

## ANNEXURE - I

### Technical Specification of 74V 200Ah Li - Ion Battery Pack with BMS & Charger

#### **1. Application:**

The Unmanned Ground Vehicle (UGV) is an un-tethered, remotely operated system for outdoor applications. The vehicle uses BLDC/ HUB motors (72V DC) for its movement. There are other accessories, such as computers, sensors, actuators/ end effectors etc. for safe navigation in an outdoor environment and fulfillment of its objectives/ mission. The power to all these components will be provided from the on-board battery. The specifications of the battery and its individual cells, battery management system and the chargers are mentioned below.

#### **2. Complete Specification of the 74V 200Ah Li-Ion Battery:**

##### **2.1. Battery Pack Specification:**

(i) *Output Voltage (V):*

- Nominal Voltage: 74.0
- Maximum Charge Voltage:  $82 \pm 1.0$
- Discharge Voltage:  $61 \pm 1.0$

(ii) *Battery Pack Capacity: 200 Ah*

(iii) *Standard Discharge & Charge Current (A):*

- Continuous Discharge Current: 40
- Peak Discharge Current: 80
- Continuous Charge Current: 40
- Peak Charge Current: 50

(iv) *Rated Discharge & Charge Current (A):*

- Continuous Discharge Current: 360
- Peak Discharge Current: 720 (10 sec duration)
- Continuous Charge Current: 100
- Peak Charge Current: 110

(v) *Charging Method:*

- Constant Current – Constant Voltage

(vi) *Charging Duration:*

- Duration:  $\leq 7$  Hours @ Standard Charge Current

(vii) *Battery Cycle Life:*

- 4000 cycles @80% DoD
  - 2000 cycles @100% DoD
- (Standard Charge/ Discharge Condition @ 25°C)

(viii) *Power Output & Signal Connectors:*

- Power Terminal Connector for high current
  - Allied / Amphenol Connector for Signal & Low current
- (Note: Customer Preference should also be accepted)

(ix) *Power ON/OFF Button:*

- Ignition button for Battery Power ON/OFF

(x) *Status Indicator:*

- LED indicator

(xi) *Battery Casing:*

- Made up of Aluminium sheet (maximum 3mm) to meet environmental specs., shock & vibration (shape or configuration of the casing may be finalized in consultation with the user)

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(xii) *Battery Insulation Resistance:*

- Between Positive to Cell case, Negative to Cell case shall be greater than 20MΩ when tested with 500V DC Megger

(xiii) *Battery IP Protection:*

- IP 65 class

(xiv) *Weight of the Battery Pack:*

- 160 kg ± 5 kg

(xv) *Dimension of the Battery Pack:*

- To be finalized in consultation of the user

(xvi) *Standard Operation Environment:*

- Operating Temperature: - 20°C to +55°C
- Charging Temperature: 0°C to +55°C
- Storage Temperature:
  - -30°C to +40°C for less than 6 months
  - -30°C to +25°C for less than 1 year
- Storage Humidity @ 25°C: Min 0% - Max 95%

## 2.2. Cell Specifications:

(i) *Cell Type:*

- Rechargeable Li – Ion

(ii) *Cell Model:*

- Prismatic

(iii) *Cell Chemistry:*

- NMC
- Anode Material: Carbon
- Cathode Material: Li-NMC (Nickel Manganese Cobalt Oxide)
- Electrolyte: Li-Salt: LiPF6
- Type of Electrolyte: Liquid

(iv) *Cell Outer Container:*

- Metallic case

(v) *Cell Insulation Resistance:*

- Between Positive to Cell case, Negative to Cell case shall be greater than 20MΩ when tested with 500V DC Megger

(vi) *Cell Internal Impedance / Resistance:*

- ACIR < 0.6mΩ (1kHz alternating current method)
- DCIR < 1.2mΩ (50% SOC, 300A-10sec discharge)

(vii) *Cells Arrangement:*

- Series & Parallel Construction (approximately 20 cells in series, 4 cells in parallel or any other suitable combination as fit deemed)

## 2.3. Battery Management System:

(i) *Type:*

- Programmable with user friendly software

(ii) *On-Board memory Storage:*

- Micro SD card (8GB) capable of storing 4000 charge and discharge cycles (to be included within the scope of supply)

(iii) *BMS Programmable Parameters:*

- Voltage
- Current
- Capacity

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- Temperature
- (iv) *BMS Protection features:*
  - Over Charge Voltage
  - Over Discharge Voltage
  - Over Temperature
  - Over Current
  - Short circuit
  - Cell unbalance
  - Reverse Polarity Protection
- (v) *BMS Monitoring & recording:*
  - Individual cell voltage
  - State of Charge (SoC) indication
  - State of Health (SoH) estimation
  - Temperature of the Cells & BMS
  - Current during charge / discharge cycle
- (vi) *Cell Balancing:*
  - During Charge, Discharge & Storage
- (vii) *Communications:*
  - CAN BUS 2.0 / RS 485
- (viii) *Software:*
  - Real time data monitoring software
  - Bluetooth app for data monitoring
- (ix) *Temperature Sensor:*
  - NTC Thermistor
  - No. of Sensors – 5 Temperature sensors
- (x) *Current consumption of BMS:*
  - ≤15mA (typical) in normal mode and 200µA (typical) in sleeping mode

### 3. Compatible High Capacity Lithium-Ion Battery Charger:

- (xi) *Type:*
  - Constant Current/ Constant Voltage
- (xii) *Input Voltage:*
  - 220 – 240V AC, 50 Hz
- (xiii) *Maximum Output Voltage:*
  - 84V
- (xiv) *Charging Current:*
  - 20 ~ 30 Amps
- (xv) *Feature:*
  - Charging complete LED/ Indicator

### 4. Certification & Performance details:

- (i) UL 1642 / UL 1973 for cell
- (ii) UN 38.3 for cell
- (iii) Declaration of Conformity for Cell
- (iv) Safety & Reliability test details for cell

### 5. Acceptance (Environmental) Tests:

Battery will be subjected to Charge - Discharge test before and after Environmental Tests. The following Environmental Tests are the acceptance tests for the battery pack. The tests are to be

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carried out at DRDO Laboratories or NABL accredited Govt. Testing Laboratories. The certificates have to be delivered along with the materials in original. **The charges for these tests will be paid at actual and on submission of bills. Hence it will not be included in the Tender price. CSIR – CMERI preserves the right either to completely waive or reduce the number of acceptance tests as deemed fit.**

| Sl.          | Tests  | Levels and Duration   |       |   |          |  |       |   |           |   |       |            |  |       |       |    |          |      |   |       |              |  |       |
|--------------|--|---|-------|---|----------|--|-------|---|-----------|---|-------|------------|--|-------|-------|----|----------|------|---|-------|--------------|--|-------|
| 1.           | Shock  | 30 ± 3 g for not less than 8 ms duration of half sine pulse in all 3 axes as per MIL-STD-810F   |       |   |          |  |       |   |           |   |       |            |  |       |       |    |          |      |   |       |              |  |       |
| 2.           | Vibration  | At room temperature in each axis in each frequency range. Sweep rate 3 – 5 min. Sine wave.<br><b>Non-operating (60 min.)</b><br>10 – 30Hz 1.5 ± 0.15 mm<br>31 – 60 Hz 3.0 ± 0.3 g<br>61 – 100Hz 3.0 g ± 0.3g  |       |   |          |  |       |   |           |   |       |            |  |       |       |    |          |      |   |       |              |  |       |
| 3.           | Temperature Cycling (14 Cycles)  | <b>High Temperature Testing:</b><br><table border="1"> <thead> <tr> <th>Temp.</th> <th>RH</th> <th>Duration</th> </tr> </thead> <tbody> <tr> <td>50 +5° C</td> <td>95%</td> <td>8 Hrs</td> </tr> <tr> <td>50 ± 5° C</td> <td>95%</td> <td>8 Hrs</td> </tr> <tr> <td>Room Temp.</td> <td></td> <td>4 Hrs</td> </tr> </tbody> </table><br><b>Low Temperature Testing:</b><br><table border="1"> <thead> <tr> <th>Temp.</th> <th>RH</th> <th>Duration</th> </tr> </thead> <tbody> <tr> <td>0° C</td> <td>-</td> <td>8 Hrs</td> </tr> <tr> <td>-10 °C ± 3°C</td> <td></td> <td>6 Hrs</td> </tr> </tbody> </table>   | Temp. | RH  | Duration | 50 +5° C   | 95%   | 8 Hrs   | 50 ± 5° C | 95%   | 8 Hrs | Room Temp. |  | 4 Hrs | Temp. | RH | Duration | 0° C | - | 8 Hrs | -10 °C ± 3°C |  | 6 Hrs |
| Temp.        | RH   | Duration  |       |   |          |  |       |   |           |   |       |            |  |       |       |    |          |      |   |       |              |  |       |
| 50 +5° C     | 95%  | 8 Hrs   |       |   |          |  |       |   |           |   |       |            |  |       |       |    |          |      |   |       |              |  |       |
| 50 ± 5° C    | 95%  | 8 Hrs   |       |   |          |  |       |   |           |   |       |            |  |       |       |    |          |      |   |       |              |  |       |
| Room Temp.   |  | 4 Hrs   |       |   |          |  |       |   |           |   |       |            |  |       |       |    |          |      |   |       |              |  |       |
| Temp.        | RH   | Duration  |       |   |          |  |       |   |           |   |       |            |  |       |       |    |          |      |   |       |              |  |       |
| 0° C         | -  | 8 Hrs   |       |   |          |  |       |   |           |   |       |            |  |       |       |    |          |      |   |       |              |  |       |
| -10 °C ± 3°C |  | 6 Hrs   |       |   |          |  |       |   |           |   |       |            |  |       |       |    |          |      |   |       |              |  |       |
| 4.           | EMI / EMC  | Radiographic susceptibility and compatibility (EMI / EMC) requirements for the BMS shall be as per the clause CE102, CS101, RE102 and RS103 of MIL-STD-461G.<br><table border="1"> <tbody> <tr> <td>CE102</td> <td>Conducted Emission, Power leads, 10 kHz to 10 MHz</td> </tr> <tr> <td>CS101</td> <td>Conducted Susceptibility, Power leads, bulk cable injection, 10 kHz to 200 MHz</td> </tr> <tr> <td>RE102</td> <td>Radiated Emission, Electric field, 2 MHz to 18 GHz.</td> </tr> <tr> <td>RS103</td> <td>Radiated Susceptibility, Electric field, 200V/m, 2 MHz to 40 GHz.</td> </tr> </tbody> </table> | CE102 | Conducted Emission, Power leads, 10 kHz to 10 MHz | CS101    | Conducted Susceptibility, Power leads, bulk cable injection, 10 kHz to 200 MHz | RE102 | Radiated Emission, Electric field, 2 MHz to 18 GHz. | RS103     | Radiated Susceptibility, Electric field, 200V/m, 2 MHz to 40 GHz. |       |            |  |       |       |    |          |      |   |       |              |  |       |
| CE102        | Conducted Emission, Power leads, 10 kHz to 10 MHz                              |   |       |   |          |  |       |   |           |   |       |            |  |       |       |    |          |      |   |       |              |  |       |
| CS101        | Conducted Susceptibility, Power leads, bulk cable injection, 10 kHz to 200 MHz |   |       |   |          |  |       |   |           |   |       |            |  |       |       |    |          |      |   |       |              |  |       |
| RE102        | Radiated Emission, Electric field, 2 MHz to 18 GHz.                            |   |       |   |          |  |       |   |           |   |       |            |  |       |       |    |          |      |   |       |              |  |       |
| RS103        | Radiated Susceptibility, Electric field, 200V/m, 2 MHz to 40 GHz.              |   |       |   |          |  |       |   |           |   |       |            |  |       |       |    |          |      |   |       |              |  |       |

## 6. Other Terms & Conditions:

- (i) Cell Technical data sheet needs to be submitted during Technical evaluation duly signed by OEM in ink
- (ii) UL 1642 / UL 1973 Certificate needs to be submitted during Technical evaluation duly signed by OEM in ink
- (iii) UN 38.3 Certificate needs to be submitted during Technical evaluation duly signed by OEM in ink
- (iv) Cell date of manufacturing should be lesser than 6 months at the time of supply.
- (v) Cell date of manufacturing certificate duly signed by OEM in ink needs to be submitted at the time of supply.
- (vi) Battery Management System technical data sheet needs to be submitted during Technical evaluation duly signed by OEM in ink
- (vii) The Director(s) of the Bidder should be Indian national(s).
- (viii) Bidder Firm should have experience in supply of similar batteries to Indian Govt. R&D (CSIR, DRDO, ISRO etc.) organizations. Relevant PO copies are to be shared as documentary evidences.

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- (ix) The acceptance tests have to be carried out at DRDO or NABL accredited laboratories and testing charges will be at actual. CSIR - CMERI will pay for these charges directly on submission of bills and hence should not be included in the Tender price.
- (x) CSIR-CMERI preserves the right to accept or reject the certificates, documents (issued by OEM and testing laboratories) being submitted by the vendors or reduce the numbers of certificates and acceptance tests or waive completely the numbers of certificates and tests, if required.

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