E-TENDER DOCUMENT

Solar UPS with dual charging unit: Solar PV and House Hold LT line (1-Ph 240).

PREFACE:

Nalanda University Campus is designed for the Net- Zero campus and Solar PV captive unit capacity of approximately 7 MW in PHASE MANNER is proposed. Before entering into the tendering process of solar captive unit in the main campus, the University intend to know the hands on expertise of the system. Although, main campus will have solar PV unit On-Grid connected and without battery bank, while in this tender we are looking for OFF-GRID with battery bank facility but this must be electricity line interactive.

Hence, the University has decided to undertake a PILOT test for the system as explained in this tender.

Looking to the power backup in the Proposed Medical Center of the University at Ajatshatru Campus, Rajgir and upcoming Solar project in the main campus, The University has decided to install a Solar UPS with dual source of input for the charging of its integrated battery bank as recommended by the MNRE, GOI.

The basic idea is that if solar input goes under outage or effect of weather/climate condition then UPS should be charged through the available LT line. Means, the University is looking for a synchronized Inverter system with charging through Solar on priority first and LT line on secondary priority and AC output for the defined critical load distribution point of the medical center.

On the basis of performance in all respect from this module, the University may incorporate the experience accordingly.

BASIC REQUIREMENT FOR PILOT TEST AT THE MEDICAL CENTER:

Minimum Size of the online solar Inverter which may act as UPS: 5 KVA with battery bank @7.2Vah/W_p in accordance of the MNRE guidelines.

SOLAR PV UNIT Capacity: Full load input load 5KVA.

Tender: E-tender as per the scheduled time line, however both the envelope (Envelope – I : must contains the documents pertaining to the techno commercial and eligibility criteria and Envelope-II: must be contain the Price bid in the prescribed format only)

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Rajgir, District: Nalanda, Bihar – 803 116
Ph. No: 06112 255330
Web: www.nalandauniv.edu.in

SHORT TERM NOTICE INVITING TENDER ENQUIRY (Urgent Requirement)

No. NU/Engg/Electrical/AJH/606 Dated: 20.09.2017

To

1. (As per list Attached – Gathered from impalement list of MNRE, GOI)
2. Notice Board(NU)
3. Notice Board of CPWD, Patna
4. CPPP website (2017_NUNIV_248172_1)
5. NU website
6. Open for all the eligible bidders as per the MNRE guidelines

Dear Sir(s)/Madam

On behalf of the honourable Vice Chancellor, Nalanda University, Rajgir, Bihar, eligible bidders are being invited to submit quotation under two Envelope System (Techno commercial, Tender Processing, EMD fee along with eligibility credential in Envelope-I and Price Bid in ENVELOPE-II) for "**providing and fixing of Solar online Inverter with battery @7.2KVA/Wp backup and Solar PV Unit at Proposed Medical Center in Ajatshatru Residential campus of Nalanda University at Rajgir, Bihar**" as per the Schedule of Quantities enclosed herein below as Annexure I and as per the Terms & Conditions specified here under:

1. The tender shall be accompanied with the following documents:

The Tender must be addressed to the Tender Accepting Authority as indicated below:
The Registrar, Nalanda University, Rajgir. Bihar-803116.

a. Demand Draft against the EMD @ INR 10000.00 & the Tender Processing Fee @ INR 1000.00, credential, if any, along with price bid shall be placed in a sealed Envelope. Copies of certificates of work experience and other prequalifying documents such as registered/impaneled contractor s in MNRE/ CPWD/ or in any ministries or in any state govt for same category of work. The demand draft must be in favor of " Nalanda University" Payable at Rajgir.

b. Bill of quantities duly filled in and compiled with rates, amounts, of the same and other relevant commercial information (tender) signed by authorized signatory shall be placed in the same envelope.

c. The bidders shall be evaluated as per the GFR-2017, GOI, the University's Financial Regulations and MNRE guidelines.

2. Critical Dates:

Particulars	Dates	Remarks, if any
Tender Issued vide dispatch no 606 dated 20th September 2017	20 September 2017	
Clarification Start Dates	21st September 2017	
Pre-bid meeting	26th September 2017 , 1130 Hours	In-order to attract the maxim participation, to explain the University required, reply to the queries and also understand the industry technical practice for better solution, if any, the bidders are welcome to attend the pre-bid meeting at the University Interim campus. Bidders, who are unable to attend the pre-bid meeting may also submit their queries in written by the 26th September 2017, 1130 Hours.
Online submission end date	11th October 2017, 1500 Hours	Mandatory
Off line submission End date	12th October 2017, 1500 Hours.	Hard copy in original required for evaluation
Technical Bid opening date	12th October 2017, 1530 Hours.	Bidders may be present to witness the opening
Financial Bid opening date (Tentatively)	15th October, 2017	Financial bid shall be opened to only qualified bidders in the technical round. In case of chance in date, if any, shall be intimated separately.

3. Venue for Submission & opening of Quotations: Interim Campus of Nalanda University, At – Chhabilapur Road, Rajgir, District–Nalanda, Bihar – 803116.

4. The tender shall be administer as per the University rule and revealing CPWD/GFR rules.

5. Eligibility:

The Contractor must be registered in CPWD/MNRE/Any Govt Department for similar category of work. Or contractor have completed similar work may also apply. Or, Contractor authorized by the impaneled agency in MNRE or OEM of Inverter or Solar PV system may also be participate.

OR

Impaneled/recognized agency by the MNRE.

OR

Dealer and distributor of the preferred make

6. Warranty: Minimum five year on PCU.

7. Solar PV Unit: Each solar PV module shall be warranted by the manufacturer for at least 95% of its rated power for 10 years and 80% for 25 years from the date of system acceptance

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8. Security guaranty during defect liability period @ 2.5% of tendered amount shall be deducted from running bills and it may be released on submission of FDR/BG of requisite amount. On successful completion of each year the security amount shall be release on prorate basis.

9. Contractor:

The Contractor shall mean the individual, firm or company, whether incorporated or not, undertaking the works and shall include the legal personal representative of such individual or the persons composing such firm or company, or the successors of such firm or company and the permitted assignees of such individual, firm or company.

10. Mode of Submission:

a. The quotation may be sent by post or may be dropped in the Tender Box of the Nalanda University, Rajgir, placed in the Reception, on or before due date & time of receipt of offer as indicated above. Quotations which do not reach this office latest by 3:00 PM on the due date, will not be opened and will be summarily rejected. The Nalanda University will not be responsible for any delay in receipt of quotation by post whatsoever may be the reason.

Copy of Certificates of PAN card, copy of the GST registration (if applicable) is to be submitted along with the quotation.

NALANDA UNIVERSITY will not be bound by any Power of Attorney granted by the Bidder or changes in the constitution of the firm made subsequent to submission of the bid or after the award of the contract. The University may, however, recognize such Power of Attorney and changes after obtaining proper legal advice, the cost of which will be borne by the Bidder.

The cancellation of any document such as Power of Attorney, Partnership Deed etc. should be communicated by the Bidder to the NALANDA UNIVERSITY in writing well in time, failing which NALANDA UNIVERSITY shall have no responsibility or liability for any action taken by NALANDA UNIVERSITY on the strength of the said documents.

11. Validity of Quotations:

The offer shall be kept valid for a period of 90 days (Ninety days) from the date of opening of quotation.

12. Prices:

The Bidder should quote the final rates in both figures and in words (English) system as per the format provided in Schedule of Quantities (Annexure I). The amount for each item should be worked out and entered. Prices shall be quoted in Indian National Rupees (INR) only. This enquiry is based on door delivery principle which implies that the successful contractor will be responsible for fulfilment of any statuary payment in accordance of the Govt of India. The taxes will be as per the guidelines of GOI. However, no any additional charges like transportation or any other charges shall be paid extra.

13. Billing & Payments:

The Contractor shall submit the bill(s) / invoice(s) in a format to be decided between the NALANDA UNIVERSITY and the Contractor. The NALANDA UNIVERSITY shall release the payments within 15 Days from the date of receipt of the Bill(s)/ invoice(s) duly certified by Engineer in-charge along with necessary supporting documents, if found in order. However, the sequence for releasing payments shall be as detailed below:

a. 90 % payment shall be released after successful supply, Installation, Testing and Commissioning of the wiring job in accordance of the MNRE/CPWD guidelines.
b. Remaining 10% after successful completion of three months.

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14. Time Schedule:

The time stipulated for completion of job (Providing & Fixing both) in all is 30 days from issuance of letter of award or purchase order.

15. Nalanda University's Rights:

NALANDA UNIVERSITY reserves the right to accept a quotation other than the lowest and to accept or reject any quotation in whole or part, or to reject all the quotations received with or without assigning any reasons.

16. Extension Order:

Repetition of order: If required, Nalanda University reserves right to place 100% extension order or part hereof awarder work order on company subjected to the condition within one year from date of order.

17. Additional quantity other than SOQ: Nalanda University reserves right to place an extension order for any additional quantity to extent of 100% quantity of the original order on the same rates subjected to the condition within one year from date of order. However payment will be based on actual measurement of work.

18. Liquidated Damage:

If work is not completed within specified period a liquidation damage will be charged from contractor @ 0.5% per week from contractor up to maximum of 5% of contract value of tender.

19. Acceptance:

It is not binding to the University to accept the lowest or any tender. The Nalanda University reserves the right to accept or reject any offer at its option or place order with more than one supplier for full or part quantity of this enquiry without assigning any reason and the same shall be binding on suppliers unless otherwise stated in the offer. The University may cancel or reject the offer/order at any time without assigning any reasons. No correspondence shall be entertained on this account.

20. Disputes:

All disputes, if any, out of or in respect of this enquiry are to be settled at Rajgir or be tribunal only in any competent court situated at Rajgir, Bihar. Stated specifically to the contrary, it shall be deemed that you have agreed to all terms and conditions mentioned in the enquiry and the same shall be binding on you.

21. List of Approved Makes

SL	Item	Makes
5	Cable and wires	Polycab/KEI/RPG/Finolex
6	Control cable	As per manufacturer's practice
7	Cable Lugs	Dowels/Asian/comet
8	Cable Glands	Dowels / Asian/comet
	Solar PV	TATA/ SONI/ ABB/As per the Engineer In-Charge
	PCU	Console/ Delta/Su-Kam/ As per the Engineer In-Charge
	Others	As per the Engineer In-Charge

22. Check List:

The Envelope I superscripted with "Providing and fixing of Solar Inverter with battery backup at Medical Center, Ajatshatru Residentail Campus addressed to the Registrar, Nalanda University, Rajgir must contains as indicated Below:

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a. Tender Processing Fee and EMD
b. Copy of Certificates of PAN card, copy of the GST registration, power of attorney for authorisation to sign and submit the tender on behalf of the firm, if applicable.
c. Signed copy of the NIT which means that bidder is accepting all the terms and conditions of this enquiry.
d. The price bid offer in the prescribed format as per the Annexure-I. The price bid must be sealed
Envelope II: Price bid in the prescribed format.

23. For any clarification may contact to the following officials:
Mr. Manoj Kumar, AE (E) @ +91-7033698507 [E-mail: mkumar@nalandauniv.edu.in]

24 TECHNICAL SECTION:

A. TECHNICAL SPECIFICATIONS.

D.1 SOLAR PV PANELS

D.1.1 Scope

The scope of work shall include:

- This section of the specification includes the furnishing, installation, connection and testing of the Solar PV panels on the roof of the Ajatshatru Building with mounting arrangement and all accessories.
- This section also includes cabling works from Solar PV panel to inverter and solar inverter to the Emergency LT panels or sub distribution board provided by the University.

D.1.2 Definitions

The Solar system is used for utilizing solar energy to electrical energy with the help of solar inverters. Solar inverter shall convert DC supply to 50 Hz, 240Volt-1 Phase AC supply.

D.1.3 Codes & Standards

All Equipment and accessories shall comply to requirement of standards published by Bureau of Indian Standards (BIS). In case no BIS codes exist the equipment shall meet the requirement of international standard including IEEE for design and installation of LT line connected PV system. The list of standards adopted shall be indicated in the bid. The SPV Module must be provided with acceptable Test & Certified documents. The quality of equipment supplied shall be generally controlled to meet the guidelines for engineering design included in the standards and codes listed in the relevant ISI and other standards, such as:

IEEE 928: Recommended Criteria for terrestrial PV power systems.

IEEE 929 Recommended practice for utility interface of residential and intermediate PV systems.

IEEE 519 Guide for harmonic control and reactive compensation of Static Power

Controllers.

National Electrical NFPA 70-1990 (USA) or equipment national standard.

National Electrical Safety Code ANSI C2 (USA) or equipment national standard.

IEC: 61215 (2005)- Crystalline silicon terrestrial photovoltaic (PV) modules – Design

Qualification and type approval

IEC: 61730 -1, -2 Photovoltaic (PV) module safety qualification Part 2: Requirements for testing

IEC: 60904-1(2006) Photovoltaic Devices-Part-I:

Measurement of Photovoltaic current-Voltage Characteristic

IS 9000 Basic environmental testing procedure for Electronic and electrical items.

The arrangement must follow the MNRE guidelines

D.1.4 Specification

The PV power project developers will provide a copy of the type test certificate(s)/ report(s) with the bid and routine type reports before the dispatch of the equipment. Solar PV system shall consist of following equipment:

i. Solar PV modules consisting of required number of PV cells .

ii. Power Conditioning Unit/ Inverters with communication port (SCADA Modbus/ RS 485/TCP-IP)

iii. Mounting structures

iv. Cables and hardware

v. Junction box and distribution boxes

vi. Earthing kit

vii. Lightning arrestors

viii. PVC pipes and accessories

ix. Tool kit

x. Control room and civil pedestals xi. Spares for 3 years

Duty Cycle

Average Hours of Operation/day: 8-10 hrs per day, as per insolation levels of the site.

PV ARRAYS

The PV modules convert the light reaching them into DC power. The amount of power they produce is roughly proportional to the intensity and the angle of the light reaching them. They are therefore required to be positioned to take maximum advantage of available sunlight within siting constraints.

Supplier will position the PV modules in such a manner that the maximum power is obtained with the sun's movements during the day.

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Supplier shall follow the latest engineering practice; ensure long-term compatibility requirements and continuity of equipment supply and the safety of the operating staff.

The PV power project developers are required to optimize generation of electricity in terms of kWh generated per kWp of PV capacity installed vs available solar radiation at the site (may be obtained through use of efficient electronics, lower cable losses, maximization of power transfer from PV modules to electronics and the grid, maximization of power generation by enhancing incident radiation by optional methods like seasonally changing tilt angles etc).

The PV system shall support remote monitoring of important parameters. The system shall be designed such that personnel without any background knowledge in Microprocessor-based technology are able to operate the system. The operator interface shall be intuitive such that operating personnel shall be able to operate the system easily after having received some basic training.

The SPV cells shall be manufactured using unique highly efficient diffusion process or any other technology in vogue so as to ensure uniform diffusion profiler to achieve close spread and higher efficiency for each cell.

Stabilized net output of the Solar PV Array for the Solar Power System should not be less than the Nominal design level for the System under Standard Test Condition.

Each solar PV module shall be warranted by the manufacturer for at least 95% of its rated power for 10 years and 80% for 25 years from the date of system acceptance. The preference may be given to 320W system or as per the OEM/integrator precise.

Photo electrical conversion efficiency of GTRTSPVS module shall not be less than 13%. The bidder shall indicate minimum module efficiency.

Fill factor of the module shall not be less than 0.70.

The bidder shall provide the sample solar PV module electrical characteristics including current voltage (I-V) performance curves and temperature coefficients of power, voltage and current. However, the tabulated document with all the relevant data like voltage, current, power output for all the modules also to be provided.

The PV modules shall be suitable for continuous outdoor use The PV module shall be made of high quality laminated in ultra violet stabilized polymer material such as Ethyl Vinyl Accelerate (EVA), Tedler, and toughened class. The size of single crystalline silicon PV cells shall be so chosen so as to maximize energy density and align with economies of scale.

PV module shall be provided with frame of anodized channels for size and simplicity in installation offered as a single module or series parallel combination of modules. The PV module shall be provided with screen-less frame with solar cable and connector.

The PV modules shall be equipped with bypass diode to minimize power drop caused by shade.The PV modules shall be made of light weight cells, resistant to abrasion, hail impact, rain, water and environmental pollution. The PV modules shall be provided with anti-reflection coating and back surface field (BSF) structure to increase conversion efficiency. The PV module shall use lead wire with weatherproof connector for output terminal.

The power output of the PV system under Standard Test Conditions (STC) should be 50 kWp made of 310 Wp or any other module size depending upon manufacturer

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prudent practice. With nominal output voltage of 24 V. The number of modules to be supplied shall be worked out accordingly. The operating voltage corresponding to the power output mentioned above should be 35.2 V for 24V system.

The terminal box on the module should have a provision for opening for replacing the cable, if required.

A strip containing the following details should be laminated inside the module as to be clearly visible from the front side.

a) Name of the Bidder or distinctive Logo

b) Model or Type No.

c) Serial No.

d) Year of make.

The GTRTSPVS shall perform satisfactorily in relative humidity up to 85% and temperature between -10ºC to + 86ºC.

Inverter

The DC power produced is fed to inverter for conversion into AC. In a grid interactive system AC power shall be fed to the UPS LT Distribution Board at single phase AC bus. Power generated from the solar system during the daytime is utilized fully by powering the building loads. In cases, where solar power is not sufficient due to more demand or cloud cover etc. the critical and separated loads shall be served by drawing power from the LT line. The inverter should always give preference to the Solar Power and will use LT Line/DG power only when the Solar Power is insufficient to meet the load requirement. The inverter shall be 1Phase type which shall convert dc output from solar PV to single phase AC output .The output of the inverter must synchronize automatically its AC output to the exact AC voltage and frequency of the grid. Inverter shall continuously monitor the condition of the grid and in the event of grid failure; the inverter automatically switches to off-grid supply within 20-50 milliseconds. The solar system is resynchronized with the grid within two minutes after the restoration of grid or generator. Alternatively, the UPS may also be online giving charging preference to the Solar on priority and in case of any insufficiency in solar Unit should be charged through house Hold LT line.

Grid voltage shall also be continuously monitored and in the event of voltage going below a preset value and above a preset value, the solar system shall be disconnected from the grid withinthe set time. Both over voltage and under voltage relays shall have adjustable voltage (50% to130%) and time settings (0 to 5 seconds).

Metal Oxide Varistors (MOVs) shall also be provided on DC and AC side of the inverter. The inverter control unit shall be so designed so as to operate the PV system near its maximum

Power Point (MPP), the operating point where the combined values of the current and voltage of the solar modules result in a maximum power output.

Following specifications shall be provided by the OEM

- Continuous output power rating
- Nominal AC output voltage and
- frequency

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- Accuracy of AC voltage control
- Output frequency
- Accuracy of frequency control
- Grid Frequency Control range
- Maximum Input DC Voltage
- MPPT Range
- Ambient temperature
- Humidity
- Protection of Enclosure
- Grid Voltage tolerance
- Power factor control
- No-load losses
- Inverter efficiency(minimum)

Liquid crystal display shall at least be provided on the inverters front panel or on separate data logging/display device to display following

- DC Input Voltage
- DC Input current
- AC Power output(kW)
- Current time and date
- Time active
- Time disabled
- Time Idle
- Temperatures (C)
- Converter status

Protective function limits (VIZ-AC over voltage, AC under voltage, Over frequency, under frequency, ground fault, PV starting voltage, PV stopping voltage, over voltage delay, under voltage delay over frequency, ground fault delay, PV starting delay, PV stopping delay.) shall also be displayed. Nuts & bolts and the inverter enclosure shall have to be adequately protected taking into consideration the atmosphere and weather prevailing in the area.

Dimension and weight of the inverter shall be indicated by the bidder in the offer. All doors, covers, panels and cable exists shall be gasketed or otherwise designed to limit the entry of dust and moisture. All doors shall be equipped with locks.

Solar PV systems shall be provided with synchronizing equipment having three input for comparison i.e. grid supply vs. solar output, Generator output vs solar output so as to connect the SPV systems in synchronism with grid or Generator. In case of grid failure, solar PV system shall be disconnected from the grid and out of synchronization for a period Generator supply is not restored. PV system shall be synchronized with the GENERATOR supply after Generator is started

Static Phase Converter

The inverter shall be 1Phase type which shall convert dc output from solar PV to single phase AC output which shall then be converted into 415V,3Phase ,50Hz by a static phase converter, if required, this is optional and additional if manufacturer feel comfortable but not mandatorily. The University cannot force for this requirement this is may be done by the OEM/bidder as per their choice but free of cost.

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Protection and Control

PV system software and control system shall be equipped with islanding protection as described above. In addition to disconnection from the grid (islanding protection i.e. on no supply) , under and over voltage conditions , PV systems shall be provided with adequate rating fuses, fuses on inverter input side (DC) as well as output side (AC) side for overload and short circuit protection and disconnecting switches to isolate the DC and AC system for maintenances are needed. Fuses of adequate rating shall also be provided in each solar array module to protect them against short circuit. A manual disconnect switch beside automatic disconnection to grid would have to be provided at utility end to isolate the grid connection by the utility personal to carry out any maintenance. This switch shall be locked by the utility personal.

D.3 GRID TIE INVERTERS

D.3.1 Scope

The scope of work shall include:

1. Supplying, installation testing and commissioning of Inverters for solar station.

2. Inverter handling, loading unloading and storage.

3. Associated works.

D.3.2 Definitions

The definitions shall be as per relevant IEC/IEEE standards and MNRE guidelines.

D.3.3 Codes & Standards

The contractor is required to follow all relevant IS and IEC codes as per latest amendments, following codes shall be followed in particular:

1. IEEE Standard 446-1987: Emergency and standby power systems.

2. ANSI C 37.90a, IEEE Standard 472 : Surge withstand capability test.

3. ANSI C 37.90 : Relays and relay system associated with electrical power apparatus.

4. IS 2208 & IS 9224 : Cartridge fuses for voltages up to and including (Part 1&2) (IEC 269) 650 V.

5. IS 9224 (Part - 4) : Fuses for protection of semiconductors.

6. BS 4417 (I.E.C 146) : Semi-conductor Rectifier Equipments.

7. NEC- 2008 - National electrical code.

8. NBC-2016 - National building code.

9. IER-1956 : Indian electricity rules.

10. IEA-2007: Indian electricity act 2007.

11. Any other local bye-law or supply company norm as applicable.

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D.3.4 Service conditions

System particulars

a. Nominal system voltage - 320V bipolar DC

b. Rated system voltage - 1.8kV

c. Frequency - 50Hz ± 3%

d. No. of phases – 2pole + earth

e. System neutral - Solidly earthed

f. Short circuit rating - 50kA for 1sec on LV side.

Tropical conditions

a. Ambient temperature : 40 degree celsius

b. Relative humidity (avg.) : 60

c. Isokeraunic level : 33

d. Seismic Zone : Zone-4

e. Climate type : hot and humid

The climatic conditions are prone to wide variations in ambient conditions and hence the equipment shall be of suitable design to work satisfactorily under these conditions.

Tolerances and creepage distance

Tolerances (on all the dimensions) and creepage distances shall be in accordance with provisions made in the relevant Indian/IEC/BIS standards and in these specifications. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product.

D.2.5 Specifications

- The static LT line tie inverter shall be of solid state type using proven pulse width modulation (PWM) technique. The inverter equipment shall include all necessary control circuitry and devices to conform requirements like voltage regulation, current limiting, wave shaping, transient recovery, automatic synchronization etc. as given below.
- The inverter shall utilize IGBT which shall provide intelligent features like the drive circuitry, over-current protection, over temperature protection, control power failure protection and short circuit protection.
- The IGBT / IPM transistors shall enable high speed switching of 6 Khz or as per the ORM practice confirming to reducing the heat dissipation and thereby providing high efficiency.
- The Inverter shall utilize both voltage and current feedback control circuits so that the inverter shall act not only as a constant voltage source but also as a load required current source. This shall enable the inverter to quickly adapt to the changing load current value and wave shape.

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- The controller used shall be DSP type.
- The inverter output voltage shall not deviate by more than + 2% RMS due to the following steady state conditions :
  a. From 0 to 100% loading
  b. Inverter DC input voltage varies from maximum to minimum.
- The inverter output frequency shall be controlled by an oscillator internal to the Inverter module logic. The inverter output frequency shall not vary during steady state or transient operation due to the following conditions:
  a. From 0 to 100% loading.
  b. Inverter DC input varies from maximum to minimum.
- The inverter output shall limit the amount of harmonic content to the values stated in section. The use of excessive or additional filtering shall not be required to limit the harmonic content thus maintaining a high level of efficiency, reliability and original equipment footprint.
- The inverter output shall be capable of providing an overload current while maintaining rated output voltage to the values stated. An LED indicator shall be located on the control panel to identify this condition. If the time limit associated with the overload condition expires or the overload is in excess of the set current amplitude, the load shall be switched off by isolating the load with the help of output AC switchgear.
- The inverter output shall be limited to 150% of rated load current.
- The AC output from the inverter shall utilize fuses for overload protection. The inverter shall utilize a contactor to isolate the inverter output from the critical bus. The inverter fuses shall be the fast acting semiconductor type. The inverter output isolation contactor shall be located in the inverter module and shall be controlled by the internal inverter module system logic.
- The inverter shall meet the following specifications in addition to other requirements stated herein:
  a. Voltage Input : 325V bipolar DC or asper the OEM for this case.
  b. Input voltage range : ± 12%
  c. Nominal Voltage Output : 240 V + 1% AC 3 Phase, 4 Wire
  d. Voltage Regulation :
  For 0 to 100% loading: <+ 1%
- Transient Voltage Regulation :
  a. At 100% step load change : <+ 3%
  b. At loss or return of AC input : <+ 1%
  c. At load transfer from bypass to inverter : <+ 3%
  d. Total voltage harmonic distortion :< 5% THD for 100% linear load < 7% THD for 100% non-linear load
  e. Output power factor > 0.9
  f. Duty : Continuous
  g. Cooling : Forced cooling using fans.
  h. Ambient operating temperature range : 0 to 50 deg.C maximum continuous.
  i. Output : Suitable terminals are provided for termination of cables for connecting inverter output to AC distribution board.

D.3.6 Installation, Testing & Commissioning

- Installation of Inverter shall be carried out as per manufacturer's instructions and installation shall be verified by the manufacturer before energizing.

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- Type testing shall be conducted from accredited Lab. Copies of the test certificates for same rating shall be submitted at the time of vendor approval. These shall not be more than 3 years old.
- Testing at manufacturers' works shall be conducted before dispatch as per routine verification requirements.
- Physical check including checking damage/crack in any components, etc shall be done at site.
- Following test shall be performed, as a minimum, at site prior to handing over, to confirm the functional and the performance specification of the inverter as specified. All required test equipment like Digital Oscilloscope, Voltage Regulator and Measurement Meters etc. shall be the responsibility of the concerning vendor without any additional cost.
- Full load testing of inverter with required size load bank shall be done at site as per the approved QAP. All testing expenses including load bank and its arrangements shall be under the scope of vendor.
- The vendor shall demonstrate as a minimum the following features on site by providing all required test equipment, such as power factor improvement, input current THD, output voltage THD, output frequency and all other performance monitoring requirements detailed before as required by the Owner.
- The MNRE guidelines are mandatory

D.4 LT CABLE AND TERMINATION (AC and DC cables)

D.4.1 Scope

The scope of work shall include:

1. Supplying, laying, testing and commissioning of 1.1kV grade power cables and control cables suitable for 415V, 3Phase , 50Hz AC supply and also for 230V, 1Phase , 50Hz AC supply.

2. Supplying, laying, testing and commissioning of 1.8kV grade, DC power cables suitable for 325V, bipolar DC supply.

2. Handling, loading, unloading and storage of both AC and DC cables.

3. Civil works, piping works and ducting works required for cable laying as per tender document.

4. Cable termination using double compression brass glands and lugs (cu lugs for cu cables and Al lugs for Al cables) as specified

D.4.2 Definitions

The definitions shall be as per IS 7098-Part 1, IEC 60050-461 and IEC 60502-2

Abbreviation used to define the following are stated in front of the entity

Aluminum Conductor - A

XLPE Insulation - 2X

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Steel round wire armor - W

Steel strip armor - F

Steel Double round wire armor - WW

Steel Double strip armor - FF

Non-magnetic (A1.) round wire armor - Wa

Non-magnetic (A1.) strip armor - Fa

PVC outer sheath - Y

D.4.3 Codes & Standards

The contractor is required to follow all relevant IS and IEC codes as per latest amendments, however in particular following codes may be applied in addition.

1. IS 7098-Part 1- Specifications for XLPE insulated thermoplastic sheathed cables, for working voltage up to 1.1kV (including 1.1kV)

2. IS-1255 - Code of practice for installation and maintenance of power cable up to 33KV rating

3. IEC 60502-1- Standard for cables for rated voltage from 1KV up to 6kV (Um=1.2kV)

4. IEC-60050-461- Definitions for cables.

5. IEC-60811 - Common test methods for cable insulation.

6. IS : 3961- Part 2: Recommended current ratings for cables.

7. IS : 8130 Conductors for insulated cables.

8. IS : 583 XLPE Insulation and outer sheath of electric cables.

9. IS : 10418 Specification for drums for electric cables.

10. NEC- 2008 - National electrical code.

11. NBC-2016 - National building code.

12. IER-1956: Indian electricity rules.

13. IEA-2007: Indian electricity act 2007

14. MNRE guidelines

15. Any other local bye-law or supply company norm as applicable.

D.4.4 Service conditions

System particulars

a. System voltage - 415/230 V for AC cables and ±325V for DC cables

b. Frequency - 50Hz ± 3% for AC cables

c. No. of phases - 3 for AC / 2 (poles) for DC

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d. System neutral - Solidly earthed

e. Short circuit rating - As per system fault level

Tropical conditions

a. Ambient temperature: 40 degree celsius

b. Relative humidity (avg.) : 60

c. Isokeraunic level: 33

d. Seismic Zone: Zone-4

e. Climate type : hot and humid

The climatic conditions are prone to wide variations in ambient conditions and hence the equipment shall be of suitable design to work satisfactorily under these conditions.

Tolerances and creepage distance

Tolerances (on all the dimensions) and creepage distances shall be in accordance with provisions made in the relevant Indian/IEC/BIS standards and in these specifications. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product.

D.4.5 Specifications

LT Cables (AC & DC):

- Cables shall be XLPE insulated PVC sheathed, Copper conductor as specified.
- Stranded Aluminum/Copper conductor shall be used.
- All Aluminum/Copper XLPE cables insulation shall be of high grade Cross-linked Polyethylene for insulation for extrusion process. Cores laid up.
- The inner sheath shall be bonded over with thermoplastic material for protection against mechanical and electrical damage.
- Armoring should be provided over the inner sheath to guard against mechanical damage.
- Armoring should be Galvanized steel wires or galvanized steel strips as specified.
- In single core cables used in A.C. wires/strips, round steel wires should be used; where diameter over the inner sheath does not exceed 13 mm, flat steel armor should be used.
- Insulation shall be of XLPE type as per latest IS general-purpose insulation for maximum rated conductor temp 90 degree C.
- The Conductor shall be stranded Aluminum/Copper circular/sector shaped and compacted.
- In multi core cables the core shall be identified by red, yellow, blue and black coloring of insulation.
- Conductor shall be of electrolytic Aluminum/Copper conforming to IS: 8130 and are compact circular or compact shaped. I
- In Inner sheath laid up cores shall be bonded over with thermo-plastic material for protection against mechanical and electrical damage.

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- Insulation, inner sheath and outer sheath shall be applied by extrusion and lapping up process only. The outer sheath shall have FRLS properties.
- Repaired cables or cables made up of re-used copper / aluminium shall not be used.
- The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installations with uncontrolled back fill and chances of flooding by water.
- Progressive automatic in line sequential marking of the length of cables in meters at every one meter shall be provided on the outer sheath of all cables.
- Both ends of the cables shall be properly sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation, storage and erection.
- Embossing of outer sheet: the following details on the other sheet of cable at a regular interval of 1(one) meter:
  a. Name of customer : Nalanda University
  b. Conductor size, type of insulation and voltage grade.
  c. Manufacturer's name along with ISI mark

- Typical parameters for AC cables shall be as follows :
  a. Rated Maximum Voltage: 1.1 kV (rms)
  b. Rated Frequency: 50 Hz
  c. Rated Power Frequency Withstand Voltage (1 min): 2 kV (rms)
  d. Rated short time withstand current for 1 sec: as per fault level
  e. Conductor material: Aluminium / Cu. as per cable schedule.

- Typical parameters for DC cables shall be as follows :
  a. Rated Maximum Voltage: 1.5 kV
  b. Maximum permissible DC voltage : 1.8 kV
  c. Voltage withstand for 5 minutes : 6.5kV
  d. Rated short time withstand current for 1 sec: as per fault level
  e. Conductor material: Aluminium / Cu. as per cable schedule.

LT cable termination:

- All cable glands shall be made out of brass and of good quality as approved.
- All cable glands shall be of double compressions type.
- Termination/ Joining of power and control cables shall be done by means of compression methods using solder less tinned copper or Aluminum terminal lugs.
- For control cables terminations, ring tongue or reducer pin type lugs shall be used to suit the purpose.
- Proper crimping tools with crimping paste shall be used to maintain proper conductivity and avoid any air gap.

Cable Tags:

- Cable tag shall be made out of stainless steel minimum 1.2 mm thick and 25 mm x 100 mm size with holes provided to tag the cable.
- Following information shall be engraved in the cable with good quality material and the lettering height shall be 4.5mm
  a. Source of the Cable from where it is supplied power.

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b. Destination where the cable is terminated.
c. No of cores of cables.
d. Cross sectional area of the cable
e. Complete notation as described under definition part of cable specification.

D.6.6 Installation, Testing & Commissioning

- Cables shall be stored in a dry covered place to prevent exposure to climate conditions and wear and tear of wooden drums and it should be preferably concrete surface.
- All drums should be stored in such a manner as to leave sufficient space between them for air circulation. It is desirable for drums to stand on battens directly placed under the flange.
- In no case should the drums be stored "on the flat" i.e. flange horizontal.
- Both ends of the cables shall be properly sealed with PVC/Rubber caps so as to prevent ingress of water, miniaturization of cores and armors during transportation, storage and erection.
- On receipt of cable drums visual inspection of drums should be carried out for any damages to these cables.
- While unloading the cables certain precautions are to be taken to ensure the safety of cables. The cable end to be opened on one side and tested for its insulation and continuity.
- The cable drums should not be dropped or thrown from the trucks/railway wagons etc. during unloading operations as shock may cause serious damage to cable layers.
- A crane may be used for unloading cable drums. While lifting the cable drums with crane, it is recommended that the lagging should be left in place to prevent the flanges from crushing on the cables.
- the earth surface. Drums should be rolled in the direction of arrow only.
- For laying of cables special care is to be taken to prevent sharp bending, kinking, twisting.
- Cable should be unwound from drum by proper mounting the cable drum on a cable wheel making sure the spindle is strong enough to carry the weight without bending and that it is lying horizontally in the bearings, so as to prevent the drum creeping to one side or the other, while it is rotating.
  b. Copper conductor cables: 5 Kg/mm2
- Special care is to be taken while laying cable at bends. Following are the recommended bending radius for power and control cables.

Sr. No.	Voltage rating (kV)	PVC / XLPE cables	
		Multi core	Single core
1	Up to 1.1 kV	12D	15D
2	Above 1.1 kV to 33 kV	15D	15D

D = D is over all diameter of cable.

- Armored cables are to be laid on cable trays/ underground as per relevant

design drawing and specifications.

- All flexible cables shall be laid inside exposed / canceled conduits (rigid / flexible)/ raceways or as per relevant design drawing and specifications.
- After the cable trench has been properly excavated and straightened, it shall be covered with 100 mm thick layer of sand, the cable shall then be lifted and placed over the sand cushion.
- It may be planned to lay down the cables in stacks under the trench and under such circumstances, cables shall be laid with the help of angular supports or cable trays suitable to take the load of the cable.
- In case the cable is laid with the help of angular supports inside the trench, such supports shall be provided at a regular intervals so that the cable does not sag due to its weight.
- After laying the cable the complete trench shall be filled with sand / earth up to 200 mm depth from the ground level.
- A layer of silver sand along with a good quality caution tape with warning written in Hindi and regional language shall be laid throughout along the length of the trench at this level to indicate that electrical cables are running below and the area shall not be further excavated without suitable precautions and permissions.
- The complete trench may then be backfilled with earth up to ground level.
- Riggers shall ensure that while laying, the cable should not be subjected to any form of damage. Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable.
- The cables shall not be laid in such a fashion that one cable crosses over the other. Proper spacing shall be left between two cables as mentioned in the GFC or as specified or directed by engineer-in-charge.
- Drain points shall be ensured inside these trenches so that in case of water logging, the water ejects out through these drain points as a result of natural gradient provided.
- Man-holes shall be provided at strategic locations so as to ease the pulling of cables and maintenance. The manhole shall be covered with suitable covers of mentioned material and dimensions as per GFC.
- When laid in cable trays above ground, power cables to be placed at the bottom most layer and control cables at the top most layer. In case of multi core power cables, cables shall be laid side by side with spacing not less than half the diameter of larger cable.
- Multi-core cables shall be clamped by means of mild steel galvanized saddles. All cables below 1.1 KV single core cables if any should be clamped by means of non-magnetic saddles.
- The saddles / clamps shall not be placed at the intervals more than 1500 mm for horizontal and 1200 mm for vertical runs.
- Multi core control cables can be laid touching each other in cable racks and wherever required may be taken in two layers. These cables should be clamped by means of PVC straps for horizontal and vertical runs. Fabricated aluminum clamps may be used at regular intervals.
- All the cable shall be properly identified at regular intervals and care shall be exercised in laying cables to avoid forming kinks.
- The relative position of the cables, laid on the cable tray shall be preserved and the cables shall not cross each other.
- At all changes in direction in horizontal and vertical planes, the cable shall

be bent smooth with a radius as recommended by the manufacturers.

- All cables shall be laid with minimum half diameter gap and shall be clamped at every meter to the cable tray and shall be tagged for identification with cable tag and clamped properly.
- Tags shall be provided at both ends and all changes in directions both sides of wall and floor crossings.
- All cable shall be identified by embossing on the tag the information as laid down under this specification.
- If there is a need to joint the cable due to finishing of cable in cable drum such joints shall be made through the approved straight through joints and jointing kits as directed by and approved by engineer-in-charge at site.
- Cables shall be fully tested (both type and routine test) as per the specification laid under Indian standards. In particular following test shall be done at site.
  a. Insulation resistance test.
  b. Continuity test.

D.6 LT PANEL

D. 6.1 Scope

The scope of work shall include :

1. Supplying, installation testing and commissioning of LT Panels for :

- Main receiving station.
- Central power station.
- All distribution substations.
- All CHP stations.
- All solar stations

2. Panel handling, loading unloading and storage.

3. Associated inter panel and intra panel wirings including both ac and dc wirings as well as control cabling, from panel to panel and from panel to DB.

D.6.2 Definitions

The definitions shall be as per IEC-61439 and other relevant IEC standards.

D.6.3 Codes & Standards

The contractor is required to follow all relevant IS and IEC codes as per latest amendments, however in particular following codes may be applied in addition.

1. IEC-61439 - Standard for low voltage switchgear and assemblies.

2. IEC-60044 - Standard for instrument transformer.

3. IEC-60099- Standard for surge arrester.

4. IEC: 60255- Measuring relays and protection equipment.

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5. IEC -60947 - Low voltage switchgear and controlgear.

6.IS 2147 - Degrees of protection provided and enclosures for low voltage switchgear and control gear

7. IS 375 - Marking and arrangement of bus bars.

8. IS 13703-1993- HRC Fuse Links

9. IS 2705- Current Transformer

10.IS 3231- Relay

11.IS 1248- Indicating Instruments

12.IS 722- Integrating Instruments

13.IS 6875- Control Switches & Push Buttons.

14. NEC- 2008 - National electrical code.

15. NBC-2016 - National building code.

16. IER-1956 : Indian electricity rules.

17. IEA-2007 : Indian electricity act 2007

18. Any other local bye-law or supply company norm as applicable.

D.6.4 Service conditions

System particulars

a. Nominal system voltage - 415V

b. Rated system voltage - 1.1kV

c. Frequency - 50Hz ± 3%

d. No. of phases - 1

e. System neutral - Solidly earthed

f. Short circuit rating - 50kA for 1 sec

g. Automation compatibility : SCADA compatible

Tropical conditions

a. Ambient temperature : 40 degree celsius

b. Relative humidity (avg.) : 60

c. Isokeraunic level : 33

d. Seismic Zone : Zone-4

e. Climate type : hot and humid

The climatic conditions are prone to wide variations in ambient conditions and hence the equipment shall be of suitable design to work satisfactorily under these conditions.

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Tolerances and creepage distance

Tolerances (on all the dimensions) and creepage distances shall be in accordance with provisions made in the relevant Indian/IEC/BIS standards and in these specifications. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product.

D.6.5 Specifications

Panel Cubical Construction

- The complete panel assembly shall be a design verified assembly with design verification done as per IEC-61439.
- Panel fabricated out of 2mm CRCA sheet steel throughout and shall have undergone 7 tank process or better.
- Undrilled gland plates shall be 3mm thick. The gland plates shall have knock able type holes of suitable diameter of cable glands. Minimum 30% extra knock able holes shall be provided on each gland plate. Non-magnetic gland plates shall be used where single core cables are used for three-phase supply.
- The panel shall be self-supporting, free standing or wall mounted.
- The enclosure shall confirm to IP55 protection for outdoor panels and IP42 for indoor panels.
- The Panel shall be dust, vermin, corrosion proof and shall be mechanically stable to take the mechanical load of complete assembly with all fixed and moving components.
- The panel shall have appropriate protection against mechanical impact.
- The panel shall be extendable from both sides.
- The terminal blocks shall be provided at convenient location for cable termination. The distance between the terminal strip and gland plate shall be kept in such a way that the cables can be properly dressed & no cable tension is transferred on the terminal strip/or equipment.
- Proper grouting arrangement shall be made in panel for installation of panel in accordance with seismic requirement.
- Complete panel assembly shall be fixed on ISMC-100.
- The design shall ensure generous availability of space for ease of installation and maintenance of cabling, and adequate safety for working in one vertical section without coming into accidental contact with live parts.
- Front and rear doors should be fitted with synthetic rubber or neoprene gaskets with fasteners designed to ensure proper compression of gaskets.
- All sheet steel work forming the exterior of switch boards shall be smoothly finished, leveled and free from flaws. The corners should be rounded. The apparatus and circuits in the panels shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.
- Panel shall be constructed in form-3b methodology.
- All sheet steel work used in construction of panels shall be given for proper shot blasting/surface finish to make it free from all rusts/impurities/deposits.
- It shall be then provided with two primer coat and then/powder coated (electro-statically) with final paint shade RAL7032 as per IS ‐ 5.

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- It shall be the process of Powder Coating with suitable primer and having total coating thickness of 85-100 micron. The M.S Sheet Steel shall be given for proper shot blasting / surface finish to make it free from all impurities.
- All sheet steel work used in construction of panels should have undergone a rigorous metal treatment 7 tank process or better as mentioned below.
  a. All sheet steel work shall be phosphate in accordance with the procedure in accordance with relevant standards for phosphatizing iron and steel. Oil, grease and dirt shall be thoroughly removed by emulsion cleaning.
  b. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.
  c. A recognized phosphate process to facilitate durable coating of the paint on the metal surface and also to prevent the speared of rustling in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.
  d. After phosphatizing through rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying.
  e. Passivation in deoxalate solution to retain and augment the effects of phosphatizing.

Busbars and internal connections

- The selection, design and construction of bus bars shall conform to IS/IEC specifications and the latest amendments.
- Busbars shall be designed to carry rated currents during both steady state and transient conditions.
- The bus bars shall be air insulated and made of high conductivity, high strength electrolytic grade aluminium.
- Bus bars shall be located in air-insulated enclosures and segregated from all other compartments of the cubicle.
- Direct access or accidental contact with bus bars and primary connections shall not be possible.
- Bus bars shall be rated in accordance with service conditions and the rated for continuous and short time current ratings specified in SLD / data sheets.
- Busbars shall be design for a temperature rise of 50 degree celsius above the ambient temperature, while for all bolted connections of bus it shall be 55 degree celsius.
- The busbar shall be designed for a temperature of 190 degree during transient conditions.
- Bus bars shall be adequately supported on SMC/DMC insulator supports to with stand electro dynamic stresses due to short circuit currents.
- Bus bar support insulators shall be of non-hygroscopic material and shall confirm to relevant IS standards.
- The current density of the bus bars shall not be less than 0.8 Amp / sq mm.
- Bus bars should be color coded for easy identification of individual phases and neutral.
- All the bus bars should be provided with color coded heat shrink sleeves.
- A main horizontal aluminum grounding bus, rated to carry maximum fault current, extending along the entire of the panel shall be provided.

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- The ground bus shall be provided with two-bolt drilling with GI bolts and nuts at each end to receive the main Earthing grid.
- The size of the earth bus shall be as mentioned in drawings and schedules
- Important parameters for complete panel assembly shall be as follows :
  a. Voltage - 240V ± 6%
  b. Frequency - 50hz ± 3%
  c. No. of Phases - 3 + 100% Neutral + Earth bus
  d. Peak Impulse Voltage - 12KV
  e. Power frequency withstand capability - 2KV
  f. Short circuit withstand capacity - 50kA for 1 second
  g. Type of discrimination required among switchgears - Total discrimination
  h. Min clearance and creepage distance - As per IEC-61439
  i. Dimensions : As per approved type tested design.

- Control wiring for all control circuit shall be done as follows :
  a. Each control circuit shall be protected with the help of fuse in the phase and neutral shall be provided with suitable neutral links.
  b. Control wiring shall be done with 1.1kV grade FRLS type control cables tested for power frequency withstand of 2kV.
  c. All voltage circuits shall be wired with 1.5sqmm cu control cables.
  d. All current circuits shall be wired with 2.5sqmm cu control cables.
  e. Control wiring shall be done neatly with proper dressing and ferruling done.
  f. Control wiring shall be color coded appropriately.
  g. Terminal links used for control wiring shall be of good quality and shall withstand the temperature.
  h. All connections must be be tight.

- Power wiring for main circuit shall be done as follows :
  a. Switchgears of 100A rating and above shall be connected by the means of suitable busbars only.
  b. Cable terminal blocks used for power cable termination shall be suitable to withstand the temperature rise due to steady state and transient currents.
  c. All connections must be tight.

Safety features and Interlocks

- The safety shutter shall be provided in breaker panels, which shall prevent in advertent contact with isolating contacts when breaker is withdrawn from the Cradle.
- Door interlocking shall be provided in each switchgear compartment with a provision of defeat interlock .
- All panel doors shall have provision of padlocking.
- Insulating barriers shall be provided in all live sections of the panel.
- There shall be provision of positive earth connection between fixed and moving portion of the ACB either through connector plug or sliding solid earth mechanism.
- Earthing bolts shall be provided on the cradle or body of fixed ACB.

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- Arc chute covers shall be provided wherever necessary.
- In case of drawout type switchgears safety shutters shall be provided to fully cover the live section automatically once the switchgear is being draw out
- It shall be possible to bolt the draw-out frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration.
- There shall be provision for locking the breaker in all three positions.
- The breaker shall be provided with interlock to prevent the breaker from being withdrawn or replaced except in the fully isolated position.
- Interlock shall also be provided to prevent the breaker from closing without in service position.
- Space heaters triggered by thermostat shall be provided in cable compartments to avoid moisture.
- Lamp operated with a door limit switch and a toggle switch shall also be provided in panel compartments along with 6/16A witch socket for ease of maintenance

Circuit Breaker (CB)-If required otherwise as per OEM practice

- As per standard
- / features :
  a. Rated voltage - 690V
  b. Rated frequency - 50Hz
  c. P.I.V - 12kV
  d. Rated short circuit capacity - 50kA for 1 sec.
  e. Poles - Four pole
  f. Temperature deration : No deration upto 50 degree celsius (In case deration is applicable, higher rating switchgear shall be provided)
  g. Self watt loss : As per IEC-60947
  h. Total breaking time : less than 70ms
  i. Closing coil : suitable for 230V AC
  j. Shunt coil : suitable for 230V AC
  k. Drawout type : Electrical
  l. Spring charge operation : Through 230V AC motor as well as through handle.
  m. Antipumping feature : Required and shall be inbuilt.
  n. Ics = Icu = Icw = 100%
  o. Spare contacts required : 4NO + 4NC
  p. Indications : On, Off, Trip, Spring Charge, Ready to close
  q. Undervoltage coil : As per design requirement.
  r. Time delay (td) - 0-400 m sec
  s. Inbuilt thermal memory

- Release of ACB shall have following parameters / features :
  a. Protections : L,S,I,G
  b. Setting options : L - 40%-100% In (nominal current rating) = Ir
  S - 2 x Ir to 10 x Ir
  I - 6 x In to 12 x In
  G - 10% ,20% , 50% , 100%
  c. Release type : microprocessor based.
  d. Zone selective interlocking - required.

e. Communication : Fully communicable and shall be equipped with RS-485 port.
f. Memory : Non volatile memory to record 10 trip histories and 10 alarm history.
g. Alarm and indications : Visual indications for % loading in each phase, L,S,I,G fault, release failure
h. Release shall be capable to generate remote alarm in case of any internal fault and Spare contacts shall be provided with release to do so.

Moulded Case Circuit Breaker (MCCB) –IF required otherwise as per integrator or manufacturer or impaled agency in MNRE

- MCCB shall be mechanically rugged and shall be designed to carry steady state current and also transient current up to the time arc gets quenched.
- MCCB shall be provided with door operating mechanism having interlock, defeat and padlocking facility.
- MCCB should trip free, quick make and quick break type and should be equipped with a current limiting feature.
- MCCB shall have spreader links and terminal shroud as a feature for safety and proper heat dissipation.
- MCCBs shall have double break mechanism.
- MCCB shall have following parameters / features :
  a. Rated voltage - 690V
  b. Rated frequency - 50Hz
  c. P.I.V - 12kV
  d. Rated short circuit capacity - 25kA (minimum)
  e. Poles - Four pole
  f. Temperature deration : No deration upto 50 degree celsius (In case deration is applicable, higher rating switchgear shall be provided)
  g. Self watt loss : As per IEC-60947
  h. Total breaking time : less than 40ms
  i. Shunt coil : suitable for 230V AC
  j. Drawout type : Non withdrawable (fixed type)
  k. Ics = Icu = 100%
  o. Spare contacts required : 2NO + 2NC
  p. Indications : On, Off, Trip
  q. Undervoltage coil : As per design requirement

- Release of MCCB shall have following parameters / features :
  a. Overload setting (L) 0.4-1 x In
  b. Short circuit setting (with time delay)(S) 2 ‑10 x Ir
  c. Time delay (td) 0-400 m sec
  d. Short circuit setting (Instantaneous) (I) 11 x In
  (Where In = nominal current of MCCB & Ir = rated current to which it is set.)
  e. Ground Fault Setting with time delay (0-300ms) (G) : 0.1-1 x In
  f. Neutral setting (N) (where ever required): 0.5-1 x In
  g. Release type : microprocessor based
  h. Communication : Fully communicable and shall be equipped with RS-485 port.
  i. Memory : Inbuilt thermal memory.
  g. Alarm and indications : Visual indications for L,S,I,G fault

h. Release shall be capable to generate remote alarm in case of any internal fault and Spare contacts shall be provided with release to do so.

Contactors (If required otherwise as per standard/ manufacturer/Impawned agency/ integrator practice)

- All contactors and bi-metal relays should conform to IS - 13947 - 4/IEC - 947-4 standards.
- Contactors should be suitable for requisite duty and the contactor shall be designed to operate even in severe operating conditions.
- The Contactors shall be suitable for switching and controlling squirrel cage and slipping motors as well as other AC loads such as solenoids, capacitors, lighting loads, heating loads and transformer loads.
- The contactors shall be suitable for operation in service temperature up to 50 degree C without derating.
- The contactors and bimetal relays shall have been tested for type-2 co-ordination at 50 KA, 240/415 V 50 Hz as per IS 13947 for both fuse protected as well as fuse-less motor feeders.
- The contactor shall have coil of 220/240 V AC or as may be specifically asked for.
- The design of the current carrying parts, contact system and the magnet system should be such that it should increase reliability of electrical and mechanical endurance.
- Auxiliary contact should have double break parallel bridge contact mechanism. For operator safety the contactors above 45 Amp should have arc-chamber. The construction of the arc chamber should be such that there is no emission of arc by-products on the surrounding equipment.
- The contactor shall have funnel shaped cable entries, cable end stops and predetermined insertion depths.
- Contactor below 63 Amp shall have captive screws preventing the screws from falling.
- Main contacts should be of silver alloy to have long contact life; it should withstand to keep the contact bounce to minimum and should be shrouded with an arc chute.
- Both moving and fix contacts should be accessible for inspection or replacement without disturbing terminal wiring.
- The magnet system should have laminated, construction to minimize the losses.
- Coils should withstand high temperature and ensure low power consumption. Coil should be resin cast/encapsulated. It should have inter layer insulation.
- Contactor should have facility to mount add-on auxiliary contact block. Mechanical interlocks should be provided for sequential operations if required.
- Contactor should be comfortably mounted in any position on a vertical plane. Contactor should be capable of handling high transient currents.
- It’s Insulation voltage level should be – 1000 v. Contactor shall be designed to have mechanical endurance of the order of minimum 15 million operations or better.
- Contactor should operate without deration from - 30° C to +50° C

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Current Transformer

- Current transformers shall comply with the requirements of IS. 2705.
- The current transformers shall be core type with cast resin/encapsulated secondary winding.
- CTs shall withstand stresses originated from short circuit for 1 sec. These shall be mounted on the switchboard stationary part.
- The secondary CT leads from all panels should be terminated on the front of the board on easily accessible shorting type terminal connectors so that operation and maintenance can be carried out when the panels are in service.
- CT’ s shall be given heat run test.
- CT shall have following parameters / features :
  a. Rated voltage - 415V
  b. Rated frequency - 50Hz
  c. Class : 0.5 (for metering) / 5P10 for protection / PS for unit protection
  d. Rated short circuit capacity - As per fault level
  e. Construction - Ring / wound type
  f. Burden - As per SLD
  g. Rated secondary current : 5A

Control switches

- Control Switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position.
- They shall be semi-flush mounting with only the front plate and operating handle projecting.
- Circuit breaker control switches shall be of the spring return to neutral type, while instrument selector switches shall be of the stay-put type.

Push Buttons

- Push buttons should be of the momentary contact, push to actuate type.
- Push Buttons should be panel mounted, flush type having 22.5 mm Ø.
- Push Buttons should be spring returns type.
- Lock and key head with Push turn facility.
- Modular blocks should contain NO-NC contact.
- It should be snap-fit type for easy assembly.
- Double break self-cleaning contacts for prolong life.
- NO-NC contact block should be colour coded for easy identification.
- Push Buttons should have transparent shroud and rubber shroud to enhance protection against ingress as per IP- 67.
- It should withstand operating voltage as well as frequent operation.
- It should have finger proof shrouded terminals.

Terminal Blocks

- Insulating barriers shall be provided between adjacent terminals. CT Terminal blocks shall be shorting type.
- Terminal blocks shall have a minimum current rating of 10 Amps & 650 volt grade rating complete with insulated barriers. Provisions shall be made for label inscriptions.

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- It should have snap fit action.
- It should have captive-screws and self-lifting washers.
- Withstand temp range from -30° C to 100° C.
- Terminal Connectors should have flame retardant property confirming to UL-94, V-2.
- Terminal Block should be suitable for commonly used DIN Rail - 35 X7.5 mm and mounting channel 'C' shaped Std.32 mm.
- Terminal Block should be suitable for commonly used DIN Rail - 35 X7.5 mm and mounting channel 'C' shaped Std.32 mm.
- The construction material should be of high quality like polyamide 6/6 and contacts of Nickel plated brass. Labels shall be of anodized aluminum, with white engraving on black background.
- They shall be properly secured with fasteners.

Digital Energy Meter

- The load manager shall be micro-controller based unit capable to measures a host of electrical parameters and display them on a 128 x 64 backlit LCD.
- It shall have load management feature and shall have six numbers of output relay contacts apart from CT/PT contacts.
- These outputs shall be individually field programmable for both the parameter on which to generate alarm as well as the values on which to activate alarm and deactivate it.
- In addition to this flexibility in terms of load management, the load manager shall also have RS485 port. RS485 supports MODBUS RTU protocol for connections to EMS/SCADA.
- The Load Manager with its six relay contacts shall be capable to be used as a Demand Controller. The method of Demand calculation i.e. sliding window, fixed window shall be selected at site. The device shall have all the features needed to implement a robust electrical load management system. This load manager will be optional for the contractor. This is not mandatory and hence the University cannot force. In-order to maintain the efficiency and basic required of power backup as explained for the separated critical load, the contractor may provide free of cost.

- It shall be programmable / configurable to suit most control and communication needs. The load manager shall be capable to measure following parameters:
  1. Voltage (Volts L-N & L-L) VL-N Accuracy: 0.5% of Reading VL-L Accuracy: 1.0% of Reading.
  2. Current (Amps IR, IY, IB) Accuracy: 0.25% of Reading.
  3. Line Frequency 45 to 55 Hz, Accuracy: 0.3% of Reading.
  4. Active Power (P) Accuracy: 0.5% of Reading (For IPFI>0.5).
  5. Reactive Power (Q) Accuracy: 1.5% of Reading (Between 0.5 Lag to 0.8 Lead).
  6. Apparent Power (S) Accuracy: 0.5% of Reading.
  7. Power Factor For Individual phases and System. Accuracy: 0.5% of Reading (IPFI≥0.5) Range of Reading: 0.05 to 1.000 Lag/Lead.
  8. Total Active Energy (KWh) Range of Reading: 0 to 9999999.9 KWh

Accuracy: Class 0.5 as per IS14697.
9. Total Apparent Energy (KVAh) Range of Reading: 0 to 9999999.9 KVAh Accuracy: Class 0.5 as per IS14697.
10. Total Reactive Energy (KVARh) Range of Reading: 0 to 9999999.9 KVARh Accuracy: Class 0.5
11. 3 rd to 15 th Harmonics(Odd) for all Voltages with THD.
12. 3 rd to 15 th Harmonics(Odd) for all Currents with THD.
13. Active Power (KW) Demand - Sliding & Fixed, Selectable.
14. Apparent Power (KVA) Demand - Sliding & Fixed, Selectable

- The device shall also have following features:
  1. Display 128 X 64 Graphical LCD with Operating temp 10° C to 50° C.
  2. Data Logging Buffer 2 MB, Non-volatile memory, capable of holding 19691 records Logging Duration Site selectable.
  3. RS485 Modbus-RTU protocol
  4. Communication USB 8.0 Pen-drive For downloading logged data

E. INSTALLATIONS, TESTING & COMMISSIONING

- The complete Panel assembly shall be installed in accordance with the manufacturer's installation drawing duly approved by "The consultant "
- The panels needs to be grouted considering the seismic zone requirement.
- Panels shall be properly aligned and the leveled within tolerance of +/- 2mm and shall been sured with a water level indicator or a laser gun whichever available. No shim shall be allowed to make a panel level suitably.
- All live sections and compartments shall be covered with insulation barriers.
- All the components of the panel shall be easily accessible.
- The location of installation shall be cleaned and co-ordination shall be made with other disciplines.
- Grouting holes shall be provided from inside and the panel shall be suitably and tightly bolted. No tuck welding with base channel is allowed.
- Panels shall have peel-able poly layer on the cover for protection from cement, plaster, paints etc. during the construction period.
- The holes made in enclosure for cable termination or anything else shall be made only through drill machine or approved cutting tool with marking of dia done prior to cutting or drilling. Extra left out holes shall be filled neatly with fire retardant sealant.
- The Panel shall be tightly grouted. No spare nuts-bolts shall be left out un-tightened / open inside the DB enclosure in any case.
- Gland plates where ever used for cable termination shall be tightly fixed and shall be earthed.
- Size of Horizontal and vertical bus bars shall be equal.
- Switchgears above 63A shall be mounted on bus bars tightly and accurately.
- Termination lugs shall be tightly fixed and connected and there shall not be any bare wire strand jetting out of the lugs. Suitable crimping tool shall be used. And terminal wires shall be coved with heat shrinkable sleeves whose color coding has to match with the color of the wire used.
- Color coding shall be followed for internal wiring also in a similar pattern as described in chaper-1 wiring under the specification document. Bus bar shall be tagged for phase indication.
- Panel compartments shall be provided with space heaters and lights operated by door limit switches.
- Capacitors Panels shall be provided with fans controlled by door limit switch

and thermostat.

- The door of panel shall be aligned properly and there shall be no air gap left after closing the DB door. Gaskets shall be used to make DB free from moisture.
- Panel shall have Padlocking arrangement and shall be pad locked after complete installation.

Tolerances (on all the dimensions) and creepage distances shall be in accordance with provisions made in the relevant Indian/IEC/BIS standards and in these specifications. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product and MNRE guidelines.

Enclosed: Annexure I – Schedule of Quantities

Yours Sincerely

Registrar (Ofg)
Nalanda University, Rajgir
District – Nalanda, Bihar

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No. NU/Electrical/AJH/606 Dated:20th September 2017

Annexure I (Please submits this on the firm/bidder's letter head)

Schedule of Quantities for the providing and fixing of the following items:

	Particulars	UNIT	Qty	Unit Rat	Total Cost
1	Supply, Installation, Testing and Commissioning of Polycrystalline Solar Module made up of high quality laminated in ultra violet stabilized polymer material with a fill factor not less than 0.7 and suitable for continuous outdoor duty. The rate shall also include weather proof connectors, anodised channel frame, by pass diode and any other accessories required as per specifications or requirement. Output should not be 5KVA accordingly system must be designed . Here, 5KVA = 7143 W at 0.7pf . This is just for the Unit rate. Howeverr, Payment shall be made as per the actual basis. The PV modules shall be installed at the roof of the Ajatshatru Building from this roof to the Inverter location will be 75 Meter. This is including of all the basic structurer for PV modules at the Building roof.	LS	1		
2	Supply, Installation, Testing and Commissioning of IGBT PWM technology , outdoor type compact inverter of rating minimum 5KVA for with battery backup @7.2VAh/W with dual input and single phase AC output voltage 240 ± 1% volts & frequency 50 ± 0.5 Hz , String Type Off-grid inverter but dual charging input as explaned in the technical section.	Nos	1		
3	Power Copper cable with end termination unit like gland	Meter	50		
4	DC cables and wires	Meter	100		
5	Supply, installation, connections, testing & commissioning of 17.2 mm dia. rod of 3 meter length having copper bonding of 250 micron, along with 5 kg of maintenance free ground enhancing compound & shall comply as per IEEE 80:2000 Clause 14.5d with fused rod to tape clamp for interconnection of strip from earth pit to equipment.	Each	1		
6	Providing and fixing of lightning conductor finial , made of 25mm dia 300mm long Copper tube, having single prong at top, with 85mm dia 6mm thick G.I. base plate including holes etc. complete as required.	Each	1		

NOTE:

1. Above price should be inclusive of each and every charge. Nalanda University should not be liable to pay any extra charges beyond price quoted above. The statutory taxes shall be paid by the bidder. However, bidder may claim as per the actual and statutory compliance. The ED, CST/VAT and Entry tax shall or any other statutory taxes shall be applicable as per the guidelines of the Govt of India.
2. While quoting the prices, the quality of material and works shall be confirming to the applicable standards.
3. Rates in various tapering steps shall not be considered.
4. The offers, with rates given in any other format (other than mentioned above) may be liable for rejection.

Signature with stamp of the bidder

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(Name in full & Designation)

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