ANNEXURE-I TO AMENDMENT-1

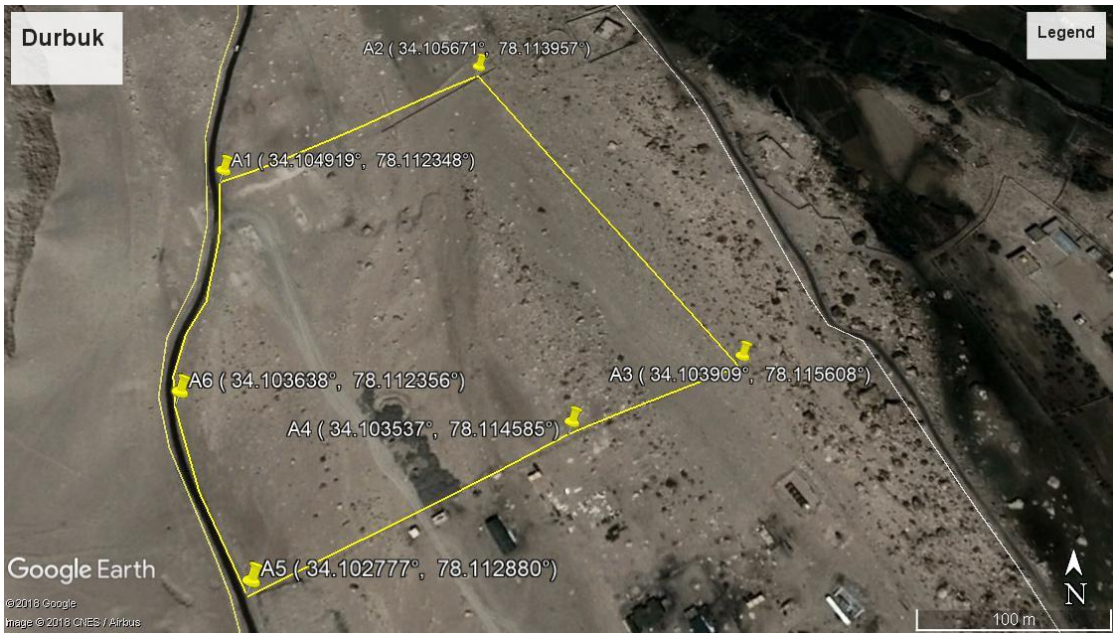
22. Land Co-ordinates:

(a) Tangste Site:

Sufficient land is available around the reference point B2 (34.0527297°N, 78.154077°E). Maximum 7 (seven) acres of contiguous land around point B2 will be finalized jointly by MES and the Contractor after award and the same will be handed over by MES to the Contractor.

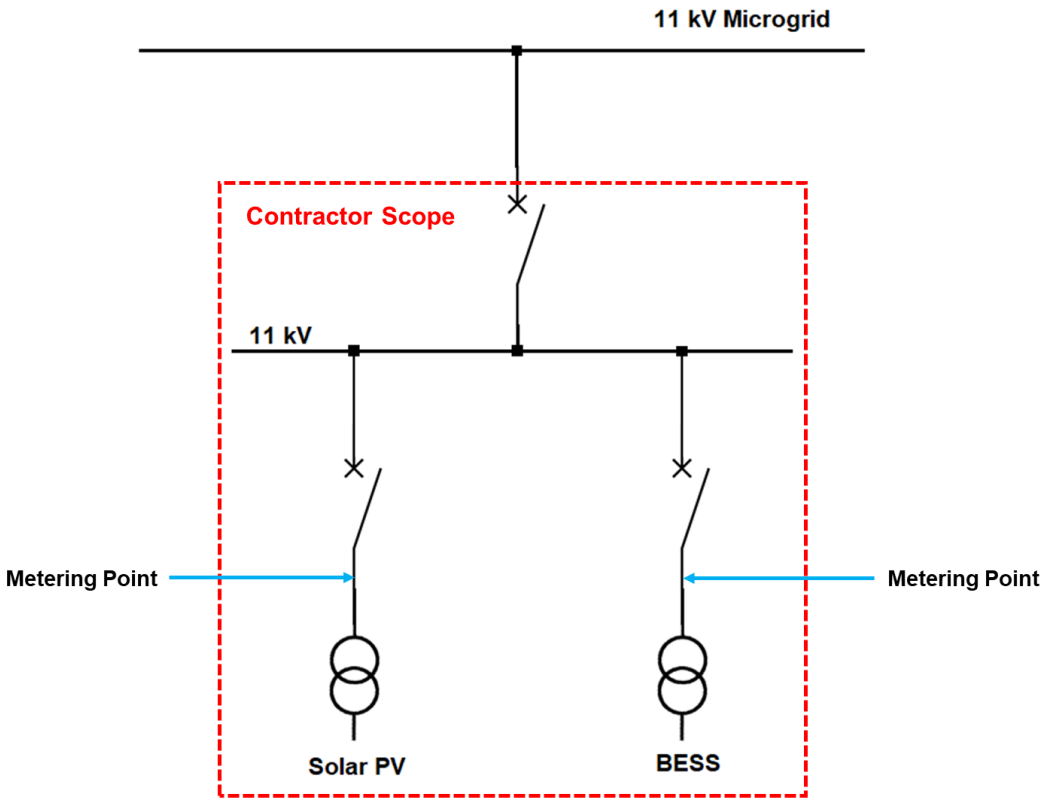
(b) Durbuk Site:

The land plot shown below for Durbuk is of 14 acres. The final land co-ordinates (maximum 7 acres) out of the total 14 acres will be finalized jointly by MES and the Contractor after award and the same will be handed over by MES to the Contractor.



ANNEXURE-II TO AMENDMENT-1

23. Indicative Single Line Diagram:



ANNEXURE-III TO AMENDMENT-1

15 SCADA

15.1 General Requirements

15.1.1 The Contractor shall provide complete SCADA system with all accessories, auxiliaries and associated equipment and cables for the safe, efficient and reliable operation and monitoring of entire solar plant and its auxiliary systems.

15.1.2 The Contractor shall provide all the components including, but not limited to, Hardware, Software, Panels, Power Supply, HMI, Laser Printer, Gateway, Networking equipment and associated Cables, firewall etc. needed for the completeness.

15.1.3 SCADA System shall have the provision to perform the following features and/or functions:

(i) Web enabled Operator Dashboards: Showing key information on Generation, Performance and Current Status of various equipment in Single Line Diagram (SLD) format with capability to monitor PV array string level parameters.

(ii) Real time Data Logging with Integrated Analytics & Reporting: Logging of all parameters - AC, DC, Weather, System Run Hours, Equipment Status and Alarms as well as derived/ calculated/ integrated values. The SCADA User interface shall be customizable and enable Report Generation and Graphical Analysis.

(iii) Fault and System Diagnostics with time stamped event logging.

(iv) Support for O&M Activities: The interface shall allow integration with Surveillance System(s), Module Cleaning System and various other O&M support systems to provide a Data Analysis and Decision Support System for smooth and efficient Plant Operations.

(v) AI based Distributed Analytics for Predictive Maintenance, trend analysis and Alerts.

(vi) Generate, store and retrieve user configurable Sequence of Event (SOE) Reports.

(vii) Interface with different field equipment in the plant and work seamlessly with field equipment supplied by different companies.

(viii) Transfer of plant data reliably, to an Owner designated server or Cloud (Option: check with client) on any kind of remote network including low bandwidth and wireless links such as 2G/3G/VSAT

(Note: Telecom Lease line connection, if required for transferring data from Plant over internet shall be taken by Contractor in the name of Employer for O&M period)

15.1.4 The Control system shall be designed to operate in non-air-conditioned area. However, the Contractor shall provide a Package/ Split AC of suitable capacity decided by heat load requirement in SCADA room at Main Control Room.

15.2 Architecture

15.2.1 The SCADA System shall be built over Industrial IoT architecture with integrated Analytics, secure web access, enterprise software and Database.

15.2.2 Data acquisition shall be distributed across MCR and LCRs while plant level data aggregation shall be done in both local and remote server (as specified by Owner).

15.2.3 Analog and Digital IO modules shall have integrated processor for distributed IO processing and control.

15.2.4 Data communication system shall be built over fibre optic cables/ wireless network with high bandwidth TCP/IP communication (Fast Ethernet or 802.11a/b/g/n) across all Inverter and Control Rooms with Internet/Intranet access at Main Control Room. Firewall shall be provided for network security.

15.2.5 Plant SCADA Server shall have Industrial Grade server hardware running SCADA & Monitoring Software with data storage (complete plant data) space for 2 years.

15.2.6 Plant data for monitoring and control operations should be accessible without dependence on external network.

15.2.7 A server running SCADA & Monitoring Software shall be configured at the Owner's office in Leh (HQ Server/Remote Server) having the same specifications as the Plant Server, in parallel with Plant Server to enable easy access to plant data from outside the plant without having to login to plant server. Effectively, the plant data shall be replicated in both places i.e. between systems at the Plant Server and Remote Server to provide data redundancy for critical plant data.

15.2.8 Operator Workstation/PC shall be of Industrial Grade for browser-based access to plant data from Plant or remote server. Plant control & SLDC/Utility related operations shall only be initiated through browser-based interface requiring no client software or database to be installed on the Workstation. All critical software and Plant Data shall be installed/stored on local and remote servers only with user access control for protecting the software and data assets from accidental deletion or corruption.

15.2.9 Internet/Intranet at Plant: Public or private network access shall be provided at the plant through any broadband/VSAT connectivity of 2Mbps or higher bandwidth. In case no broadband/VSAT connectivity can be provided at the plant, a 3G/4G data card from any Internet Service Provider (ISP) may be provided. SCADA system shall be capable of sending all plant data in real time to the Remote Server.

15.2.10 GPS based Time Synchronization System: The SCADA system shall have a

Master/Slave Clock system along with antenna, receiver, cabinet and internal interconnection cables. All SCADA controllers, servers, OWS and communicating equipment shall be synchronized to the GPS clock.

15.3 Industrial IoT Controllers & Data Acquisition

The Plant SCADA and Monitoring System may use one or more IIoT Controllers at each Inverter Control Room and MCR for the purpose of data acquisition and data forwarding to the Local and Remote SCADA Servers. The IIoT Controllers shall meet the following minimum requirements:

15.3.1 The IIoT Controllers shall be distributed in nature and work independently of other IIoT Controllers or any central controller in the system.

15.3.2 Shall be capable of supporting wide range of field protocols to communicate with different field equipment (Modbus over RS485/Ethernet, etc.)

15.3.3 Shall have local storage for a minimum of 2 weeks (in case of network failure).

15.3.4 Provide web-based interface to configure the controller for various equipment in the field.

15.3.5 IO Functionality: Shall support status monitoring of VCBs & Trip relays on RMU/HT & Transformer panels through distributed DI/AI modules.

15.3.6 Controls: Shall be capable of Controlling breakers (ON/OFF). Both ON/OFF and Parameter control of inverters shall be supported.

15.3.7 Data Communication with Servers: Shall send the data collected, from all the equipment at Inverter Control Room and/or Main Control Room, to the Monitoring & Control Server.

15.3.8 Controllers shall be capable of sending data over Internet connections USB data cards.

15.3.9 Shall not require a static public IP address, at the plant for the purpose of remote access.

15.4 Functionalities

15.4.1 The SCADA system shall monitor instantaneous and cumulative electrical parameters from all DC& AC Equipment including inverters, string combiner boxes, weather station, MFM, Transformer and Switchgear (LT & HT Panels) at regular intervals not greater than one minute.

15.4.2 The SCADA system shall monitor Instantaneous and cumulative environment parameters from weather sensors or data loggers at same interval as electrical parameters and provide PR, CUF on the fly.

15.4.3 The SCADA system shall provide Alarms and Alerts on equipment faults and failure in less than 5 seconds. Alarms on status change of hardwired DI shall also be

provided.

15.4.4 The SCADA system shall provide configurable alerts on any parameter crossing settable thresholds. The list of such parameters shall be finalised in consultation with the Owner.

15.4.5 The SCADA system shall enable integration with other sub-systems at the plant for supporting O&M activities. The list shall include but not limited to:

(ix) Surveillance Cameras,

(x) Module Cleaning System – For monitoring of water usage and efficacy of cleaning process.

15.4.6 The SCADA system shall have user-friendly browser-based User Interface for secure access from anywhere, for minimum ten concurrent connections from the Operator PC or other securely connected laptop/mobile, for plant monitoring, O&M, daily reporting, and analysis. A dashboard providing summary details of total plant generation, day's export, irradiance, Inverter Control Room level generation and performance indicators like PR and CUF.

15.4.7 Reporting: The SCADA system shall provide downloadable reports in Excel/PDF, configurable for equipment parameters across the plant.

15.4.8 The system shall have Configurable Analysis page for self-configured as well as on demand Analytics charts.

15.4.9 The SCADA system shall be extensible to include maintenance of O&M schedules and related activities for plant equipment as per the O&M Manual.

15.4.10 Connectivity shall be provided to Owner's Data Monitoring Centre. Data collected by Plant SCADA shall be replicated in real-time, using industry standard interfaces such as Web Services, OPC-UA, data files, as required – with Owner's Central Monitoring System in Leh. The data recording intervals for different parameters from different devices in the solar plant shall be considered when creating schedules to "push" the data from Plant SCADA to data receivers stationed at Leh.

15.4.11 Mobile User Interface: summary of plant performance and issues should be accessible in a mobile Native UI or browser UI.

15.4.12 Data Communication to SLDC: SCADA system shall provide required interface to integrate with TRANSCO-SLDC, in compliance with grid code, to send any parameters specified by SLDC.

Note: The methodology and specification of SLDC interface will be provided separately by SLDC/TRANSCO and it shall be the responsibility of the Contractor to determine the same.

15.4.13 Power Plant Control: SCADA system shall provide required interface to the local

SCADA operator to set various power control modes (active/reactive power/frequency/PF) through the inverters over industry standard communication protocols like Modbus over TCP/IP.

15.4.14 Forecasting and Scheduling: SCADA shall provide day ahead and week ahead forecasting and scheduling for power generation at the plant as per SLDC/Utility stipulations.

15.4.15 Predictive Maintenance: SCADA system shall have in-built or pluggable frameworks to support AI based Predictive Maintenance for all key equipment including inverters, transformers and switchgear at the plant.

15.4.16 All programming functionalities shall be password protected to avoid unauthorized modification.

15.4.17 The Contractor shall provide software locks and passwords to Employer for all operating & application software. Also, the Contractor shall provide sufficient documentation and program listing so that it is possible for the Employer to carry out modification at a later date.

15.5 Cable Specifications

15.5.1 RS485 & IO Cables shall meet the following minimum specifications:

- For RS485: 0.5sq.mm ATC multi-strand (class-5), insulated core, twisted pair, overall screened with ATC drainwire, GI wire Armored, PVC sheathed, DIN47100 color standard, FRLS, 1.1KV grade
- For IO cabling (between HT/RMU panels and SCADA panel) – 1.0 sq.mm multi-strand, 4/8/12 core screened, armored, FRLS cable, 1.1KV grade.
- For Optical Cabling: 6F, Armored, Single/Multi mode laid through HDPE conduits to minimize cable breaks.

15.6 Earthing

15.6.1 Two isolated electronic earth pits near to SCADA panel at every Inverter and Control Room with < 1 Ohm resistance shall be provided. One earth pit shall be used for protective/body earth and the other to be used for Signal Earth.

15.6.2 Apart from providing separate earth pits, manufacturer specified earthing recommendations shall be followed for all communicating equipment connected to SCADA. This includes but is not limited to SMBs, Inverters, WMS and Switchgear panels.

15.6.3 In the case of SMBs (String Monitoring Boxes), separate electronic earth pit, isolated from electrical/structure earth shall be provided for each SMB (or one for nearby SMBs) to connect RS485 shield inside each SMB.

15.7 Communication Cable Laying

15.7.1 All RS485, IO and CAT6 cables shall be laid in separate conduits with a minimum separation of 1.5ft from AC/DC power cables all along.

15.7.2 Power cables shall be laid deep in the trenches first. Data cables shall be laid in separate conduits after partially filling the trenches to ensure minimum 1.5 ft separation between power and communication cables all along the trench.

15.7.3 IO Cables between switch gear panels and SCADA panel shall be laid on separate cable trays, with a minimum of 1.5ft separation from trays carrying AC Power cables.

15.7.4 RS485 & CAT6 cables between switch gear panels or Inverters and SCADA panel shall be laid on separate cable trays, with a minimum of 1.5ft separation from trays carrying AC Power cables.

15.8 Control Cabinets / Panels / Desks at Main Control Room

15.8.1 The cabinets shall be IP-22 protection class. The Contractor shall ensure that the temperature rise is well within the safe limits for system components even under the worst condition and specification requirements for remote I/O cabinets.

15.8.2 The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications.

15.9 Software Licences

The Contractor shall provide software license for all software being used in Contractor's System. The software licenses shall be provided for the project and shall not be hardware/ machine-specific.

15.10 Hardware at Main Control Room

15.10.1 The Hardware as specified shall be based on latest state of the art Workstations and Servers and technology suitable for industrial application & power plant environment.

15.10.2 The Local Monitoring & Control Server and the Operating Work station, to be deployed in the Plant Control Room, shall have the following server hardware and operating system along with accessories:

Plant Server	
Server Hardware	Hex/Octal Core Xeon, 32GB RAM (expandable to 64 GB RAM), 4 X 2TB SATA hard discs in RAID 5 configuration, 2TB external USB hard disc (for backup), dual power supplies, 2 LAN ports, LCD console, keyboard & mouse. The Server hardware shall be housed in a rugged fan-cooled, and rodent-proof Server

	Rack.
Operating System	Operating System and Database shall be of enterprise scale (RedHat Linux or equivalent Linux OS, Oracle/MySQL or equivalent DB), with required AMC for 5 years.
Accessories	1. Monitor: Min 22” LED Flat Monitor with non-interfaced refresh rate min. 75 Hz. 2. Keyboard: ASCII type 3. Pointing Device: Mouse 4. Intelligent UPS (on line): Minimum 2 hour battery backup.
Operator Workstation	
Hardware	i7 CPU running at 3.0 GHz or faster with 8GB RAM, 500GB hard disk, 25” LED monitor, keyboard and mouse, 4 USB ports, LAN port
Operating System	Windows operating system with necessary tools, anti-virus software.
Accessories	1. Screen Display Unit: Min 50” LED Flat Monitor with wall mounted arrangement for the display of SCADA screen 2. A4 size monochrome laser printer. 3. UPS of required capacity with 2 hour battery backup.

15.10.3 All network components of LAN and Workstations shall be compatible to the LAN, without degrading its performance.

15.11 Factory Acceptance Test (FAT)

FAT procedure shall be submitted by bidder for approval. SCADA shall communicate with all third devices which are part of solar plant and same shall be demonstrated during the FA

ANNEXURE-IV TO AMENDMENT-1

16 HT Switchgear

16.1 Standards and Codes

All equipment provided under HT switchgear shall comply with latest editions and amendments of the relevant IEC standards and IS codes. In particular, the switchgear shall comply with the following standards and codes.

Standard/Code	Description
IS/IEC 62271-1	High Voltage Switchgear and Control gear - Part 1: Common Specifications
IS/IEC 62271-100	High Voltage Switchgear and Control gear - Part 100: AC Circuit Breakers
IS/IEC 62271-102	High Voltage Switchgear and Control gear - Part 102: AC Disconnectors and Earthing Switches
IS/IEC 62271-200	High Voltage Switchgear and Control gear - Part 200: AC Metal Enclosed Switchgear and Control gear for Rated Voltages Above 1 kV and Up to and Including 52 kV
IEC 61869	Instrument Transformers
IS 3231	Electrical relays for power systems protection
IEC 60255	Measuring relays and protection equipment
IEC 61850	Communication networks and systems for power utility automation
IEC 61131-3	Programmable controllers - Part 3: Programming languages
IS 9385	High voltage fuses
IS 9431	Indoor post insulators of organic material for systems with nominal voltages greater than 1000 V up to and including 300 kV
IEC 60099-4	Surge arresters - Part 4: Metal-oxide surge arresters without gaps for A.C. systems
IS 3070-3	Lightning Arresters for Alternating Current Systems - Part 3: Metal Oxide Lightning Arresters Without Gaps
IEC 62052-11	Electricity metering equipment (A.C.) - General requirements, tests and test conditions - Part 11: Metering equipment
IEC 62053	Electricity metering equipment (A.C.) - Particular requirements
IS 14697	AC Static Transformer Operated Watthour and Var-hour Meters, Class 0.2S and 0.5S

16.2 Technical Parameters

Parameter	**Specification**
System Parameters	
Highest system voltage	36 kV
Rated system voltage	33 kV
Rated frequency	50 Hz
Number of phases	3
Power frequency withstand voltage	70 kV (r.m.s.)
Lightning impulse withstand voltage	170 kV (peak)
System fault current	As per system requirement
Circuit Breaker	
Type	Vacuum type
Operating duty cycle	O – 0.3sec – CO – 3min – CO
Short circuit breaking current	As per system requirement
Short circuit making current	2.5 times S.C. breaking current
Re-strike performance class	C1
Mechanical endurance class	M1
Current Transformer	
Accuracy class	0.2 for metering (0.2s for metering at outgoing feeder), 5P20 for protection
Rated VA burden	As per requirement
Insulation class	Class F
Voltage Transformer	
Accuracy class	0.2 for metering, 3P for protection
Rated VA burden	As per requirement
Insulation class	Class F

16.3 Switchgear Panel

16.3.1 The switchgear panel shall be free standing, floor mounted, single front, single tier fully compartmentalized, metal enclosed construction. Each panel shall have separate compartments for circuit breaker, bus bars, cable termination and auxiliary circuit.

16.3.2 The circuit breakers shall be mounted on horizontally withdrawable trucks with locking facility in SERVICE and TEST positions.

16.3.3 The panel enclosure shall be constructed with CRCA steel/Aluzinc sheet. The

thickness of load bearing members shall be minimum 3 mm and that of non-load bearing members shall be minimum 2 mm.

16.3.4 All surfaces shall be painted with two coats of epoxy-based paint of colour shade RAL 7032. The minimum dry film thickness (DFT) shall be 100 micron.

16.3.5 The circuit breaker and auxiliary circuit compartments provided on the front side shall have separate concealed hinged doors. Cable and bus bar compartments provided on the rear side shall have separate bolted covers. All doors and covers shall be provided with neoprene/synthetic rubber gaskets to prevent entry of vermin and dust.

16.3.6 Pressure relief device shall be provided in each high voltage compartment of a panel to safely vent the gases in the event of internal arc. Seal-off bushing arrangement shall be provided between the breaker compartment and bus bar/cable compartments to prevent transfer of arc from one compartment to other.

16.3.7 Automatic safety shutters shall be provided to cover up the fixed high voltage contacts on bus bar and cable sides when the truck is moved to TEST position.

16.3.8 Degree of protection shall not be less than IP 5X for auxiliary circuit compartment. However, for remaining compartments it shall not be less than IP 4X.

16.3.9 Mechanical /Electrical interlocks shall be provided to prevent mal-operation and in particular to ensure the following.

(i) The breaker shall be operated only if it is in SERVICE or TEST position.

(ii) Movement of the breaker truck between SERVICE and TEST positions shall be possible only if the breaker is OFF.

(iii) It shall be possible to open the door only when the breaker is in TEST position.

16.3.10 Each switchgear panel shall be provided with thermostatically controlled space heaters, separately for breaker, cable and bus bar compartments, to prevent condensation within the compartment. The space heater shall be connected to 240 V, 50 Hz, single phase AC supply through suitable switch and fuse.

16.3.11 240 V, 5 A, SPN industrial socket-outlet with ON/OFF switch shall be provided in each panel.

16.3.12 Each panel shall be provided with LED lamp rated for 240 V, 50 Hz, single phase AC supply for interior illumination controlled by door switch.

16.3.13 Gapless, metal-oxide surge arrestors shall be provided between line and earth in cable compartment of the switchgear panel.

16.3.14 Suitable lifting hooks shall be provided for each panel.

16.4 Circuit Breakers

16.4.1 Circuit breakers shall be of vacuum type. It shall comprise of three separate identical single pole units operated through the common shaft and shall be fully

interchangeable both electrically and mechanically.

16.4.2 The circuit breaker operating mechanism shall be based on motor operated spring charging and it shall be re-strike free, trip free both electrically and mechanically, with anti-pumping feature.

16.4.3 The rated control voltage of the spring charging motor shall be 110 VDC/230 VAC. Closing coil shall operate at all values of voltages between 85% and 110% of rated voltage. Opening coil shall operate correctly under all operating conditions of the circuit breaker up to the rated breaking capacity and at all values of supply voltage between 70% and 110% of rated voltage.

16.4.4 The spring charging motor shall have adequate thermal rating such that continuous sequence of the closing and opening operations is possible as long as power supply is available to the motor. It shall also be possible to charge the spring manually and close the breaker in the event of failure of motor / control supply to motor. Operating handle shall be provided for charging the operating mechanism. After failure of control supply to the motor, one open-close-open operation shall be possible with the energy contained in the operating mechanism.

16.4.5 The motor rating shall be such that it requires not more than 30 seconds for full charging of the closing spring. Closing action of the circuit breaker shall compress the opening spring ready for tripping. When closing springs are discharged after closing the breaker, they shall be automatically charged for the next operation.

16.4.6 Mechanical indicators shall be provided to indicate OPEN/CLOSED positions of the circuit breaker and CHARGED/ DISCHARGED positions of the closing spring. An operation counter shall also be provided. These indicators and counter shall be visible from the panel front door without opening it.

16.5 Relays

16.5.1 All relays shall be microprocessor based numerical type. However, auxiliary relays can be static or electromechanical type. The relays shall be flush mounted on panel front with connections from the inside.

16.5.2 Auxiliary voltage of the relays shall be 110 VDC and the relays shall be capable of operating continuously between 80 – 120% of auxiliary voltage.

16.5.3 All numerical relays shall have adequate number of freely configurable, optically isolated, Binary Inputs (BI) and potential free Binary Outputs (BO).

16.5.4 All numerical relays shall have minimum four no. of current inputs, three for phase current and one for earth current, suitable for CT secondary current of 1A. The current inputs shall be compatible with both residual connected CT and Core Balance CT (CBCT). In addition, numerical relay in main outgoing feeder shall have three no. of

voltage inputs for Under Voltage/Over Voltage protection.

16.5.5 All I/O's shall have galvanic isolation. Analog inputs shall be protected against switching surges and harmonics.

16.5.6 Making, breaking and continuous capacity of the relay contacts shall be adequate enough for the circuits in which they are used.

16.5.7 The numerical relay shall have the following protection functions with at least two independent protection setting groups. The protection functions shall be selectable from any of the IEC characteristic curves.

(i) Definite time (DT) phase over current protection
(ii) Inverse Definite Minimum Time (IDMT) phase over current protection
(iii) Definite time (DT) earth fault current protection
(iv) Inverse Definite Minimum Time (IDMT) earth fault current protection
(v) Under Voltage protection
(vi) Over Voltage protection

16.5.8 Transformer feeder protection relay shall have provision for the following protection functions.

(i) Buchholz alarm & trip
(ii) Oil Temperature Indicator (OTI) alarm & trip
(iii) Winding Temperature Indicator (WTI) alarm & trip
(iv) Pressure Relief Valve (PRV) trip
(v) Magnetic Oil Gauge (MOG) alarm

16.5.9 All numerical relays shall have provision for measurement and storage of electrical parameters such as voltage, current, frequency, active power, reactive power etc.

16.5.10 The numerical relay shall be able to record faults and events in non-volatile memory.

(i) Fault record – At least 5 recent faults including the protection function operated, operating phase(s), voltages and currents along with date and time stamp.
(ii) Event record – At least 200 events with date and time stamp.

16.5.11 The numerical relay shall have trip circuit supervision facility to monitor the circuit breaker trip circuit both in pre-trip and post-trip conditions. The relay shall also be able to provide circuit breaker monitoring, CT and VT supervision.

16.5.12 The numerical relay shall have self-diagnostic feature with separate output contact for indication of any internal relay failure.

16.5.13 The numerical relay shall have RS-232/RS-485/RJ-45/USB ports on front side for local communication with PC and on rear side for remote communication to SCADA system.

16.5.14 The numerical relay shall have feature for time synchronization through the SCADA

System / networking.

16.5.15 The numerical relay shall be provided with backlit alphanumeric LCD to access protection settings, measurement parameters, fault and event records. Read and write access to protection settings shall be password protected.

16.6 Instrument Transformers

16.6.1 Instrument transformers shall be completely encapsulated cast resin type, suitable for continuous operation at the ambient temperature prevailing inside the switchgear enclosure, when the switchgear is operating at its rated load and the outside ambient temperature is 50°C.

16.6.2 Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals at the associated terminal block.

16.6.3 Voltage transformers shall be single phase units. Bus voltage transformers shall be housed in a separate panel on withdrawable truck.

16.6.4 HRC fuses of suitable rating shall be provided on primary side of voltage transformers. For secondary side, four pole Miniature Circuit Breakers (MCB) shall be provided.

16.7 Earthing

16.7.1 An earth bus made of copper shall be provided throughout the length of the panel. It shall be bolted to the framework of each panel and brazed to each breaker earthing contact bar.

16.7.2 The earth bus shall have sufficient cross section to carry maximum fault current without exceeding the allowable temperature rise.

16.7.3 All non-current carrying conductors of the panel shall be connected to the earth bus. All joints to the earth bus shall be made through at least two bolts. Hinged doors shall be earthed through flexible earthing braid of adequate cross section. Suitable provision shall be provided at each end of the earth bus for connection with Owner's Earth conductor.

16.7.4 Positive earthing of the breaker truck and frame shall be maintained when it is in the connected position and in all other positions whilst the auxiliary circuits are not totally disconnected.

16.7.5 All metallic cases of relays, instruments and other panel mounted equipment shall be connected to earth bus by independent copper wires of size not less than 2.5 sq. mm with green colour insulation.

16.7.6 Instrument transformer secondary neutral point shall be earthed at one place only on the terminal block. Such earthing shall be made through links so that earthing of one circuit may be removed without disturbing the earthing of other circuits.

16.7.7 Separate earthing trucks shall be provided for earthing of busbars and incoming/outgoing feeders. The trucks shall have voltage transformer to indicate presence of voltage prior to earthing. An audible alarm shall also be provided in case of voltage on the earthing terminal. Integral earth switches may also be considered instead of earthing trucks. The earthing truck/switch shall have short circuit withstand capability equal to that of the associated switchgear panel.

16.7.8 The interlocks shall be provided to ensure the following.

(i) It is not possible to rack-in the earthing truck/close the earthing switch when the breaker truck is in SERVICE position.

(ii) It is not possible to rack-in the breaker truck into SERVICE position when earthing truck is connected/earthing switch is in closed position.

16.8 Bus bar

16.8.1 Bus bar shall be made of copper or aluminium with uniform cross section throughout their length. They shall be adequately supported on insulators to withstand electrical and mechanical stresses due to specified short circuit current.

16.8.2 All bus bars joints shall be thoroughly cleaned and anti-oxide grease shall be applied. Plain and spring washers shall be provided to ensure good contacts at the joints and taps. Wherever aluminium to copper connections are required, suitable bimetallic connectors or clamps shall be used.

16.8.3 Bus bars shall be provided with heat shrinkable sleeves of suitable insulation class throughout their length with proper colour coding. All bus bar joints and taps shall be shrouded.

16.8.4 Bus bar support insulators shall be made of non-hygroscopic, arc and track resistant, high strength material suitable to withstand stresses due to over voltage and short circuit current.

16.8.5 The Contractor shall submit busbar sizing calculation for specified continuous and short time current ratings during detailed engineering.

16.9 Measuring Instruments

16.9.1 All the measuring instruments shall be digital, flush mounting type with communication facility.

16.9.2 All feeders (Solar PV, BESS and main outgoing) shall be provided with Tri Vector Meter (TVM). Accuracy class of TVM shall be 0.2S.

16.9.3 Measuring instruments shall have provision to display the following parameters.

(i) Line and phase voltages

(ii) Line and phase currents

(iii) Active power, Reactive power, Apparent power

(iv) Frequency

(v) Power factor

(vi) Total Harmonic Distortion (THD)

16.10 Wiring and Terminal blocks

16.10.1 All internal wiring shall be done with 650 V grade, 1.5 sq.mm. PVC insulated stranded flexible copper wire. For CT secondary circuits, 2.5 sq.mm copper wire shall be used.

16.10.2 Wire terminations shall be made with solderless crimping type tinned copper lugs, which shall firmly grip the conductor. Insulation sleeves shall be provided at all the wire terminations.

16.10.3 Printed identification ferrules, marked to correspond with panel wiring diagram shall be provided at both ends of each wire. The ferrules shall be firmly located on each wire so that they cannot move or turn freely on the wire. Wire identification shall be done in accordance with IS 11353.

16.10.4 The Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.

16.10.5 All internal wiring to be connected to the external equipment shall terminate on terminal blocks. Terminal blocks shall be rated for 650 V, 10 A and made of non-inflammable material.

16.10.6 CT and VT secondary circuits shall be terminated on stud type, non-disconnecting terminal blocks.

16.10.7 At least 10% spare terminals shall be provided on each panel and these spare terminals shall be distributed on all terminal blocks.

16.11 Warranty

The HT panel unit shall be warranted for minimum of 5 (five) years against all material/ manufacturing defects and workmanship.

16.12 Testing and Inspection

16.12.1 Type Tests

The switchgear panel shall be of type tested design. The following type test reports shall be submitted during detailed engineering. The tests should have been conducted on the similar equipment by NABL accredited laboratory.

Test	**Standard**	**Relevant IEC Clause**
Switchgear Panel		
Dielectric tests		
Power frequency voltage test	IEC 62271-200	6.2.6.1

Lightning impulse voltage test	IEC 62271-200	6.2.6.2
Dielectric tests on auxiliary and control circuits	IEC 62271-200	6.2.10
Measurement of the resistance of the main circuit	IEC 62271-200	6.4.1
Temperature-rise tests	IEC 62271-200	6.5
Short-time withstand current and peak withstand current tests	IEC 62271-200	6.6
Verification of the IP coding	IEC 62271-200	6.7.1
Verification of making and breaking capacities	IEC 62271-200	6.101
Mechanical operation test	IEC 62271-200	6.102
Internal arc test	IEC 62271-200	6.106
Circuit Breaker		
Mechanical operation test at ambient air temperature (M2 Class)	IEC 62271-100	6.101.2
Basic short-circuit test-duties	IEC 62271-100	6.106
Relays		
Vibration tests	IEC 60255-21-1	
Shock and bump tests	IEC 60255-21-2	
Seismic tests	IEC 60255-21-3	
Electromagnetic compatibility requirements	IEC 60255-26	
Product safety requirements	IEC 60255-27	
Common requirements	IEC 60255-1	
Functional requirements	Relevant parts of IEC 60255-100 series	
Communication requirements	IEC 61850	
Current Transformers		
Temperature-rise test	IEC 61869-2	7.2.2
Impulse voltage withstand test on primary terminals	IEC 61869-2	7.2.3
Tests for accuracy	IEC 61869-2	7.2.6
Short-time current tests	IEC 61869-2	7.2.201
Voltage Transformer		
Temperature-rise test	IEC 61869-3	7.2.2

Impulse voltage withstand test on primary terminals	IEC 61869-3	7.2.3
Electromagnetic Compatibility tests	IEC 61869-3	7.2.5
Test for accuracy	IEC 61869-3	7.2.6
Short-circuit withstand capability test	IEC 61869-3	7.2.301

In case the contractor is not able to submit the test reports during detailed engineering, the contractor shall submit the reports of type/special tests either conducted by NABL accredited laboratory or witnessed by Employer.

16.12.2 Routine Tests

Routine tests and acceptance tests shall be as per the Quality Assurance Plan (QAP) approved by the Employer.

ANNEXURE-V TO AMENDMENT-1

BESS SUBCONTRACTING AGREEMENT

(To be executed within 03 months of signing of CA)

THIS AGREEMENT made on this……..day of……BETWEEN ……, a company registered under ……, having its registered office at……. (hereinafter referred to as "A") of the one part AND……, a firm/Company registered under ……../ having its principal place of business at……..(hereinafter called "B") of the other part.

WHEREAS "A" is engaged in the business of setting up …… on Design, Supply & Installation basis …….and has considerable engineering know-how and technical information and equipment regarding said ……..Projects with its ……Equipment , is keenly interested to participate in competitive bid invited by Solar Energy Corporation of India Limited, for the Design, Engineering, Supply, Construction, Erection, Testing, Commissioning including 10 Years Plant O&M of 2x1.5 MW (AC) Solar PV Power Plant with BESS at Tangtse and Durbuk in Leh district of J&K.

AND WHEREAS "A" in addition to **……..MW** ……Generator is desirous of setting up **…….MWh** energy storage system requirements, in Collaboration with manufacturers of such Battery Energy Storage System suppliers, of proven credentials suitable for the Technical requirements for the specific ambient conditions of NIT (refer SECI NIT No. SECI/C&P/MES/LEH/042018) which are annexed herewith.

AND Whereas 'B' having the requisite wherewithal, technical knowhow and past experience of execution of such **…….. MWh BESS** and operating in such ambient conditions, have expressed their interested to participate and contribute to the Project in a subcontracting manner with A'.

All the Parties concerned have noted and understood that though there are two (02) independent systems of …… & Battery Energy Storage system and each is required to function satisfactorily as per their design requirements, all are also required to function satisfactorily as a composite system of the composite Project. To ensure this, all the parties have agreed to not only keep their portion of the system in optimum working condition but have agreed to coordinate and cooperate with other system suppliers so that the combined plant facility as a whole is executed and operates to its true potential.

NOW THEREFORE IT IS AGREED between the parties that:

1. "Know how" means and includes all inventions, processes, patents, engineering and manufacturing skill and other technical information whether patent or patentable or not which are presently owned by "B" or which may be so owned, during the term of this agreement including without limitation regarding **…….*MWh BESS*** **:**
    - Technical and engineering data, calculations and information.
    - Design data, calculations and information.
    - Details of layout of works, civil foundations, Electrical, Mechanical, Control & Instrumentation details & including details and specification of machinery
    - All other forms of recovered information, technique and design in making of jigs, tools, dies, patterns and moulds.

2.
    a. "B" shall fully and promptly furnish "A" with drawings, schemes, brochures, maintenance manuals literature for its BESS and its complete system for the required capacity power generation for the project, and its transmission, for approval of the Employer as may be required to meet the project schedule and such "know-how" as "A" may require from time to time during the term of this agreement in connection with the equipment & system of the Project..

    b. "B" will supply fully and promptly its BESS as approved by Employer, along with all its systems and subsystems, equipment, cables, tools, tackles, consumables and spares to meet the requirement of the project completion schedule and depute

    Engineers, and technicians at the expense of "A" to help set up, establish and operate the BESS for the duration of the agreement as per requirement of the SECI referred NIT at the designed output and also to train ……..A's technicians in its work in…….at expense of "A".

3. In consideration of "B" having agreed to work as a subcontractor in the Project and supply to "A" the latest PRODUCTS of BESS and other processes and having further agreed to supply spares for the entire duration of the project, technical advice and required Engineers.

4. "A" shall maintain secrecy at all time during this agreement of all the know-how, drawings and the like disclosed by "B" to "A" and/or pursuant to the terms herein or about which "A" learns during the performance of this agreement.

5. This subcontracting agreement shall become effective after it has been duly approved and signed by "A" and "B" and the approval of the Employer has been obtained thereto (if necessary).

6. This agreement shall remain effective for a period of…….. years (period should not be less than the Construction and O&M period of the Project as specified in NIT) from the date of signing the agreement and shall be irrevocable by either of the parties to the agreement, unless rendered null and void by any government instrumentality.

7. This agreement shall be binding upon and ensure to the benefit of the successors and assigns of the respective parties hereto, and the obligations hereunder shall not be assignable by either party without written consent being first obtained from the other as well as Employer.

8. This agreement embodies entire understanding of the parties as to its subject matter, and it shall not be amended except in writing executed by both parties to the agreement with the consent of Employer.

9. Either party may by notice in writing to the other terminate this agreement in the event of :

   a. Judicial proceedings for bankruptcy, composition with creditors, sequestration of assets for creditors, or receivership instituted by or against such other party, insolvency of such other party or its failure to meet its obligations as they mature for any material period of time.

   b. Liquidation , compulsory or voluntary of such other party except in connection with an amalgamation, reconstruction, merger, consolidation, re-organisation or disposition of assets as a going concern voluntarily undertaken and with a view to the continuance of the business by the transferee thereof, provided, however, that upon such event the business entity continuing the business formerly carried on by such other party shall, in an appropriate instrument delivered to the other party to this agreement, undertake to perform all of the obligations of such other party hereunder.

10. Neither party shall be in default under this agreement by reason of its failure or delay in the performance of its obligations if such failure or delay is caused by acts of God, Government laws and regulations, strikes, lock-outs, war or any other cause beyond its control and without its fault or negligence.

11. All disputes, questions, or differences, etc., arising in connection with this agreement shall be referred to a single arbitrator in India in case parties agree upon one, otherwise two arbitrators in India are to be appointed by each party in accordance with and subject to the provision of the Arbitration & Conciliation Act, 1996, or any other enactment or statutory modification thereof for the time being in force.

12. Notices and other communications under the agreement shall be in writing, or by established cable, radio or facsimile service, addressed as indicated in the description of parties above or as either party may request in writing, and the effective date of each is the date of its repaid deposit in the mail for dispatch by air or such service properly addressed.

13. The agreement should be construed in accordance with and be governed by the laws of India.

IN WITNESS WHEREOF, the parties hereto have executed this agreement as of the date first above written.

For "B"

…….

For "A"

…….

Note: The above format provides for minimum and a skeletal scope of subcontracting between A and B for the purpose of the NIT. However the parties will be at liberty to further enlarge their scope or incorporate details of the scope of subcontracting envisaged between themselves and suitable for Work concerned, provided the same are in conformity with the scope and essence of the Work as laid down in the Section VII of the Bidding document.