.</li> </ul>                                                                                                                                                                                                                    |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software should have features and protocols for method development and method diagnosis.</li> </ul>                                                                                                                                                                                                                                                                                                                                                |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software must have the capability to reprocess all stored data – samples and standards without having to rerun the solutions again.</li> </ul>                                                                                                                                                                                                                                                                                                     |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software should also compute statistical values such as mean standard deviation and relative standard deviation (i.e. coefficient of variation).</li> </ul>                                                                                                                                                                                                                                                                                        |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- An off-line version of the software should be able to be run while the automated analysis is in progress to allow for data reprocessing, examining and manipulation of data, and creation of new methods etc.</li> </ul>                                                                                                                                                                                                                               |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software should be compatible with Microsoft Office applications such as Microsoft Excel and Microsoft Words. Data from Microsoft Excel and Microsoft Words can be directly copied and paste on the sequence list of the software.</li> </ul>                                                                                                                                                                                                      |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The ICP-MS software must allow the lab to control the ICP-MS during the acquisition and processing of data. Full integration between the ICP-MS and any peripheral components (that minimally include autosampler, chromatography) is essential.</li> </ul>                                                                                                                                                                                            |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software must allow addition of samples into the sequence during an analysis without having to stop and restart the sequence (for both HPLC and ICP-MS).</li> </ul>                                                                                                                                                                                                                                                                                |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software must have a full graphical instrument control and tune window with the ability to display multiple system parameters concurrently in real time. Fully automated system starts up and shutdown</li> </ul>                                                                                                                                                                                                                                  |                    | Yes/ No                                                                                    |

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| <b>Equipment 1: High Performance Liquid Chromatography/ Inductively Coupled Plasma-Mass Spectrometer (HPLC/ICP-MS) System</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                    | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <b>Location: Chemical Metrology Laboratory (CML)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Quantity: 1</b> |                                                                                            |
| must be available via the instrument control window, and automated, unattended shutdown must also be provided. A real time graphics mode, for monitoring of instrument tuning must be available, and should display several masses or mass ratios (e.g. oxide ratio) simultaneously, giving real time readout in counts or a ratio (%). Ratios of oxide or doubly charged species must be user selectable. Real time display of signal RSD's must also be provided.                                                                                                                                                                                              |                    |                                                                                            |
| - The software must be able to store an electronic record of the tuning report, including all meter values and tuning parameter values. The option to run the tune solution 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.                                                                                                                                                                                                                                                                                                                                        |                    | Yes/ No                                                                                    |
| - All tuning parameters, including plasma torch position, must be able to be stored on disk in a tune file that can be recalled at any time. Full auto-tune capability must be provided, including automatic optimization of plasma position (x-, y- and z-axis), ICP parameters, ion lenses (if applicable), mass calibration, and detector. The auto-tune software must be able to simultaneously optimize the ion signal while adjusting the plasma parameters to reduce interferences and background. Tune report generator to automatically assess all aspects of system performance and generate a detailed, time stamped record for audit trail purposes. |                    | Yes/ No                                                                                    |
| - The software must perform internal diagnostics including error checking and a complete fault log. A continuous run time clock shall be included, to keep track of instrument component usage hours and total current for the electron multiplier, to enable scheduling of preventive maintenance.                                                                                                                                                                                                                                                                                                                                                              |                    | Yes/ No                                                                                    |
| - Software must be able to perform interference correction in all measurement modes to correct for isobaric and polyatomic interferences. Equations must be user-editable.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                    | Yes/ No                                                                                    |
| <b><u>Installation, Commissioning, Training and Warranty</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                    |                                                                                            |
| - Prices quoted must include installation, commissioning, initial calibration and operator training. The system with PC must come with a minimum 1 year warranty. The warranty must include unlimited breakdown calls and on-site services, replacement of parts and at least 1 preventive maintenance per year, and cover the overall system (both hardware and software). Any software revisions should also be provided free-of-charge.                                                                                                                                                                                                                       |                    | Yes/ No                                                                                    |

| <b>Equipment 1: High Performance Liquid Chromatography/ Inductively Coupled Plasma-Mass Spectrometer (HPLC/ICP-MS) System</b><br><br><b>Location: Chemical Metrology Laboratory (CML)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
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| <b>Quantity: 1</b><br><br>The Contractor is required to oversee overall systems integration, site preparation, installation and necessary configuration of the system.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                            |
| <ul style="list-style-type: none"> <li>- <b>Option to purchase:</b> Tenderer is required to quote comprehensive maintenance contract for additional 3 years after the warranty period. The comprehensive maintenance contract shall cover the overall system including hardware and software. The price quoted shall minimally include the following:               <ul style="list-style-type: none"> <li>a) provision of unlimited breakdown calls and on-site services;</li> <li>b) provision of replacement parts at no additional cost</li> <li>c) to provide 1 preventive maintenance per year</li> <li>d) any software revisions should also be provided at free-of-charge</li> </ul> </li> </ul> | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Tenderer is required to quote the price of a hydride generation accessory.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Tenderer shall quote the unit prices of essential consumables parts (additional) in <b>Annex C Schedule of Rates (SOR)</b>: nebuliser, spray chamber, torch, injector, nickel and platinum cones (skimmer and sample cones).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                         | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- A declaration of Conformity certificate and System Validation certificate must be provided upon commissioning of equipment. All systems proposed must be GLP compliant.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The Contractor shall coordinate with the Laboratory for the delivery of the equipment.</li> <li>- A Risk Assessment Report in 5x5 matrix must be provided prior to the delivery.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Any cost (if any) involved for the application of the import license for ICP-MS should be borne by the tenderer.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The tenderer is required to provide after-sales support from engineers and application chemists in Singapore. The tenderer must have a strong track record in providing personalised and responsive after-sales support in Singapore, that is, the company must provide:               <ol style="list-style-type: none"> <li>1. Contacts (handphone number and email) of at least two engineers experienced with the HPLC-ICP-MS system;</li> </ol> </li> </ul>                                                                                                                                                                                                | Yes/ No                                                                                    |

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| <p><b>Equipment 1: High Performance Liquid Chromatography/ Inductively Coupled Plasma-Mass Spectrometer (HPLC/ICP-MS) System</b></p> <p><b>Location: Chemical Metrology Laboratory (CML)</b> <b>Quantity: 1</b></p>                                                                                                                                                                                                          | <p><b>Compliances (Yes/ No)</b><br/> <i>**If No, please indicate reason of non-compliances.</i></p> |
| <ul style="list-style-type: none"> <li>2. Immediate instruction for trouble shooting by telephone when requested;</li> <li>3. On-site service within 2 working days when requested; and</li> <li>- Replacement of parts (within 2 working days when parts are available in Singapore, within 5 working days when parts are not available in Singapore and are needed to be ordered from overseas) when necessary.</li> </ul> |                                                                                                     |

## COMPLIANCE OF REQUIREMENT SPECIFICATIONS

**I hereby confirm that I can meet all the specifications and requirements as stated in Section 3: Requirement Specifications, Equipment 1: HPLC/ICP-MS System.**

Tenderer's (as \*Principal/Agent)  
Company or Business Registration No:

Tenderer's official  
Stamp:

Authorized Signature

Name:

Designation:  
(\*Delete whichever is not applicable)

Please indicate any non-compliance to requirement specifications here should there be any.

[illegible]

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| <b>Equipment 2: Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES) System</b><br><br><b>Location: Chemical Metrology Laboratory (CML)</b><br><b>Quantity: 1</b>                                                                                                                                                                                                                                      | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <b><u>Technical Specifications</u></b>                                                                                                                                                                                                                                                                                                                                                                               |                                                                                            |
| <ul style="list-style-type: none"> <li>- The ICP-OES system shall consist of a computer-controlled, inductively-coupled plasma optical emission spectrometer for the analysis of metals/organics in a wide range of sample matrix.</li> </ul>                                                                                                                                                                        | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The system must be bench top (not floor standing). The system should not be more than 800 mm width, 750 mm depth, and 1000 mm height in order to fit onto a limited bench space, and also to allow entry into a cleanroom laboratory through a material shower.</li> </ul>                                                                                                  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The system must have durable chassis to withstand exposure to acids fumes and organic solvent vapours.</li> </ul>                                                                                                                                                                                                                                                           | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The system must have safety interlocks to allow safe shutdown, so that the instrument will not be damaged in the case of loss of power, gas supply, water cooling, or other system malfunction. In addition, all events must be automatically logged to a user-retrievable electronic error file and must include event description, time and date.</li> </ul>              | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The instrument shall operate from one single phase electrical supply. All other components, including the chiller must run from standard 110/240V power outlet.</li> </ul>                                                                                                                                                                                                  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The ICP-OES must employ a single exhaust vent with flow <math>\leq 3.0 \text{ m}^3/\text{min}</math>. This is important to keep a positive air pressure in the cleanroom laboratory without overloading the existing air handling system.</li> </ul>                                                                                                                        | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The ICP-OES must maintain optimum performance under the following conditions: Temperature: between 18 °C and 30 °C inclusive (maximum rate of change 2 °C /hr). Humidity (non-condensing): between 40% and 70 % inclusive.</li> </ul>                                                                                                                                       | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Tenderers who demonstrate excellent after sales support services such as trouble-shooting and application support would be preferred. Tenderers shall submit supporting documents to show that they are capable of providing above-mentioned services by listing the experience of their engineers and application chemists on the proposed system upon request.</li> </ul> | Yes/ No                                                                                    |

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| <b>Equipment 2: Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES) System</b><br><br><b>Location: Chemical Metrology Laboratory (CML)</b><br><b>Quantity: 1</b>                                                                                                                                                                                                                                                                                                                     | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <b><u>Major hardware and software components</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                            |
| <p>The ICP-OES system should be simultaneous analysis type and shall consist of, but not be limited to, the following major components, complete with all software/hardware and interfacing necessary to make a fully integrated system:</p> <ul style="list-style-type: none"> <li>- RF Generator</li> <li>- Gas Controller</li> <li>- Sample Introduction System</li> <li>- Spectrometer/Optical System/Detector System</li> <li>- Autosampler</li> <li>- System Software and Computer</li> </ul> | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The generator should be solid state type and should have an operating frequency of 27 MHz. A generator operating at a frequency of 27 MHz is more efficient as an ion source, resulting in low oxides. It should require no maintenance.</li> </ul>                                                                                                                                                                                                        | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- It should be capable of an output within the range of 700-1500 kW and the power output is variable by computer control.</li> </ul>                                                                                                                                                                                                                                                                                                                         | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- It should be capable of automated operations such as auto ignition, auto tuning and auto shutdown with user defined analytical methods.</li> </ul>                                                                                                                                                                                                                                                                                                         | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- System must have the minimum safety devices and interlocks. If any irregularities are detected, the plasma should shutdown safely and automatically.</li> </ul>                                                                                                                                                                                                                                                                                            | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- A water cooling generator should be included for better cooling efficiency.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                     | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The stray RF shielding from ICP source must comply with all Federal Communications Commission (FCC) certification requirements for RF emission.</li> </ul>                                                                                                                                                                                                                                                                                                 | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Mass flow controllers must be computer-controlled and adjustable by the user.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                   | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The system should have effective control of gas flow in plasma, auxiliary, nebulizer, make up (if any) and option gas (used for</li> </ul>                                                                                                                                                                                                                                                                                                                 | Yes/ No                                                                                    |

| <b>Equipment 2: Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES) System</b><br><b>Location: Chemical Metrology Laboratory (CML)</b><br><b>Quantity: 1</b>                                                                                                                                                                                                                                                                                                                                                                                 | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
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| some organic solvent applications) flows.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                            |
| <ul style="list-style-type: none"> <li>- The port module should supply argon for plasma gases, nitrogen for optics purge, and argon/oxygen blend for option gas.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                 | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The introduction system should be closely coupled to the peristaltic pump to minimize sample uptake delays.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                             | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- All the components of the system supplied shall be totally corrosion resistant to all acids including aqua regia and all organic solvents commonly used in ICP-OES analysis.</li> </ul>                                                                                                                                                                                                                                                                                                                            | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Components in the sample introduction system shall be easily dismantled for cleaning and re-assembling by the user without any requirement for re-alignment.</li> </ul>                                                                                                                                                                                                                                                                                                                                            | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The spray chamber must be constructed of a material that minimizes cross contamination from samples and capable of fast washout.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                        | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The torch must be easily demountable for various applications and matrices. It should not require realignment after dismantling. Changeover for sample introduction components from one matrix to the other must be easy.</li> </ul>                                                                                                                                                                                                                                                                               | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- A vertical torch configuration is preferred so that samples with high salt or matrix content can be measured without clogging.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                          | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- A gas purging system is preferred to eliminate the risk of oil mist contamination from the vacuum pump in the event of electrical failure. For gas purging system, it should allow for total shut-off of purging gas when the system is not be used for extended period of time. The time taken for the system to be "plasma ready" from a total shut-off state should be <math>\leq 15</math> minutes. The warm-up time from standby mode should be <math>\leq 30</math> minutes from plasma ignition.</li> </ul> | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The spectrometer should consist of an optical covering a wavelength range from at least 167 to 785 nm or better.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                        | Yes/ No                                                                                    |

| <b>Equipment 2: Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES) System</b><br><br><b>Location: Chemical Metrology Laboratory (CML)</b><br><b>Quantity: 1</b>                                                                                                                                                                                                                                        | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
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| <ul style="list-style-type: none"> <li>- The spectrometer should have a Peltier cooling and temperature-controlled feature or similar for better stability and repeatability.</li> </ul>                                                                                                                                                                                                                               | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The resolution of the system should be <math>\leq 10</math> pm at 200 nm of the measured spectral peak.</li> </ul>                                                                                                                                                                                                                                                            | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The spectrometer should be able to operate in both radial and axial viewing of the plasma simultaneously and be fully computer-controlled.</li> </ul>                                                                                                                                                                                                                         | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- A plasma light source that lowers running costs such as requiring reduced consumption of argon without sacrificing stability and sensitivity will be an added advantage (please indicate argon gas consumption in L/min).</li> </ul>                                                                                                                                          | Yes/ No<br><br>Ar gas consumption:                                                         |
| <ul style="list-style-type: none"> <li>- The detector for the spectrometer should be Charge-Coupled Device (CCD) type with long term high stability. System should ensure that no condensation occurs on the CCD at the given operating laboratory conditions (Temperature: between 18 °C and 30 °C inclusive (maximum rate of change 2 °C /hr). Humidity (non-condensing): between 40% and 70 % inclusive.</li> </ul> | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The spectrometer should be capable of analysing at least 20 elements simultaneously.</li> </ul>                                                                                                                                                                                                                                                                               | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The system must come with a fast and high precision autosampler, including an acrylic enclosure with HEPA filter fan unit (to reduce the risk of environmental contamination).</li> </ul>                                                                                                                                                                                     | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The autosampler must be close to the ICP-OES mainframe to reduce the sample up take time, reduce possible carry over from the tubing and allow sample uptake by peristaltic pump.</li> </ul>                                                                                                                                                                                  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The sample probe must be metal-free and must return to an integral rinse port, where it is continuously rinsed by fresh wash solution between samples.</li> </ul>                                                                                                                                                                                                             | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The autosampler must have flexible rack configurations, allowing loading of at least 60 sample vials (15 mL), and at least 30 sample vials (50 mL) at the same time.</li> </ul>                                                                                                                                                                                               | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- A Reset/Stop Switch shall be available to prevent sample wastage in the case of an emergency.</li> </ul>                                                                                                                                                                                                                                                                      | Yes/ No                                                                                    |

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| <b>Equipment 2: Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES) System</b><br><br><b>Location: Chemical Metrology Laboratory (CML)</b><br><b>Quantity: 1</b>                                                                                                                                                                                                                                                                                                                                           | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <ul style="list-style-type: none"> <li>- Operation of the autosampler is to be fully controlled from system computer.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                          | Yes/ No                                                                                    |
| <b><u>System Software and Computer</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                            |
| <ul style="list-style-type: none"> <li>- Minimum configuration: Intel i5-2400 processor or equivalent, 4GB RAM, 500 GB hard drives, wireless modem 802.11a/b/g/n/ac, USB 3.0, DVD RW (CD RW capable), mouse and keyboard, high resolution 19 inch flat screen color monitor.</li> </ul>                                                                                                                                                                                                                                   | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Window 7 Prof. Operating System and Microsoft Office.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                 | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software should provide real time graphics during analysis.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                       | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software should have a built-in database with which the system selects/recommends the best wavelength for analysis for each sample.</li> </ul>                                                                                                                                                                                                                                                                                                                               | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software must allow creation of analytical methods easily using parameters such as choice of prominent wavelengths, RF power, nebulizer argon flow observation/viewing height, integration/sampling time, and background correction etc. One set of operating parameters can be set for all elements in the method or for individual elements in the method for optimum results. These parameters shall be adjusted automatically, without operator intervention.</li> </ul> | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software must be capable of internal standard correction, background correction, drift correction, inter-element correction (IEC), weight correction and dilution correction automatically, or similar features that address possible interferences.</li> </ul>                                                                                                                                                                                                              | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software should have features and protocols for method development and method diagnosis.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                          | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software must have the capability to reprocess all stored data – samples and standards without having to rerun the solutions again.</li> </ul>                                                                                                                                                                                                                                                                                                                               | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software should also compute statistical values such as mean standard deviation and relative standard deviation (i.e. coefficient of variation).</li> </ul>                                                                                                                                                                                                                                                                                                                  | Yes/ No                                                                                    |

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| <b>Equipment 2: Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES) System</b><br><br><b>Location: Chemical Metrology Laboratory (CML)</b><br><b>Quantity: 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <ul style="list-style-type: none"> <li>- An off-line version of the software should be able to be run while the automated analysis is in progress to allow for data reprocessing, examining and manipulation of data, and creation of new methods etc.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                 | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software should be compatible with Microsoft Office applications such as Microsoft Excel and Microsoft Words. Data from Microsoft Excel and Microsoft Words can be directly copied and paste on the sequence list of the software.</li> </ul>                                                                                                                                                                                                                                                                                                                                                        | Yes/ No                                                                                    |
| <b><u>Accessories</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                            |
| <ul style="list-style-type: none"> <li>- A sample introduction kit for small quantity samples/organics/HF applications should be provided.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Yes/ No                                                                                    |
| <b><u>Installation, Commissioning, Training and Warranty</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                            |
| <ul style="list-style-type: none"> <li>- The system shall consist, but not be limited to, the above listed major components, complete with all the accessories and interfacing necessary to make a fully functional and operable system.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                               | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The power supply must be <math>230 \pm 6\%</math>, 50/60 Hz, suitable for use in Singapore.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Prices quoted must include installation, commissioning, initial calibration and operator training. The system and PC must come with a minimum 1 year warranty. The warranty must include unlimited breakdown calls, unlimited on-site services, replacement of parts and at least one preventive maintenance per year, and cover the overall system (both hardware and software). Any software revisions should also be provided free-of-charge. The Contractor is required to oversee overall systems integration, site preparation, installation and necessary configuration of the system.</li> </ul> | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- <b><u>Option to purchase:</u></b> Tenderer is required to quote comprehensive maintenance contract for additional 3 years after the warranty period. The comprehensive maintenance contract shall cover the overall system including hardware and software. The price quoted shall minimally include the following: <ul style="list-style-type: none"> <li>(a) provision of unlimited breakdown calls and on-site services;</li> <li>(b) provision of replacement parts at no additional cost;</li> </ul> </li> </ul>                                                                                    | Yes/ No                                                                                    |

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| <b>Equipment 2: Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES) System</b><br><br><b>Location: Chemical Metrology Laboratory (CML)</b><br><b>Quantity: 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| (c) to provide 1 preventive maintenance per year;<br>(d) any software revisions should also be provided at free-of-charge                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                            |
| <ul style="list-style-type: none"> <li>- Tenderer is required to quote for the trade-in of the existing 1 unit of Shimadzu ICPE-9000 ICP-OES. The value shall include removal, transportation and other required services. . Price “0” shall be indicated in <b>Price Summary</b> if one of the following conditions is fulfilled. <ul style="list-style-type: none"> <li>a) there is no trade-in value but removal of existing system is provided; or</li> <li>b) trade-in option and removal of existing system is not provided</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                      | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- A declaration of Conformity certificate and System Validation certificate must be provided upon commissioning of equipment.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The Contractor shall coordinate with the Laboratory for the delivery of the equipment.</li> <li>- A Risk Assessment Report in 5x5 matrix must be provided prior to the delivery.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The tenderer is required to provide after-sales support from engineers and application chemists in Singapore. The tenderer must have a strong track record in providing personalised and responsive after-sales support in Singapore, that is, the company must provide: <ol style="list-style-type: none"> <li>4. Contacts (handphone number and email) of at least two engineers experienced with the ICP-OES system;</li> <li>5. Immediate instruction for trouble shooting by telephone, when requested;</li> <li>6. On-site service within 2 working days when requested; and</li> <li>7. Replacement of parts (within 2 working days when parts are available in Singapore, within 5 working days when parts are not available in Singapore and are needed to be ordered from overseas) when necessary.</li> </ol> </li> </ul> | Yes/ No                                                                                    |

**COMPLIANCE OF REQUIREMENT SPECIFICATIONS**

**I hereby confirm that I can meet all the specifications and requirements as stated in Section 3: Requirement Specifications. Equipment 2: ICP-OES System.**

Tenderer's (as \*Principal/Agent)  
Company or Business Registration No:

Tenderer's official  
Stamp:

Authorized Signature

Name:

Designation:  
(\*Delete whichever is not applicable)

Please indicate any non-compliance to requirement specifications here should there be any.

| Reference To | Remarks |
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| <b>Equipment 3: Gas Chromatography coupled with Headspace Sampler, Flame Ionization and Electron Capture Detectors (GC-FID)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                    | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <b>Location: CML</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Quantity: 1</b> |                                                                                            |
| <b>Technical Specifications</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                    |                                                                                            |
| <ul style="list-style-type: none"> <li>- The gas chromatography system must be able to operate on these conditions:               <ul style="list-style-type: none"> <li>(a) Ambient operating temperature: minimum 15-35 °C;</li> <li>(b) Ambient operating humidity: minimum 5-95%;</li> <li>(c) Storage extremes: minimum -40 °C to 70 °C;</li> <li>(d) Line voltage requirements: 230 V ± 10 %; and</li> <li>(e) Conforms to the following safety standards and regulations: CSA, IEC, EN, and ISO9001.</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                    | Yes/ No                                                                                    |
| <b>(A) GC Mainframe</b> <ul style="list-style-type: none"> <li>- The system must have the ability to support simultaneously for at least 2 inlets, 3 detectors and 4 detectors signals for future upgrade.</li> <li>- Full Electronic Pneumatic Control (EPC) must be available for all inlets and detectors.</li> <li>- The system must be able to install 6 EPC modules, providing control of 16 channels of EPC.</li> <li>- EPC with capillary columns must provide four column flow control modes: constant pressure, ramped pressure, constant flow or ramped flow.</li> <li>- The system must have atmospheric pressure and temperature compensation.</li> <li>- The system must have pre-programmed leak tests.</li> <li>- Automatic liquid sampling must be fully integrated into mainframe control.</li> <li>- The system must have 550 timed events.</li> <li>- The system must be able to initiate clock-time programming from the front panel to initiate events (on/off, method start, etc) at a future date and time.</li> <li>- The system must have built-in column bleed compensation.</li> <li>- The system must be able to run log to record at least 50 potential errors that occurred during the last analytical run.</li> <li>- The system must be able to display of all GC and ALS setpoints at the GC or data system.</li> <li>- The system must have built-in ability to update to the latest firmware.</li> <li>- The system must have built-in Capillary Flow Technology which provides devices with reliable, leak free, in-oven capillary connection to help analyze complex sample and provide gain in productivity.</li> <li>- The system must be upgradeable for Solvent Bypass, Back flush and Heart Cutting for future application.</li> </ul> |                    | Yes/ No                                                                                    |
| <b>(B) Chromatographic Performance</b> <ul style="list-style-type: none"> <li>- The Retention time repeatability must be ≤0.008 % or ≤ 0.0008 min.</li> <li>- Area repeatability must be 1% RSD or below.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                    | Yes/ No                                                                                    |
| <b>(C) Column Oven</b> <ul style="list-style-type: none"> <li>- Oven must be able to accommodate two 105 m × 0.53 mm ID capillary</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    | Yes/ No                                                                                    |

| Equipment 3: Gas Chromatography coupled with Headspace Sampler, Flame Ionization and Electron Capture Detectors (GC-FID)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             | Compliances (Yes/ No)<br><i>**If No, please indicate reason of non-compliances.</i> |
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| Location: CML                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Quantity: 1 |                                                                                     |
| <p>columns or two 10-ft glass packed columns (9 in. coil diameter, 1/4in. OD), or two 20-ft stainless steel packed columns (1/8in. OD).</p> <ul style="list-style-type: none"> <li>- Oven operating temperature range must be from ambient temperature minimum +4 °C to 450 °C.</li> <li>- Oven temperature set point resolution must be 0.1 °C or smaller.</li> <li>- The fastest oven temperature ramp-up rate must be no slower than 120 °C/minute.</li> <li>- Maximum run time must be 999.99 min (16.7 h) or longer.</li> <li>- Oven temperature ramp-down rate (cooling down from 450 °C to 50 °C at ambient temperature of 18 - 25 °C) should be no longer than 4.5 minutes.</li> <li>- The system should support 20 oven ramps with 21 plateaus and negative ramps.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |                                                                                     |
| <p><b>(D) Electronic Pneumatics Control (EPC)</b></p> <ul style="list-style-type: none"> <li>- The system must have compensation for barometric pressure and ambient temperature changes.</li> <li>- The system must have Leak Detection and Automatic Shutdown.</li> <li>- The pressure setpoint resolution must be no greater than 0.001 psi.</li> <li>- The units for pressure must be able to be express in bar, psi and kPa.</li> <li>- Pressure sensor accuracy must be within ±2 %.</li> <li>- Pressure sensor repeatability must be within ±0.05 psi.</li> <li>- Drift must be within ±0.1 psi/ 6 months.</li> <li>- Flow sensor accuracy must be within ±5 %.</li> <li>- Flow sensor repeatability must be within ±0.35 %.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             | Yes/ No                                                                             |
| <p><b>(E) Split/Splitless Inlet (1 Unit)</b></p> <ul style="list-style-type: none"> <li>- The system must have at least one split/splitless injector with digital flow control.</li> <li>- Pressure range must be 0-100 psig or wider.</li> <li>- Pressure set points must be able to be adjusted by increments of 0.001 psi.</li> <li>- Split ratio set point must be 7500 : 1 or larger.</li> <li>- Maximum total flow rate for He must be 1200 ml/min or higher.</li> <li>- Inlet modules pressure sensors: <ul style="list-style-type: none"> <li>(f) Accuracy must be within ±2% full scale;</li> <li>(g) Repeatability must be within ±0.05 psi;</li> <li>(h) Temperature coefficient must be within ±0.01 psi/°C;</li> <li>(i) Drift must be below 0.1 psi/6 months</li> </ul> </li> <li>- For inlet modules flow sensors, the repeatability must be within &lt;±0.35% of setpoint under normalized temperature and pressure per °C for He</li> <li>- Inlet must have electronic pneumatic control of carrier, split and septum purge gases, including electronic ON/OFF.</li> <li>- The system must be capable to install two inlets.</li> <li>- The system must be suitable for all capillary columns (50 µm to 530 µm ID).</li> <li>- Maximum operating temperature of split/splitless injector must be 400 °C or higher.</li> </ul> |             | Yes/ No                                                                             |

| Equipment 3: Gas Chromatography coupled with Headspace Sampler, Flame Ionization and Electron Capture Detectors (GC-FID) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Compliances (Yes/ No)<br><i>**If No, please indicate reason of non-compliances.</i> |
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| Location: CML                                                                                                            | Quantity: 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                     |
| (F) MMI Inlet (1 Unit)                                                                                                   | <ul style="list-style-type: none"><li>- The system must allow all the following injection modes:<ul style="list-style-type: none"><li>(a) Hot split/splitless</li><li>(b) Cold split/splitless</li><li>(c) Pulsed split/splitless</li><li>(d) Solvent vent</li><li>(e) Direct</li></ul></li><li>- Pressure range must be 0-100 psig or wider.</li><li>- The system must allow temperature programming to 10 ramps at 900°C/min or lower.</li><li>- Maximum temperature must be no lower than 450 °C.</li><li>- Split ratio set point must be 7500 : 1 or larger.</li><li>- The system must have electronic septum purge flow control.</li><li>- The system must be able to setup parameters facilitated with solvent elimination calculator.</li><li>- Total flow setting range must be as follows or wider:<ul style="list-style-type: none"><li>(a) 0 – 200 ml/min N<sub>2</sub></li><li>(b) 0 – 1250 ml/min H<sub>2</sub> or He</li></ul></li></ul> | Yes/ No                                                                             |
| (G) Flame Ionization Detector (1 Unit)                                                                                   | <ul style="list-style-type: none"><li>- Minimum detectable level must be no greater than 1.4 pg C/s (for tridecane).</li><li>- Linear dynamic range must be 107 (± 10 %) or greater.</li><li>- Dynamic range must be auto-ranging.</li><li>- Maximum data rates must be 500 Hz (10 msec peaks at half height) or higher.</li><li>- Standard EPC for 3 gases must cover the following range:<ul style="list-style-type: none"><li>(c) Air: 0 to 800 mL/min</li><li>(d) Hydrogen: 0 to 100 mL/min</li><li>(e) Makeup (Nitrogen or Helium): 0 to 100 mL/min</li></ul></li><li>- Maximum operating temperature must be 450 °C or higher.</li><li>- FID Ignition must allow auto ignition and re-ignition upon flameout.</li></ul>                                                                                                                                                                                                                          | Yes/ No                                                                             |
| (H) Micro-Electron Capture Detector (1 Unit)                                                                             | <ul style="list-style-type: none"><li>- Minimum detectable level must be no greater than 4.4 fg/ml (for lindane).</li><li>- Linear dynamic range must be 5 x 10<sup>4</sup> or higher with lindane.</li><li>- Maximum data acquisition rate must be 50 Hz or higher.</li><li>- Maximum operating temperature must be 400 °C or higher.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                     |
| (I) Autosampler                                                                                                          | <ul style="list-style-type: none"><li>- The system must have an autosampler tower with an autosampler tray which can support 100 sample vials, the control must be random access using the data management software.</li><li>- The autosampler must have the ability to inject liquid sample as well as headspace capability, it must be able to upgrade for SPME function in future.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Yes/ No                                                                             |

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| <b>Equipment 3: Gas Chromatography coupled with Headspace Sampler, Flame Ionization and Electron Capture Detectors (GC-FID)</b>                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <b>Location: CML</b>                                                                                                                                        | <b>Quantity: 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                            |
| <ul style="list-style-type: none"> <li>- The autosampler must be able to hold up at least 2 mL x 100 vials, 10 mL or 20 mL x 32 headspace vials.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                            |
| <b>(J) Headspace Autosampler</b>                                                                                                                            | <ul style="list-style-type: none"> <li>- The autosampler must have a larger capacity of 100 vial or more. Vials in removable vial racks must be suitable for in-rack vial capping (racks are resistant to common solvents used in gas chromatography).</li> <li>- Racks must be exchangeable.</li> <li>- Twelve position air-bath vial oven must be provided.</li> <li>- Adaptive algorithmic sample overlapping must be provided.</li> <li>- Vial shaker with frequency and acceleration adjustable parameters must be provided.</li> <li>- Vial chiller plate with temperature sensor (5 °C to ambient range) must be provided.</li> <li>- Complete control of the sampling process must be provided.</li> <li>- Unrestricted GC column selection from 50 to 530 µm regardless of sampling conditions must be available.</li> <li>- Sample flow path must be chemically inert.</li> <li>- Adaptor-free compatibility with headspace vials of 20 mL and 22 mL sizes must meet the following specifications:               <ul style="list-style-type: none"> <li>(a) Screw or crimp top closure</li> <li>(b) Flat or rounded bottom style Dimensions, 20 mL and 22 mL sizes (79.0 mm maximum height with closure)</li> </ul> </li> <li>- Single Extraction mode with overlapping of 12 vials or more must be available.</li> <li>- Must be capable for Multiple Headspace Extraction (MHE) model with 100 extractions or more per vial.</li> <li>- Must be capable for Multiple Headspace Concentration (MHC) model with 100 extractions or more from a single vial followed by one GC start.</li> <li>- Control software must have interface via LAN connection and must be available for integrated control via GC.</li> <li>- Vial equilibration time must be from 0 to 900 min or longer; Injection duration must be from 0 to 900 min or longer;</li> <li>- The system must have automatic vial leak checking, ensuring vials have been sealed correctly before sampling and requires no calibration or setup.</li> <li>- Logging of movements, events, and errors for each vial must be provided.</li> <li>- The system must allow Sequence Actions (continue, skip, pause, abort) when any of the following occur: missing vials, wrong vial size, vial leak detected and system not ready.</li> </ul> |                                                                                            |
| <b>(K) Gas saver mode</b>                                                                                                                                   | <ul style="list-style-type: none"> <li>- The system must have built-in gas saver mode to reduce gas consumption without compromising GC performance.</li> <li>- The system must have built-in automatic carrier gas shutoff if the inlet gas pressure drops significantly.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Yes/ No</b>                                                                             |

| <b>Equipment 3: Gas Chromatography coupled with Headspace Sampler, Flame Ionization and Electron Capture Detectors (GC-FID)</b><br><b>Location: CML                      Quantity: 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
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| <b>(L) Data system</b><br><br><ul style="list-style-type: none"> <li>- Data processing and complete system control with software must be available.</li> <li>- Real time monitoring with diagnostics functions (listed below) must be available:               <ul style="list-style-type: none"> <li>(a) Instrument diagnostics, including leak tests.</li> <li>(b) Access to maintenance, run and even logs.</li> <li>(c) Access to maintenance information, such as manuals and videos.</li> </ul> </li> <li>- Software must be capable of performing sequencing, reporting, easy processing and transferring of data to Microsoft excel, etc.</li> <li>- Retention time locking software must be included for analyzing target compounds in complex matrices.</li> <li>- The software must be able to generate both standard and user settable custom reports to suit different needs.</li> <li>- The system must have automation control from local keyboard; which can provides clock-time programming initiated from the front panel to initiate events (on/off, method start, etc.) at a future date and time and can provide one- button access to maintenance and service modes from the keyboard.</li> <li>- The GC system must be able to interface to a comprehensive real-time monitoring and diagnostic software which includes the functions such as real time notification via advisories and indicators, counters, chromatographic attributes, instrument diagnostics (i.e. leak tests), access to maintenance, run and even logs, access to maintenance information (manuals and videos), etc.</li> <li>- Free software upgrade must be provided. If the upgraded software is not compatible with the existing computer and/or existing operation system, free computer and/or operation system must be provided.</li> </ul> |  | Yes/ No                                                                                    |
| <b>(J) PC</b><br><br><ul style="list-style-type: none"> <li>- Minimum configuration: Intel i5-2400 processor or equivalent, 4GB RAM, 500 GB hard drives, wireless modem 802.11a/b/g/n/ac , USB 3.0, DVD RW (CD RW capable), mouse and keyboard, high resolution 19 inch flat screen color monitor.</li> <li>- Microsoft® Windows® 7 Professional 32 or 64 bit must be installed.</li> <li>- System Documentation Kit must be provided.</li> <li>- Microsoft office software must be installed</li> <li>- The PC(s) must be provided with with their system recovery CDs or DVDs.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | Yes/ No                                                                                    |
| <b><u>Miscellaneous</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                                                                            |
| <ul style="list-style-type: none"> <li>- A declaration of Conformity certificate must be provided upon commissioning of equipment.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- All Gas line must be I.D. labelled.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Prices quoted must include installation, commissioning, initial calibration and operator training. The system and PC must come with a minimum 1</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  | Yes/ No                                                                                    |

| Equipment 3: Gas Chromatography coupled with Headspace Sampler, Flame Ionization and Electron Capture Detectors (GC-FID)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             | Compliances (Yes/ No)<br>**If No, please indicate reason of non-compliances. |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------|
| Location: CML                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Quantity: 1 |                                                                              |
| year warranty. The warranty must include unlimited breakdown calls and on-site services, replacement of parts and at least 1 preventive maintenance per year, and cover the overall system (both hardware and software). Any software revisions should also be provided free-of-charge. The Contractor is required to oversee overall systems integration, site preparation, installation and necessary configuration of the system.                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |                                                                              |
| <ul style="list-style-type: none"> <li>- <b>Option to purchase:</b> Tenderer is required to quote for a 3-year post warranty comprehensive maintenance. The comprehensive maintenance contract shall cover manpower and the overall system including hardware and software. The price quoted shall minimally include the following: <ul style="list-style-type: none"> <li>a) provision of unlimited breakdown calls and on-site services;</li> <li>b) provision of replacement parts at no additional cost;</li> <li>c) to provide 1 preventive maintenance per year; and</li> <li>d) any software revisions should also be provided at free-of-charge</li> </ul> </li> </ul>                                                                                                                                                                                       |             | Yes/ No                                                                      |
| <ul style="list-style-type: none"> <li>- The delivery of the equipment must be coordinated with the Laboratory.</li> <li>- A Risk Assessment Report in 5x5 matrix must be provided prior to the delivery of the system.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             | Yes/ No                                                                      |
| <ul style="list-style-type: none"> <li>- The tenderer is required to provide after-sales support from engineers and application chemists in Singapore. The tenderer must have a strong track record in providing personalised and responsive after-sales support in Singapore, that is, the company must provide: <ul style="list-style-type: none"> <li>8. Contacts (handphone number and email) of at least two engineers experienced with the system;</li> <li>9. Immediate instruction for trouble shooting by telephone when requested;</li> <li>10. On-site service within 2 working days when requested; and</li> </ul> </li> <li>- Replacement of parts (within 2 working days when parts are available in Singapore, within 5 working days when parts are not available in Singapore and are needed to be ordered from overseas) when necessary.</li> </ul> |             | Yes/ No                                                                      |
| <ul style="list-style-type: none"> <li>- The GC system must be a bench top model.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |                                                                              |
| <ul style="list-style-type: none"> <li>- The system must have a minimum 8-year value guarantee such that vendor shall have a minimum of 8 years' guaranteed parts and comprehensive service available or give residual value credit for replacement.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             | Yes/ No                                                                      |
| <ul style="list-style-type: none"> <li>- The Contractor must provide on-site instrument operation and user maintenance training by qualified engineer(s)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             | Yes/ No                                                                      |
| <ul style="list-style-type: none"> <li>- The Contractor shall obtain the necessary licence and test for the installation of the Micro-Electron Capture Detector.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             | Yes/ No                                                                      |
| <ul style="list-style-type: none"> <li>- Tenderer is required to quote for the trade-in of the existing 1 unit of</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             | Yes/ No                                                                      |

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| <b>Equipment 3: Gas Chromatography coupled with Headspace Sampler, Flame Ionization and Electron Capture Detectors (GC-FID)</b>                                                                                                                                                                                                                                                                                             |                    | <b>Compliances<br/>(Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <b>Location:</b> CML                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Quantity:</b> 1 |                                                                                                |
| Agilent Technologies 7890/G1888 Gas Chromatography with Headspace Sampler. The value shall include removal, transportation and other required services. Price "0" shall be indicated in <b><u>Price Summary</u></b> if one of the following conditions fulfilled.<br>a) there is no trade-in value but removal of existing system is provided;<br>or<br>- b) trade-in option and removal of existing system is not provided |                    |                                                                                                |

## COMPLIANCE OF REQUIREMENT SPECIFICATIONS

**I hereby confirm that I can meet all the specifications and requirements as stated in Section 3: Requirement Specifications, Equipment 3: GC-FID.**

Tenderer's (as \*Principal/Agent)  
Company or Business Registration No:

Tenderer's official  
Stamp:

Authorized Signature

Name:

Designation:  
(\*Delete whichever is not applicable)

Please indicate any non-compliance to requirement specifications here should there be any.

| Reference To | Remarks |
|--------------|---------|
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| <b>Equipment 4: Gas Chromatography – Mass Spectrometer (GCMS)</b><br><br><b>Location: CML</b> <b>Quantity: 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <b><u>Technical Specifications</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                            |
| <ul style="list-style-type: none"> <li>- The gas chromatography system must be able to operate on these conditions:               <ul style="list-style-type: none"> <li>(j) Ambient operating temperature: minimum 15-35 °C;</li> <li>(k) Ambient operating humidity: minimum 5-95%;</li> <li>(l) Storage extremes: minimum -40 °C to 70 °C;</li> <li>(m) Line voltage requirements: 230 V ± 10 %; and</li> <li>(n) Conforms to the following safety standards and regulations: CSA, IEC, EN, and ISO9001.</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <p style="text-align: center;">Yes/ No</p>                                                 |
| <b>(A) GC Mainframe</b> <ul style="list-style-type: none"> <li>- The system must have the ability to support simultaneously for at least 2 inlets, 3 detectors and 4 detectors signals for future upgrade.</li> <li>- Full Electronic Pneumatic Control (EPC) must be available for all inlets and detectors.</li> <li>- The system must be able to install 6 EPC modules, providing control of 16 channels of EPC.</li> <li>- EPC with capillary columns must provide four column flow control modes: constant pressure, ramped pressure, constant flow or ramped flow.</li> <li>- The system must have atmospheric pressure and temperature compensation.</li> <li>- The system must have preprogrammed leak tests.</li> <li>- Automatic liquid sampling must be fully integrated into mainframe control.</li> <li>- The system must have 550 timed events.</li> <li>- The system must be able to initiate clock-time programming from the front panel to initiate events (on/off, method start, etc) at a future date and time.</li> <li>- The system must have built-in column bleed compensation.</li> <li>- The system must be able to run log to record at least 50 potential errors that occurred during the last analytical run.</li> <li>- The system must be able to display of all GC and ALS setpoints at the GC or data system.</li> <li>- The system must have built-in ability to update to the latest firmware.</li> <li>- The system must have built-in Capillary Flow Technology which provides devices with reliable, leak free, in-oven capillary connection to help analyze complex sample and provide gain in productivity.</li> <li>- The system must be upgradeable for Solvent Bypass, Back flush and Heart Cutting for future application.</li> </ul> | <p style="text-align: center;">Yes/ No</p>                                                 |
| <b>(B) Chromatographic Performance</b> <ul style="list-style-type: none"> <li>- The Retention time repeatability must be ≤0.008 % or ≤0.0008 min.</li> <li>- Area repeatability must be 1% RSD or below.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p style="text-align: center;">Yes/ No</p>                                                 |

| <b>Equipment 4: Gas Chromatography – Mass Spectrometer (GCMS)</b><br><br><b>Location: CML</b> <b>Quantity: 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
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| <b>(C) Column Oven</b> <ul style="list-style-type: none"> <li>- Oven must be able to accommodate two 105 m × 0.53 mm ID capillary columns or two 10-ft glass packed columns (9 in. coil diameter, 1/4in. OD), or two 20-ft stainless steel packed columns (1/8in. OD).</li> <li>- Oven operating temperature range must be from ambient temperature minimum +4 °C to 450 °C.</li> <li>- Oven temperature set point resolution must be 0.1 °C or smaller.</li> <li>- The fastest oven temperature ramp-up rate must be no slower than 120 °C/minute.</li> <li>- Maximum run time must be 999.99 min (16.7 h) or longer.</li> <li>- Oven temperature ramp-down rate (cooling down from 450 °C to 50 °C at ambient temperature of 18 - 25 °C) should be no longer than 4.5 minutes.</li> <li>- The system should support 20 oven ramps with 21 plateaus and negative ramps.</li> </ul>                                                                                                                        | <p>Yes/ No</p>                                                                             |
| <b>(D) Electronic Pneumatics Control (EPC)</b> <ul style="list-style-type: none"> <li>- The system must have compensation for barometric pressure and ambient temperature changes.</li> <li>- The system must have Leak Detection and Automatic Shutdown.</li> <li>- The pressure setpoint resolution must be no greater than 0.001 psi.</li> <li>- The units for pressure must be able to be express in bar, psi and kPa.</li> <li>- Pressure sensor accuracy must be within ±2 %.</li> <li>- Pressure sensor repeatability must be within ±0.05 psi.</li> <li>- Drift must be within ±0.1 psi/ 6 months.</li> <li>- Flow sensor accuracy must be within ±5 %.</li> <li>- Flow sensor repeatability must be within ±0.35 %.</li> </ul>                                                                                                                                                                                                                                                                    | <p>Yes/ No</p>                                                                             |
| <b>(E) MMI Inlet (1 Unit)</b> <ul style="list-style-type: none"> <li>- The system must allow all the following injection modes: <ul style="list-style-type: none"> <li>(f) Hot split/splitless</li> <li>(g) Pulsed split/splitless</li> <li>(h) Cold split/splitless</li> <li>(i) Solvent vent</li> <li>(j) Direct</li> </ul> </li> <li>- Pressure range must be 0-100 psig or wider.</li> <li>- The system must allow temperature programming to 10 ramps at 900°C/min or lower.</li> <li>- Maximum temperature must be no lower than 450 °C.</li> <li>- Split ratio set point must be 7500 : 1 or larger.</li> <li>- The system must have electronic septum purge flow control.</li> <li>- The system must be able to setup parameters facilitated with solvent elimination calculator.</li> <li>- Total flow setting range must be as follows or wider: <ul style="list-style-type: none"> <li>(f) 0 – 200 ml/min N<sub>2</sub></li> <li>(g) 0 – 1250 ml/min H<sub>2</sub> or He</li> </ul> </li> </ul> | <p>Yes/ No</p>                                                                             |

| Equipment 4: Gas Chromatography – Mass Spectrometer (GCMS) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Compliances<br>(Yes/ No)<br><i>**If No, please<br/>indicate reason of<br/>non-compliances.</i> |
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| Location: CML                                              | Quantity: 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                |
| (F) Mass spectrometer                                      | <ul style="list-style-type: none"><li>- The mass spectrometer must be a single quadrupole.</li><li>- Electron ionization scan sensitivity: 1pg octafluoronaphthalene (OFN) must give no lower than1500:1 signal-to-noise ratio scanning from 50-300 amu at nominal m/z 272 ion. This will be used as acceptance criterion during installation.</li><li>- Electron ionization SIM sensitivity: 8 sequential 1 µL injections of 100 fg/µL OFN standard solution at nominal 272 u ion must give instrument detection limit of 10 fg or less.</li><li>- EI Ion source type must be non-coated inert extractor source.</li><li>- The system must utilise an air-cooled high-vacuum performance turbo pump with a minimum pumping speed of 255 Liters/second.</li><li>- Mechanical pump capacity must be 2.5 m³/hr or higher.</li><li>- The system must have an electronic scan rate of 20,000 u/sec.</li><li>- The mass spectrometer must use an ion source where the metallic parts are constructed from inert material. Ion Source temp must be controllable from 150 – 350 °C. Stainless steel is NOT acceptable nor is coating the metallic parts with an inert material.</li><li>- Mass spectrometer must utilize a quadrupole mass filter consisting of a monolithic quartz structure.</li><li>- The quadrupole must be allowed to be independently heated and its temperature must be user-selectable from 100– 200 °C (or wider) enabling bakeout.</li><li>- The system must have a mass range of 1.6 to 1050 amu or wider with unit mass resolution over the entire mass range.</li><li>- Mass axis stability must be better than 0.1 amu/48hour.</li><li>- Dynamic range must be 10<sup>6</sup> or higher.</li><li>- The range of transfer line temperature must be100-350 °C or wider</li><li>- The system must have the capability to create 100 selective ion monitoring (SIM) ion groups with at least 60 ions per group.</li><li>- SIM speed must be down to no longer than 0.1 msec.</li><li>- Automated SIM setup must be available as an option that can convert a full scan method to a SIM or SIM/Scan method. The software must be able to automatically configure the number of SIM groups, SIM cycles across the peak, and the ions added to each group.</li><li>- Two filaments must be available in the ion source allowing automatic switching to another when one fails to minimize downtime.</li></ul> | Yes/ No                                                                                        |
| (G) Autosampler                                            | <ul style="list-style-type: none"><li>- The system must have an autosampler tower with an autosampler tray which can support 100 sample vials, the control must be random access using the data management software.</li><li>- The autosampler must have the ability to inject liquid sample as well as headspace capability, it must be able to upgrade for SPME function in future.</li><li>- The autosampler must be able to hold up at least 2 mL × 100 vials, 10 mL or 20 mL x 32 headspace vials.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Yes/ No                                                                                        |

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| <b>Equipment 4: Gas Chromatography – Mass Spectrometer (GCMS)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                    | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <b>Location: CML</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Quantity: 2</b> |                                                                                            |
| <b>(H) Gas saver mode</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The system must have built-in gas saver mode to reduce gas consumption without compromising GC performance.</li> <li>- The system must have built-in automatic carrier gas shutoff if the inlet gas pressure drops significantly.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                    | Yes/ No                                                                                    |
| <b>(I) Data system</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                    |                                                                                            |
| <ul style="list-style-type: none"> <li>- Data processing and complete system control with software must be available.</li> <li>- Real time monitoring with diagnostics functions (listed below) must be available: <ul style="list-style-type: none"> <li>(d) Instrument diagnostics, including leak tests.</li> <li>(e) Access to maintenance, run and even logs.</li> <li>(f) Access to maintenance information, such as manuals and videos.</li> </ul> </li> <li>- Software must be capable of performing sequencing, reporting, library searching, auto- tuning , calibration , easy processing and transferring of data to Microsoft Excel, QA/QC checking , etc.</li> <li>- Retention time locking software must be included for analyzing target compounds in complex matrices.</li> <li>- The software must be able to generate both standard and user settable custom reports to suit different needs.</li> <li>- The system must have automation control from local keyboard; which can provides clock-time programming initiated from the front panel to initiate events (on/off, method start, etc.) at a future date and time and can provide one- button access to maintenance and service modes from the keyboard.</li> <li>- The GC system must be able to interface to a comprehensive real-time monitoring and diagnostic software which includes the functions such as real time notification via advisories and indicators, counters, chromatographic attributes, instrument diagnostics (i.e. leak tests), access to maintenance, run and even logs, access to maintenance information (manuals and videos), etc.</li> <li>- A license of latest Wiley library and NIST library must be provided free of charge.</li> <li>- The system must have capability to share and distribute electronic methods between different GC/MS and/or labs easily and securely.</li> <li>- The system must have an integrated retention time-locking module for analyzing target compounds in complex matrices. The software module must provide the creation of custom compound databases as well as the utilization of vendor provided databases.</li> <li>- The system must have autotune for decafluoro-triphenylphosphine (DFTPP).</li> <li>- The system must have automated quantitation setup.</li> <li>- The system must be able to perform manual integration of single and group peaks capability for better peak identification.</li> <li>- The system must come with software to identify unknown compounds based on the concept of mass accuracy and mass spectral purity.</li> </ul> |                    |                                                                                            |

| Equipment 4: Gas Chromatography – Mass Spectrometer (GCMS)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             | Compliances<br>(Yes/ No)<br><i>**If No, please<br/>indicate reason of<br/>non-compliances.</i> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------------------|
| Location: CML                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Quantity: 2 |                                                                                                |
| - Free software upgrade must be provided. If the upgraded software is not compatible with the existing computer and/or existing operation system, free computer and/or operation system must be provided.                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             |                                                                                                |
| <b>(J) PC and Printer</b> <ul style="list-style-type: none"> <li>- Minimum configuration: Intel i5-2400 processor or equivalent, 4GB RAM, 500 GB hard drives, wireless modem 802.11a/b/g/n/ac , USB 3.0, DVD RW (CD RW capable), mouse and keyboard, high resolution 19 inch flat screen color monitor.</li> <li>- Microsoft® Windows® 7 Professional 32 or 64 bit must be installed.</li> <li>- System Documentation Kit must be provided.</li> <li>- Microsoft office software must be installed.</li> <li>- Laser jet printer must be provided.</li> <li>- The PC(s) must be provided with their system recovery CDs or DVDs.</li> </ul>                                       |             | Yes/ No                                                                                        |
| <b>Miscellaneous</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             |                                                                                                |
| - A declaration of Conformity certificate must be provided upon commissioning of equipment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             | Yes/ No                                                                                        |
| - All Gas line must be I.D. labelled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             | Yes/ No                                                                                        |
| - Prices quoted must include installation, commissioning, initial calibration and operator training. The system and PC must come with a minimum 1 year warranty. The warranty must include unlimited breakdown calls and on-site services, replacement of parts and at least 1 preventive maintenance per year, and cover the overall system (both hardware and software). Any software revisions should also be provided free-of-charge. The Contractor is required to oversee overall systems integration, site preparation, installation and necessary configuration of the system.                                                                                            |             | Yes/ No                                                                                        |
| <ul style="list-style-type: none"> <li>- <b>Option to purchase:</b> Tenderer is required to quote for a 3-year post warranty comprehensive maintenance contract. The comprehensive maintenance contract shall cover manpower and the overall system including hardware and software. The price quoted shall minimally include the following: <ul style="list-style-type: none"> <li>a) provision of unlimited breakdown calls and on-site services;</li> <li>b) provision of replacement parts at no additional cost</li> <li>c) to provide 1 preventive maintenance per year</li> <li>d) any software revisions should also be provided at free-of-charge</li> </ul> </li> </ul> |             | Yes/ No                                                                                        |
| <ul style="list-style-type: none"> <li>- The delivery of the equipment must be coordinated with the Laboratory.</li> <li>- Risk Assessment Report in 5x5 matrix must be provided prior to the delivery of the system.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |                                                                                                |
| - The GC system must be a bench top model.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                                                                                                |
| - The system must have a minimum 8-year value guarantee such that vendor shall have a minimum of 8years' guaranteed parts and comprehensive service available or give residual value credit for replacement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             | Yes/ No                                                                                        |

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| <b>Equipment 4: Gas Chromatography – Mass Spectrometer (GCMS)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Compliances<br/>(Yes/ No)<br/>**If No, please<br/>indicate reason of<br/>non-compliances.</b> |
| <b>Location: CML                      Quantity: 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                  |
| - Supplier must provide on-site instrument operation and user maintenance training by qualified engineer(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Yes/ No                                                                                          |
| - Tenderer is required to quote for the trade-in of the existing 1 unit of Agilent Technologies 7890/5975 Gas Chromatography – Mass Spectrometer. The value shall include removal, transportation and other required services. Price “0” shall be indicated in <b><u>Price Summary</u></b> if one of the following conditions is fulfilled.<br>b) there is no trade-in value but removal of existing system is provided; or<br>c) trade-in option and removal of existing system is not provided.                                                                                                                                                                                                                                                    | Yes/ No                                                                                          |
| - The tenderer is required to provide after-sales support from engineers and application chemists in Singapore. The tenderer must have a strong track record in providing personalised and responsive after-sales support in Singapore, that is, the company must provide:<br>(a) contacts (handphone number and email) of at least two engineers experienced with the system;<br>(b) immediate instruction for trouble shooting by telephone when requested;<br>(c) on-site service within 2 working days when requested; and<br>(d) replacement of parts (within 2 working days when parts are available in Singapore, within 5 working days when parts are not available in Singapore and are needed to be ordered from overseas) when necessary. | Yes/ No                                                                                          |
| - <b><u>Option to purchase:</u></b> Tenderer is required to quote for the following:<br><br>i) Volatile Organic Compounds (VOCs) library<br>ii) Pesticides library<br>iii) Pharmaceutical library.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Yes/ No                                                                                          |

## COMPLIANCE OF REQUIREMENT SPECIFICATIONS

**I hereby confirm that I can meet all the specifications and requirements as stated in Section 3: Requirement Specifications, Equipment 4: GC-MS System.**

Tenderer's (as \*Principal/Agent)  
Company or Business Registration No:

Tenderer's official  
Stamp:

Authorized Signature

Name:

Designation:  
(\*Delete whichever is not applicable)

Please indicate any non-compliance to requirement specifications here should there be any.

| Reference To | Remarks |
|--------------|---------|
|              |         |
|              |         |
|              |         |
|              |         |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| <b>Equipment 5: High Performance Liquid Chromatography – Mass Spectrometer/ Diode Array Detector with Fraction Collector (HPLC-MS-DAD with Faction Collector)</b>                                                                                                                                                                                                                                                                                    | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <b>Location: CML                      Quantity: 1</b>                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                            |
| <b><u>Technical Specifications</u></b>                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                            |
| <ul style="list-style-type: none"> <li>- The system must be a high performance liquid chromatography (HPLC) coupled to an ultrafast single quadrupole mass spectrometer (MS), a diode array detector (DAD) and a fraction collector. The modules must be capable of standalone operation and have internal diagnostics to monitor the instrument's performance. The system must have a single software to control all individual modules.</li> </ul> | Yes/ No                                                                                    |
| <b>(A) High Performance Liquid Chromatograph</b>                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                            |
| <b>(A.1) Solvent delivery system with high pressure and binary gradient features.</b>                                                                                                                                                                                                                                                                                                                                                                | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Minimum flow rate must be no higher than 0.001 mL/min.</li> </ul>                                                                                                                                                                                                                                                                                                                                           | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Maximum flow rate must be no less than 10 mL/min.</li> </ul>                                                                                                                                                                                                                                                                                                                                                | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Allow 0.01 mL/min flow rate step change from micro to semi-preparative flow rates without any hardware changes.</li> </ul>                                                                                                                                                                                                                                                                                  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Flow rate accuracy must be no more than <math>\pm 1</math> %.</li> </ul>                                                                                                                                                                                                                                                                                                                                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Flow rate precision must be no more than <math>\pm 1</math> % relative standard deviation (RSD). Pressure setting range must be no less than 60 MPa.</li> </ul>                                                                                                                                                                                                                                             | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Gradient formation must be produced through low pressure binary mixing.</li> </ul>                                                                                                                                                                                                                                                                                                                          | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Precision of composition must be less than 0.2% RSD.</li> </ul>                                                                                                                                                                                                                                                                                                                                             | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Allow stable delivery of even non-polar organic solvents.</li> </ul>                                                                                                                                                                                                                                                                                                                                        | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Automatic rinsing of plunger must be available.</li> </ul>                                                                                                                                                                                                                                                                                                                                                  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must be capable of standalone operation for maintenance</li> </ul>                                                                                                                                                                                                                                                                                                                                          | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Reservoir tray (with at least four solvent bottles complete with fittings) and automatic rinsing kit must be supplied.</li> </ul>                                                                                                                                                                                                                                                                           | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must have a leak sensor as safety feature.</li> </ul>                                                                                                                                                                                                                                                                                                                                                       | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must have internal degassing unit.</li> </ul>                                                                                                                                                                                                                                                                                                                                                               | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must allow control from external software and local control on the instrument.</li> </ul>                                                                                                                                                                                                                                                                                                                   | Yes/ No                                                                                    |
| <b>(A2) Auto-Sample Injector</b> <ul style="list-style-type: none"> <li>- Sample injection volume must be variable between 0.1 <math>\mu</math>L to 100 <math>\mu</math>L inclusive with zero sample loss during injection.</li> </ul>                                                                                                                                                                                                               | Yes/ No                                                                                    |

| Equipment 5: High Performance Liquid Chromatography – Mass Spectrometer/ Diode Array Detector with Fraction Collector (HPLC-MS-DAD with Faction Collector)                                                                                                     | Compliances (Yes/ No)<br><i>**If No, please indicate reason of non-compliances.</i> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <b>Location: CML</b> <b>Quantity: 1</b>                                                                                                                                                                                                                        |                                                                                     |
| - Number of samples to be processed automatically, random access for a minimum of 100 positions for 2 ml vial volume.                                                                                                                                          | Yes/ No                                                                             |
| - Must be able to perform customised continuous analyses according to the conditions specified for each sample, including pre-treatment, injection and analysis conditions. Priority samples must be allowed to be inserted in the queue during automated run. | Yes/ No                                                                             |
| - Flow line rinse capability both before and after sampling must be possible.                                                                                                                                                                                  | Yes/ No                                                                             |
| - Carry over must be $\leq 0.1\%$ .                                                                                                                                                                                                                            | Yes/ No                                                                             |
| - Injection precision must be $\leq 0.25\%$ of RSD value.                                                                                                                                                                                                      | Yes/ No                                                                             |
| - Must have a leak sensor, automatic rack and vial recognition as safety feature.                                                                                                                                                                              | Yes/ No                                                                             |
| - Sample holder must have capability to control temperature, range covering minimally from 4 °C to 40 °C                                                                                                                                                       | Yes/ No                                                                             |
| <b>(A.3) Column Compartment</b>                                                                                                                                                                                                                                |                                                                                     |
| - Must have uniform temperature distribution that can maintain constant temperature level even when power source voltage fluctuates.                                                                                                                           | Yes/ No                                                                             |
| - Allow a temperature range of 10 °C to 80 °C                                                                                                                                                                                                                  | Yes/ No                                                                             |
| - Temperature control precision should be $\pm 0.2$ °C or less.                                                                                                                                                                                                | Yes/ No                                                                             |
| - Must have temperature limit device and temperature fuse.                                                                                                                                                                                                     | Yes/ No                                                                             |
| - Capable of temperature programming in linear and step programmes.                                                                                                                                                                                            | Yes/ No                                                                             |
| - Must be able to accommodate at least two columns with a minimum length of 25 cm.                                                                                                                                                                             | Yes/ No                                                                             |
| - Must have a leak sensor as safety feature.                                                                                                                                                                                                                   | Yes/ No                                                                             |
| <b>(B) Mass Spectrometer</b>                                                                                                                                                                                                                                   |                                                                                     |
| - The instrument must be a bench top model with a maximum scan speed of 10,400 Da/sec.                                                                                                                                                                         | Yes/ No                                                                             |
| - The mass analyser must be a single quadrupole MS system.                                                                                                                                                                                                     | Yes/ No                                                                             |
| - Mass range must be cover m/z 2 to 2000.                                                                                                                                                                                                                      | Yes/ No                                                                             |
| - Mass stability of detection ion must be less than 0.1 amu over a period of 12 hours.                                                                                                                                                                         | Yes/ No                                                                             |

| Equipment 5: High Performance Liquid Chromatography – Mass Spectrometer/ Diode Array Detector with Fraction Collector (HPLC-MS-DAD with Faction Collector)                                                                                                                                  |                    | Compliances (Yes/ No)<br><i>**If No, please indicate reason of non-compliances.</i> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------------------------------------------------------------------------|
| <b>Location: CML</b>                                                                                                                                                                                                                                                                        | <b>Quantity: 1</b> |                                                                                     |
| - Dynamic range of quantification must be more than or equal to $6 \times 10^6$ ppm.                                                                                                                                                                                                        |                    | Yes/ No                                                                             |
| - Detection of positive/negative ions must be user-selectable and the switching time between positive and negative polarity must be no more than 30 msec.                                                                                                                                   |                    | Yes/ No                                                                             |
| - Resolution: The full width at half mass for the target peaks must be between 0.45 and 0.74 inclusive during auto-tuning.                                                                                                                                                                  |                    | Yes/ No                                                                             |
| - Mass measurement accuracy must be less than $\pm 0.13$ Da during tuning.                                                                                                                                                                                                                  |                    | Yes/ No                                                                             |
| - Auto-tuning must be standard with a syringe pump that delivers accurate calibrant injection under full workstation control in both positive and negative modes. Manual tuning must also be allowed.                                                                                       |                    | Yes/ No                                                                             |
| - Sensitivity requirement (positive ESI): The measured signal-to-noise ratio obtained from the chromatogram monitoring the quantification of m/z 609 ion on injection of 1 pg of reserpine must be more than 75:1, based on a 1- $\mu$ L injection of a 1 pg/ $\mu$ L reserpine solution.   |                    | Yes/ No                                                                             |
| - Sensitivity requirement (positive APCI): The measured signal-to-noise ratio obtained from the chromatogram monitoring the quantification of m/z 609 ion on injection of 1 pg of reserpine must be more than 10:1, based on a 10- $\mu$ L injection of a 1 pg/ $\mu$ L reserpine solution. |                    | Yes/ No                                                                             |
| - A LC-MS start-up kit must be supplied.                                                                                                                                                                                                                                                    |                    | Yes/ No                                                                             |
| - Software controlled flow switching valve for diverting the flow to waste must be available.                                                                                                                                                                                               |                    | Yes/ No                                                                             |
| <b>(C) Diode Array Detector</b>                                                                                                                                                                                                                                                             |                    |                                                                                     |
| - Must be a 1024-element diode array                                                                                                                                                                                                                                                        |                    | Yes/ No                                                                             |
| - Must have a leak sensor as safety feature.                                                                                                                                                                                                                                                |                    | Yes/ No                                                                             |
| - Must allow control using external software.                                                                                                                                                                                                                                               |                    | Yes/ No                                                                             |
| - Maximum sampling rate of detector must be no less than 20 Hz.                                                                                                                                                                                                                             |                    | Yes/ No                                                                             |
| - Wavelength range of detector must cover the range of 190 nm to 950 nm with accuracy of no greater than $\pm 1$ nm.                                                                                                                                                                        |                    | Yes/ No                                                                             |
| - Must allow programmable slit width of 1 to 16 nm and diode width of less than 1 nm.                                                                                                                                                                                                       |                    | Yes/ No                                                                             |
| - Flow cell must have path length of 10 mm and ability to modify to switch or upgrade to different flow cells when required.                                                                                                                                                                |                    | Yes/ No                                                                             |

| <b>Equipment 5: High Performance Liquid Chromatography – Mass Spectrometer/ Diode Array Detector with Fraction Collector (HPLC-MS-DAD with Fraction Collector)</b><br><br><b>Location: CML                      Quantity: 1</b>                                                                                                          | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>- Must have programmable instrument's attributes including wavelength, polarity, peak width, wavelength range.</li> </ul>                                                                                                                                                                         | Yes/ No                                                                                    |
| <b>(D) Fractional Collector</b>                                                                                                                                                                                                                                                                                                          |                                                                                            |
| <ul style="list-style-type: none"> <li>- Collection of fractions must be fully automated using pre-set experimental conditions and manual collection must also be allowed.</li> </ul>                                                                                                                                                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Delay volume must be 50 µL or less.</li> </ul>                                                                                                                                                                                                                                                  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The unit must allow flow rate of 10 mL per min for analytical scale purification and upgradable to 100 mL per min for semi-preparative configuration when necessary.</li> </ul>                                                                                                                 | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Multi fraction tray configuration must be available to hold the following:               <ul style="list-style-type: none"> <li>(a) 40 x 20 mL test tubes</li> <li>(b) 60 x 15 mL test tubes</li> <li>(c) 126 x 8 mL test tubes</li> <li>(d) 100 x 2 mL centrifuge vials</li> </ul> </li> </ul> | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Collector must have capability to maintain temperature, range covering minimally from 4 °C to 55 °C, with ability to prevent condensation of water vapours when temperature set below room temperature.</li> </ul>                                                                              | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Trigger source for collection must be using either through pre-determined time set in the experimental procedures or through peak detection (UV-DAD detector) or mass detection (MS spectrometer). Manual trigger should also be an option available for manual collection.</li> </ul>          | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Diverter valves must be available for multi-detectors configuration to allow simultaneous analysis using UV-DAD detector/ MS spectrometer and fractional collection. Diverter valve switch time should be less than 100 msec.</li> </ul>                                                        | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Maximum operation pressure of fractional collector must be no lower than 6 bar.</li> </ul>                                                                                                                                                                                                      | Yes/ No                                                                                    |
| <b>(E) Software and computer</b>                                                                                                                                                                                                                                                                                                         |                                                                                            |
| <ul style="list-style-type: none"> <li>- Minimum configuration: Intel i5-2400 processor or equivalent, 4GB RAM, 500 GB hard drives, wireless modem 802.11a/b/g/n/ac , USB 3.0, DVD RW (CD RW capable), mouse and keyboard, high resolution 19 inch flat screen color monitor.</li> </ul>                                                 | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must provide Window 7 Prof. Operating System and Microsoft Office.</li> </ul>                                                                                                                                                                                                                   | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Single software platform must be provided for a seamless control of all the modules of LC and MS.</li> </ul>                                                                                                                                                                                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software must be able to generate both standard and customisable reports to suit different needs.</li> </ul>                                                                                                                                                                                | Yes/ No                                                                                    |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                    |                                                                                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------------------------------------------------------------------------------|
| <b>Equipment 5: High Performance Liquid Chromatography – Mass Spectrometer/ Diode Array Detector with Fraction Collector (HPLC-MS-DAD with Faction Collector)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                    | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <b>Location: CML</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Quantity: 1</b> |                                                                                            |
| <ul style="list-style-type: none"> <li>- The software must be able to perform manual integration of single and group peaks capability for better peak identification.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software must be able to perform automatic integration of single and group peaks with both standard perimeters and user settable perimeters.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The software must be able to generate numeric data compatible with Microsoft Excel for plotting chromatogram.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Free software upgrade must be provided throughout the warranty period. If the upgraded software is not compatible with the existing computer and/or existing operation system, free computer and/or operation system must be provided.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                    | Yes/ No                                                                                    |
| <b><u>Miscellaneous</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                    |                                                                                            |
| <ul style="list-style-type: none"> <li>- The system shall consist, but not be limited to, the above listed major components, complete with all the accessories and interfacing necessary to make a fully functional and operable system.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- The power supply must be 230 ± 6%, 50/60 Hz, suitable for use in Singapore.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Prices quoted must include installation, commissioning, initial calibration and operator training at Chemical Metrology Laboratory. The system with PC must come with a minimum 1 year warranty. The warranty must include unlimited breakdown calls and on-site services, replacement of parts and at least 1 comprehensive preventive maintenance (includes both labour and consumables/replacement parts) per year, and cover the overall system (both hardware and software). Any software revisions should also be provided free-of-charge. The Contractor is required to oversee overall systems integration, site preparation, installation and necessary configuration of the system.</li> </ul> |                    | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- <b><u>Option to Purchase:</u></b> Tenderer is required to quote for the option to exercise 3-year post warranty comprehensive preventive maintenance contract in <b><u>Annex C Price Summary</u></b>.</li> <li>- The post warranty comprehensive maintenance contract shall minimally include the following: <ul style="list-style-type: none"> <li>a) Unlimited breakdown calls and on-site support</li> <li>b) All replacement parts and consumables</li> <li>c) 1 PM per year with PM kit provided where necessary</li> <li>d) Update of software revision</li> </ul> </li> </ul>                                                                                                                     |                    | Yes/ No                                                                                    |
| Standard consumables that are required for the set up and commissioning of the system must be provided. In addition to the standard consumables, tenderer is                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                    | Yes/ No                                                                                    |

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| <b>Equipment 5: High Performance Liquid Chromatography – Mass Spectrometer/ Diode Array Detector with Fraction Collector (HPLC-MS-DAD with Faction Collector)</b><br><br><b>Location: CML                      Quantity: 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <p>required to provide the list of consumables parts and the frequency of change of such part, for the respective modules as follow in the format set out in <b><u>Annex C Schedule of Rates</u></b>.</p> <p>Auto-Sampler:</p> <ul style="list-style-type: none"> <li>(a) Rotor Seal Unit</li> <li>(b) Gripper Arm Unit</li> <li>(c) Cooling/ Thermostat Unit</li> <li>(d) Switch/ Diverter Valve Unit</li> <li>(e) Sampling/ Injection Unit</li> <li>(f) Fuse Unit</li> </ul> <p>Column Compartment</p> <ul style="list-style-type: none"> <li>(a) Thermostat Unit</li> <li>(b) Switch/ Diverter Valve Unit</li> <li>(c) Fuse Unit</li> </ul> <p>Diode Array Detector:</p> <ul style="list-style-type: none"> <li>(a) Flow Cell Unit</li> <li>(b) UV Lamp</li> <li>(c) Diode Array Unit</li> <li>(d) Fuse Unit</li> </ul> <p>Quaternary Pump:</p> <ul style="list-style-type: none"> <li>(a) Degasser Unit</li> <li>(b) Pump Seal/ Purge Valve Unit</li> <li>(c) Switch/ Diverter Valve Unit</li> <li>(d) Fuse Unit</li> </ul> <p>Fractional Collector</p> <ul style="list-style-type: none"> <li>(a) Switch/ Diverter Valve Unit</li> <li>(b) Flow Cell Unit</li> <li>(c) Needle Unit</li> <li>(d) Tubing Unit(s)</li> <li>(e) Mechanical Arm Unit</li> </ul> <p>Mass Spectrometer</p> <ul style="list-style-type: none"> <li>(a) Sample unit</li> <li>(b) Collision Cell Unit</li> <li>(c) Quadrupole Unit</li> </ul> |                                                                                            |
| <ul style="list-style-type: none"> <li>- A declaration of Conformity certificate must be provided upon commissioning of equipment.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>Yes/ No</p>                                                                             |
| <ul style="list-style-type: none"> <li>- The delivery of the equipment must be coordinated with the Laboratory.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <p>Yes/ No</p>                                                                             |
| <ul style="list-style-type: none"> <li>- The tenderer must be able to provide after-sales support from engineers and application chemists in Singapore. The tenderer must have a strong track record in providing personalised and responsive after-sales support in Singapore, that is, the company must provide: <ul style="list-style-type: none"> <li>(a) contacts (handphone number and email) of at least two engineers experienced with the system;</li> <li>(b) immediate instruction for trouble shooting by telephone when requested;</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <p>Yes/ No</p>                                                                             |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                            |
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| <b>Equipment 5: High Performance Liquid Chromatography – Mass Spectrometer/ Diode Array Detector with Fraction Collector (HPLC-MS-DAD with Faction Collector)</b><br><br><b>Location: CML</b> <b>Quantity: 1</b>                                                                                                                                                                                                                                                                                        | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| (c) on-site service within 2 working days when requested; and<br>(d) replacement of parts (within 2 working days when parts are available in Singapore, within 5 working days when parts are not available in Singapore and are needed to be ordered from overseas) when necessary.                                                                                                                                                                                                                     |                                                                                            |
| - The system must have a minimum 8-year value guarantee such that vendor shall have a minimum of 8 years' guaranteed parts and comprehensive service available or give residual value credit for replacement.                                                                                                                                                                                                                                                                                           | Yes/ No                                                                                    |
| - Tenderer must be able to provide on-site instrument operation and user maintenance training by qualified engineer(s)                                                                                                                                                                                                                                                                                                                                                                                  | Yes/ No                                                                                    |
| - Tenderer is required to quote trade-in price for Waters 2996/2769/3100 High Performance Liquid Chromatography – Mass Spectrometer with Fraction Collector. The price shall include removal, transportation and other required services. Price "0" shall be indicated in <b>Price Summary</b> if one of the following conditions is fulfilled.<br>a) there is no trade-in value but removal of existing system is provided;<br>or<br>b) trade-in option and removal of existing system is not provided | Yes/ No                                                                                    |

**COMPLIANCE OF REQUIREMENT SPECIFICATIONS**

**I hereby confirm that I can meet all the specifications and requirements as stated in Section 3: Requirement Specifications, Equipment 5: HPLC-MS-DAD with Fraction Collector.**

Tenderer's (as \*Principal/Agent)  
Company or Business Registration No:

Tenderer's official  
Stamp:

Authorized Signature

Name:

Designation:

Please indicate any non-compliance to requirement specifications here should there be any.

| Reference To | Remarks |
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| <b>Equipment 6: High Performance Liquid Chromatography –Diode Array Detector (HPLC-DAD)</b><br><br><b>Location: CML                      Quantity: 1</b>                                                                                                                                                                                                               |  | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <b><u>Technical Specifications</u></b>                                                                                                                                                                                                                                                                                                                                 |  |                                                                                            |
| <ul style="list-style-type: none"> <li>- The system must be a high performance liquid chromatography (HPLC) coupled to a diode array detector (DAD). The modules must be capable of standalone operation and have internal diagnostics to monitor the instrument's performance. The system must have one single software to control all individual modules.</li> </ul> |  | Yes/ No                                                                                    |
| <b>(A) High Performance Liquid Chromatograph</b>                                                                                                                                                                                                                                                                                                                       |  | Yes/ No                                                                                    |
| <b>(A.1) Solvent delivery system with high pressure and binary gradient features.</b>                                                                                                                                                                                                                                                                                  |  |                                                                                            |
| <ul style="list-style-type: none"> <li>- Minimum flow rate must be no higher than 0.001 mL/min.</li> </ul>                                                                                                                                                                                                                                                             |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Maximum flow rate must be no less than 10 mL/min.</li> </ul>                                                                                                                                                                                                                                                                  |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Allow 0.01 mL/min flow rate step change from micro to semi-preparative flow rates without any hardware changes.</li> </ul>                                                                                                                                                                                                    |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Flow rate accuracy must be no more than <math>\pm 1</math> %.</li> </ul>                                                                                                                                                                                                                                                      |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Flow rate precision must be no more than <math>\pm 1</math> % relative standard deviation (RSD). Pressure setting range must be no less than 60 MPa.</li> </ul>                                                                                                                                                               |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Gradient formation must be produced through low pressure binary mixing.</li> </ul>                                                                                                                                                                                                                                            |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Precision of composition must be less than 0.2% RSD.</li> </ul>                                                                                                                                                                                                                                                               |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Allow stable delivery of even non-polar organic solvents.</li> </ul>                                                                                                                                                                                                                                                          |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Automatic rinsing of plunger must be available.</li> </ul>                                                                                                                                                                                                                                                                    |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must be capable of standalone operation for maintenance</li> </ul>                                                                                                                                                                                                                                                            |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Reservoir tray (with at least four solvent bottles complete with fittings) and automatic rinsing kit must be supplied.</li> </ul>                                                                                                                                                                                             |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must have a leak sensor as safety feature.</li> </ul>                                                                                                                                                                                                                                                                         |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must have internal degassing unit.</li> </ul>                                                                                                                                                                                                                                                                                 |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must allow control from external software and local control on the instrument.</li> </ul>                                                                                                                                                                                                                                     |  | Yes/ No                                                                                    |
| <b>(A2) Auto-Sample Injector</b>                                                                                                                                                                                                                                                                                                                                       |  |                                                                                            |
| <ul style="list-style-type: none"> <li>- Sample injection volume must be variable between 0.1 <math>\mu</math>L to 100 <math>\mu</math>L inclusive with zero sample loss during injection.</li> </ul>                                                                                                                                                                  |  | Yes/ No                                                                                    |

| <b>Equipment 6: High Performance Liquid Chromatography –Diode Array Detector (HPLC-DAD)</b><br><b>Location: CML                      Quantity: 1</b>                                                                                                                                                             |  | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>- Number of samples to be processed automatically, random access for a minimum of 100 positions for 2 ml vial volume.</li> </ul>                                                                                                                                          |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must be able to perform customised continuous analyses according to the conditions specified for each sample, including pre-treatment, injection and analysis conditions. Priority samples must be allowed to be inserted in the queue during automated run.</li> </ul> |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Flow line rinse capability both before and after sampling must be possible.</li> </ul>                                                                                                                                                                                  |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Carry over must be <math>\leq 0.1\%</math>.</li> </ul>                                                                                                                                                                                                                  |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Injection precision must be <math>\leq 0.25\%</math> of RSD value.</li> </ul>                                                                                                                                                                                           |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must have a leak sensor, automatic rack and vial recognition as safety feature.</li> </ul>                                                                                                                                                                              |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Sample holder must have capability to control temperature, range covering minimally from 4 °C to 40 °C.</li> </ul>                                                                                                                                                      |  | Yes/ No                                                                                    |
| <b>(A.3) Column Compartment</b>                                                                                                                                                                                                                                                                                  |  |                                                                                            |
| <ul style="list-style-type: none"> <li>- Must have uniform temperature distribution that can maintain constant temperature level even when power source voltage fluctuates.</li> </ul>                                                                                                                           |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Allow a temperature range of 10 °C to 80 °C</li> </ul>                                                                                                                                                                                                                  |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Temperature control precision should be <math>\pm 0.2</math> °C or less.</li> </ul>                                                                                                                                                                                     |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must have temperature limit device and temperature fuse.</li> </ul>                                                                                                                                                                                                     |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Capable of temperature programming in linear and step programmes.</li> </ul>                                                                                                                                                                                            |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must be able to accommodate at least two columns with a minimum length of 25 cm.</li> </ul>                                                                                                                                                                             |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must have a leak sensor as safety feature.</li> </ul>                                                                                                                                                                                                                   |  | Yes/ No                                                                                    |
| <b>(B) Diode Array Detector</b>                                                                                                                                                                                                                                                                                  |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must be a 1024-element diode array</li> </ul>                                                                                                                                                                                                                           |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must have a leak sensor as safety feature.</li> </ul>                                                                                                                                                                                                                   |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must allow control using external software.</li> </ul>                                                                                                                                                                                                                  |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Maximum sampling rate of detector must be no less than 20 Hz.</li> </ul>                                                                                                                                                                                                |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Wavelength range of detector must cover the range of 190 nm to 950 nm with accuracy of no greater than <math>\pm 1</math> nm.</li> </ul>                                                                                                                                |  | Yes/ No                                                                                    |
| <ul style="list-style-type: none"> <li>- Must allow programmable slit width of 1 to 16 nm and diode width of less than 1 nm.</li> </ul>                                                                                                                                                                          |  | Yes/ No                                                                                    |

| Equipment 6: High Performance Liquid Chromatography –Diode Array Detector (HPLC-DAD)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             | Compliances (Yes/ No)<br><i>**If No, please indicate reason of non-compliances.</i> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------------------------------------------------------------------------|
| Location: CML                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Quantity: 1 |                                                                                     |
| <ul style="list-style-type: none"> <li>Flow cell must have path length of 10 mm and ability to modify to switch or upgrade to different flow cells when required.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             | Yes/ No                                                                             |
| <ul style="list-style-type: none"> <li>Must have programmable instrument's attributes including wavelength, polarity, peak width, wavelength range.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             | Yes/ No                                                                             |
| <b>(E) Software and computer</b> <ul style="list-style-type: none"> <li>Minimum configuration: Intel i5-2400 processor or equivalent, 4GB RAM, 500 GB hard drives, wireless modem 802.11a/b/g/n/ac , USB 3.0, DVD RW (CD RW capable), mouse and keyboard, high resolution 19 inch flat screen color monitor.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                         |             | Yes/ No                                                                             |
| <ul style="list-style-type: none"> <li>Must provide Window 7 Prof. Operating System and Microsoft Office.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             | Yes/ No                                                                             |
| <ul style="list-style-type: none"> <li>Single software platform must be provided for a seamless control of all the modules of LC and MS.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             | Yes/ No                                                                             |
| <ul style="list-style-type: none"> <li>The software must be able to generate both standard and customisable reports to suit different needs.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |             | Yes/ No                                                                             |
| <ul style="list-style-type: none"> <li>The software must be able to perform manual integration of single and group peaks capability for better peak identification.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             | Yes/ No                                                                             |
| <ul style="list-style-type: none"> <li>The software must be able to perform automatic integration of single and group peaks with both standard perimeters and user settable perimeters.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             | Yes/ No                                                                             |
| <ul style="list-style-type: none"> <li>The software must be able to generate numeric data compatible with Microsoft Excel for plotting chromatogram.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             | Yes/ No                                                                             |
| <ul style="list-style-type: none"> <li>Free software upgrade must be provided throughout the warranty period. If the upgraded software is not compatible with the existing computer and/or existing operation system, free computer and/or operation system must be provided.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             | Yes/ No                                                                             |
| <b>Miscellaneous</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                                                                                     |
| <ul style="list-style-type: none"> <li>The system shall consist, but not be limited to, the above listed major components, complete with all the accessories and interfacing necessary to make a fully functional and operable system.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             | Yes/ No                                                                             |
| <ul style="list-style-type: none"> <li>The power supply must be 230 ± 6%, 50/60 Hz, suitable for use in Singapore.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             | Yes/ No                                                                             |
| <ul style="list-style-type: none"> <li>Prices quoted must include installation, commissioning, initial calibration and operator training at Chemical Metrology Laboratory. The system with PC must come with a minimum 1 year warranty. The warranty must include unlimited breakdown calls and on-site services, replacement of parts and at least 1 comprehensive preventive maintenance (includes both labour and consumables/replacement parts) per year, and cover the overall system (both hardware and software). Any software revisions should also be provided free-of-charge. The Contractor is required to oversee overall systems integration, site preparation, installation and necessary configuration of the system.</li> </ul> |             | Yes/ No                                                                             |

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| <b>Equipment 6: High Performance Liquid Chromatography –Diode Array Detector (HPLC-DAD)</b><br><br><b>Location: CML</b> <b>Quantity: 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Compliances<br/>(Yes/ No)</b><br><i>**If No, please indicate reason of non-compliance.</i> |
| <ul style="list-style-type: none"> <li>- <b><u>Option to Purchase:</u></b> Tenderer is required to quote for the option to exercise 3-year post warranty comprehensive maintenance contract in <b><u>Annex C Price Summary</u></b>.</li> <li>- The post warranty comprehensive maintenance contract shall minimally include the following:               <ul style="list-style-type: none"> <li>a) Unlimited breakdown calls and on-site support</li> <li>b) All replacement parts and consumables</li> <li>c) 1 PM per year with PM kit provided where necessary</li> <li>d) Update of software revision</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <p style="text-align: center;">Yes/ No</p>                                                    |
| <p>Standard consumables that are required for the set up and commissioning of the system must be provided. In addition to the standard consumables, tenderer is required to provide the list of consumables parts and the frequency of change of such part, for the respective modules as follow in the format set out in <b><u>Annex C Schedule of Rates</u></b>.</p> <p>Auto-Sampler:<br/>           (a) Rotor Seal Unit<br/>           (b) Gripper Arm Unit<br/>           (c) Cooling/ Thermostat Unit<br/>           (d) Switch/ Diverter Valve Unit<br/>           (e) Sampling/ Injection Unit<br/>           (f) Fuse Unit</p> <p>Column Compartment<br/>           (a) Thermostat Unit<br/>           (b) Switch/ Diverter Valve Unit<br/>           (c) Fuse Unit</p> <p>Diode Array Detector:<br/>           (a) Flow Cell Unit<br/>           (b) UV Lamp<br/>           (c) Diode Array Unit<br/>           (d) Fuse Unit</p> <p>Quaternary Pump:<br/>           (a) Degasser Unit<br/>           (b) Pump Seal/ Purge Valve Unit<br/>           (c) Switch/ Diverter Valve Unit<br/>           (d) Fuse Unit</p> | <p style="text-align: center;">Yes/ No</p>                                                    |
| <ul style="list-style-type: none"> <li>- A declaration of Conformity certificate must be provided upon commissioning of equipment.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p style="text-align: center;">Yes/ No</p>                                                    |
| <ul style="list-style-type: none"> <li>- The delivery of the equipment must be coordinated with the Laboratory.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <p style="text-align: center;">Yes/ No</p>                                                    |
| <ul style="list-style-type: none"> <li>- The tenderer must be able to provide after-sales support from engineers and application chemists in Singapore. The tenderer must have a strong track record in providing personalised and responsive after-sales support</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <p style="text-align: center;">Yes/ No</p>                                                    |

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| <b>Equipment 6: High Performance Liquid Chromatography –Diode Array Detector (HPLC-DAD)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                |                    | <b>Compliances (Yes/ No)</b><br><i>**If No, please indicate reason of non-compliances.</i> |
| <b>Location: CML</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Quantity: 1</b> |                                                                                            |
| in Singapore, that is, the company must provide:<br>(a) contacts (handphone number and email) of at least two engineers experienced with the system;<br>(b) immediate instruction for trouble shooting by telephone when requested;<br>(c) on-site service within 2 working days when requested; and<br>(d) replacement of parts (within 2 working days when parts are available in Singapore, within 5 working days when parts are not available in Singapore and are needed to be ordered from overseas) when necessary. |                    |                                                                                            |
| - The system must have a minimum 8-year value guarantee such that vendor shall have a minimum of 8 years' guaranteed parts and comprehensive service available or give residual value credit for replacement.                                                                                                                                                                                                                                                                                                              |                    | Yes/ No                                                                                    |
| - Tenderer must be able to provide on-site instrument operation and user maintenance training by qualified engineer(s)                                                                                                                                                                                                                                                                                                                                                                                                     |                    | Yes/ No                                                                                    |

## COMPLIANCE OF REQUIREMENT SPECIFICATIONS

**I hereby confirm that I can meet all the specifications and requirements as stated in Section 3: Requirement Specifications, Equipment 6: HPLC-DAD**

Tenderer's (as \*Principal/Agent)  
Company or Business Registration No:

Tenderer's official  
Stamp:

Authorized Signature

Name:

Designation:  
(\*Delete whichever is not applicable)

Please indicate any non-compliance to requirement specifications here should there be any.

| Reference To | Remarks |
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