IISc/SSCU/NPH/PC99345-T02

Tender Notification for a Battery Cycler with High Current Capability

(Last Date for Submission: Tuesday, 17th Dec 2019)

Kindly send your best quotation for a Battery Cycler *including high current capability* with the following technical specifications on C.I.P. Bangalore basis (by ***Air Freight*** only). Your quotation should clearly indicate the terms of delivery, delivery schedule, estimated delivery date, and payment terms. The tender should be submitted in two separate sealed envelopes - one containing the technical bid and the other containing the commercial bid, both of which should reach us, duly signed on or before 1700 hours on Tuesday, 17th Dec 2019.

The bids should be addressed to:

The Chairman,
Solid State and Structural Chemistry Unit
Indian Institute of Science (IISc)
Bengaluru, India - 560012.

The sealed bids should be sent to:

Naga Phani B Aetukuri
Solid State and Structural Chemistry Unit
Indian Institute of Science (IISc)
Bengaluru, India - 560012.
Ph: +91-80-2293-3534
email: phani@iisc.ac.in

<u>*Please enclose a compliance statement along with the technical bid in the format provided in Annexure I.*</u>

Technical Specifications for Battery Cycler

1. Hardware Configuration

The system being quoted should have the following current-voltage configurations:

Configuration ID	Number of Channels	Maximum Current Rating	Measurable Current Range	Voltage Range	Parallel Connections for Higher Current	Current Measurement Resolution
Low Current Intermediate Voltage (LCIV)	16	1 A	50 nA to 1 A with at least four current ranges. Specify the current ranges.	0 to 10 V	At least 8 channels should be parallelizable so as to get a maximum current of 8 A at +/-5 V	24-bit or higher
Intermediate Current Low Voltage (ICLV)	16	10 A	500 nA to 10 A with at least four current ranges	+/- 5 V	At least 8 channels should be parallelizable so as to get a maximum current of 80 A at +/-5 V	24-bit or higher
High Precision Coulombic Efficiency Module (HPCE)	8	1 A	500 nA to 1 A with at least four current ranges. Specify the current ranges.	0 to 5V or +/- 5 V	It is preferable but not required to have the 8 channels parallelizable to get a maximum current of 8A at 5 V	24-bit or higher
High Current and High Voltage (HCHV)	4	100 A	100 mA to 100 A with at least two current ranges	0 to 100 V	All channels should be parallelizable to get a maximum current of 400 A at 100 V	16-bit or higher

2. Technical Specifications for the above configurations

2.1. Low Current Intermediate Voltage (LCIV) Configuration

2.1.1. The current measurement resolution should be 24-bit or higher for all current ranges and the current control accuracy should be ≤0.02% of full-scale range (FSR). *Data that proves this measurement resolution and control accuracy should be provided.*

2.1.2. The voltage measurement resolution should be 24-bit or higher and the control accuracy should be ≤0.02% of FSR. *Data that proves this measurement resolution and control accuracy should be provided.*

2.1.3. The minimum voltage at maximum current should be 0 V – the error in measurement of 0 V should be in accordance with II.1.2.

2.1.4. The maximum continuous power per channel should be 10 W. *Measurement data over 24 hours should be provided in support of this technical specification.*

2.1.5. The input impedance of each channel should be 10 GΩ or higher.

2.1.6. Each of the channels should have at least four current ranges, preferably with current ranges of 1 A, 50 mA, 2 mA and 100 μA. The current control accuracy on all ranges should be in accordance with II.1.1.

2.1.7. Time measurement resolution should be 100 μs or lower.

2.1.8. A minimum step time of 5 ms or faster should be achievable.

2.1.9. Data logging rate of 2000 samples per second or faster is required.

2.1.10. ***Twenty*** numbers of electrical cables for measurements, that are at least 6 feet in length, with 4-point connections and ending with alligator clips on banana plugs (interchangeable between alligator clips or banana plug connections), should be included. There should at least be one cable per channel with each cable capable of supporting the current, voltage and power requirements listed above.

2.1.11. It should be possible to **measure impedance on all channels** – either via a multiplexed electrochemical impedance spectroscopy (EIS) unit or by having a stand-alone frequency response analyzer (FRA) on each of the channels.

2.2. Intermediate Current Low Voltage (ICLV) Configuration

2.2.1. The current measurement resolution should be 24-bit or higher for all current ranges and the current control accuracy should be ≤0.02% of full-scale range (FSR). Data that proves this measurement resolution and control accuracy should be provided.

2.2.2. The voltage measurement resolution should be 24-bit and the control accuracy should be ≤0.02% of FSR. Data that proves this measurement resolution and control accuracy should be provided.

2.2.3. The minimum voltage at maximum current should be 0 V – the error in measurement of 0 V should be in accordance with 2.2.2.

2.2.4. The maximum continuous power per channel should be 50 W. Measurement data over 24 hours should be provided in support of this technical specification.

2.2.5. The input impedance of each channel should be 10 GΩ or higher.

2.2.6. Each of the 24 channels should have at least four current ranges, preferably with current ranges of 10 A, 500 mA, 20 mA and 1 mA. The current control accuracy on all ranges should be in accordance with 2.2.1.

2.2.7. Time measurement resolution should be 100 μs or lower.

2.2.8. A minimum step time of 5 ms or faster should be achievable.

2.2.9. Data logging rate of 2000 samples per second or faster is required.

2.2.10. **Twenty** numbers of electrical cables for measurements, that are at least 6 feet in length, with 4-point connections and ending with alligator clips on banana plugs (interchangeable between alligator clips or banana plug connections), should be included. There should at least be one cable per channel with each cable capable of supporting the current, voltage and power requirements listed above.

2.2.11. It should be possible to measure impedance on all channels – either via a multiplexed electrochemical impedance spectroscopy (EIS) unit or by having a stand-alone frequency response analyzer (FRA) on each of the channels.

2.3. High Precision Coulombic Efficiency Module (HPCE)

2.3.1. The current measurement resolution should be 24-bit or higher for all current ranges and the current control accuracy should be ≤0.02% of full-scale range (FSR). *Data that proves this measurement resolution and control accuracy should be provided.*

2.3.2. The voltage measurement resolution should be 24-bit or higher and the control accuracy should be ≤0.02% of FSR. *Data that proves this measurement resolution and control accuracy should be provided.*

2.3.3. The minimum voltage at maximum current should be 0 V – the error in measurement of 0 V should be in accordance with 2.3.2.

2.3.4. The maximum continuous power per channel should be 5 W. *Measurement data over 24 hours should be provided in support of this technical specification.*

2.3.5. The input impedance of each channel should be 10 GΩ or higher.

2.3.6. Each of the channels should have at least four current ranges, preferably with current ranges of 1 A, 100 mA, 10 mA and 1 mA. The current control accuracy on all ranges should be in accordance with 2.3.1.

2.3.7. Time measurement resolution should be 100 µs or lower.

2.3.8. A minimum step time of 5 ms or faster should be achievable.

2.3.9. Data logging rate of 2000 samples per second or faster is required. *Data that proves this measurement resolution and control accuracy should be provided.*

2.3.10. Coulombic efficiency measurement accuracy of <100 ppm is required.

2.3.11. ***Ten*** numbers of electrical cables for measurements, that are at least 6 feet in length, with 6-point connections and ending with alligator clips on banana plugs (interchangeable between alligator clips or banana plug connections), should be included. There should at least be one cable per channel with each cable capable of supporting the current, voltage and power requirements listed above. In addition, auxiliary voltage measurement cables should be in-built into the cable.

2.3.12. It should be possible to **measure impedance on all channels** – either via a multiplexed electrochemical impedance spectroscopy (EIS) unit or by having a stand-alone frequency response analyzer (FRA) on each of the channels.

2.4. High Current and High Voltage (HCHV) Configuration

2.4.1. The current measurement resolution should be 16-bit for all current ranges and the current control accuracy should be better than 0.1% of full-scale range (FSR). *Data that proves this measurement resolution and control accuracy should be provided.*

2.4.2. The voltage measurement resolution should be 16-bit and the control accuracy should be better than 0.1% of FSR. *Data that proves this measurement resolution and control accuracy should be provided.*

2.4.3. The minimum voltage at maximum current should be 10 V or lower – the error in measurement of 10 V should be in accordance with 2.4.2.

2.4.4. The maximum continuous power per channel should be 10 kW. *Measurement data over 24 hours should be provided in support of this technical specification.*

2.4.5. Owing to the high power of the channels, the power circuit should be of the regenerative kind – that is power should be discharged back to the grid. A discharge efficiency of at least 85% is required.

2.4.6. The input impedance of each channel should be 4 MΩ or higher.

2.4.7. Each of the 4 channels should have at least two current ranges, preferably with current ranges of 100 A and 50A. The current control accuracy on all ranges should be in accordance with 2.4.1.

2.4.8. A minimum step time of 100 ms or faster should be achievable.

2.4.9. Data logging rate of 2000 samples per second or faster is required.

2.4.10. ***Six*** numbers of electrical cables for measurements, that are at least 9 feet in length, with 4-point connections and ending with lugs for current leads and alligator clips for voltage, should be included. Each cable should be capable of supporting the current, voltage and power requirements listed above.

3. Accessories and Options for LCIV, ICLV and HPCE configurations

3.1. EIS and FRA Option

The EIS or FRA option mentioned in 2.1.11, 2.2.11 and 2.3.12 should have the following specifications:

3.1.1. Impedance should be measurable over a frequency range of 100 μHz to 1 MHz.

3.1.2. The frequency resolution should be 0.003% or smaller.

3.1.3. The DC voltage range should be 0 – 10 V.

3.1.4. AC voltage of up to 300 mV should be possible.

3.1.5. Suitable plotting and impedance analysis software must be provided.

3.1.6. If a multiplexed option is being provided, the channels must automatically queue when simultaneous EIS requests are received.

3.2. Battery Holders

3.2.1. ***Sixteen*** independent battery holders for holding 30 mm diameter coin cells should be provided.

3.2.2. ***Eight*** 10 A cylindrical cell holders should be provided.

3.2.3. ***Eight*** 10 A pouch cell holders should be provided.

3.3. Auxiliary Voltage Probes

3.3.1. **32** auxiliary voltage inputs with a voltage range of +/-5 V should be provided for LCIV and ICLV configuration.

3.3.2. Necessary cables, that are 6 feet in length, for measuring auxiliary voltages should be included.

3.3.3. These auxiliary voltage inputs should be preconfigured to work with cells being measured on channels belonging to the LCIV and ICLV configuration.

3.3.4. One-to-many virtual mapping of auxiliary channels should be possible in the software.

4. Accessories and Options for HCHV configuration

4.1. Auxiliary Voltage Probes

4.1.1. **40** auxiliary voltage inputs with a voltage range of +/-5 V should be provided.
4.1.2. Necessary cables, that are 6 feet in length, for measuring auxiliary voltages should be included.
4.1.3. These auxiliary voltage inputs should be preconfigured to work with cells being measured on channels belonging to the LCIV and ICLV configuration.

4.2. CANBus Communication Interface

4.2.1. A CANbus communication interface should be provided to communicate with any battery management system in a battery module.

5. Software specifications

5.1. All channels must be controllable by a software and this should enable setting several different types electrochemical characterization/battery testing protocols.
5.2. At the least, the software should enable measurements in the galvanostatic (constant current), potentiostatic (constant voltage) and a combination of galvanostatic and potentiostatic modes.
5.3. In addition, the software should allow for C-rate controlled charge/discharge of batteries, constant power charge/discharge of electrochemical devices, should allow current and voltage ramp/staircase measurements.
5.4. The software should have the capability to allow for cycling of cells and should also allow for setting up measurement loops with a combination of above listed control modes.
5.5. Preferably, the software should also allow for the electrochemical titration such as PITT and GITT.
5.6. The software should allow for arbitrary current-time profile simulation such as, for example, a drive profile simulation or a grid-integrated energy storage system simulation. The software should allow for profiles to be loaded from database files such as excel.
5.7. It would be preferable to have the software control a charge/discharge experiment dynamically with a mathematical formula in addition to a constant value-based control.
5.8. The software should also make it possible to map auxiliary channels to any of the channels in each of the configurations.

6. Auxiliaries and other options

6.1. A controlled-temperature chamber with a temperature range of 10 ºC to 60 ºC or wider should be included in the quotation.
6.2. Necessary accessories such as cell trays for coin cells, cylindrical cells and pouch cells that are compatible with the temperature chamber should be provided. At least 8 numbers for each of the cell types should be provided.
6.3. I/V cables and auxiliary cables compatible for such a chamber should be provided. The numbers of these cables should be as given in 2.1.10, 2.2.10 and 2.3.11.

6.4. The cell test system should also provide necessary interfacing hardware for interfacing the cell tester with a third-party environment chamber such as those provided by Cincinnati Sub-Zero.

6.5. Autocalibration accessories/modules that are compatible with the current/voltage ranges of *LCIV, ICLV and HPCE* configurations should be included.

6.6. Electrical power input for the cell tester and other accessories should be compliant to Indian standards. The single phase voltage range is 220-240 V_{ac} frequency range 50-60 Hz and in case of three phase the voltage range is 415 - 440 V_{ac}.

6.7. Suitable computer(s) for the software control of the cell tester should be quoted as an option. The vendor should provide the option of necessary software installation on a computer provided by us. The required computer specifications and numbers should be clearly mentioned.

7. Terms and conditions

7.1. The vendor is responsible for the installation of the system at the institute.

7.2. The price quotation should include the cost of installation and training of potential users.

7.3. The system should be provided with at least two years of warranty, on all parts and labor, from the date of installation.

7.4. The vendor should have a track record of having previously supplied at least 50 equipment similar to the requirements in the tender document. Details of such systems with model numbers and users should be provided.

7.5. The vendor should have qualified technical service personnel for the equipment based in India and should assure a response time of <2 business days after receiving a service request.

7.6. Vendor must provide a user list (with contact details including emails and phone numbers) of at least 5 customers from Indian Institutes/Labs where similar measurement systems are installed.

7.7. The lead-time for the delivery of the equipment should not be more than 3 months from the date of receipt of our purchase order.

7.8. Wherever requested in this specifications sheet, data must be supplied along with technical compliance documents. Technical bids without supporting data will be deemed as technically non-compliant.

7.9. All guaranteed specifications will have to be demonstrated, upon request, in an active installation. *Failure to demonstrate any promised specifications will be deemed as technical non-compliance.*

7.10. Printed literature and published papers in support of compliance to all the prescribed specifications may be provided.

7.11. The vendor must provide compliance statement in a tabular form with respect to each technical hardware and software specification in the tender document duly supported by the manufacturer's literature and published papers. Any other claim will not be accepted and may lead to technical non-compliance.

7.12. Technical evaluation by the institute may include demonstration to verify functionalities and capabilities of the system quoted. Any discrepancy between the promised specifications and demonstrated specifications will be deemed as technical non-compliance.

7.13. The vendor must quote, as an option, a non-comprehensive irrevocable AMC price beyond the 2-year warranty, with a price lock in for 2 years beyond the standard 2-year warranty period. 2 services per year should be included in the AMC.

7.14. The quote should also include additional spares sufficient for two years of system usage assuming an average usage of 120 hours of operation per week.

7.15. The validity of commercial quotation should be at least 60 days from the last date for the submission of tender documents. The validity of the quotation should be clearly mentioned in the technical bid.

7.16. The indenter reserves the right to withhold placement of final order. The right to reject all or any of the quotations and to split up the requirements or relax any or all of the above conditions without assigning any reason is reserved.

Annexure I: Technical Compliance Sheet

5. Hardware Configuration

The system being quoted should have the following current-voltage configurations:

	Configuration ID	No. of Channels	Max Current Rating	Measurable Current Range	Voltage Range	Parallel Connections for Higher Current	Current Measurement Resolution
Requested Specifications	Low Current Intermediate Voltage (LCIV)	16	1 A	50 nA to 1 A with at least four current ranges. Specify the current ranges.	0 to 10 V	At least 8 channels should be parallelizable so as to get a maximum current of 8 A at +/-5 V	24-bit or higher
Provided Specifications							
Requested Specifications	Intermediate Current Low Voltage (ICLV)	16	10 A	500 nA to 10 A with at least four current ranges	+/- 5 V	At least 8 channels should be parallelizable so as to get a maximum current of 80 A at +/-5 V	24-bit or higher
Provided Specifications							
Requested Specifications	High Precision Coulombic Efficiency Module (HPCE)	8	1 A	500 nA to 1 A with at least four current ranges. Specify the current ranges.	0 to 5V or +/- 5 V	It is preferable but not required to have the 8 channels parallelizable to get a maximum current of 8A at 5 V	24-bit or higher
Provided Specifications							
Requested Specifications	High Current and High	4	100 A	100 mA to 100 A with at least two	0 to 100 V	All channels should be parallelizable	16-bit or higher

	Voltage (HCHV)			current ranges		to get a maximum current of 400 A at 100 V	
Provided Specifications							

Sl.No.	Technical Specifications	Complied? Yes or No.	Data or Specs Provided where requested? (please write NA if data is not requested)
2.	**Technical Specifications for Battery Cycler**		
2.1	***Low Current Intermediate Voltage (LCIV) Configuration.***		
2.1.1	The current measurement resolution should be 24-bit or higher for all current ranges and the current control accuracy should be ≤0.02% of full-scale range (FSR). Data that proves this measurement resolution and control accuracy should be provided.		
2.1.2	The voltage measurement resolution should be 24-bit or higher and the control accuracy should be ≤0.02% of FSR. Data that proves this measurement resolution and control accuracy should be provided.		
2.1.3	The minimum voltage at maximum current should be 0 V – the error in measurement of 0 V should be in accordance with II.1.2.		
2.1.4	The maximum continuous power per channel should be 10 W. Measurement data over 24 hours should be provided in support of this technical specification.		
2.1.5	The input impedance of each channel should be 10 GΩ or higher.		
2.1.6	Each of the channels should have at least four current ranges, preferably with current ranges of 1 A, 50 mA, 2 mA and 100 µA. The current control accuracy on all ranges should be in accordance with II.1.1.		
2.1.7	Time measurement resolution should be 100 µs or lower.		
2.1.8	A minimum step time of 5 ms or faster should be achievable.		

2.1.9	Data logging rate of 2000 samples per second or faster is required.		
2.1.10	***Twenty*** numbers of electrical cables for measurements, that are at least 6 feet in length, with 4-point connections and ending with alligator clips on banana plugs (interchangeable between alligator clips or banana plug connections), should be included. There should at least be one cable per channel with each cable capable of supporting the current, voltage and power requirements listed above.		
2.1.11	It should be possible to **measure impedance on all channels** – either via a multiplexed electrochemical impedance spectroscopy (EIS) unit or by having a stand-alone frequency response analyzer (FRA) on each of the channels.		
2.2	***Intermediate Current Low Voltage (ICLV) Configuration***		
2.2.1	The current measurement resolution should be 24-bit or higher for all current ranges and the current control accuracy should be ≤0.02% of full-scale range (FSR). Data that proves this measurement resolution and control accuracy should be provided.		
2.2.2	The voltage measurement resolution should be 24-bit and the control accuracy should be ≤0.02% of FSR. Data that proves this measurement resolution and control accuracy should be provided.		
2.2.3	The minimum voltage at maximum current should be 0 V – the error in measurement of 0 V should be in accordance with 2.2.2.		
2.2.4	The maximum continuous power per channel should be 50 W. Measurement data over 24 hours should be provided in support of this technical specification.		
2.2.5	The input impedance of each channel should be 10 GΩ or higher.		
2.2.6	Each of the 24 channels should have at least four current ranges, preferably with current ranges of 10 A, 500 mA, 20 mA and 1 mA. The current control accuracy on all ranges should be in accordance with 2.2.1.		
2.2.7	Time measurement resolution should be 100 µs or lower.		
2.2.8	A minimum step time of 5 ms or faster should be achievable.		
2.2.9	Data logging rate of 2000 samples per second or faster is required.		

2.2.10	**Twenty** numbers of electrical cables for measurements, that are at least 6 feet in length, with 4-point connections and ending with alligator clips on banana plugs (interchangeable between alligator clips or banana plug connections), should be included. There should at least be one cable per channel with each cable capable of supporting the current, voltage and power requirements listed above.		
2.2.11	It should be possible to measure impedance on all channels – either via a multiplexed electrochemical impedance spectroscopy (EIS) unit or by having a stand-alone frequency response analyzer (FRA) on each of the channels.		
2.3	***High Precision Coulombic Efficiency Module (HPCE)***		
2.3.1	The current measurement resolution should be 24-bit or higher for all current ranges and the current control accuracy should be ≤0.02% of full-scale range (FSR). Data that proves this measurement resolution and control accuracy should be provided.		
2.3.2	The voltage measurement resolution should be 24-bit or higher and the control accuracy should be ≤0.02% of FSR. Data that proves this measurement resolution and control accuracy should be provided.		
2.3.3	The minimum voltage at maximum current should be 0 V – the error in measurement of 0 V should be in accordance with 2.3.2.		
2.3.4	The maximum continuous power per channel should be 5 W. Measurement data over 24 hours should be provided in support of this technical specification.		
2.3.5	The input impedance of each channel should be 10 GΩ or higher.		
2.3.6	Each of the channels should have at least four current ranges, preferably with current ranges of 1 A, 100 mA, 10 mA and 1 mA. The current control accuracy on all ranges should be in accordance with 2.3.1.		
2.3.7	Time measurement resolution should be 100 µs or lower.		
2.3.8	A minimum step time of 5 ms or faster should be achievable.		
2.3.9	Data logging rate of 2000 samples per second or faster is required. Data that proves this measurement resolution and control accuracy should be provided.		
2.3.10	Coulombic efficiency measurement accuracy of <100 ppm is required.		

2.3.11	**Ten** numbers of electrical cables for measurements, that are at least 6 feet in length, with 6-point connections and ending with alligator clips on banana plugs (interchangeable between alligator clips or banana plug connections), should be included. There should at least be one cable per channel with each cable capable of supporting the current, voltage and power requirements listed above. In addition, auxiliary voltage measurement cables should be in-built into the cable.		
2.3.12	It should be possible to **measure impedance on all channels** – either via a multiplexed electrochemical impedance spectroscopy (EIS) unit or by having a stand-alone frequency response analyzer (FRA) on each of the channels.		
2.4	***High Current and High Voltage (HCHV) Configuration***		
2.4.1	The current measurement resolution should be 16-bit for all current ranges and the current control accuracy should be better than 0.1% of full-scale range (FSR). Data that proves this measurement resolution and control accuracy should be provided.		
2.4.2	The voltage measurement resolution should be 16-bit and the control accuracy should be better than 0.1% of FSR. Data that proves this measurement resolution and control accuracy should be provided.		
2.4.3	The minimum voltage at maximum current should be 10 V or lower – the error in measurement of 10 V should be in accordance with 2.4.2.		
2.4.4	The maximum continuous power per channel should be 10 kW. Measurement data over 24 hours should be provided in support of this technical specification.		
2.4.5	Owing to the high power of the channels, the power circuit should be of the regenerative kind – that is power should be discharged back to the grid. A discharge efficiency of at least 85% is required.		
2.4.6	The input impedance of each channel should be 4 MΩ or higher.		
2.4.7	Each of the 4 channels should have at least two current ranges, preferably with current ranges of 100 A and 50A. The current control accuracy on all ranges should be in accordance with 2.4.1.		
2.4.8	A minimum step time of 100 ms or faster should be achievable.		

2.4.9	Data logging rate of 2000 samples per second or faster is required.		
2.4.10	**Six** numbers of electrical cables for measurements, that are at least 9 feet in length, with 4-point connections and ending with lugs for current leads and alligator clips for voltage, should be included. Each cable should be capable of supporting the current, voltage and power requirements listed above.		
3.	**Accessories and Options for LCIV, ICLV and HPCE configurations**		
3.1	***EIS and FRA Option***		
3.1.1	Impedance should be measurable over a frequency range of 100 μHz to 1 MHz.		
3.1.2	The frequency resolution should be 0.003% or smaller.		
3.1.3	The DC voltage range should be 0 – 10 V.		
3.1.4	AC voltage of up to 300 mV should be possible.		
3.1.5	Suitable plotting and impedance analysis software must be provided.		
3.1.6	If a multiplexed option is being provided, the channels must automatically queue when simultaneous EIS requests are received.		
3.2	***Battery Holders***		
3.2.1	**Sixteen** independent battery holders for holding 30 mm diameter coin cells should be provided.		
3.2.2	**Eight** 10 A cylindrical cell holders should be provided.		
3.2.3	**Eight** 10 A pouch cell holders should be provided.		
3.3	***Auxiliary Voltage Probes***		
3.3.1	**32** auxiliary voltage inputs with a voltage range of +/- 5 V should be provided for LCIV and ICLV configuration.		
3.3.2	Necessary cables, that are 6 feet in length, for measuring auxiliary voltages should be included.		
3.3.3	These auxiliary voltage inputs should be preconfigured to work with cells being measured on channels belonging to the LCIV and ICLV configuration.		
3.3.4	One-to-many virtual mapping of auxiliary channels should be possible in the software.		
4.	**Accessories and Options for HCHV configuration**		
4.1	***Auxiliary Voltage Probes***		
4.1.1	**40** auxiliary voltage inputs with a voltage range of +/- 5 V should be provided.		

4.1.2	Necessary cables, that are 6 feet in length, for measuring auxiliary voltages should be included.		
4.1.3	These auxiliary voltage inputs should be preconfigured to work with cells being measured on channels belonging to the LCIV and ICLV configuration.		
4.2	***CANBus Communication Interface***		
4.2.1	A CANbus communication interface should be provided to communicate with any battery management system in a battery module.		
5.	**Software specifications**		
5.1	All channels must be controllable by a software and this should enable setting several different types electrochemical characterization/battery testing protocols.		
5.2	At the least, the software should enable measurements in the galvanostatic (constant current), potentiostatic (constant voltage) and a combination of galvanostatic and potentiostatic modes.		
5.3	In addition, the software should allow for C-rate controlled charge/discharge of batteries, constant power charge/discharge of electrochemical devices, should allow current and voltage ramp/staircase measurements.		
5.4	The software should have the capability to allow for cycling of cells and should also allow for setting up measurement loops with a combination of above listed control modes.		
5.5	Preferably, the software should also allow for the electrochemical titration such as PITT and GITT.		
5.6	The software should allow for arbitrary current-time profile simulation such as, for example, a drive profile simulation or a grid-integrated energy storage system simulation. The software should allow for profiles to be loaded from database files such as excel.		
5.7	It would be preferable to have the software control a charge/discharge experiment dynamically with a mathematical formula in addition to a constant value-based control.		
5.8	The software should also make it possible to map auxiliary channels to any of the channels in each of the configurations.		
6.	**Auxiliaries and other options**		
6.1	A controlled-temperature chamber with a temperature range of 10 ºC to 60 ºC or wider should be included in the quotation.		

6.2	Necessary accessories such as cell trays for coin cells, cylindrical cells and pouch cells that are compatible with the temperature chamber should be provided. At least 8 numbers for each of the cell types should be provided.		
6.3	I/V cables and auxiliary cables compatible for such a chamber should be provided. The numbers of these cables should be as given in 2.1.10, 2.2.10 and 2.3.11.		
6.4	The cell test system should also provide necessary interfacing hardware for interfacing the cell tester with a third-party environment chamber such as those provided by Cincinnati Sub-Zero.		
6.5	Autocalibration accessories/modules that are compatible with the current/voltage ranges of LCIV, ICLV and HPCE configurations should be included.		
6.6	Electrical power input for the cell tester and other accessories should be compliant to Indian standards. The single phase voltage range is 220-240 V_{ac} frequency range 50-60 Hz and in case of three phase the voltage range is 415 - 440 V_{ac}.		
6.7	Suitable computer(s) for the software control of the cell tester should be quoted as an option. The vendor should provide the option of necessary software installation on a computer provided by us. The required computer specifications and numbers should be clearly mentioned.		
7.	**Terms and conditions**		
7.1	The vendor is responsible for the installation of the system at the institute.		
7.2	The price quotation should include the cost of installation and training of potential users.		
7.3	The system should be provided with at least two years of warranty, on all parts and labor, from the date of installation		
7.4	The vendor should have a track record of having previously supplied at least 50 equipment similar to the requirements in the tender document. Details of such systems with model numbers and users should be provided		
7.5	The vendor should have qualified technical service personnel for the equipment based in India and should assure a response time of <2 business days after receiving a service request.		

7.6	Vendor must provide a user list (with contact details including emails and phone numbers) of at least 5 customers from Indian Institutes/Labs where similar measurement systems are installed.		
7.7	The lead-time for the delivery of the equipment should not be more than 3 months from the date of receipt of our purchase order.		
7.8	Wherever requested in this specifications sheet, data must be supplied along with technical compliance documents. Technical bids without supporting data will be deemed as technically non-compliant.		
7.9	All guaranteed specifications will have to be demonstrated, upon request, in an active installation. *Failure to demonstrate any promised specifications will be deemed as technical non-compliance.*		
7.10	Printed literature and published papers in support of compliance to all the prescribed specifications may be provided.		
7.11	The vendor must provide compliance statement in a tabular form with respect to each technical hardware and software specification in the tender document duly supported by the manufacturer's literature and published papers. Any other claim will not be accepted and may lead to technical non-compliance.		
7.12	Technical evaluation by the institute may include demonstration to verify functionalities and capabilities of the system quoted. Any discrepancy between the promised specifications and demonstrated specifications will be deemed as technical non-compliance.		
7.13	The vendor must quote, as an option, a non-comprehensive irrevocable AMC price beyond the 2-year warranty, with a price lock in for 2 years beyond the standard 2-year warranty period. 2 services per year should be included in the AMC.		
7.14	The quote should also include additional spares sufficient for two years of system usage assuming an average usage of 120 hours of operation per week.		
7.15	The validity of commercial quotation should be at least 60 days from the last date for the submission of		

	tender documents. The validity of the quotation should be clearly mentioned in the technical bid.		
7.16	The indenter reserves the right to withhold placement of final order. The right to reject all or any of the quotations and to split up the requirements or relax any or all of the above conditions without assigning any reason is reserved.		