

# DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

## PACKAGE- 3B

TENDER FOR BIO GAS BASED CO-GENERATION ENGINE AND BIOMETHANATION PLANT FOR  
OUTREACH BUILDING AT PROPOSED PERMANENT CAMPUS (PHASE I)

OF

**NALANDA UNIVERSITY, AT RAJGIR, BIHAR.**



## TECHNICAL SPECIFICATIONS/REQUIREMENT

**NALANDA UNIVERSITY, RAJGIR, BIHAR.**

Every care has been taken while preparing this document to cover all necessary information, matters, specifications, general conditions, special conditions & provisions for smooth and complete execution of works. However, in case of any omission in the tender/ contract document, the most recent version of correction slips (as on 31<sup>st</sup> October 2019) of Electrical Specifications for CPWD Works shall be the reference manual.

# DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

## Table of Contents

1. GENERAL UNDERSTANDING.....	5
2. AMBIENT CONDITION FOR DESIGN OF THIS PACKAGE.....	6
3. CHP WITH SYNCHRONIZING PANEL .....	6
A. GENERAL.....	6
B. Technical parameters .....	7
C. Performance Guarantee .....	8
D. RATED POWER OUTPUT AND SPEED:.....	9
E. Design & Construction.....	9
F. Inspection & testing.....	10
G. Preparation for shipment .....	10
H. Proposal:.....	11
I. Synchronization & load sharing panel.....	11
J. Scope .....	12
K. TRANSFORMER (Step UP Transformer).....	12
L. Codes and Standards .....	17
M. Performance Requirements .....	18
N. Short Circuit Conditions.....	18
O. Parallel operation .....	18
P. Excitation support system .....	18
Q. Design and construction.....	18
R. Excitation system.....	19
S. System operation .....	20
T. CHP control panel.....	20
U. Painting, Packing and Transport.....	21
V. Tests and Inspection.....	21
W. General Requirements.....	22
X. Protection.....	22
Y. Materials and Workmanship .....	22
AA. Technical data for Equipment's: .....	23
BB. Alternator data sheet.....	24
CC. GENERAL.....	24
DD. Synchronizing / AMF Panels.....	25
EE. Factory acceptance test: .....	25
FF. Statutory Approval .....	26

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

GG. VENDORS DATA: TO BE SUBMITTED DURING/AFTER DESIGN CONFIRMATION AS PER THE APPROVED MAKE LIST .....	26
HH. Statutory Approval.....	26
II. Schedule of Quantity: - In case of discrepancy in Drawings and BOQ, Drawings shall be final.....	26
JJ. Price Schedule .....	26
KK. Terms of Payment.....	26
LL. Delivery .....	26
MM. Guarantee.....	26
NN. Guarantee of Complete System.....	27
OO. Dispatch .....	27
PP. Statutory Approval .....	27
QQ. PERFORMANCE GUARANTEE .....	27
4. GAS CASCADE SYSTEM .....	27
5. BIO METHANATION PLANT .....	28
A. SCOPE OF WORK.....	28
B. Indian Standards Cited for the Biogas Plant .....	35
C. OUTPUT PARAMETERS .....	39
D. TESTING .....	39
E. Payment Terms:.....	40
F. PERFORMANCE GUARANTEE.....	40
6. ELECTRICAL WORKS SPECIFICATIONS.....	40
6.1. Battery charger cum DCDB .....	40
6.1.1. Scope .....	40
6.1.2. Definitions.....	40
6.1.3. Codes & Standards.....	40
6.1.4. Service conditions.....	41
6.1.5. Specifications .....	41
6.1.6. Installation, Testing & Commissioning.....	43
6.2. UPS .....	43
6.2.1. Scope .....	43
6.2.2. Definitions.....	43
6.2.3. Codes & Standards.....	43
6.2.4. Service conditions.....	44
6.2.5. Specifications .....	45
6.2.6. Rectifier.....	47
6.2.7. Inverter .....	48
6.2.8. Isolation transformer and bypass switches .....	50

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

6.2.9. Battery system .....	51
6.2.10. Operation .....	52
6.2.11. Control and monitoring.....	53
6.2.12. Installation, Testing & Commissioning.....	53
6.3. Cable trays.....	54
6.3.1. Scope.....	54
6.3.2. A.6.2 Definitions.....	54
6.3.3. Codes & Standards .....	55
6.3.4. Service conditions .....	55
6.3.5. Specifications .....	55
6.3.6. Installation, testing and commissioning.....	56
6.4. Relay .....	56
6.5. Multifunction meter.....	58
6.6. Analog voltmeter.....	59
7. CIVIL WORKS SPECIFICATIONS .....	59

# DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

## 1. GENERAL UNDERSTANDING:

- A. The General requirement of the University is described herein.
- B. The detail of the technical specification will be approved during the design confirmation post.
- C. Tendering and after issuance of the Letter of Award on the NIT terms and conditions.
- D. Brief requirements are mentioned below:

- i. CHP (a) 200KWe- Biogas based Engine with hot water recovery arrangement at 85 to 90 deg Cel or as per the design confirmation for its optimal temp recovery at least through jacket water. Generation at 415V/LT level with panels confirming to the tender drawings and operation table mentioned in the same

(b) 1000KWe– Dual fuel based (PNG & Biogas both) with hot water recovery arrangement at mix point 90 deg Cel or as per the design confirmation for its optimal temp recovery FROM BOTH i.e. through EXHAUST and Jacket. Generation at 415V/LT level with divert panels provision, and step up transformer with its necessary HT Panel confirming to the tender drawings and operation table mentioned in the same.

- ii. Biogas Plant /Digester System including feed handling in the University Campus based plant designed and developed by the successful bidder. The design will be confirmed by the university on the NIT terms and Conditions. The digester will be RCC or good quality of the FRP as per the standard industry practice duly approved by the University.

- iii. All the panels will be SCADA communicable.

- iv. **Operation and Maintenance:**

- A. Requisite quality and quantity of the biogas generation and supply to the University. This includes operation and maintenance of the biogas plant as well and gas cost will be including this. The Plant supply cost will be including replacement during DLP and major comprehensive maintenance of the plant as well.
- B. Comprehensive -AMC with onsite manpower support to undertake continuous run of the CHP engine. The cost of the major enquired during operation and maintenance of the CHP engine to be considered under the supply cost. The spares and consumables required during O&M will be considered under CAMC for which separate cost under onsite support will be given in the BOQ. The Plant supply cost will be including replacement during DLP and major comprehensive maintenance of the plant as well.

# DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

## 2. AMBIENT CONDITION FOR DESIGN OF THIS PACKAGE

All the components in the package shall be designed considering the ambient condition of the site as follows.

- a. Ambient temperature : 50 degree Celsius
- b. Lowest Ambient Temperature for heating requirement; 5 Degree Celsius
- c. Relative humidity (avg.) : 60
- d. Isokeraunic level : 33
- e. Seismic Zone : Zone-4
- f. Climate type : hot and humid

All the components which comes under the design scope of the contractor shall be designed considering the above conditions. The Vetting of the system design including detailed design of all the components including quantity confirmation (final SOQ as per design in consultation of the university) shall be done before commencement of work by the contractor.

## 3. CHP WITH SYNCHRONIZING PANEL

### A. GENERAL:

- a. This general specification defines the minimum requirements the design, supply, installation, testing and commissioning of CHP engines for educational institute purposes. The rating of Engine is majorly as per the site requirement, however, the supplier may offer higher rating of the CHP Engine and there will be no any price advantage.
- b. The construction, design and rating of the CHP engine shall meet fully, the requirements of the specified driven machine and the Vendor shall select and provide the requisite ancillaries and controls with the gas engine for its safe and satisfactory operation.
- c. No deviations or exceptions from this specification shall be permitted without the written approval of the purchaser. Intended deviations supported by reasons, there of shall be separately listed by the vendor and submitted with the bid for the consideration of the Purchaser.
- d. Compliance with this specification shall not relieve the vendor of the responsibility of furnishing equipment and accessories of proper design, materials and workmanship to meet the specified operating conditions.
- e. This general specification supplements the specific requirements contained in the attached equipment data sheets. In the event of any contradiction between the two, more stringent shall govern.
- f. Other attachments of the Material Requisition from an apart of this specification.
- g. The 200 KWe CHP shall run on Bio-Gas primarily while the 1000 KWe CHP shall have a dual fuel arrangement sothat it can run on Bio-Gas as well as PNG. At any point of time the engine will run either on Bio-Gas or PNG. Mixing of Gas is not allowed. The changeover shall be designed and done as per the manufacturers specifications.
- h. The CHP operation in Island mode as well as in synchronization with grid power is considered in this offer. Facility for synchronization i.e. parallel operation of CHP supply with grid supply as well as emergency DG power supply shall be provided / available. CHP shall be suitable for running in synchronization with grid supply as well as emergency DG power supply. Voltage signal before and after grid circuit breaker shall be provided **by Client**. Grid circuit breaker shall have shunt trip coil, under voltage coil / release (and not operated through under voltage relay), closing coil, service / test position, over load short circuit protection, potential free contact for breaker on / off position etc. Grid monitoring relay and check / auto synchronizing relay is covered under contractor's scope of supply.
- i. The CHP shall be provided with acoustical enclosure with minimum 1.5 meter working space around the engine within the enclosure. The panels for the CHP shall be housed within the enclosure. The Enclosure shall be with acoustical lining so that there is sufficient sound dissipation as per applicable IS CODE.

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

### j. Terms and definitions:

- The Net Calorific value of bio-gas is defined as the heat resulting from the complete combustion of a unit quantity of bio-gas. A net calorific value of 5000 Kcal/m<sup>3</sup> (to be confirmed at site) shall be considered while declaring the bio-gas consumption and for testing purposes. NCV for Natural Gas is considered at 8500 Kcal/m<sup>3</sup>. The Gas pressure shall be maintained as per the CHP requirement.
- |                          |  |
|--------------------------|--|
| Required Component       | % Volume   |
| Methane Approx.          | CHP should run with 100% efficiency on 40% to 65% of methane gas content in biogas |
| Carbon Dioxide Approx.   | 40% to 45%   |
| Hydrogen Sulphide        | Less than 1%   |
| Bio-gas gas availability | On continuous basis  |
- The unit of horse power as defined in this specification is the metric horse power equivalent to 4,500 n-Kg/Min. The horse power in F.P.S. system is equal to 1.014 metric horse power.
- Other terms used in this specification or in the equipment data sheets are as defined in the latest edition of British Standard-5514.
- Generating electrical output of 200 kW / 1000 KW as per BOQ, at 415 V, unity power factor, 50 Hz, and at the **Alternator** terminals. Electric efficiency should be greater than 38% at 100% load.

### B. Technical parameters

All data in the technical specification are based on engine full load (unless stated otherwise) at specified temperatures and the methane number and subject to technical development and modifications. All pressure indications are to be measured and read with pressure gauges (psi.g.).

- Mechanical output** is at nominal speed and standard reference conditions ICFN according to DIN-ISO 3046 and DIN 6271, respectively
- Power output given above is** According to DIN-ISO 3046 and DIN 6271, respectively, with a tolerance of +5 %. Efficiency performance is based on a new unit (immediately upon commissioning). Reference Methane percentage of 65% in the Fuel gas.
- Lube oil consumption value to be** average value between oil change intervals according to maintenance schedule, without oil change amount
- Electrical output mentioned above is** at p. f. = 1.0 according to VDE 0530 REM / IEC 34.1 with relative tolerances
- Total output with a tolerance of ±5 %.
- Exhaust gas temperature with a tolerance of ±2 %.
- Ambient Condition:

Season	Dry Bulb Temp	Wet Bulb Temp	Relative Humidity
Summer	112.3 °F (44.6 °C)	73.9 °F (23.3 °C)	15.8 %
Monsoon	92.1 °F (33.4 °C)	84.5 °F (29.2 °C)	73.4 %
Winter	40.9 °F (5.0 °C)	39.9 °F (4.4 °C)	92.1 %

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

### h. Intercooler heat on:

- Standard conditions (Vxx) - If the turbocharger design is done for air intake temperature > 30°C w/o de-rating, the intercooler heat of the 1st stage need to be increased by 2%/°C starting from 25°C. Deviations between 25 – 30°C will be covered with the standard tolerance.
- Hot Country application (Vxxx) - If the turbocharger design is done for air intake temperature > 40°C w/o de-rating, the intercooler heat of the 1st stage needs to be increased by 2%/°C starting from 35°C. Deviations between 35 – 40°C will be covered with the standard tolerance.

- **Definition of output**

ISO-ICFN continuous rated power:

Net break power that the engine manufacturer declares an engine is capable of delivering continuously, at stated speed, between the normal maintenance intervals and overhauls as required by the manufacturer. Power determined under the operating conditions of the manufacturer's test bench and adjusted to the standard reference conditions.

Performance gas Standard reference conditions:

- a. Barometric pressure: 1000 mbar (14.5 psi) or 100 m (328 ft) above sea level
- b. Air temperature: 25°C (77°F) or 298 K
- c. Relative humidity: 30 %
- d. Volume values at standard conditions (bio-gas gas, combustion air, exhaust gas)
- e. Pressure: 1013 mbar (14.7 psi)
- f. Temperature: 0°C (32°F) or 273 K

### C. Performance Guarantee:

#### a. Performance Guarantee:

Biogas based Genset have been designed for operating performance parameters specified herein. However, they are depending on the scope of supply finally selected at the time of the placement of order. The guarantee parameters would depend on strict adherence to the operating and maintenance instructions issued by the manufacturer.

#### b. Performance guarantee figures:

Specific Fuel Consumption (SFC): **To calculate with NCV 5000 kCal/m<sup>3</sup> for Bio Gas and 8500 kCal/m<sup>3</sup> for Natural gas**

Power Output : 200 kW & 1000 KW electrical as per BOQ Description.

Hot water Output : 90 Deg C (Supply Water) & 85 deg C (return water)

Jacket for heat recover and hot water generator shall be provided along with the CHP by the vendor.

The above performance is based on following parameters

- Power output at 100% steady load, 415V, p f 1.0 and 50 Hz.
  - The above SFC is subject to tolerance of +5% According to DIN-ISO 3046 and DIN 6271. Reference Methane percentage of 65% in the Fuel gas.
  - Subject to Technical Parameters of this offer.
  - Tolerance of gas flow meter not considered.
- c. Performance trial of Genset will be conducted for 4 hours for electrical power output on 100% steady load and SFC shall be established based on the average of 4 readings taken at an interval of 15 minutes every hour during trial.



## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

### D. RATED POWER OUTPUT AND SPEED:

- a. The gas engine rating shall be the net output in **Kilowatt**, which the engine is capable of delivering continuously at the stated crank shaft speed under the conditions specified, provided the engine is maintained in good operating condition and is service/ overhauled regularly as per the schedules laid down by the Manufacturer.
- b. No negative tolerance shall be allowed on the gas engine rating specified by the Vendor in the equipment data sheets.
- c. The gas gensets shall not be overloaded more than 100%, since gas gensets are meant for base load operation and cannot be overloaded. The CHP will have automatic over load protective unit. Here over load means – load more than 100%
- d. The normal power requirement of the engine driven radiator fan or the coolant pump and the battery charging dynamo shall be clearly stated for the engine which is so equipped.
- e. Unless otherwise specified in the equipment data sheets, the site rating of the engine shall be worked out considering the duration's specified under the latest edition of B.S.-5514 and the power absorbed by all the engine driven ancillaries shall also be deducted.

### E. Design & Construction:

#### a. General:

- The Gas engine offered shall be of the regular production models of the manufacturer for industrial applications and already type tested either at the manufacturer's works or outside. The type test report shall be furnished to the purchaser for his review if so desired.
- Unless otherwise specified in the equipment data sheets, the gas engine shall be provided with class A2 governing as per the latest edition of B.S. 5514.
- The "Cyclic irregularity" of the gas engine for direct coupling to an electric CHP, "angular deviation of p73 A.C. CHPs" driven by gas engine for parallel operation, and the "engine governor speed droop characteristics", shall be restricted to the values specified under the latest edition of B.S.-5514.
- The vendor shall be responsible for carrying out torsion analysis of the dynamic system as specified in the latest edition of British Standard-5514. The results in the form of a report shall be submitted to the purchaser for scrutiny and reference, if desired.
- Vendor shall provide the flexible exhaust connection /s to connect the engine exhaust to the exhaust piping. The required size of the exhaust piping should be clearly specified by the Vendor.
- If specified, the common base plate for mounting the gas engine and the driven equipment as well as the flexible coupling, shall be supplied by the vendor.
- Vendor shall indicate in the bid, the ISO Noise Level rating i.e. 83 dB at 3-meter distance **from the surface of Acoustic Enclosure**, of the gas engine with the offered exhaust silencer/s.

#### b. Engine starting:

- Gas engines shall be capable of starting without the use of cold starting aids so long the ambient temperature at the site is not below 4°C. The vendor shall provide suitable cold starting aids with gas engine for quick starting below 4°C of ambient and such aids shall be clearly detailed out along with the offer.
- The battery charger if specified in the equipment data sheet, shall be capable of delivering a current equal to 100 percent of the 20- hour discharge rate of the battery and also equipped with charging rate selector device.
- Where the gas engine is specified / offered with compressed air starting, the Vendor shall also provide the air compressor driven by a gas engine / electric motor and equipped with necessary instruments and controls as specified in the equipment data sheets.

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

- The air receiver supplied by the vendor shall provide batteries and battery charging equipment for operating the electrical controls of the gas engine.
- If as specified in the data sheets, the gas engine is required to start / stop automatically, the vendor shall provide the necessary controls (automatic-cum-manual) in the engine panel and the interconnecting wiring and piping from the panel to the engine and starting equipment. A pilot lamp shall be provided in the line side of the starting equipment circuit to indicate that the controller is in the automatic position. In the event the engine does not start after three attempts have been made, the controller shall stop all further cranking and operate the audio-visual alarm. A D.C. motor driven per lubrication pump with timer suitably interlocked with the starting system shall be provided by the vendor. Whenever the unit is arranging for automatic shutdown, a running period time set for a specific time interval, shall be provided.

### c. Engine cooling:

- Where the engine cooling is achieved by closed circuit cooling water system, the vendor shall provide the complete jacket water (primary water) circuit, heat exchanger circuit including but not limited to the following:
- Raw water pump with driver, unless the raw water is required to be obtained from the discharge of the pump driven by the gas engine.
- Instruments and controls as specified in the equipment data sheets.

### d. Engine bio-gas system:

- A bio-gas float (surge) tank if recommended by the manufacturer, shall be supplied with the gas engine along with its interconnecting piping / hoses.
- **Biogas holder of suitable retention time shall be provided.**

### F. Inspection & testing:

- a. The inspector representing Purchaser shall have entry to the plant while and wherever work for the equipment is being performed.
- b. The vendor shall have the responsibility of providing purchaser's inspector with all requisite facilities / equipment for carrying out satisfactory testing.
- c. The routine load and bio-gas consumption test shall be of the following duration:
- d. The hydrostatic test certificates for the heat exchanger / intercooler, bio-gas tanks and other pressure vessels shall be furnished to the purchaser's inspector for his review and approval at the time of load testing of the gas engine.
- e. The engine control panel/s after assembly and wiring, shall be functionally tested in the presence of the purchaser's inspector.

### G. Preparation for shipment:

- a. Immediately upon completion of all tests and inspections, all exposed machined surfaces shall be cleaned and coated with a suitable rust preventive by the vendor and the un-machined surface shall be painted by at least two coats of red oxide primer.
- b. Gas engines shall be transported assembled as far as possible.
- c. All untapped opening shall be provided with 4mm thick metal closures with full rubber gaskets and bolted by not less than 4 bolts. All connections including those for instruments, instrument leads, lubricating oil and the like shall be identified with securely attached tags indicating the type of connection, the instrument or the line description as applicable.
- d. The equipment shall be crated for domestic / export shipment as specified in the data sheets considering for storage at job site for at least 6 months. Lifting load-out, and handling instructions shall be securely attached to the exterior of the largest packing in a well-marked weather proof container. Upright position lifting points, weight (including packing and dimensions shall be clearly identified with item no., serial no.,

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

package no., and the names of the equipment.)

### H. Proposal:

- a. The proposals must include either a specified statement that all equipment is in accordance with the purchaser's specifications or exceptions, if any, to this general specification including attachments shall be clearly brought out by the vendor on separate sheets, supported with suitable reasons thereof for the consideration of the purchaser.
- b. Additions or exclusions from the scope of supply shall be clearly brought out on separate sheets giving reasons for such deviations for the purchaser's approval.
- c. Rating (HP) curves for the gas engine for different duties and their interpretation as per the applicable standard, shall accompany the proposal.
- d. The drawings and data as listed under "prints with Quote" on the vendor data requirement sheet attached with this specification, shall be provided.

### I. Synchronisation & load sharing panel

The Synchronising Panel as a System shall be provided with Synchronizing Relay & Load Sharing Relay & all required accessories including digital meters, transducers, sensors, sensor cables, control cables, hardware, software etc which shall facilitate Synchronizing & load sharing of Power between Local Sources (i.e. Grid, DG, Solar etc) & the CHP. This panel is to sense the load demand on down side, sense the source available, decide & give command to control the motorised electrical switchgears in the separately provided electrical panels as per requirement of synchronizing for the system. This Panel shall be completely SCADA compatible on IEC 61850 and shall be Automatic control module, microprocessor based and fully programmable with event logging and communications. Minimum Features shall as follows

(Note: Logic shall be set so in normal mode if load is up to capability of CHP than only CHP shall supply the power, if load increases than CHP + GRID shall supply the power in synchronizing & in case of grid failure based on load either (in priority) CHP shall feed the power or Dg Set + CHP shall feed the power in synchronizing to the load)

Controls:

- Start
- Stop/reset
- Auto
- Manual

Monitoring & Display:

- Voltage
- Amperage
- Frequency
- kW
- kVA
- Power factor

Functions and protections:

- Reverse power
- Dead bus sensing
- Voltage matching
- Frequency matching
- Phase angle matching
- Ramp control
- Blend control
- Circuit breaker closing contact
- Engine speed control

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

### J. Scope:

- a. This specification defines the requirements of design, manufacture, testing and supply of **self-excited** CHP complete with accessories as specified in the material requisition.
- CHP shall be supplied with **Brush less excitation system complete with AVR.**
  - **Housing of CHP, Common base frame, anti-vibrating isolators, flexible coupling for engine/alternator & painting as per manufactures standard.**
  - **Starting System like starting battery & battery charger.**
  - Automatic voltage regulator, CHP breaker.
  - Bio-gas storage system (**Gas holders**) & flexible gas pipe.
  - Electric panel including control cubicle and associated auxiliary devices, relay panel and CHP breaker battery and charger (unless otherwise specified).
  - **Jacketing for hot water generation at 90°C via heat transfer at exhaust line & engine jacketing.**
  - Lifting arrangement for the machine.
  - **Foundation frame complete with foundation bolts and base frame.**
  - **Acoustical enclosure for the entire CHP set which can house the CHP panel.**
  - Lube oil system integral with clean oil tank with level gauge, pump to transfer clean oil, waste oil tank with pump & associated valves & fittings as per standard layout.
  - All control valves & accessories should be BMS compatible.
  - Exhaust Silencer, Exhaust piping from CHP to stack / chimney via silencer, Support structure for the piping, Condensate drainage at silencer and system low points, structurally supported 30.5 m high exhaust gas Stack / Chimney with Aviation Light and Lightning arrestor arrangement. Chimney/ Stack shall be with Hot Dip Galvanized MS pipe and with Acoustic Layer to provide sound insulation.
  - Spares for commissioning.
  - The specification of items falling under the common subhead with other services, CPWD specification shall supersede. Vendor to take the written approval from Client/ consultant before actual procurement
  - Scope of cables including laying and terminations from output of CHP engine up to Sync. Panel. Synchronisation Panels as required shall be supplied by the CHP Vendor. **Cabling from the CHP output to the nearest substation shall be in the contractor's scope including power and control cable laying, terminations, glands, clamping, trenching/ refilling etc.**
  - Spares for two years of operation and maintenance.
  - Any other part / accessories not specifically mentioned above but considered necessary for safe and reliable operation.
  - Test Certificates government approved and NABL certified labs.
  - All the required input/ output for BMS connectivity shall be provided by the tenderer.
  - Documents containing description, operation manual, maintenance manual, Spare part catalogue with drawings.

### K. TRANSFORMER (Step UP Transformer)

#### 1 Scope

The scope of work shall include:

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

1. Supplying, installation testing and commissioning of ester oil transformers or dry type transformers for:

- CHP Step Up Transformer

2. Transformer handling, loading unloading and storage.

3. Associated wirings including both ac and dc wirings as well as control cabling within transformer and from transformer to other panels / DBs.

### 2 Definitions

The definitions shall be as per IS 2026 / IS 1180 and other relevant IEC standards.

### 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 2026 - Specifications for power transformer.
2. IS 1180 - Specifications for distribution transformer.
3. IEC-60076- Standard for power transformer.
4. IEC- 60726- Standard for dry type transformers.
5. IEC- 60354- Standard for transformer loading.
6. IEC- 60616- Standard for transformer marking.
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. IEC- 62770- Standard for Ester oil.
12. ECBC as applicable and latest
13. Any other local bye-law or supply company norm as applicable

### 4 Service conditions

#### System particulars

- a. Primary system voltage - 415V
- b. Secondary system voltage - 11kV
- c. Frequency - 50Hz  $\pm$  3%
- d. No. of phases - 3
- e. System neutral - Solidly earthed
- f. Short circuit rating - 25kA / 25kA, 3sec on 33kV/11kV HV side and 50kA, 3 sec on 415V LV side.
- g. Automation compatibility : SCADA compatible

#### Tropical conditions

- a. Ambient temperature: 50 degree Celsius
- b. Relative humidity (avg.): 60
- c. Isokeraunic level: 33

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

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.

## **5 Specifications**

### **Power Transformer (Synthetic Ester oil type)**

- Transformer core shall be made up of high quality ferromagnetic material of CRGO (cold rolled grain oriented) class M-4 or better. The laminations of transformer core shall be lapped one over the other in such a way that there shall be no air gap and hence magnetic flux leakage shall be very minimal.
- Both high voltage and low voltage windings of transformer shall be made up of double wound copper and shall be suitable for respective voltage grade.
- Windings shall be helical in construction.
- Transformer shall be oil cooled suitable for continuous outdoor duty, IP-55 rated and oil used in transformer shall be ester oil which shall be superior to conventional mineral oil both in terms of its dielectric properties and fire retardant properties.
- Concerning vendor needs to submit necessary reports as required in support of ester oil versus mineral oil.
- It is preferred to have transformer manufacturing done through automatic advanced machines, CNC, robotic machines to ensure best quality of product.
- Transformer losses shall be as described IS 1180.
- Transformer accessories shall be provided as per the schedule and transformer shall be suitable for parallel operation with same or different rating transformers.
- Complete transformer assembly shall be corrosion/dust/vermin proof and shall be made up of sheet steel, pre painted and galvanized.
- Complete assembly shall be suitable for rated fault withstand for 2 sec.
- Phase barriers of required thickness and materials shall be provided on both primary and secondary side of transformers.
- Flux density at rated voltage shall be limited to 1.6Tesla (max)at rated voltage and frequency.
- Magnetization current shall be limited to 1% of rated current.
- Typical parameters for power transformer shall be as follows:
  - a. Rated Power: As per CHP step Up requirement
  - b. Primary voltage : 415 volts
  - c. Secondary voltage : 11000 volts
  - d. Percentage Impedance : 7.15 % / 6.25 %
  - e. Vector Group : DYN-11
  - f. Grounding: Solidly grounded with copper
  - g. Insulation class : Class-A
  - h. Cooling : ONAN (oil natural air natural)
  - i. Oil type: Ester oil.
  - j. HV Bushings : Porcelain (suitable for 33000V) / (Suitable for 11000V)
  - k. LV Bushings : Porcelain (suitable for 11000V) / ( Suitable for 415V)

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

- l. Primary winding fault withstand capacity : 25 kA for 3 sec
  - m. Secondary winding fault withstand capacity: 25 kA for 3 sec
  - n. Temperature rise : As per schedule
  - o. Tap changer type : On load tap changer (OLTC) / OFF Load tap Changer
  - p. Remote tap changing : through RTCC
  - q. Tapping range : +/- 10% in the steps of 1.25 / +/- 5 % in steps of 2.5%
  - r. BIL for primary windings : 75kV (BIL) / 28kV (dry power frequency for 1 minute)
  - s. BIL for secondary windings: 170kV (BIL) / 70kV (dry power frequency for 1 minute)
  - t. Operation: continuous outdoor in parallel
- Tap changing range shall be site adjustable on both +ve and -ve side and may change as per the site condition.
  - OLTC shall be housed in a separate compartment on HV side and motor used for changing tap shall be IE-2 rated with its winding made up of copper and connected in delta. Appropriate capacity of OLTC motor shall be decided by the manufacturer and duly approved by owner's representatives.
  - OLTC compartment shall have auto / manual switch for local and remote operation of OLTC.
  - RTCC panel shall be wall mounted type accessible from front ( for both operation and maintenance)
  - RTCC circuit shall be provided with inbuilt AVR, with front LCD/LED screen showing tap position, raise/lower, AVR voltage etc. proper ferruling shall be done for circuit identification.
  - RTCC shall be SCADA compatible
  - RTCC panel shall be provided with separate hooter and annunciation window for any fault in AVR and internal circuit.
  - RTCC panel shall be provided with thermostat operated fans and space heater and lamp controlled with door limit switch, 6/16A socket controlled with a toggle switch.
  - Control wirings from OTI/WTI/NCT/MOG/Buchholz/OSR etc shall be brought into a separate terminal block inside marshalling box from where the same shall be fed to respective switchgears as per design and schedule.
  - Proper ferruling shall be done inside marshalling box for circuit identification.
  - Marshalling box shall be provided with thermostat operated space heater and lamp controlled with door limit switch, 6/16A socket controlled with a toggle switch.
  - Winding Temperature Indicator (WTI) and Oil Temperature Indicator (OTI) shall be designed to measurement of temperature indication and controllers for transformers for implementation of SCADA in distribution network automation.
  - WTI & OTI shall have local numeric display on LED with two communication port RS 485 for SCADA connectivity.
  - The OTI/WTI should be of better accuracy and repeatability for longer periods. These instruments should be electrically isolated from input power supplies and hence safe to use in a computerised data acquisition system or recorder.
  - The scheme should be used to indicate the OTI / WTI of oil-immersed transformers in remote control room. This should have an output of 4mA to 20mA DC proportional to the temperature ranges.
  - Actual temperature display should be of 3 digit, 7 segment LED. Temperature range should be 0°C - 150°C
  - Resolution of 1°C
  - Output should be of
    - a) 4mA - 20 mA analogue output 1
    - b) 4mA - 20 mA analogue output 1 corresponds to 0°C -150 °C
    - c) 4mA - 20 mA analogue output 2
    - d) 4mA - 20 mA analogue output 2 corresponds to 0°C - 150 °C
  - Multiple temperature setting range  
1°C - 150°C
  - Operating ambient temperature  
0°C - 50°C

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

- Power supply  
230 V AC and 30Volt DC
- Housing  
Molded ABS
- Method of fixing  
By brackets screwed in from the side.
- Serial communication ports with several on-board communication protocols.
- Two active serial communication ports, through RS-232 & RS-485.
- The instrument should be properly interfaced with the transducer in the RTU

### Tap Changing Circuit

- The on load tap changer shall include the following –
  - (a) An oil immersed tap selector and arcing switch or arc suppressing tap selector, provided with reactor or resistor for reduction of make and break arcing voltages and short circuits.
  - (b) Motor driven mechanism.
  - (c) Control and protection devices.
  - (d) Local/Remote tap changer position indicator.
  - (e) Manual/Electrical operating device.
  - (f) Voltage tapping range on H.V. side will be (+10%) to (-10%) in steps of 1.25%.
- The on-load tap changer shall be designed so that the contacts do not interrupt arc within the main tank of the transformer.
- The tap selector and arcing switch or arc suppressing tap selector switch shall be located in one or more oil filled compartments.
- The compartment shall be provided with oil surge relay.
- Those compartments shall be designed so as to prevent the oil in tap selector compartments from mixing with the oil in the transformer tank.
- A suitable pressure relieving arrangement should be provided to take care of sudden pressure rise in the compartment. But this should, in no way, affect the performance of the Oil Surge relay provided for this compartment. Oil surge relay (0.49 kg/cm<sup>2</sup>.) with trip float arrangement shall be provided for OLTC compartment.
- The tap changer shall be capable of permitting parallel operation with either existing or future transformers of the same type as Master or Follower.
- The manual operating device shall be so located on the transformer that it can be operated by a man standing at the level of the transformer track. It shall be strong and robust in construction.
- The control scheme for the tap changer shall be provided for independent control of the tap changers when the transformers are in independent service. In addition, provision shall be made so that under parallel operation the tap changer will give alarm and visual indication for becoming out of step.
- Visual indication during the operation of motor shall also be incorporated. The control scheme of the tap changer of the existing transformer to run in parallel will be furnished to the successful bidders, if required.
- The tap change control must ensure step by step operation under all operating conditions. Necessary interlock blocking independent control when the units are in parallel shall be provided.
- Under parallel operation, as may occur if the contactor controlling one tap changer sticks, the arrangement must be such as to switch off supply to the motor so that an out of step condition is limited to one tap difference between the units. Details of out of step protection provided for the taps shall be furnished in the bid.
- The contactors and associated gear for the tap change driving motors shall be housed in a local kiosk mounted on the transformer. The motors shall be suitable for operation with 3- phase 400 volts, 50 cycle external power supply.

### Buchholz Relay

- Each transformer shall be provided with gas and oil actuated Relay (Buchholtz Relay) equipment conforming of IS:3637 double float type with one set of alarm contacts, one set of trip contacts and a testing pet cock.
- The contacts shall be wired with a P.V.C. armoured cable.
- A machined surface shall be provided on the top of Relay to facilitate the setting of Relay and to check the mounting angle in the pipe and cross level of the Relay.
- The pipe work shall be so arranged that all gas arising from the Transformer shall pass into the gas and oil actuated Relay.



## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

- The oil circuit through the Relay shall not form a delivery path in parallel with any circulating oil pipe.
- The Buchholz relay should have gas collection pit cock with extension pipe with proper fixing arrangement.

### Conservator

- The conservator should be air cell/ atmoseal type to prevent direct contact of Transformer oil with atmospheric air for retarding oxidation contamination of oil.
- The Air cell shall be made from suitable material with outer coating resistant to transformer oil & inner coating resistant to ozone & weathering.
- The conservator shall be provided with necessary valves to drive out the air in the space between conservator wall & air cell during filling of oil, drain valves for complete draining of oil and cut off valves etc.
- The conservator complete with necessary valves shall be provided in such a position as not to obstruct the electrical connections to the transformer from H.V & L.V Side.
- The conservator shall be of capacity to meet the requirement of expansion of the total cold oil volume in the Transformer & cooling equipment and it should be such that the oil level will always be visible through the plain oil level gauge.
- The conservator shall be designed so that it can drain oil completely by means of the drain valve provided when mounted. One end of the conservator shall be bolted into position so that it can be removed for cleaning purpose.
- One Magnetic type oil gauge shall be provided. The oil level at 30 Deg. C. shall be marked on the gauge along with 1/4th Level, max & Min. level. A plain oil level gauge of prismatic type is also to be provided on the opposite side of the conservator, on which MOG is provided with marking as per ISS.

### Breather

- Each conservator vessel shall be fitted with a glass container type breather in which silica gel is dehydrating agent and so designed that
  - a) The passage of air through the Silica gel.
  - b) The moisture absorption indicated by a change in colour of the tinted crystals can be easily observed from the distance.
  - c) All breathers shall be mounted at approximately 1400 mm above ground level and shall be connected to the air cell of the conservator through pipe for the purpose of breathing during contraction or expansion of the air cell.
  - d) A suitable metallic cover should be provided on the pipe on which breather is provided at a location just above the breather so that it can protect rain water from falling directly onto the breather. The same arrangement shall be made in case of breather associated with OLTC tank conservator.

### L. Codes and Standards:

Unless they are in variance with the clause of this specification the gas engine driven CHP and their components shall comply with the latest edition of the applicable standards listed below / **other applicable International standards:**

- IS: 22534 Designation for type of construction and mounting arrangement of rotating electrical machines.
- IS: 46914 Degree of protection providing by enclosures of rotating electrical machinery.
- IS: 47284 Terminal marking of rotating electrical machines. IS: 71324 Guide for testing 3 Ph. syn. Machines.
- IS: 54224 Turbine type CHPs.
- IS: 48894 Methods of determination of efficiency of rotating electrical machines. IS: 12714 Insulating materials for Electric machinery and apparatus in relation to their thermal stability service, classification of
- IS: 47224 Specification for rotating electrical machines. IS: 25164 A.C. Circuit breakers.
- Other codes shall be: AS2789, BS4999, BS5000, DIN6271, EGSA101P, IEC34/1, IS4722, ISO3046/1, ISO8528, NEMAMG1-22, SAEJ1349.

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

### M. Performance Requirements:

#### a. Operative Conditions:

CHPs shall be suitable for operating satisfactorily in humid and corrosive atmosphere found in pump house. Service conditions shall be as specified in the data sheet. The CHP shall operate satisfactorily under sudden load application.

#### b. Transient Voltage performance

The dip or rise in system voltage load variations is dependent on the leakage voltage drop of the machine which shall be kept to the minimum.

In case of sudden application of full load at rated power factor the voltage drop shall not exceed 15% of the rated voltage. The rated voltage shall be restored within **5 to 8** second depending on the size of the machine.

#### c. Voltage Regulation

The voltage regulation of the machine shall be within **+/-2 %** of the nominal voltage under following conditions:

- Between no load and nominal load with p.f. of 0.8 lag to unity.
- With the machine cold or warm. At a speed drop of approximately 3% of the nominal speed.

#### d. Voltage setting range:

The CHP terminal voltage shall be adjustable with a continuously variable potentiometer. The adjustment range shall be **+/- 5%** of the nominal voltage with a possible extension to **+/- 10%**.

#### e. Harmonic Content

The maximum permissible deviation from the sine wave shall be 5%. The harmonic content of the voltage shall be less than 3% measured between phases off load and up to nominal rating for a power factor of 0.8 lag to unity and with symmetrical distortion free consumers in circuit.

#### f. Frequency limits

The CHP shall be suitable for continuous operation at rated load for frequency variation of **+/- 3%** of rated value in addition the vendor shall furnish the short time under-frequency operating limits.

#### g. Overloads: No overloading

### N. Short Circuit Conditions:

The CHP shall be capable of withstanding without damage, a three phase, a line to line, line to earth or two line to earth short circuit for a period of **3 seconds** when operating at rated speed and with an excitation corresponding to 5% over voltage at no load.

### O. Parallel operation:

CHP sets shall be suitable **for Island operation and parallel operation with Grid supply** at operating voltage and under load conditions up to rated value. The set shall be provided with Electronic governor system.

### P. Excitation support system

Excitation system shall be provided with short circuit support equipment (Series compounding) to maintain three times the rated current for three seconds in case of short circuit to ensure proper fault clearance in outgoing feeders.

### Q. Design and construction:

- The CHP design shall meet the requirement specified in data sheet and shall be suitable for the site conditions specified therein.
- The CHP shall be mounted on a common base frame together with the prime mover unless otherwise agreed. The CHP shall be provided with necessary lifting hooks and two earth terminals for connection to main earth grid.
- The **Alternator** winding shall be class "H" insulation with temperature limitation for **class "F"** the windings

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

and overhangs shall be braced to withstand the short circuit forces. For machines rated 1000 KW and above shall have six no. RTDs suitably distributed in stators winding.

- d. The stators windings shall be brought out to **four** insulated terminals in two separate terminal boxes.. The terminal box for the line terminals shall have sufficient space for the termination of cable size specified in data sheet. The neutral box shall in addition to space for neutral earthing cable have sufficient room for current transformers used for protection of CHP.. The terminal box for control cables shall contain properly marked terminals for all internal equipment e.g. embedded temperature detectors etc. All terminals shall be stud type. The terminal boxes shall be complete with lugs and double compression cable glands. Current transformers shall be as specified in data sheet.
- e. All parts and accessories shall be suitable to withstand stresses due to over speed / overload / short circuit conditions specified & should be compatible to BMS.
- f. Bearings shall be double shielded and re-lubricated. Grease in the bearing enclosure shall provide additional lubrication to bearing as well as provide sealing against dust and moisture.
- g. The CHP shall be water cooled unless otherwise agreed CHP enclosure shall be as specified in data sheet.
- h. The direction of rotation of the rotor of the machine shall be compatible with that of the prime mover. A clear indication of the direction of rotation shall be given on either end of the machine.
- i. Space heaters shall be installed within the enclosure, location and max. surface temperature of the heaters shall be such that no damage can be caused to any insulation. Heaters shall suitable for operation on a single phase 240V AC supply unless otherwise specified.
- j. A suitable double pole switch shall be mounted on or adjacent to the stators frame or enclosure for the manual switching off of the heaters.
- k. Field winding shall have **class "H"** insulation with excellent electrical and mechanical properties. The field winding shall be capable of operating at a field voltage of 125% of rated load field voltage for at least one minute starting from stabilized temperatures at rated conditions.
- l. All cabling on the CHP set skid shall be in GI cable trays / conduits. All cables shall be identified close to their termination point. Double compression type cable glands shall be used for cable termination.
- m. The CHP shall be designed to run for 24 hours continuously without any stoppage.
- n. The CHP shall have the exhaust gas confirming to CPCP emission norms for Bio-Gas engines.
- o. A rating plate of corrosion resistant material shall be fixed on the CHP frame and shall give the following information:
  - Manufacturer's name.
  - Serial Number, Type and frame reference
  - Rated output in MVA & MW
  - Rated power factor, frequency and voltage
  - Rated stators current and speed in Rev. / Min.
  - Class of insulation
  - Phase rotation (CW or CCW)
  - Customer's indent no.
  - Year of manufacture
  - Weight rotor and stators in KG.

### R. Excitation system:

The CHP shall be provided with brush less type solid state excitation system with automatic voltage regulator. The excitation system shall include the automatic voltage regulator, **Construction shall be as per manufacturer's standard.**

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

The exciter capacity shall be at least 20% more than the maximum requirement at any time. The exciter winding shall be insulated with class "F" insulation.

Automatic solid-state voltage shall be provided with the following features as a minimum.

- Under frequency protection.
- short circuit protection.
- annual voltage control switch with adjuster.
- Cross current compensation for parallel operation.
- Voltage build up circuitry.
- Stators current limited.
- Field current limited.

The Current and potential transformers required to feed the AVR from the CHP terminal shall be adequately rated.

### S. System operation

The CHP set shall normally be in an unattended area. The Control system shall operate in fail safe mode and shall include all controls and protection necessary for the safe operation of the package. The CHP set shall function as per one of the following schemes:

- Auto main failure scheme (AMF).
- Manual start in service mode.

### T. CHP control panel:

- a. The Local CHP control panel for the CHP set shall comprise of the following unless otherwise specified in the attached data sheet.
  - Automatic Voltage Regulator.
  - Protection and metering equipment's.
  - Indicating instruments.
  - Control gear for CHP set auxiliaries.
- a. Any other accessories require to make the CHP set operational as a package shall be included in scope of supply. If required the CHP control panel shall be split into various functional sections viz. protection, metering and control, regulation etc.
- b. The breaker rating shall be as specified in the drawing. The protective relays in the Gen. Control panel shall act to trip this breaker on fault conditions unless otherwise specified. This breaker also serves the purpose of local isolation.
- c. All motor starters for CHP set auxiliaries shall be DOL type.
- d. Unless otherwise specified, the DC control supply required for relays, controls, closing / tripping of CHP breaker, annunciation circuit and for any other purpose shall be met by a DC system consisting of battery and battery charger of suitable capacity to be supplied by the CHP set manufacturer. **Battery & battery charger shall be as per manufacturer's standard design.**
- e. The panel shall be free standing, metal enclosed, dust and vermin proof type with a hinged door and having a degree of protection IP 55 as per IS:51 as per IS:2147 unless otherwise specified. Power and control equipment shall be segregated inside the panel as far as practicable. The maximum height of the operation handle/switches shall not exceed 1000 mm. and the minimum height not below 300 mm. All hardware shall be corrosion resistant and bolts, nuts and washers shall be made of galvanized zinc passivated or cadmium plated high quality steel. Unless otherwise specified the panel shall be suitable for bottom cable entry. Necessary glands shall be provided with the panel.

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

All auxiliary devices for control, indication, measurement and alarm such as push buttons control / selector switches, indicating lamps, metering instruments, annunciation's etc. shall be mounted on the front door of the panel. Adequate number of potential free contacts shall be provided in the control panel for any remote control, monitoring of the CHP set.

- f. All switches shall be load - break, heavy duty type. All fuses shall be non-deteriorating HRC cartridge pressure filled, link type. The contactor shall be air-break type having AC-3 duty rating. Thermal overload relays shall be three elements, positive acting, ambient temperature compensated type with adjustable setting range and built in protection feature against single phasing. All indicating instruments shall be moving iron, flush mounting type and of 96 mm x 96 mm square pattern. All control / selector switches shall be rotary back connected type having a cam-operated contact mechanism with knob type handle. "STOP" push buttons shall be stay put type.
- g. Wiring for power, control and signalling circuits shall be done with PVC insulated copper conductors having 660 / 1100 V grade insulation. Minimum size of control wires shall be 2.5 mm "ELEMEX" type terminals shall be acceptable for wires up to 10 mm<sup>2</sup> size and for conductors larger than 10 mm<sup>2</sup> bolted type terminals with crimping lugs shall be provided. A minimum of 10% spare terminals shall be provided on each terminal block.
- h. An adequately sized earth bus shall be provided in the panel for connection to the main earth grid. All noncurrent carrying metallic parts of the mounted equipment's shall be earthed. Doors and movable parts shall be earthed using flexible copper connections.
- i. Engraved nameplates shall be provided for all devices mounted on the front of the panel. Nameplate or polyester adhesive stickers shall be provided for each equipment mounted inside the panel.

### U. Painting, Packing and Transport:

- a. All metal surfaces shall be thoroughly cleaned of scale, rust and grease etc. prior to painting. Cleaned surfaces shall be given two coats of primer and prepared for final painting. Final finish shall be free from all sorts of blemishes.
- b. The equipment shall be shipped to site suitably packed to prevent any damage. Each package shall have labels to show purchaser's name, purchase order and equipment no. suitable lifting lugs etc. shall be provided and lifting points shall be clearly marked on the package. Packing shall be suitable for storage at site for a minimum period of 6 months.

### V. Tests and Inspection:

- a. The owner or his authorized representative may visit the works during manufacture of equipment to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given all assistance to carry out the inspection.
- b. Detailed test procedure along with the facilities available at vendors works shall be furnished along with the bid. Owner's representative shall be given minimum four weeks advance notice for witnessing the final testing. Test certificates including test records and performances curves etc. shall be furnished by the vendor.
- c. Tests Equipment shall be tested to conform to the appropriate standards and the following tests shall be conducted in the presence of purchaser's:
- d. Functional tests, continuity tests and high voltage test on control panel to establish the performance called for in the specification.
- e. Power frequency voltage test on switch gear and mechanical / electrical operational check. Routine tests for alternator as per IS: 4722.
- f. Over speed test (1.2 times the rated speed for 2 minutes)
- g. Wave form test (type test results are acceptable)
- h. Phase sequence test.
- i. Vibration test
- j. Noise level test.
- k. Dimensional and alignment test.

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

### I. String test.

### W. General Requirements

#### a. Material quality:

All the materials used for the manufacturing of equipment shall confirm to the specifications and shall be supported with tests certificates. Materials used shall be of the very best quality of their respective kinds as specified or described, and all materials to be used in and about every part of the work may from time to time be subjected to tests as per requirements viz: chemicals, mechanical, instruments and appliances as the case may be, as directed by CLIENT AND/OR ITS CONSULTANTS at the expenses of the Vendor / Contractor. Samples subjected to any tests, will not be returned or paid for.

#### b. Rates:

Rate for any one description of work in the schedule of quantities shall include the rates of main components and the associated accessories, consumables, necessary for completing the work and, for these, no separate or specific charge will be accepted.

#### c. Material Measurement:

Material shall be measured as described in the BOQ as per established applicable codes / or established industrial practices as deemed right in the opinion of Client / or project consultant.

#### d. Supervising:

The Vendor / Contractor supervisors shall always carry with them the required tool box together with measuring tape and pad to note any and all the instructions given during the visit of client and or project consultants.

#### e. Measurements:

The Vendor / Contractors or their representative shall accompany the CLIENT AND/OR ITS CONSULTANTS or his representative or the clerk-of-works when required to do so and assist in taking the measurements and shall agree to the measurements recorded on the spot.

- f. If the Contractors / Vendors fail to accompany the clerk-of-works or any other person that has been duly authorized by the CLIENT AND/OR ITS CONSULTANT to take measurements, they shall be bound by the measurements recorded by the CLIENT AND/OR ITS CONSULTANT or his representatives.

### X. Protection:

The **Contractors** / Vendors must cover up and protect from damage due to any cause all material. Any sort of insurances required shall be borne by Contractor / Vendor and the Client shall not pay vendor any additional charges on these accounts.

### Y. Materials and Workmanship:

#### a. General:

All materials brought on the site of works and meant to be used in the same, shall be of the best quality meeting specifications of their respective kinds and shall be subject to the approval of the CLIENT AND/OR ITS CONSULTANT.

#### b. Samples:

Samples of all materials shall be got approved by the CLIENT AND/OR ITS CONSULTANT and shall be deposited with him before the order for the materials is placed with the supplier. The materials brought on the work shall confirm in every respect to the respective approved samples.

#### c. Check:

The Contractors shall check each fresh consignment of materials, as it is brought on to the site of the works, to see that they conform in all respects to the specification and/or the samples approved by the CLIENT AND/OR ITS CONSULTANT.

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

### d. Testing:

The CLIENT AND/OR ITS CONSULTANT will have the option to have any of the materials tested to find whether they are in accordance with the specification and the Contractors will bear all expenses incurred for testing of such materials. Contractor / Vendor shall provide all the supporting bills and documents, test certificates which, in the opinion of the CLIENT AND/OR ITS CONSULTANT or his representatives are necessary to establish the quality of the materials or their suitability shall be produced for his inspection on requisition.

### e. Rejection:

Any materials that have not been found to conform to the specifications will be rejected forthwith and shall be removed from the site by the Contractors at their own cost.

### f. Storing:

The materials shall be stored or stocked on the site as directed by the CLIENT AND/OR ITS CONSULTANT and if any additional space is to be hired for this purpose, the Contractors will do so at their own expenses.

### g. Purchase:

The CLIENT AND/OR ITS CONSULTANT shall have the discretion to ask / instruct Contractor to purchase and use such materials from any particular source as may in his opinion be necessary for the proper execution of the work.

### h. Special Materials:

Any special materials that may be required on the works which are supplied by any other person or firm selected by the CLIENT or by the CLIENT AND/OR ITS CONSULTANT on their behalf shall be taken over in writing by the Contractors for safe custody until they are required on the works when called upon to do so by the CLIENT AND/OR ITS CONSULTANT.

## AA. Technical data for Equipment's: -

### i. Prime mover for CHP

- Prime mover rating 1 nos. capable of generating 200 KWe / 1000 KWe Electricity
- Service Prime power.
- Horse power - Vendor to specify.
- Rated RPM - 1500 RPM.
- Type Radiator cooled set.
- Make- GAS ENGINE (Fuel- Biogas)

Nos. Of cylinder	Vendor to specify.
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Method of starting	Vendor to specify.
--------------------	--------------------

Prime Mover for Air Compressor (If starting method is with Air	Vendor to specify
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Aspiration Method	Vendor to specify
-------------------	-------------------

Specific bio-gas oil consumption (gm/BHP/hr)	Vendor to specify.
--	--------------------

Bio-gas Consumption at full load At 75% / 50% / 25% in Ltrs / Hr. including bio-gas required	Vendor to specify.
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Lub. Oil Recommended	Vendor to specify.
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Qty of Lub. Oil required	Vendor to specify.
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## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

Whether meets CPCB norms for emission.

### Note:

1. The engine HP. should be selected so as to achieve required KW rating to be generated considering derating of engine due to altitude, temp. humidity etc.
2. The engine test shall be witnessed by the client's representative.

### BB. Alternator data sheet

a. Rating	: 1 nos. capable of generating 200 KWe / 1000 KWe electrical power <b>at unity p.f.</b>
b. Power factor	: 1.0
c. Rated voltage	: 415 V
d. Voltage regulation	: + / - 1%
e. Rated current	: Vendor to Specify
f. Speed	: 1500 RPM.
g. Frequency	: 50 Hz.
h. Enclosure detail	: Vendor to Specify.
i. Full load Output in KVA	: Vendor to Specify.
j. Full load Output in KW at 1.0 PF	: Vendor to Specify.
k. 12.Design overload cap. at max ambient temp	: Vendor to Specify.
l. at max ambient temp :	: Vendor to Specify.
m. Efficiency at full load :	: Vendor to Specify.
n. Field current at rated output and power factor	: Vendor to Specify.
p. Field voltage at rated output and power factor	: Vendor to Specify.
r. Method of excitation and regulation	: Self
t. Class of insulation	: A) Starter – F : B) Rotor - <b>F</b>
u. Degree of protection	: Screen protected, drip proof.
v. Base plate	: The Engine & alternator shall be mounted and aligned on a common base plate fabricated from steel.

### CC.GENERAL

a. Overall Dim ( LxWxH)	: Vendor to Specify.
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## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

- b. Overall weight : Vendor to Specify.
- c. Noise level of CHP set at three meter with acoustic enclosure: : Vendor to Specify.

### DD. Synchronizing / AMF Panels

- a. Make : As per vendor
- b. Finish : Powder Coat.
- c. Type (Floor / Wall Mounted) : Floor Mounted. OUT DOOR TYPE IP 65
- d. Instruments / Switchgear : Consist of On/off indicator.
- e. Auxiliary switch.
- f. Ammeter & Voltmeter with assessors
- g. KWH meters with CTs.
- h. Over voltage relay
- i. Under Voltage relay
- j. Reverse & Forward Power relay.
- k. Over & Under frequency Relay
- l. KVA meter
- m. Frequency meter.
- n. Annunciation windows.
- o. LED Lamp indicator.
- p. AMF relay

### EE.

Separate box for sealing of ct. & kwh meter as per supply electricity board / electrical inspector requirement.

### EE. Factory acceptance test:

The Seller will permit Client's Inspectors, Consultant and their authorized representatives free access during normal working hours to his works, go down, storage or loading spot etc. and will give them all necessary assistance to perform their task including free use of all accessories, testing and control instruments. The seller shall ensure that the same facilities are granted by his sub-suppliers.

Unless specifically stated to the contrary in the order, all expenses relevant to the preparation and performance of testing, inspection and preparation of any test reports or certificates shall be borne by the Seller EXCEPT for the salaries, fees, traveling, lodging and boarding expense of the Consultant's/ Client's representatives. However, if the visit duration of Client's or his representatives is extended for the reasons not attributable to CLIENT, the cost of the extended period of visit shall be borne by the seller.

The sellers shall carry out tests related to performance tests as described in the specifications and specified in the order. All such performance tests shall be at supplier costs. Supplier shall also provide all the tests certificates

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

and documents as demanded by the Inspector for his satisfaction that the order has been executed as per PO specifications. All such certificates, documents in original shall be submitted to the Client before dispatch of material. The goods shall be dispatched from suppliers shop only after written confirmation from clients / or its authorized representative.

### FF. Statutory Approval:

The unit supplied shall be duly approved by the statutory / regulatory approval as per prevailing laws and regulations. The supplier shall submit all the documents along with all the dispatch documents.

### GG. VENDORS DATA: TO BE SUBMITTED DURING/AFTER DESIGN CONFIRMATION AS PER THE APPROVED MAKE LIST

Post tender or after issuance of the LOA, the successful Vendor shall provide information on the offered make and Cat nos. of items offered for respective items.

HOWEVER, IT IS ADVISABLE TO DISCUSS THE TECHNICAL SOLUTION CONFIRMING TO THE REQUIREMENT DURING THE PRE-BID MEETING/CONFERENCE.

### HH. Statutory Approval:

The unit supplied shall be duly approved by the statutory / regulatory approval as per prevailing laws and regulations. The supplier shall submit all the documents along with all the dispatch documents.

### II. Schedule of Quantity: - In case of discrepancy in Drawings and BOQ, Drawings shall be final

### JJ. Price Schedule

Price shall be quoted for Design, Engineering, Fabrication, Supply at Site, unloading at site at one location for BOQ items as per specifications of this tender and details given in their respective SLDs. Cost shall be inclusive of all taxes, transportation and supervision required for installation. In case of discrepancy between drawings and BOQ above, drawings shall be considered final and the same should be brought to notice of client / consultant. The price in the BOQ shall be the total price including supply, installation, testing and commissioning of the CHP engine as per design intent at site and handing over to the client including all the cost of transportation, handling at site, Installation, Testing, Commissioning, related taxes, labour etc.

### KK. Terms of Payment

Payment terms shall be as detailed in the Notice Inviting tender document.

### LL. Delivery

The Delivery of the CHP engine and all related equipment's shall be done to the site at Permanent Campus of Nalanda University at Rajgir Bihar.

### MM. Guarantee

If any trouble or defect originating with the design, material, workmanship, or operating characteristic of any materials arises at any time prior to Twelve (12) months from the date of the first commercial operation of the plant for which the materials supplied under the order from a part thereof, or eighteen (18) months from the date of last dispatch whichever period shall first expire, and the Sellers is notified thereof, Seller shall within 10 days of such intimation at his own expense and as promptly as possible make such alterations, repairs and replacements as may be necessary to permit the materials to function in accordance with the specifications and to fulfill the foregoing guarantees. Purchaser may, at its option, remove such defective materials, at Seller's expense in which event seller shall, without cost to Client and as promptly as possible rectify the defect. Repaired or replaced materials shall be similar guaranteed for a period of not less than 12 months from the date of replacement.

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

### **NN. Guarantee of Complete System:**

All the PANELS supplied under this enquiry shall be subject to for a guarantee of 12 months from the date of commissioning or 18 months from the date of supply whichever is earlier towards defective design, material of construction, poor performance.

In the event of poor performance for not achieving the intended performance stated in the specifications the complete unit shall be subject to be rejected and shall be replaced by supplier. If on test any portion of the plant, equipment or components is found to be defective or not fulfilling the intent or the meaning of the specifications, the defective parts shall be replaced with new parts. The defective parts after repair shall not be accepted. Final performance of the Panel and associate accessories shall be performed and validated at site as part of the complete system.

### **OO. Dispatch:**

The entire unit from the factory cleared after inspection shall be dispatched to site dully packed and in assembled conditions with all the documents. The Test certificates, drawings, documents etc. for the complete unit and for all the accessories shall be submitted to the Purchaser before dispatch of unit.

If the unit during transit or during erection under the supervision of supplier representative is damaged due to any reason whatsoever, the supplier shall carryout the repair of unit or replaces the damaged components at site free of cost to Purchaser.

The leak test of the unit at site shall be carried by the supplier after unit erection is completed at site by Purchaser.

### **PP. Statutory Approval:**

The unit supplied shall be duly approved by the statutory / regulatory approval as per prevailing laws and regulations. The supplier shall submit all the documents along with all the dispatch documents.

### **QQ. PERFORMANCE GUARANTEE:**

Contractor has to submit a performance guarantee for the entire installation of CHP system on letter head stating that the system will not fail during the functioning of the campus. If there is a downtime in the system then the contractor shall be liable to pay a penalty of Rs 1500 per hour for every hour of downtime other than for regular maintenance after 5000 hrs. The contractor need to submit the guarantee to NU on completion of the work including testing, commission and stabilisation period while submitting the final bill. In the absence of such performance guarantee, the final bill shall not be release.

The performance guarantee submitted above shall be released to the bidder at the end of successful completion of the operation and management period of 5 years /60 months from the date of successful commissioning of the plant after stabilisation period.

## **4. GAS CASCADE SYSTEM.**

The Gas cascade system shall comprise of Gas cylinders, interconnecting pipes, Cascade Frame, Base Support, Lifting arrangement for Cascade, Necessary pressure gauges, Valves, inlet and outlet manifold in SS 316 / Brass material, etc.

The Cylinder shall be made out of High Pressure seamless steel and the cylinder shall confirm to IS: 7285 Part II- Latest revision. All the tests mentioned in the IS code shall be done during manufacturing and shall be submitted along with the invoice. The Cylinder shall be coated with epoxy paint of approved quality to safeguard the cylinder from rusting.

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

All the connecting pipes between the cylinders shall be in SS 316 / Brass of approved grade and shall confirm to relevant Indian Standard codes.

The Support frame for the cascade shall be made out of Hot-Dip galvanized MS. Hot dip galvanizing shall be as per IS: 2629. The Frame shall be provided with Hooks on all the four corners at the top of the cascade for lifting with crane. Necessary arrangements shall also be done in the bottom for lifting the cascade with a fork lift.

All the Fitting used in the cascade shall be of SS 316 Grade.

The Entire assembly shall be capable of withstanding gas pressure upto 250 bar.

The Rate shall be for per number of cascade supplied to the satisfaction of the Engineer in charge.

The contractor shall submit the shop drawing for the proposed cascade with all the piping and fixture details for approval to Engineer in charge and on approval of the same, the procurement of cascade shall be done.

### 5. BIO METHANATION PLANT

The Biomethanation plant shall be a civil construction structure and all the items used in construction shall be as per relevant CPWD specifications for Excavation, Concrete, Reinforced concrete, Steel works, Door Window Works, Flooring works, and Finishing works. All the Plant structure like digester, slurry mixer etc which are to be constructed (Civil Structures) shall be in RCC of suitable grade or FRP material of good quality. The design for all the structures shall be submitted by the vendor to client for vetting and approval before starting of work. The list of buildings and equipment's provided in the specifications are only for preliminary information and it is in the scope of the contractor to do the complete design of the system with all civil works, equipment's, pumps etc to meet the requirement of the biogas generation.

#### A. SCOPE OF WORK

The Scope of work for the tender includes the following:

- a. Design of the Biomethanation plant capable of generating 110 cum per hour of Bio gas continuously for 24 hours and 365 days.
- b. Design of all related accessories, electrical Equipment's, Pumps, Blowers and any other work required for the efficient and effective working of the BIOMETHANATION plant
- c. Construction, testing and commissioning of the Biomethanation plant as per the design after getting the design vetted by third part expert from client side.
- d. Under O&M and per unit cost of the gas: Complete operation and maintenance of the plant including provision of required manpower, maintenance, safety equipment's for plant and for workers, project staff etc complete as required shall be within the quoted rate of the per the gas. The per unit gas cost will be including the financial commitment towards these man & machineries deployments either through the contractor capital or back to back outsourcing/rental agreement provision with the concerned.
- e. The Design of the entire bio-methanation plant shall be done considering the ambient condition for the site as mentioned in the start of this document. Necessary heating equipment required for the entire setup to keep the Plant operations during Peak winter also to be considered by the bidder in the plant design. The technical specifications provided below are for guidance only and the vendor has to provide complete design for the Bio-Methanation plant of the capacity as mentioned in the BOQ.
- f. Internal Distribution of Water and Electricity within the plant premises.

**Note: In order to have confirmation on each and every stage involved, the successful contractor has to provide the IoT (Internet of things related to automation) based/integrated solution for the collection, transportations, PARKINGS and operations as well. A single dashboard provision with hardware and software to be provided, and as an extension of the dashboard system the integration, if required, in the main SCADA for monitoring purpose will also be extended. The Main SCADA will be facilitated by the University, if required.**

- a. Under O&M and per unit cost of the gas: Complete operation and maintenance of the plant including provision of required manpower, maintenance, manure and waste handling, safety equipment's for plant

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

and for workers, project staff etc complete as required shall be within the quoted rate of the per the gas. The per unit gas cost will be including the financial commitment towards to undertake the operation and maintenance with the requisite manpower & machineries deployment either through the contractor capital or back-to-back outsourcing/rental agreement provision with the concerned. The vermicompost/compost or any waste or output other than gas will be removed by the contractor at their own risk, cost and benefits followed by the campus entry and Exit rules, if any. However, the priority of organic fertilizer supply will be given to the university without any charge, if fertilizer will be required for the university campus.

Note: In order to have confirmation on each and every stage involved, the successful contractor has to provide the IoT (Internet of things related to automation) based/integrated solution for the collection, transportations and operations as well. A single dashboard provision with hardware and software to be provided, and as an extension of the dashboard system the integration, if required, in the main SCADA for monitoring purpose will also be extended. The Main SCADA will be facilitated by the University, if required. The GIS Integration with SWM System including door to door, central mess/kitchen, garden, horticulture waste collections including software and hardware for the campus shall be developed by the successful bidder.

S.No	Section	Name	Specification	Quantity	Unit
<b>A</b>	<b>Feed Handling Section</b>		<b>Will be designed and Supplied by the EPCC party on the Capital and BOQ cost under Biomethanization Plant</b>		
1	Electro-mechanical Equipment & Civil	Weigh Bridge with Civil Foundation	Capacity up to 40 MT including Data Logging, Type – pit less, Civil Foundation included	1	Set
2	Civil	Raw Material Storage Shed (if pressmud is available)	Raw Material storage for 15days on-site, remaining inventory at the sugar factory, Shed of min 30 m x 40 m, with 6 m truss bottom; with 2m side walls	1	No.
3	Electro-mechanical Equipment	Unloading Pit	Civil Works, - Capacity - About 10 MT organic waste, with tractor loader, mounted on weighing platform of 20 T capacity (included)	1	No.
4	Calibrated Measuring Instrument for the Dry Content and Liquid Content in feedstock/bio-waste on Instant Basis.	Calibrated Measuring Instrument for the Dry Content and Liquid Content in feedstock/bio-waste on Instant Basis.	Calibrated Measuring Instrument for the Dry Content and Liquid Content in feedstock/bio-waste on Instant Basis.	2	Nos.
5	Electro-mechanical Equipment	Screw Feeder	Capacity to feed about 20 TPH of organic waste	2	No
6	Electro-mechanical Equipment	Shredding system for organic waste (if food & vegetable waste available)	Shredder of suitable capacity depending upon the food waste feed qty	1	Set

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

B	Feed Preparation Section		Will be designed and Supplied by the EPCC party on the Capital and BOQ cost under Biomethanization Plant		
1	Civil	Mixing Tank	Volume approx. 30cum, RCC	1	Nos.
2	Electro-mechanical Equipment	Strainer Grill on top of Mixing tank with additional safety railing	Safety grill in fabricated MS on top and around the Mixing tank	1	Set
3	Electro-mechanical Equipment	Mixers / Agitators in Mixing Tank	Submersible Mixer, 3-phase-motor 400 V, 50 Hz, 1450 rpm, protection class IP68	1	Set
4	Electro-mechanical Equipment	Feed Pump	Solid Handling Capacity, Submersible feed pump - Flowrate min. 50cum/hr with min 20m head	1	Nos.
5	Electro-mechanical Equipment	Fresh Water Pumps	Pump with flow rate of 30 m <sup>3</sup> /h, NPSH of about 15~20 m	1	Nos.
6	Civil	Water storage tank	RCC or other appropriate material, to store about 20 m <sup>3</sup> fresh water with about 10% extra space	1	No.
7	Electro-mechanical Equipment	Scum breaker, Removal in digester tank, submersible agitator.	15KW	2	Nos.
C	CSTR Anaerobic Digester Section		Will be designed and Supplied by the EPCC party on the Capital and BOQ cost under Biomethanization Plant		
1	Civil	CSTR Digester	Volume approx. 5000 cum, RCC confirming to the site requirement for 200KW CHP.	1	No.
2	Electro-mechanical Equipment	Submersible Agitators in digesters	Submersible Agitator, 3-phase-motor 400 V, 50 Hz, 1450 rpm, protection class IP68 with mast / david arm for vertical movement of mixer	2	Nos.
3	Electro-mechanical Equipment	High flow agitator in digester tank	15 KW	3	Nos.
4	Electro-mechanical Equipment	Slurry level Sensor with indicator	Level control & indicator devices for digester slurry	1	Set
5	Electro-mechanical Equipment	Bulleye 300	sideview window with safety glass, wall seal & wiper	2	Nos.

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

6	Electro-mechanical Equipment	EX-Light	Explosion Proof LED light for fixing in front of bulleye 300, with resetting time- delay switch to be installed outside of EX- zone. The EX-Light can be combined with EX-CAM in same bulleye.	1	No.
7	Electro-mechanical Equipment	EX-CAM	Explosion Proof Fixed Lens Camera for fixing outside of bulleye 300. For inspection and remote observation the EX-CAM can be combined with EX-Light in same bulleye	1	No.
8	Electro-mechanical Equipment	Double-Membrane Gas-Roof for tank, Storage: 1000cum	Double-Membrane Gas-Storage Roof for CSTR Digester, shell PVC coated Polyester fabric, inner shell Polyethylen, belts structure & safety net for inner support, gas-tight wall fitting syteme with railing, airblower for form fitting roof support, deflation flap, over-/underpressure valve, mechanical gaslevel indicator	1	Set
9	Electro-mechanical Equipment	Monitoring Island	connection plate with installation sockets for O/U pressure, & foam /liquid max level sensors	1	No.
10	Electro-mechanical Equipment	Under-/ Over-PressureSensor for DoubleMembrane Gas-Roof	Pressure Sensor for Under-/ Over-Pressure control with calibrated Monitor/screen, and cable connection for 4-20 mAmp signal	1	No.
11	Electro-mechanical Equipment	CAP-sensor for Double-Membrane GasRoof	Cable actuated position(CAP) sensor for filling level indication of DoubleMembrane Gas-Roof with cable connection clamp for 4-20 mAmp signal	1	No.
12	Electro-mechanical Equipment	pH measurement	Measurement of digester slurry pH, can be done for the extracted slurry, meter to have data logger connectivity	1	No.
13	Electro-mechanical Equipment	Temperature measurement	Measurement of digester slurry temperature at outlet, meter to have data logger connectivity	1	No.
14	Electro-mechanical Equipment	Slurry heating circuit	Heat exchanger that uses hot water from waste heat recovery of the genset or from other source to maintain digester temperature close to 38 °C, 16 heating coil	1	Set
15	Electro-mechanical Equipment	Digestate withdrawal pump	Mud pump with flow rate of 15 m3 /h, NPSH of about 15~20 m	1	Nos.
16	Electro-mechanical Equipment	Compressor for Bottling Bio Gas	For compressing Bio gas for Efficient storage in Cylinders for future usage with minimum capacity of 40m3/hr	1	Nos.
17	Civil	Digestate Slurry Tank	Volume approx. 50cum Capacity	1	No.
D	Solid Liquid Separation and		<b>Will be designed and Supplied by the EPCC party on the Capital and BOQ cost</b>		

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

	Manure Section		under Biomethanization Plant		
1	Electro-mechanical Equipment	Solid Liquid Separator (SLS) Feed pump	Mud pump with flow rate of 30 m <sup>3</sup> /h, NPSH of about 15~20 m	2	Nos.
2	Electro-mechanical Equipment	Solid Liquid Separator (SLS)	Screw Press type solid liquid separator of 10 m <sup>3</sup> /h capacity	2	Nos.
3	Electro-mechanical Equipment	Liquid Recycling Pump (Filtrate tank to Mixing tank/ Feed Hopper)	Mud pump with flow rate of 15 m <sup>3</sup> /h, NPSH of about 15~20 m	2	Nos.
4	Civil	Digestate Liquid Storage - Output of Solid Liquid Separator ( Filtrate)	Volume approx. 50 cum, RCC	1	No.
5	Electro-mechanical Equipment	Extracted Solid Trolleys	Trolley on wheels, with self-tilting mechanism, to be taken from SLS to storage / manure handling area	2	Nos.
6	Civil	Shed over SLS section	Area to accommodate the SLS and handling area for manure of about 5x5 (25 sq mtr)	1	No.
<b>E</b>	<b>Scrubbing and Clean Biogas Storage</b>		<b>Will be designed and Supplied by the EPCC party on the Capital and BOQ cost under Biomethanization Plant</b>		
1	Electro-mechanical Equipment	Biogas Blower for Scrubber	Roots type twin lobe blower, capacity - 100cum/hr @ 0.5 bar	2	Nos.
2	Electro-mechanical Equipment	Desulfurization scrubber	Scrubber suitable for H <sub>2</sub> S removal. H <sub>2</sub> S less than 100ppm at the outlet	1	Set
3	Electro-mechanical Equipment	Biogas Flare	Flare with capacity to completely burn biogas at a flow rate of up to 120 m <sup>3</sup> / h at atmospheric pressure	1	No.
4	Civil	Scrubber Shed	Shed to cover the scrubber and Blower 10m X 10m	1	No.
5	Civil	Ground Mounted Biogas Holders	Suitable Foundation for the clean Balloon (Ground Mounted Biogas Holders), approx. (12 mtr)	1	No.
6	Electro-mechanical Equipment	(Ground Mounted Biogas Holders)with necessary instrumentation & accessories	Capacity 500m <sup>3</sup> , Double-Membrane Clean Gas-Storage Roof outer shell PVC coated Polyester fabric, inner shell Polyethylene, belts structure & safety net for inner support, gas-tight wall fitting system with railing, air blower for form fitting roof support, deflation flap, over-/under pressure valve, mechanical gas level indicator. Min. 12 hrs storage	1	Set



## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

F	Electrical, Piping and Instrumentation		Will be designed and Supplied by the EPCC party on the Capital and BOQ cost under Biomethanization Plant		
1	Electro-mechanical Equipment	Feed Piping	Piping of SS 304 having about 6 to 8 inch diameter, with valves, instrumentation, etc., with saddle supports and other structural supports, from mixing tanks and from outlet of CSTR digester with valves	1	Set
2	Electro-mechanical Equipment	Digestate Slurry Piping	Piping of SS 304 having about 6 inch diameter, with valves, instrumentation, etc., with saddle supports and other structural supports, from CSTR digester to slurry tank, to SLS, to recycling liquid tank	1	Set
3	Electro-mechanical Equipment	Biogas Piping	Piping of SS 304 about 6 inch diameter, with valves, instrumentation, etc., with saddle supports and other structural supports, from digester to scrubbers and a bypass from there to the flare	1	Set
4	Electro-mechanical Equipment	Piping for SLS	From Digestate tank to SLS feed pump and from SLS separated liquid to recycled liquid storage tank	1	Set
5	Electro-mechanical Equipment	Online Gas Analyser	Measure Methane, carbon dioxide, H <sub>2</sub> S, meter with digital display, data logger interface capability, properly calibrated with certification	1	Set
6	Electro-mechanical Equipment	Raw Biogas Flow Meter	Meter capable of measuring biogas, flow rates of up to 100 m <sup>3</sup> / hr at atmospheric pressure	1	No.
7	Electro-mechanical Equipment	Control Panel & Electrical Cabling	Control Panel (CP) & Programmable Logic Controller (PLC) for the biogas generation plant, standardized & modularized design, integrating consumers / actuators / sensors / auto-switches as per requirement, installed inside control panel room. Electrical cabling for the biogas plant equipment	1	Set
8	Civil	Control Room	For control panel and PLC of suitable size	1	No.
G	Fire Safety Section		Will be designed and Supplied by the EPCC party on the Capital and BOQ cost under Biomethanization Plant		
1	Electro-mechanical Equipment	Fire Extinguishers	As per PESO Standards		
H	Other Civil Units				

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

1	Civil	Office Room	As required		
2	Civil	Labour Changing / Locker Room	As required		
3	Civil	Toilet block	As required		
4	Civil	Misc. Foundations	As required		
5	Civil	Fencing around the plant	As required		
6	Electrical	All areas	Electrical installation including wiring, cabling, DB, Lighting, Switches, power sockets etc as required for operation of the facility and the office spaces including illuminating the same.		

***Note: In order to have confirmation on each and every stage involved, the successful contractor has to provide the IoT (Internet of things related to automation) based/integrated solution for the collection, transportations and operations as well. A single dashboard provision with hardware and software to be provided, and as an extension of the dashboard system the integration, if required, in the main SCADA for monitoring purpose will also be extended.***

# Disposal

## Segregation and Storage of Recyclable Waste



### **B. Indian Standards Cited for the Biogas Plant**

The standards listed herein shall not be deemed as all inclusive. The Bidder shall furnish a comprehensive list of standards he would be following in the works. These shall be furnished along with the tender. In case of discrepancy between the specifications and the standards, the specifications shall govern.

### **Biogas Plant**

IS: 16087 – Biogas (Biomethane)- specifications

IS: 7285 (Part 2) : Refillable seamless steel gas 2004 cylinders: Part 2 Quenched and tempered steel cylinders with tensile strength less than 1 100 MPa (112 kgf/mm<sup>2</sup>)

### Materials

- IS : 226 - Specification for structural steel (Standard Quality)
- IS : 269 - Specification for ordinary and low-heat Portland cement.
- IS : 299 - Specifications for Sulphate of Alumina
- IS : 383 - Specification for coarse and fine aggregates from natural sources for concrete.
- IS : 428 - Specification for distemper, oil emulsion, colour as required
- IS : 455 - Specification for Portland slag cement
- IS : 458 - Specification for concrete pipes.
- IS : 459 - Specification for unreinforced corrugated & semi corrugated asbestos cement sheets.
- IS : 650 - Specification for standard sand used for testing of cement.
- IS : 651 - Specification for salt glazed stoneware pipes and fittings.
- IS : 777 - Specification for glazed earthenware tiles.
- IS : 808 - Specification for dimensions for hot rolled steel sections. [Parts-I to VI]
- IS : 814 - Specification for covered electrodes (Part I metal arc welding of struct. Steel I & II)
- IS : 961 - Specification for structural steel (High Tensile)
- IS : 1003 - Specification for timber panelled and glazed shutters. (Parts I & II)
- IS : 1038 - Specification for steel doors, windows and ventilators.
- IS : 1077 - Specification for common burnt clay building bricks.
- IS : 1148 - Specification for hot rolled steel rivet bars (upto40mm) for structural purpose
- IS : 1149 - Specification for high tensile steel rivet bars for structural purposes.
- IS : 1230 - Specification for cast iron rainwater pipes and fittings.
- IS : 1363 - Specification for black hexagonal bolts, screws, nuts and black hexagonal screws
- IS : 1364 - Specification for hexagon bolts, screws and nuts
- IS : 1367 - Technical steel supply conditions for (Parts I threaded fasteners To x VIII)
- IS : 1398 - Specification for packing paper water proof bitumen laminated.
- IS : 1489 - Specification for portland puzzolana cement.
- IS : 1540 - Specifications for Quicklime
- IS : 1566 - Specification for hard drawn steel wire fabric for concrete reinforcement.
- IS : 1580 - Specification for bituminous compounds for water proofing & caulking purposes.
- IS : 1786 - Specification for high strength deformed bars & wires for concrete reinforcement.
- IS : 1852 - Specification for rolling and cutting tolerances for hot ventilators.
- IS : 1948 - Specification for aluminum doors, windows and ventilators.
- IS : 1977 - Specification for structured steel (ordinary quality)
- IS : 2016 - Specification for plain washers.
- IS : 2062 - Specification for weldable structural steel
- IS : 2074 - Specification for ready mixed paint, air drying, red oxide zinc chrome & priming.
- IS : 2116 - Sand for masonry works
- IS : 2185 - (Part I) Specification for concrete masonry units, hollow and solid concrete blocks.
- IS : 2202 - Specification for wooden flush door shutters (Parts I & II ]
- IS : 2645 - Specification for integral cement water proofing compounds.
- IS : 2750 - Specification for steel scaffoldings.
- IS : 2835 - Specification for flat transparent sheet glass.
- IS : 3102 - Classification of burnt clay solid bricks
- IS : 3384 - Specification for bitumen primer for use in waterproofing and damp proofing.
- IS : 3502 - Specification for steel checkered plates.
- IS : 3757 - Specification for high strength structured bolts.
- IS : 4021 - Specification for concrete porous and ventilator frames.
- IS : 4351 - Specification for steel door frames
- IS : 4984 - High Density Polyethylene pipes
- IS : 4990 - Specification for plywood for concrete shuttering work.
- IS : 5369 - General requirements for plain washers and lock washers.

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

IS : 5372- Specification for taper washers for channels.  
IS : 5374 - Specification for taper washers for I beams.  
IS : 7215 - Specification for tolerances for fabrication of steel structures.  
IS : 7280 - Specification for bar wire electrodes for submerged arc welding of struct. steel.  
IS : 7634 - Laying and jointing of Polyethylene pipes  
IS : 8008 - Specifications for HDPE fittings  
IS : 8360 - Fabricated HDPE fittings  
IS : 8217 - HDPE run outs and undercuts  
IS : 10262 - Recommended guidelines for concrete mix design  
IS : 14333 - High Density Polyethylene pipes for sewerage

### Tests

IS : 516 - Methods of test for strength of concrete.  
IS : 1182 - Recommended practice for radiographic examination of fusion-welded butt joints  
IS : 1199 - Methods of sampling and analysis of concrete.  
IS : 1542 - Sand for Plastering  
IS : 2386 - [I to VIII] Methods of test for aggregates for concrete  
IS : 2720 - (Parts I to XLI) Methods of test for soils.  
IS : 3025 - Methods for sampling and test (physical and chemical) for water and wastewater.  
IS : 3495 - Methods of tests of burnt clay building bricks.  
IS : 3613 - Acceptance tests for wire flux combinations for submerged arc welding  
IS : 4020 - Methods of tests for wooden flush doors: Type tests.  
IS : 4031 - Methods of physical tests for hydraulic cement.  
IS : 5807 - Method of test for clear finishes for wooden [Parts I to VI] furniture  
IS : 7318 - Approval tests for welders when welding procedure approval is not required.

### Codes of Practice

IS : 456 - Code of practice for plain and reinforced concrete.  
IS : 783 - Code of practice for laying of concrete pipes.  
IS : 800 - Code of practice for general construction in steel.  
IS : 806 - Code of practice for use of steel tubes in general building construction.  
IS : 816 - Code of practice for use of metal arc welding for general construction in mild steel.  
IS : 817 - Code of practice for training and testing of metal arc welders.  
IS : 875 - (Parts 1 to V) Code of practice for design loads/other than earthquake safety  
IS : 919 - Recommendations for limits and fits for Engineering.  
IS : 1081 - Code of practice for fixing & glazing of metal doors, windows and ventilators.  
IS : 1172 - Code of basic requirements for water supply, drainage and sanitation.  
IS : 1477 - (Parts I & II) Code of practice for painting of ferrous metals in buildings.  
IS : 1597 - (Parts I & II) Code of practice for construction of stone masonry.  
IS : 1742 - Code of practice for building drainage  
IS : 1893 - Criteria for earthquake resistant design of structures.  
IS : 2065 - Code of practice for water supply in buildings.  
IS : 2212 - Code of practice for brickwork.  
IS : 2338 - (Parts I & II) Code of practice for finishing of wood and wood based materials.  
IS : 2394 - Code of practice for application of lime plaster finish.  
IS : 2395 - (Parts I & II) Code of practice for painting Concrete, masonry & plaster surfaces.  
IS : 2470 - (Part I) Code of practice for installation of septic tanks - Design & construction.  
IS : 2470 - (Part II) Code of practice for installation & disposal of septic tanks  
IS : 2502 - Code of practice for bending and fixing of bars for concrete reinforcement.  
IS : 2571 - Code of practice for laying insitu cement concrete flooring.  
IS : 2595 - Code of practice for radiographic testing.  
IS : 2751 - Code of practice for welding of mild steel plain and deformed bars used for RCC  
IS : 2974 - (Parts II to V) Code of practice for design and construction of machine foundations.

IS : 3007 - (Parts I & II ) Code of practice for laying of asbestos cement sheets.  
IS : 3114 - Code of practice for laying of Cast Iron pipes.  
IS : 3370 - (Parts I & IV) Code of practice for concrete structures for the storage of liquids  
IS : 3414 - Code of practice for design and installation of joints in buildings.  
IS : 3558 - Code of practice for use of immersion vibrators for consolidating concrete.  
IS : 3658 - Code of practice for liquid penetrant flow detection.  
IS : 3935 - Code of practice for composite construction.  
IS : 4000 - Code of practice for assembly of struct. joints using high tensile friction fasteners.  
IS : 4014 - (Parts I & II ) Code of practice for steel tubular scaffolding.  
IS : 4111 - Code of practice for ancillary structures in sewerage system  
IS : 4127 - Code of practice for laying of glazed stoneware pipes.  
IS : 4353 - Recommendations for submerged arc welding of mild steel and low alloy steels.  
IS : 5329 - Code of practice for sanitary pipe work above ground for buildings.  
IS : 5334 - Code of practice for magnetic particle flaw detection of wells.  
IS : 5822 - Code of practice for laying of welded steel pipes for water supply.  
IS : 7215 - Tolerances for fabrication of steel structures.  
IS : 9595 - Recommendations for metal arc welding of carbon & carbon manganese steels.  
IS:10005 - SI units and recommendations for the use of their multiples & certain other units.

### **Safety Codes**

IS : 3696 - (Parts I & II) Safety code for scaffolds and ladders.  
IS : 3764 - Safety code for excavation work.  
IS : 7205 - Safety code for erection of structural steel work.  
I.S. 456 - Code of Practice for Plain and reinforced concrete.  
I.S. 875 - Code of Practice for design load (other than earthquake) for building structures.  
I.S. 3370 - (Part I to IV) Code of practice for concrete structures for the storage of liquids.  
I.S. 1893 - Criteria for earthquake resistant design of structures  
I.S. 2974 - (Parts I to V) Code of practice for design & construction of machine foundations.  
IRC : 6 - Standard specs. & Code of Practice for road bridges - loads & stresses  
I.S. 800 - Code of Practice for general construction in steel.  
I.S: 806 - Code of Practice for use of steel tubes in general building construction.  
NFPA 850 – Recommended practice for fire protection for electrical generating plants and Highvoltage DC converter stations.  
NFPA 54 – National Fuel Gas Code  
NFPA 55- Compressed Gases and Cryogenic Fluids Code.

### **Electrical**

Standard Specifications Except where otherwise specified, all electrical machines and accessories shall comply with current national standards CPWD standards and specifications. For the purpose of inspection or testing, the Contractor shall make available to the “Employer/Technical Agency” or his representative copies of relevant standards if requested.

### **Mechanical**

Except where otherwise specified, all equipment and accessories shall comply with current national standards and CPWD standards and specifications. For the purpose of inspection or testing, the Contractor shall make available to the “Employer/Technical Agency” or his representative copies of relevant standards if requested.

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

### Electricity and Water Supply:

Water Supply for the plant shall be provided on a chargeable basis at one point along the main road and the contractor has to make all necessary distribution arrangement from the point of supply to Bio gas plant as well as internal distribution within the plant. The Water supplied shall be of the quality as shall be available with the client. The Contractor has to check for the water quality to suit his requirement and do necessary arrangements to get the quality of water required for his operation.

Similarly for Electricity Supply, single point metered supply shall be made available to the contractor at the main road and the contractor shall make all distribution arrangement from point of supply onwards for the plant.

### Piping for Gas:

The piping work for the gas produced shall be done by the vendor up to the CHP gas train with a minimum pressure of 1 bar at the gas train inlet of the CHP gas train. The piping shall be done as per the prevailing standard specifications laid down by Petroleum and Natural Gas Regulatory Board. The design and specification for pipe shall be submitted for approval and once approved it can be procured. If client requires a change in type of pipe then contractor has to follow the same. **Required pipe materials are steel pipes (Heavy Class), Polyethylene (PE) piping systems complying with ASTM D 2513 & NFPA 58.** Necessary blower/ pump for the transmission of Gas from the Bio Gas plant to the CHP station shall be in the contractor scope.

### C. OUTPUT PARAMETERS

The Bio Gas generated from the plant shall have the following minimum parameters

Description	Minimum/Maximum Value required
Methane Content	Minimum 55% by Volume
Carbon Dioxide	Maximum 45% by Volume
Hydrogen Sulphide	Less than 1% by Volume
Net Calorific Value	Minimum 5000 KCAL/Cum
Gas Pressure	As required for Operation of CHP engine
Fuel Gas Availability	On continuous Basis

### D. TESTING

All testing of the materials, equipment's and works shall be as per relevant standards as put in the Indian standard codes and CPWD specifications.

### **E. Payment Terms:**

Payment terms shall be as mentioned in Notice inviting tender document.

The complete work of SITC has to be done at the permanent campus of Nalanda University at Rajgir Bihar.

### **F.PERFORMANCE GUARANTEE:**

Contractor has to submit a performance guarantee for the entire installation of Bio Gas system @2% of the tendered value and CHP O&M amounting to 5 % of the O&M cost in the form of Bank Guarantee from Scheduled bank in the favour of Nalanda University, Rajgir Bihar. The format of the Guarantee shall be as per NIT document. The contractor needs to submit the guarantee to NU on completion of the work including testing, commission and stabilisation period while submitting the final bill. In the absence of such performance guarantee, the final bill shall not be released.

The performance guarantee submitted above shall be released to the bidder at the end of successful completion of the operation and management period of 5 years /60 months from the date of successful commissioning of the plant after stabilisation period.

During operation period of 5 years , the contractor shall be provided metered electrical and water connection at a point near the vicinity of the plant

## **6. ELECTRICAL WORKS SPECIFICATIONS**

### **6.1. Battery charger cum DCDB**

#### **6.1.1. Scope**

The scope of work shall include:

1. Supplying, installation testing and commissioning of battery charger cum DCDB.
2. Handling, loading unloading and storage.
3. Associated wiring and internal cabling works.

#### **6.1.2.Definitions**

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

#### **6.1.3.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. IEC- 60335-2-29 - Particular requirement for battery charger.
2. NEC- 2008 - National electrical code.
3. NBC-2016 - National building code.
4. IER-1956 : Indian electricity rules.
5. IEA-2007: Indian electricity act 2007.



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

### 6.1.4. Service conditions

#### System particulars

- a. Nominal system voltage - 110V bipolar DC
- b. Rated system voltage - 1.8kV
- c. Frequency - 50Hz  $\pm$  3%
- d. No. of phases – 2pole + earth
- e. System neutral - Solidly earthed

#### Tropical conditions

- a. Ambient temperature : 50 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.

### 6.1.5. Specifications

- The Sealed Maintenance Free Batteries or Lead Batteries are placed outside the Charger. The Batteries are supplied in Modular Form, suitable for Floor standing.
- The Battery Charger & DC Distribution Board shall be a composite unit.
- The Battery Charger shall be Float cum Boost type, Thyristor controlled .The charger shall have selector switch for Auto Float - Boost / Manual Float / Manual Boost Mode of Operation. During Auto Float – Boost Mode, Automatic Changeover shall takes place from Float Mode to Boost Mode and vice – versa. This mean that when the Batteries are fully charged the charging shall automatically change from Boost charge to Trickle charge.
- The Float cum Boost Charger and DC Distribution Board shall be housed in Sheet Steel Cubicle Sheet Steel Panels of 1.6 mm thickness. Louvers shall be provided in the cabinet for the ventilation. The Cubicle shall be painted in Siemens Grey shade. Channels shall be provided at the base.
- The D.C Output voltage of Float / Boost Charger shall be stabilized within +/- 2% for A.C. Input variation of 230V +/- 10%, Frequency variation of 50 Hz +/- 50% and D.C load variation of 0-100%. The voltage & regulation shall be achieved by a constant

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

voltage regulator having fast response SCR Controlled. The ripple content in output will be within 3% of D.C. Output Nominal Voltage.

- There shall be provision to select Auto Float / Manual Float / Manual Boost Modes. During Auto Float mode the Battery charging shall automatically changeover from Boost Mode to Float Mode and vice – versa. During Manual Float / Boost modes it shall be possible to set the Output Volts by separate potentiometers.
- The Battery Charger shall have automatic output current limiting feature.
- Battery charger shall constitute of following :
  - a. 1 No. Double Pole ON / OFF MCB at A.C. Input.
  - b. 1 No. Pilot lamp to indicate Charger Mains ON.
  - c. 1 No. MAIN TRANSFORMER: Double wound, naturally air-cooled, having copper winding.
  - d. 1 Set single phase full wave bridge rectifier consisting of 2 nos. Diodes and 2 nos. SCRs, liberally rated, mounted on heat sinks and complete with resistor / condenser network for surge suppression.
  - e. 1 No. Rotary Switch to selected AUTO FLOAT / MANUAL FLOAT / MANUAL BOOST. During Auto Float Mode Automatic Changeover shall take place from Float Mode to Boost Mode and vice-versa.
  - f. 1 Set solid state constant potential controller to stabilize the DC output voltage of the Float cum Boost Charger at +/- 2% of the set value for AC Input Voltage variation of 230V +/- 10%, Frequency variation of +/- 5% from 50 Hz and simultaneous load variation of 0-100% .
  - g. 1 No. Electronic controller to Automatically Changeover Battery charging from Boost to Float and vice – versa.
  - h. 1 No. DC Ammeter and Toggle switch to read charger output current and Battery Charge / Discharge Current.
  - i. 1 No. Moving coil DC Voltmeter with selector switch to read the Charger Output / Load Volts.
  - j. 2 Set Potentiometer to adjust the output voltage during Manual / Auto Float and Boost Modes.
  - k. 1 No. Double Pole ON / OFF M.C.B at Charger Output.
  - l. 1 set Dropper Diode to Automatically maintain Load Voltage constant within 110-125V (Relays) with electronic controller.
  - m. 1 set D.C. Overvoltage Trip circuit with Indication.
  - n. 1 no. Series Diode to prevent reverse current flow Battery to Charger.
- The Battery Charger shall have following alarm and annunciation feature.
  - a. A.C Mains Fail.
  - b. DC Output/ Battery Under Volt.
  - c. Charger Fail.
  - e. Battery on Boost Charge.
  - f. D.C. Output Over volt.
  - g. Battery on Boost Charge.
- DCDB shall be as per SLD
- The Battery Charger shall have following ratings :
  - a.AC INPUT - 230V +/- 10% AC 50 Hz Single Phase.

- b. DC OUTPUT - To Float / Boost Charge 110V – 100AH Batteries and also supply a continuous Load.
- c. CURRENT RATING - As per schedule : Battery – 10.0A
- d. FLOAT MODE - Nominal 122.5V (Adj between 110.0V- 125.0V)
- e. BOOST MODE - Nominal 126.5V (Adj between 110.0 V - 135.0V)
- f. VOLTAGE REGULATION: +/- 2% of the set value.
- g. RIPPLE - Less than 3%.

### 6.1.6. 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.
- 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 **5 years old from the date of approval of drawing.**
- 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 battery charger with both float and boost charge testing shall be done at site as per the approved QAP. All testing expenses shall be under the scope of vendor.

## 6.2. UPS

### 6.2.1. Scope

The scope of work shall include:

1. Supplying, installation testing and commissioning of UPS.
2. UPS and battery handling, loading unloading and storage.
3. Associated racks and other works to install the UPS.

### 6.2.2. Definitions

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

### 6.2.3. 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. IEC 146 : Performance testing of UPS.
3. ANSI C 37.90a, IEEE Standard 472 : Surge withstand capability test.
4. ANSI C 34.2 : Practices and requirements for semiconductor power rectifiers.
5. ANSI C 34.2 : Practices and requirements for semiconductor power rectifiers.
6. ANSI C 37.90 : Relays and relay system associated with electrical power apparatus.
7. IS 2208 & IS 9224 : Cartridge fuses for voltages up to and including (Part 1&2) (IEC 269) 650 V.
8. IS 9224 (Part - 4) : Fuses for protection of semiconductors.
9. BS 2709 (I.E.C 119) : The Electrical Performance of Semiconductor Rectifiers. (Metal Rectifiers)
10. BS 4417 (I.E.C 146) : Semi-conductor Rectifier Equipments.
11. IS 1652 & IS 1652 : Lead-acid stationary cells and batteries.
12. NEC- 2008 - National electrical code.
13. NBC-2016 - National building code.
14. IER-1956 : Indian electricity rules.
15. IEA-2007: Indian electricity act 2007.
16. Any other local bye-law or supply company norm as applicable.

### 6.2.4. Service conditions

#### System particulars

- a. Nominal system voltage - 415V
- b. Rated system voltage - 1.1kV
- c. Frequency- 50Hz  $\pm 3\%$
- d. No. of phases- 3P + neutral + Integrated earth
- e. System neutral- Solidly earthed
- f. Short circuit rating - 50kA for 1sec on LV side.

#### Tropical conditions

- a. Ambient temperature : 50 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.

### 6.2.5. Specifications

- The UPS system shall be of microprocessor based and so carefully designed to maximize the availability of power for critical loads and to ensure that equipment's is protected to the extent possible against power failure and quality problems.
- UPS system shall constitute of (but not limited to) following
  - a. Transient Voltage surge suppression (TVSS)
  - b. Rectifier
  - c. Inverter
  - d. Static bypass switch
  - e. Manual / Maintenance by-pass switch
  - f. Display Panel
  - g. Control Logic
  - h. Isolation Transformer
  - i. Battery Monitoring system
  - j. Temperature compensating battery charging
  - k. Audible Alarm
  - l. SMF Battery Bank
- All components of the UPS equipment shall have surge withstand capability (SWC) to meet the requirements of ANSI C 37.90a, IEEE Standard 472-1974.
- All components of UPS system shall withstand short circuit current without any damage.
- Fuses shall not be larger than 125% of the transformer primary circuit current where the secondary circuit fuse protection has not been provided. where the secondary fuses are sized not greater than 125% of the secondary current of the transformer, fuses shall not be required in the primary circuit, provided the primary feeder fuses are not larger than 250% of the transformer primary current.
- All the neutral conductors in three phase UPS systems shall be sized equal to at least 200% of the maximum phase current. In addition, all the isolators and circuit breakers used in three phase UPS system shall also to be rated such that the neutral poles shall take at least 200% of the maximum phase current.
- All control shall be designed and positioned such that possibilities of inadvertent or accidental operations are eliminated.
- All UPS system cabinets, frames and power equipment shall be double earthed.
- The various overload capacities of inverters, static switch, step down transformer/voltage stabilizer as specified herein are the minimum requirements. However, if the firm's offered system has better overload capacities for the above devices, the same shall be highlighted by the bidder in his bid.
- Maximum humming noise level of UPS shall be 75 dB one meter away from the UPS

cabinets.

- The system shall be fully microprocessor based and monitored through SCADA.
- The system shall be on line double conversion i.e. load independent from both main's voltage and frequency. Ensure server-grade high quality of power.
- The system shall have IGBT based PWM inverter resulting perfect sine wave voltage.
- The system should be wide input voltage tolerance ( +10/-10%).
- The system should be wide input frequency tolerance ( + / - 6%)
- The system shall be advance battery management system with programmable automatic battery testing, constantly monitors the health of the battery pack keeping the battery ready to work for emergency situations.
- The system shall be high overload capacity of static bypass (10 times for 100ms.)
- The system shall be built in maintenance bypass.
- Front access shall be provided for easy replacement and maintenance.
- The system shall have overload capacity :
  - a. Below 105% rated output current, continuous operation
  - b. 105% ~ 125% UPS output current, 5 minutes
  - c. 125% ~ 150% UPS output current, 1 minute
- The system shall have selectable timer.
- The system shall have adjustable frequency synchronization window upto +/-1% in the static bypass.
- The system shall have hardware for fault diagnostic unit, data logger and power monitoring system.
- The system shall have comprehensive display panel having three functional sections such as
  - a. Mimic :LED Display indicates the status of UPS.
  - b. Control :Touch membrane switches for ON, OFF, RESET, audible alarm and STOP functions.
  - c. Display :LCD display indicates operating parameters and alarm conditions.
- Each UPS shall give regulated filtered & uninterruptible power supply as described in the specifications.
- In case the calculated /specified UPS capacity is not the same as one of the standard KVA ratings of the UPS manufacturer, the next higher standard KVA rating shall be selected. UPS of non standard rating shall not be acceptable.
- UPS system supplied shall be the latest state of the art technology system fully digitalized using microprocessor controlled, IGBT based full wave rectification and IGBT inverter.

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

- Batteries shall be valve regulated lead acid specially meant for UPS application.
- Monitoring and control system shall also be state of the art technology LCD touch panel type providing all relevant data described in this document.
- The monitoring and control system shall be capable of RS485 input software for connecting to customer's computer system for data display and monitoring.
- All necessary components required for protecting UPS equipment and connected inputs and outputs shall be furnished as an integral part of the UPS system.
- The UPS systems shall include but not be limited to the following equipment:
  - a. UPS system including 100% capacity float-cum-boost charger with 100% sealed valve regulated lead acid batteries with guaranteed battery life of 5 years.
  - b. Suitable factory built battery cabinet for housing the batteries, including terminal isolator / breaker and power disconnect device.
  - c. All cables, connectors, accessories like trunking, cable trays, conduits etc. required for connection between battery and the UPS unit.

### 6.2.6. Rectifier

- The static converter (rectifier) shall be a multi-functional converter providing functions of power conversion, battery charging and shall have the additional functions of input power factor improvement and current harmonics reduction.
- The rectifier shall be a solid state, IGBT based, static PWM converter utilizing Intelligent Power Module (IPM) and shall include intelligent features like the drive circuitry, over current protection, over temperature protection, control power failure protection and short circuit protection. The IPM transistors shall enable high speed switching at 6 KHz thus reducing the heat dissipation in the UPS and thereby providing high efficiency. The PWM converter shall utilize the above and achieve unity power factor and reduce input current harmonics as given earlier and thus improve the overall power factor of the converter achieving input KVA savings. During any step inverter load change (0-100%) the converter shall only supply 100% current to the inverter.
- The rectifier equipment shall include all necessary control circuitry and device to conform requirements like voltage regulation, current limiting, wave shaping, transient recovery, automatic synchronization etc.
- The rectifier logic shall provide input current limiting by limiting the DC output current. Two (2) line side current transformers shall be employed as a means of sensing the current amplitude. The rectifier shall be capable of supplying overload current in excess to the full load rating. The DC output current limit values shall be as follows:
  - a. Rectifier output current (maximum) 100%
  - b. Rectifier output current (aux.) 25% - 100% variable.Note : 100% current shall be under the battery recharging mode.
- The rectifier logic shall provide current limiting function of battery charging to prevent the battery from damage. The following battery current limit and protection shall be provided.

- a. Battery charge current limit 10% of battery Ah rate.
- b. Over-current protection at 120% of above item.
- The rectifier / charger output voltage shall not deviate by more than +/- 1% of the nominal output voltage, due to the following conditions:
  - a. From 0 to 100% loading.
  - b. Rectifier input variations of voltage and frequency within the limitations
  - c. Environmental condition variations
- The rectifier logic shall employ circuitry to allow a delayed and timed ramping of input current. Subsequent to energizing the rectifier input, the ramping of current shall be delayed by a maximum of 3 seconds. Upon starting the walk-in process, the ramping of current is timed to assume the load gradually within 1 through 60 seconds (every 1 second selectable).
- The A/C input fuses shall be provided at the rectifier input as a means of overload protection. The AC maximum current shall be controlled by the rectifier.
- During any step inverter load change (0-100%), only the rectifier shall supply 100% current to the inverter.
- The rectifiers shall be suitable to be fed from the normal power supply source.
- Basic parameters of rectifier shall be as follows :
  - a. Nominal Voltage: 415V, 3 Phase, 3 Wire
  - b. Voltage Range.: + 10 % / - 10% AC
  - c. Frequency Range : + 6 % / - 6% AC
  - d. Input Power Factor : 0.98 lagging or more at full load (PF improvement)
  - e. Input Harmonic Current THD: 7% typical at 100% load 6% maximum at 50% load
  - f. Duty : Continuous
  - g. Cooling : Forced cooling using fans with thermal relays using a latched cut out for re-setting as protection for cooling fans. Each individual fan shall have its own thermal relay. Ambient operating temperature range: 0 to 45 deg.C maximum.

### 6.2.7. Inverter

- The static 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 thus reducing the heat dissipation in the UPS and thereby providing high efficiency.
- The UPS 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.



## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

- 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 UPS 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 transferred to the bypass source without interruption.
- 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 UPS module and shall be controlled by the internal UPS module system logic.
- The inverter shall meet the following specifications in addition to other requirements stated herein:

Voltage Input : Three Phase UPS

- Nominal DC (Range 300 V to 420 V DC to maximum DC bus voltage during charging the batteries).
- Nominal Voltage Output : 415 V + 1% AC 3 Phase, 4 Wire
- Voltage Regulation :
  - a. 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 40 deg.C maximum continuous.
  - i. Output : Suitable terminals are provided for termination of cables for connecting inverter output to AC distribution board.

### 6.2.8. Isolation transformer and bypass switches

- This shall provide neutral separation which shall mean that output neutral will be independent of incoming neutral, hence critical load shall be isolated from the problems like incoming neutral open or, short or, variations in neutral to earth voltage due to sudden loading in neighboring installation. The isolation transformer shall be connect so as to protect any unwanted voltage fluctuations in neutral to protect the UPS
- In the event of Phase sequence reversal at the input, UPS system shall continue to work and shall not trip the UPS system.
- A bypass circuit shall be provided as an alternate source of power other than the inverter. A high speed switch and wrap-around contactor shall be used for the critical load during automatic transfers to the bypass circuit. The static switch and wrap-around contactor shall drive power from an upstream bypass feed circuit breaker internal to the UPS module provided for overload protection. The wrap-around contactor shall be electrically connected in parallel to the static switch and shall at the same time as the static switch, energize and upon closure, maintain the bypass source. The static switch shall only be utilized for the time needed to energize the wrap-around contactor thus increasing reliability. The bypass circuit shall be capable of supplying the UPS rated load current and also provide fault clearing current.
- The UPS system logic shall employ sensing which shall cause the static switch to energize within 150 microseconds thus providing an uninterrupted transfer to the bypass source when any of the following limitations shall exceed:
  - a. Inverter output under voltage or over voltage.
  - b. Overload beyond the capability of the inverter
  - c. DC circuit under voltage or over voltage
  - d. Final end voltage of system battery is reached.
  - e. Bypass source present and available
  - f. System failure (eg.Logicfail, fuse blown, etc.)
- Keeping the above requirements in view, the static switch shall have the following minimum rating.
  - a. Capacity continuous equal to 100% of continuous rating of the inverter.
  - b. Capacity overload equivalent to overload characteristics specified for UPS.
  - c. Nominal bypass input voltage: 415 V, 3 phase, 4 wire
  - d. Voltage Range :+/- 10% of nominal
  - e. Nominal Frequency : 50 Hz
  - f. Frequency range :+ 6%
  - g. Output Fault Clearing : Current : 1000%, Duration : 20 milli seconds
  - h. Duty : Continuous
- In the event that the critical load must be transferred to the bypass source due to an overload, the UPS system logic monitors the overload condition and, upon the overload being cleared, performs an automatic re-transfer back to the inverter output.
- The UPS shall be capable of transferring the critical load to / from the bypass source via LCD touch panel. When performing manual transfer to inverter or automatic re-transfers, the UPS system logic shall force the inverter output voltage to match the bypass input voltage and then parallel the inverter and bypass source providing a

make-before-break transition allowing a controlled walk-in of load current to the inverter.

- The UPS shall include as standard equipment, a zero energy maintenance bypass switch. Full UPS wraparound enables personnel to do work inside the UPS module or maintenance bypass switchboard without danger for high voltage conditions.
- The UPS shall have built-in protection against: surges, sags, and over-current from the AC rectifier input source, over-voltage and voltage surges from output terminals of paralleled sources, and load switching and circuit breaker operation in the distribution system.
- The UPS shall be protected against sudden changes in output load and short circuits at the output terminals. The UPS shall have built-in protection against permanent damage to itself and the connected load for all predictable types of malfunctions. Fast-acting current limiting devices shall be used to protect against cascading failure of solid-state devices. Internal UPS malfunctions shall cause the module to trip off-line with minimum damage to the module and provide maximum information to maintenance personnel regarding the reason for tripping off line. The load shall be automatically transferred to the bypass line uninterrupted, should the connected critical load exceed the capacity of the available on-line modules. The status of protective devices shall be indicated on a graphic display screen on the front of the unit.

### 6.2.9. Battery system

- The battery system shall be sized to provide 30 minutes backup time when the UPS is supplying 100% rated load at 0.9 load power factor.
- The battery system design shall be provided with necessary devices to prevent deep discharge beyond recommended limits to prevent the batteries discharging beyond end cell voltage specified by the battery maker. The connections from battery to battery shall be by using copper cable and BCB (Battery circuit breaker).
- All batteries shall be clearly identified and identification numbers marked on the batteries and a schematic diagram along with the complete calculations, including manufacturers supporting curves, shall be submitted with the tender.
- Batteries shall be VRLA (Maintenance-Free) type. Constant current boost charging, constant voltage boost charging, float charging (float charging compensation) and EOD protection are available for different kinds of batteries.

Charging: In addition to supplying power to the load, the battery converter shall be capable of producing a battery charging current sufficient to replace 95% of the battery discharge power within ten (10) times the discharge time. Ripple voltage at the battery terminal (RMS) should be less than 1%, and ripple current must not exceed 5% (of C-10 Ah rating) nominal discharging current. (Number of battery is 25 - 40 blocks, nominal voltage is 12V per block).

- Discharging: The battery converter will supply power to the inverter when the rectifier is shut down or in joint mode, and also the rectifier is current limiting.

### 6.2.10. Operation

- Under normal operation, the UPS load will be fed from the Inverter with the bypass switch inhibited. The rectifier, apart from providing DC power to the Inverter, also charges the battery under the float charge mode. The battery charge system shall have float charge, equalizing charge and recovery charge modes, to replenish the batteries self-discharging part while the battery is fully charged, equalizing the battery cell voltage to a constant value forcibly, and recharging the battery system to the required values when the batteries have been used, respectively.
- The Inverter shall constantly monitor the AC source frequency and shall be in synchronization with the AC input source till the frequency of the AC input source is within synchronizing limit and if the frequency of the standby source exceeds the synchronizing limit the Inverter will work on its own internal oscillator maintaining an output frequency of 50 Hz +/- 0.01% under all conditions of load. When the Inverter operates on its internal oscillator, it shall continuously monitor the frequency of the input source and when the input source frequency returns to within synchronization limit, the Inverter shall automatically synchronize itself with the input A/C source frequency and use it as a signal for Inverter output frequency control.
- When the A/C input voltage drops below specified limits or in case of a power failure the Inverter continues to supply AC power of constant voltage and constant frequency utilizing the battery system as a power source until the input voltage returns to normal requirement. When the power supply is resumed or the input voltage returns to limits, the Converter shall automatically start and the load fed for normal operation status.
- If the power failure continues beyond battery backup time or the battery voltage drops to the final discharge voltage, the Inverter should automatically stop and at the same time transferring the load to the bypass circuit. On resumption of power supply, the Converter shall automatically re-start the operations and charge the batteries whereas the Inverter should inhibit automatic start and should be started manually.
- When power is supplied from the Inverter in synchronization with the bypass, it shall accomplish the following:
  - a. When the UPS output current reaches overload status it shall automatically transfer the load to bypass circuit with no interruption and when the overload status is cleared it automatically re-transfers the load to Inverter.
  - b. When the battery final discharge condition is reached, the load shall automatically be transferred to the bypass circuit without interruption.
  - c. In case of failure of the UPS, the load shall be automatically transferred to the bypass circuit with no interruption and when the failure is cleared, re-transfer the load to the Inverter shall be done manually.
  - d. There should be provision made in the system to prevent, when necessary, asynchronous transfer.
  - e. When the UPS goes on bypass mode in any of the conditions described above and if at that time there is no bypass power supply available due to power failure, the UPS shall remain in standby mode and as soon as the bypass power supply is available will transfer the load to bypass.
  - f. A maintenance bypass transfer switch shall be provided with lock and key arrangement and should be manually done by authorized personnel only.
- The entire UPS system, including all components like inverter, static switch,

maintenance bypass, shall be housed in free-standing steel type factory-finished enclosures complying with the protection standards of IP20. The enclosure shall be open able using a special tool for internal access. The color shall be light grey.

- Forced air-cooling shall be provided to allow components to operate within their rated temperature specified. The cooling fans shall have thermal relays protection using a latched cut fire re-setting, as a protection for the cooling fans.

### 6.2.11. Control and monitoring

- The UPS shall have Simple Network Management Protocol (SNMP) card with system (RS485 compatibility port) for interfacing to IBMS system or client's centralized computer network for Control and Monitoring System.
- It shall be provided with LED displays. The display system shall have, as minimum individual
  - LEDs with different colors for the following:
    - a. Load on Inverter
    - b. Battery operation
    - c. Load on Bypass
    - d. UPS failure
    - e. LCD failure
    - f. Overload
- Statistical data Providing all statistical data like no. of days of UPS operation, no. of mains failures up to 1min, 2min etc., no. of overloads up to 110%, 125% etc, no. of hours operation on battery & on bypass etc., no. of hours battery temp exceeded 25 degree C.
- LCD touch panel
- The UPS shall be provided with a operator friendly large scale LCD touch panel.
- The LCD touch panel shall also include graphic measurement display, operational procedures of each activity, fault status display and also have capability to record at least 50 faults.
- The touch screen panel shall clearly define specified areas for operational function, execution and message display.
- It should be possible to operate the entire UPS system and its components and obtain all measurements and data through the touch screen operation. The measurement software should provide capability to measure phase voltage, current in each phase, frequency, power factor, available battery time etc.
- Under all operating conditions, the system software should have capability for displaying fault alarm automatically. The Firm should describe in detail the faults that would be displayed under this mode.

### 6.2.12. Installation, Testing & Commissioning

- Installation of UPS shall be carried out as per manufacturer's instructions and

installation shall be verified by the manufacturer before energizing.

- 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 **5 years old from the date of approval of drawing.**
- 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 UPS 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 UPS 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.

### 6.3. Cable trays

#### 6.3.1. Scope

The scope of work shall include:

1. Supplying, laying, testing and commissioning of cable trays and its allied accessories.
2. Handling, loading, unloading and storage of cable trays
3. Civil works associated with the said job.

#### 6.3.2. A.6.2 Definitions

The definitions shall be as per NEMA-VE-2

**Accessory:** Components used to supplement the function of a straight section or fitting. Examples include, but are not limited to, dropout, cover, conduit adapter, hold-down device, and divider cable tray support.

**Span:** The distance between the centrelines of supports.

**Cable tray system:** A section or assembly of sections, and associated fittings, forming a mechanical system used to support cables and raceways.

**Channel cable tray:** A fabricated structure consisting of a one-piece ventilated- or solid-bottom channel section.

**Connector:** A component that joins any combination of cable tray straight sections and fittings.

### 6.3.3. 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. NEMA VE-2 -2013
2. IS 1079 - Cable trays and their accessories
3. NEC- 2008 - National electrical code.
4. NBC-2016 - National building code.
5. IER-1956: Indian electricity rules.
6. IEA-2007: Indian electricity act 2007
8. Any other local bye-law or supply company norm as applicable.

### 6.3.4. Service conditions

#### System particulars

- a. System voltage - 415/230 V for AC
- b. Frequency- 50Hz  $\pm 3\%$  for AC cables
- c. No. of phases- 3 for AC
- d. System neutral- Solidly earthed
- e. Short circuit rating - As per system fault level

#### Tropical conditions

- a. Ambient temperature: 50 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.

### 6.3.5. Specifications

- Cable tray system shall comprise of hot dip galvanized G.I cable trays, with galvanizing thickness of 65 micron and standard length of 2.5 meters made out of 2 mm thick perforated sheet metal for cable trays which are 600mm wide and above and 1.6mm thick for cable trays whose width is below 600mm.

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

- The construction of the cable trays shall be as per the approved GA drawing from Vendor.
- The construction of cable tray shall follow NEMA standards.
- The cable trays shall be hot dip galvanized with perforations not more than 17.5% and factory fabricated out of G.I., angle iron, tee, bends, sections, flats and perforated sheet for different loads.
- All accessories shall follow NEMA VE-2 standards

### 6.3.6. Installation, testing and commissioning

- The Complete installation of cable trays shall be in accordance with NEMA VE-2 standards.
- Before installing cable in the cable tray, examine cable paths to ensure all areas are free of debris that may interfere with cable installation.
- Cable tray should never be used as a walkway.
- Most cable installations require the use of cable pulling tools on horizontal straight runs, cables generally ride on rollers mounted in or on cable trays.
- These rollers should be properly spaced, depending on the size and weight of the cable, to prevent the cable from sagging and dragging in the cable tray during the pull.
- Cable manufacturer shall be contacted for information regarding proper roller spacing. Cables may be fastened to the cable tray by means of cable clamps or cable ties. Generally, cables shall be fastened every 450 mm (18 in) on vertical runs.
- Although not required by the NEC, single conductor cables can be fastened on horizontal runs to maintain spacing and ensure that the cable is confined within the cable fill area.
- When using cable clamps, the clamps should be sized correctly and tightened only enough to secure the cable without indenting the jacket.
- The same precaution should be observed with cable ties, and they should be applied with a pressure limiting device.
- Extremely long vertical drops introduce a new set of issues requiring special consideration.
- The weight per meter (foot) of the cable multiplied by the number of meters (feet) in the vertical drop, in many cases, exceeds the load carrying capacity of the cable tray component. The one or two rungs supporting this weight are likely to be damaged, and the vertical load could exceed the allowable cable tension.
- The cable weight should be supported in such a manner as to prevent damage to the cable tray or cable during this type of installation.
- As the cable is installed, intermediate supports should be installed on the vertical drop to break the cable load into segments supported at multiple places.
- Once the cable is installed in an open cable tray system, care must be taken to protect the exposed cables from falling objects or debris that could cause damage to the cable.



## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

- In areas where the cable tray is to be covered, covers should be installed as soon as possible. Temporary protection for the cables and cable tray can be constructed of available wood or metal materials until the risk of damage has passed.
- Complete installation shall be in accordance with seismic requirements.

### 6.4. Relay

- Relays shall be numeric type, microprocessor based for feeder protection and shall have following required programmable protections:
  - a. Instantaneous ( overcurrent and earth fault.)
  - b. Overcurrent
  - c. Earth fault
  - d. Overvoltage
  - e. Undervoltage
  - f. Frequency
  - g. CT / PT supervision
  - h. Phase sequence
  - i. Broken conductor protection based on negative sequence current to positive sequence current.
- Relays shall be numeric type, microprocessor based for transformer protection and shall have following required programmable protections:
  - a. Differential
  - b. Restricted earth fault
  - c. High oil temperature
  - d. High winding temperature
  - e. Sudden pressure.
- Relays shall be hinged armature type, electromechanical, for following required protections:
  - a. DC failure
  - b. Trip circuit supervision
  - c. Lockout
- Relays and circuit breakers shall be fully co-ordinated to achieve total discrimination up to main LT panel inside each distribution substation.
- Separate numeric relay shall be provided for feeder and transformer protection.
- Relay shall confirm to IEC-61850 and shall be provided with Ethernet IP communication port. Relay shall have dual port for PR to PR communication. All protection relays shall be connected in ring topology with Ethernet switch.
- Relay used for transformer protection shall have a feature to bypass the harmonic switching current at the time of transformer switching so as to prevent the breaker trip during switching of transformer. Circuit breaker shall be capable to handle the current at the same time.
- Numeric relays shall have self-supervision function and shall be able to communicate and provide indication in case of internal fault in relay.
- Relays shall have inbuilt volatile and non-volatile memories and shall be capable to

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

record and store at least 100 events with date and time, with last five faults stored in non-volatile memory.

- Relays shall be completely SCADA compatible and shall have **Ethernet IP** port available for communication.
- 4 spare binary inputs and 4 spare binary outputs shall be provided in addition to those required.
- The operation of the relay shall be practically free from errors due to normal variations in frequency, waveforms & from ambient temperature effects range between - 20 degree to +55 degree C.
- The relay shall have 3 independent time delayed O/C stages. The first stage should be programmable to have either a DT characteristics or IDMT characteristics described as follows and shall have a current
- setting range of 10% to 2500% and time setting range of 0 ms to 150 sec. The second and third settings shall have a current setting range of 50% to 4000%.
- The relay should have 3 independent time delayed E/F stages. Should have a current setting range 1% to 800% and time setting range of 0 ms to 100 sec. The lower setting is critical to take care of system which have low earth fault currents.
- The relay shall have reverse blocking or bus bar blocking feature.
- The relay shall have 8 Indication LEDs out of which minimum 4 should be freely programmable.
- Relay shall be able to record at least 5 oscillographic disturbance records each of minimum 3 seconds.
- Relay shall have independent setting groups.
- Relay shall have at least 4 shots of auto-reclose function, switch on to Fault function, circuit breaker failure function, cold load pick up function. and inbuilt output relay latching function
- Relay shall have keypad buttons at front of the relay to configure the relay and shall be easily programmable and maintainable.
- Aux Supply input voltage shall be 110VDC however relay shall be capable to operate at 24-250VDC / 240VAC.
- Relay shall have its LCD display and any other control feature required in the relay shall be provided by the contractor at the time of product data approval at no extra time and cost.

### 6.5. Multifunction meter

- Multifunction meter shall be electronic, digital type with inbuilt selector switches suitable to show parameters on 11kV
- Multifunction meter shall be suitable for panel mounting, **flushed type of size min 96 x 96 mm** and shall be fully communicable with provision of **Ethernet IP** port and shall be SCADA compatible.

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

- Meter shall have distinct indication upon front LCD screen for following (but not limited to) data and values :
  - a. Current (for all three phases)
  - b. Voltage (for lines and phases)
  - c. Power factor (Avg. and individual phases)
  - d. Active power kW ( Avg. and individual phases)
  - e. Reactive power kVAR( Avg. and individual phases)
  - f. True power KVA
  - g. Frequency
  - h. Energy kWh ( Avg., current , max in a day along with date and time, min in a day along with date and time )
  - i. Reactive kVARh( Avg, current)
  - j. Energy kVAh
  - k. Total harmonic distortion THD %
  - l. Current harmonics THDi (for harmonics up to 15th order)
  - m. Voltage harmonics THDv (for harmonics up to 15th order)
- Multifunction meter shall have accuracy class of 0.5 and shall have 2 DI/DO ports.
- Multifunction meter shall be fully programmed from factory along with its CT ratio settings.

### 6.6. Analog voltmeter

- Voltmeter shall be analog type suitable with external selector switch.
- Voltmeter selector switches shall be four position type. Selector switch shall be suitable for semi flush mounting with only switch front plate and operating handle projecting out.
- Range of voltmeter shall be 0-12000V for 11kV
- Voltmeter shall be PT operated with accuracy class 0.5
- Deflection needle shall be self-adjustable type.
- Front fascia shall have glass/polycarbonate cover.
- Range shall be properly engraved in the front fascia and shall be easily identifiable.

## 7. CIVIL WORKS SPECIFICATIONS

All the civil structure designed by the bidder shall confirm to latest Indian standard codes, CPWD Specifications, NBC 2016 and other relevant standards. The Bidder shall provide at-least the following minimum design specifications for the campus as per the final design to be done by the bidder. Due to Site Condition, the Structures have to be designed on **PILE FOUNDATION**. Contractor to take a note of the same.

Sr. No	Item Description	Minimum Specification Required	Specification Document to be followed
1	All PCC Components	Minimum M10 to be used	CPWD Specifications & Relevant IS Codes

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

2	All RCC Components	Minimum M25 to be used	CPWD Specifications & Relevant IS Codes
3	All Reinforcement steel	Minimum FE 500D	CPWD Specifications & Relevant IS Codes
4	All Brick Work	Bricks of Minimum 7.5 MPA Strength to be used. All single brick masonry to be in CM 1: 4 and remaining Brick Masonry in CM 1:6.	CPWD Specifications & Relevant IS Codes
5	All Structural steel	Minimum shall be of YST 240 Grade	CPWD Specifications & Relevant IS Codes
6	Storage sheds for feed	Shall be RCC Framed Structure with Brick masonry infill walls and roofing shall be with MS Structural frames for Epoxy Painted GI/MS Sheet or Galvalume Sheet. Flooring shall be IPS Flooring.	CPWD Specifications & Relevant IS Codes
7	Cement	OPC/ PPC 43 Grade	CPWD Specifications & Relevant IS Codes
8	Door Frames	Wooden Frames or Pressed Steel Frames with Epoxy Paint	CPWD Specifications & Relevant IS Codes
9	Door Shutters	Flush Door Shutters with Solid Cores and SS Hardware's	CPWD Specifications & Relevant IS Codes
10	Window	Wooden Windows with Glass Infill and SS Hardware or UPVC Windows with Frame and Shutter and UPVC hardware's.	CPWD Specifications & Relevant IS Codes
11	Water Proofing	All Steel Structure to be coated with Water Proof Paint. Terrace shall have Brick Bat Coba Water Proofing. Sloping roofs shall have Chemical Water Proofing. All Toilet Sunks shall have chemical water proofing	CPWD Specifications & Relevant IS Codes
12	Fencing with Gate	Chain Link fencing all around the facility to avoid unauthorized access with locking facility.	CPWD Specifications & Relevant IS Codes
13	Rolling shutters	All storage spaces in closed shall have GI rolling shutters with ventilation provision.	CPWD Specifications & Relevant IS Codes

### Building Levels:

All the Building Plinths shall be above the nearest road levels by atleast 600 mm. Contractor has to provide details for the Building plans and the overall plant layout with the details for all the Building Plinths for approval of the architect. Based on the Architects approval, the Building Plinths shall be decided. Filling of low lying land shall not be in the scope of the contractor. Contractor to consider filling of plinth upto 600 mm height in the cost of the building.

### **Roads and Pathways:**

All roads and pathways shall be designed and shall follow the architectural details as per the existing campus. All the approach roads shall be Bitumen roads and the internal roads can be with Concrete paver blocks. All roads shall have the capacity to support load for fire tender in case of emergency.

### **Sanitation and Rain water disposal:**

The Bio Gas facility shall be provided with proper sanitation facility and Sewage shall be directed to the nearest sewage treatment plant. Necessary collection and pumping arrangement for the same shall be considered by the contractor in this work scope. All the rain water in the facility shall be collected at a central location within the facility through a sand filter and then the filtered water shall be pumped to the nearest Storm water drain along the road which is developed by the University. Necessary pumping shall be considered by the contractor in this work scope.

### **Electricity and Water Supply: ( For CHP as well as BIO methanation Plant)**

Water Supply for the plant shall be provided on a chargeable basis at one point along the main road and the contractor has to make all necessary distribution arrangement from the point of supply to Bio gas plant as well as internal distribution within the plant. The Water supplied shall be of the quality as shall be available with the client. The Contractor has to check for the water quality to suit his requirement and do necessary arrangements to get the quality of water required for his operation.

Similarly for Electricity Supply, single point metered supply shall be made available to the contractor at the main road and the contractor shall make all distribution arrangement from point of supply onwards for the plant.

## Preferable Brand/Makes:

Name of Work: SITC of BIO GAS and CHP Engine for Outreach Building at Permanent Campus of NU, Rajgir		
<b>PREFERED MAKE LIST</b>		
<b>Sr. No</b>	<b>Equipment</b>	<b>Recommended Make</b>
1	Agitators	Remi/CEID or Equivalent
2	Sludge Pumps	Grundfos/ Johnson/ Xylem/ KBL/Syno/Alltech
3	Bio Gas Flow Meter	Bronkhorst/ Siemens/ Forbes Marshal/EMERSON /HONEYWELL/ENDRESS+HEUSER
4	Filter press	Hydropress Industries/ Andritz/CEID
5	Bio Gas Flaring system	Super Combustion technologies/ Ashish Engineering works/ Petroman Marketing
6	LED Indication lamps and push buttons	Schneider/ABB /Siemens
7	Numeric relay	Schneider/ABB /Siemens
8	Electromechanical relays	Schneider/ABB /Siemens
9	Multifunction meters	Schneider/ABB /Satec
10	Annunciation window, selector switch and hooter	Minilec/Vaishno/Esbee
11	HT Cables/ LT cables/ Control Cables	KEI/KEC/Universal/ Polycab/ Finolex/SSI Cables
12	Lugs and glands	Dowell/Comet/Jainson
13	Cable trays and metallic trunking	MEM/RMCON/Indiatech/MK/Legrand
14	UPS	APC (Schneider)/Emerson/Mitsubishi
15	Earthing & Lightning protection	Jeff techno/Ampere Pro Services/Dehn
16	HT /LT Panels	Schneider/ABB /L&T
17	VCB / ACB / MCCB	Schneider (Masterpact NW/ NSX)/ABB (Emax/ Tmax)/L&T (Omega/ D sine)
18	MCBs / RCCBs / RCBO	Schneider/ABB /L&T
19	Contactor	Schneider/ABB /L&T

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

20	MCB/ELCB/RCBO	Schneider/ABB /L&T
21	Voltage regulator	P2Power/ABB /Servomax
22	Battery Charger	Amar raja/Exide/Chabbi/ Allen Bradley/ Phoenix
23	Battery	Amar raja/Exide/HBL
24	Wires	Polycab/ Finolex/Universal/KEC/SSI
25	UPVC/ CPVC PIPES	Astral/ Supreme/Ashirvad
26	HDPE PIPES	Reliance industries/ Tirupati Plast/ Godavari Polymers
27	Valves	Audco/ Zoloto/KSB/ Flowchem/ Danfoss/Marck/ L&T Valves/ BDK/ Shenco/Alltech/CEID
28	CHP (Cogeneration Engine Brand)	For both CHP: GE / Caterpillar/ MWM/Kirloskar Sterling & Wilson, Or Schmitt Enertec GmbH (RSE)- for 200KW/small one subject to no deviation in TS
29	Insulation material	Supreme/ Abad Industries/Rockwool/ Twiga
30	Gas Cascade with Pipes/ Frames/ Guages/ Valves and accessories	Rama Cylinders/ JK Subsea Engg Pvt. Ltd/ Everest Kanto Cylinders Ltd/ Maruti Engineering Services/ Euro Cylinders.
31	Engine	As per OEM's Standards
32	Alternator	Marelli/ Ieroy somers/Kato / OEM Standards
33	Imported Equipments	As per OEM's Standards
34	PLC	Siemens/ Schneider/Alan Dradley
35	Switches and Sockets and other modular Accessories- Modular Type	Legrand Mylinc/ SSK-King/ Simon-Hussman
36	Light Fixtures	Philips/ Wipro/ Havells/ Regent/ Trilux/ K lite
37	Fans - High Speed/ Exhaust Fans	Usha/ Crompton/ Havells
38	Dry Type Transformers (Indoor)	ABB/Voltamp/Raychem
39	Oil Type transformers (Outdoor)	Voltamp/Schneider/ Crompton & Greeves
40	Monoblock Pumps/ Submersible Pumps/ Hot water Pumps/ Gas pumps/ HT&LT Pumpsets	Grundfos/ Johnson/ Xylem/ Kirloskar/Syno/Alltech
41	Cooling Towers	Mihir/ Paharpur/Himgiri/ Tekni
42	Ventilation system	S N Air / Waves/ Zeco/ Ventech
43	Centrifugal Blowers/ Axial Fans	Wolter/ Kruger/ Nicotra/ Flakt

## DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

44	Plate Heat Exchanger	THERMAX/ ME Energy/ Alfa laval / Funke-HRS sys/ Tranter
45	Pressure Gauges	General Instrument / H Guru / Wika/ Waree
46	Temperature Gauges	General Instrument / H Guru / Wika/ Waree
47	Gas Pipe Line	Maharashtra seamless / Indian seamless / Jindal
48	Gas Flow Meter	Emerson / E&H / Honeywell/ Equivalent
49	Air - Washer	Eminent Engineers
50	Exhaust Duct	Jindal/ Ratnamani/ Mukat/ JCO Gas Pipes
51	Exhaust Insulation	Lloyd Insulation/Rockwool India/ Minwool
52	Aluminium Cladding	NALCO/ BALCO/ JINDAL/ HINDALCO
53	Exhaust Silencer	Decimin / Acoustic India / BBM Aucostics
54	Exhaust Flexible Bellows	Siddharth Industries / N Panchal / Atulya Bellows/ Shah Bellows
	Supports	SAIL/ TATA/ VIZAG/ JINDAL
55	Waste Heat Recovery Boiler	Thermax / ME Energy / Rakhoh /Transparent or equivalent
56	Lube Oil Pipes	Jindal / Tata / Zinith
57	Lube Oil top up tank	Reputed Make like SGPL or equivalent
58	Lube Oil Transfer Pump	Tushaco / ABB/ Siemens