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6.0 <u>PROGRAMMABLE LOGIC CONTROLLER (PLC)</u> 6.1 The following specification is applicable for for PLC related to main plant auxiliaries and off-site plants (like CHP,AHP,WTP etc.). In order to provide smooth and optimal maintenance, easy inter-changeability and optimal spare part management, the bidder should ensure that the PLC system offered for main plant auxiliaries and off-site plants are of the same make, series and family of hardware. 6.2 Programmable Logic Controller (PLC) based control system shall be high end version with latest configuration with 1:1 hot redundant Central Processing Units (CPUs). CPUs shall have word length of 32 bits minimum 6.3 Following components shall be redundant as well: communication processors, memory modules, rack power supply units, bulk IO power supply units, IO communication modules, data highway and high speed (100Mbps) data network connecting the operator stations. 6.4 Two CPUs shall operate on fault tolerant mode with continuous self and cross- monitoring. Failure of the active CPU shall not affect the operation of the plant. In the event of failure of active CPU, tasks shall be transferred to the standby CPU within fastest possible transfer time (< 5m sec.) without causing any relays to drop out during the transfer. 6.5 CPUs shall not be loaded to over 60% of their capacity even under worst data loading conditions. It shall be possible to make a manual transfer from the active to the back-up CPU from engineering station and as well as from the front panel of CPU module. 6.6 Modules shall have adequate status and diagnostic indication on the front panel. 6.7 System shall be of modular construction and expandable by adding hardware modules. Bidder shall provide at least 20% or a minimum of one off, spare channels as hot-on-rail spares in each configured cards / modules.		

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In addition to this, 10% or minimum of one off, extra assigned complete spare modules mounted on rails in racks for each type of I/O modules shall also to be provided. The spare channel and cards shall be fully wired and terminated. 6.8 Memory unit of the CPU shall be field expandable at least by 25%. Operating system/application program/sequence logic etc. shall be stored in nonvolatile memory for automatic re-booting. Dynamic memories shall be provided with battery back up at least for 360 hours. 6.9 Number of input/output points per card shall not exceed 16 (sixteen) for digital and 8 (eight) for analog/thermocouple/RTD signals. Individual input and Output channels shall have galvanic/optical isolation. Merely fusing of individual or a group of channels is not acceptable. 6.10 Data communication system of the PLC shall not be limited to the following: (a) Internal bus and external data network loading shall in no case be more than 60% of its capacity. (b) Disrupted message shall be automatically retransmitted when the system is restored. (c) Failure or physical removal of any module connected on the system bus shall not lead to any loss of communication. (d) Diagnostics message shall be issued on fault detection. (e) Bus change over from active bus to stand by bus, during failure of active bus, shall be performed automatically and bumpless. Such event shall be suitably logged or alarmed. (f) Noise immunized and reliable high speed dual fault tolerant optic fiber cable communication with standard communication protocol shall be provided between PLCs and remote or extended I/O modules.		

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(g) Main data network shall comply with the International Standard IEEE-802.3 (Ethernet) for data exchange and communication. 6.11 Operator workstation shall be complete with latest user friendly operating system, 24" colour TFT monitor, membrane or positive depression KB, mouse, colour laser printer and dot matrix printer. In addition, 3 no (three) One no. laptop unit loaded with all PLC system software shall be furnished. 6.12 For PLC systems without OEWS (Operator cum Engineering work station), above mentioned Laptop shall be used. 6.13 Only licenced copy of programming software suitable for multi-user's use shall be provided. 6.14 PLC systems without OEWS (Operator cum Engineering work station) shall have panel mounted pushbuttons, lamps, hardware annunciation system and MIMIC for operation and control of the system from desk/panel. 6.15 The functions performed from the HMIs shall not be limited to the following: (a) Selection of Auto/Manual, Open/Close, Sequence Auto, Start/ Stop operation. (b) Dynamic Mimic display depicting the process. (c) Alarm monitoring, report & log generation, printing of trends etc. (d) On line/historical trending, historical storage and retrieval of data. 6.16 Software (a) Necessary software for implementation of the control logics, operational displays & logs, data storage, retrieval and other functional requirements, shall be provided. (b) Licensed version of required software including operating system, configuration and HMI software suitable for multi-user's use shall be provided.		

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	(c) Detail documentation on the programming softwares as part of the O&M manual. 6.17 POWER SUPPLY 6.17.1 Power supply to the each PLC system shall be provided from separate redundant solid-state 240V AC $\pm$ 1% packaged UPS (Uninterruptible Power Supply) units to be placed local to the control systems. UPS system shall be complete with Plante type battery & battery chargers. UPS shall have adequate capacity to cater 100% load without overloading. UPS system shall be adequate to provide back up power for not less than 60 minutes. (General guide lines as per section-10). UPS for PLC of CHP shall be provided with redundant battery. But for other PLC (AHP, (FWPH)) one battery for UPS is sufficient. 24V DC interrogation supply for off-site plant should be derived from the dual redundant ac-dc converters. 6.17.2 UPS shall be complete with AC Distribution board. Two feeders shall be extended from ACDB to PLC. 6.17.3 Bulk power supply units for interrogation, relay and solenoid voltage shall be separate from system power supply units and shall be redundant. 6.17.4 System shall have MTBF better than 99.7% and shall be hot maintainable. System hardware shall be designed to be 'fault avoidant' by selecting high-grade components of proven quality and properly thermally de-rated design. The network shall have extensive fault monitoring, self-surveillance & on-line self-diagnostic capability so that failure is immediately detected. 6.17.5 System shall automatically check and correct gain & drift for ADCs on-line. 6.17.6 Data exchange in a bus shall be fully monitored and checked for validity. 6.17.7 Response time consisting of IO scan time, data communication time, processing time etc. shall be equal to or less than the following : (a) OLCS & sequence control inputs : 100 ms. (b) CLCS inputs : 250 ms.	

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(c) Monitoring analog parameters : 500 ms. (d) Monitoring digital parameters : 100 ms. 6.17.8 Following operations will be performed on I/Os, as required: (a) Square root extraction (b) Pressure & temperature compensation (c) Reasonability check of all inputs, validation and quality tagging like good, bad, suspect etc. (d) Channel wise engineering unit conversion (e) Contact bounce filtering with adjustable time constant. 6.17.9 The PLC controllers shall be time synchronized to GPS master clock via IRIG-B or Ethernet port. Software capability shall be provided to implement closed loop control functions as follows: (a) PID control and their variations. (b) On-off control (c) Cascade control (d) Ratio and bias control 6.17.10 Features for Open Loop Control shall not be limited to following: (a) Logic functions like AND/ OR/ NOT gates, timers (on-delay, off-delay), shift registers, counters, latches, flip-flops, mono-shots etc. (b) Automatic sequence control for start up and shutdown of auxiliaries /auxiliaries/equipment in functional groups initiated by command from operator's console. A sequence shall be made of steps executed in predetermined order according to logic criteria. For each		

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step there shall be a provision for ‘waiting time’ and ‘monitoring time’. System shall have the capability to bypass a step, if desired, from the operator’s station. Such action however shall be registered as an exception. (c) Inputs for protection system shall be of high priority. In the event of either loss of control power or control signal input to the drive, the drive shall remain in its last position unless specifically required otherwise. The system shall be designed such that no upset occurs either to process or to the drive when the power is restored. 6.17.11 Interface of the system with M.C.C/Switch gears shall be in the form of potential free contacts via interposing relay modules mounted in the respective switchgear or MCC unit. Other interfacing relays shall be mounted in a cabinet separate from the system cabinet. 10% wired additional interposing relay modules shall be provided as installed spare. Freewheeling diodes shall be provided across the coil of DC solenoid and contactors/relays. For AC solenoids and contactors directly driven from output cards, arc suppressors shall be provided across the coil. Each IO rack shall have 10% spare rack space for future upgradation. 6.17.12 Single programming instruction/command shall be sufficient to delete a program rung from memory. Similarly, any rung can be inserted into the existing program. The active and the stand-by CPU programs shall equalize automatically, once the new program is permitted to “RUN”. 6.17.13 Updating time and reaction time shall be as follows: <table><tr><td>(a)</td><td>Calling up a mimic</td><td>:</td><td>2 sec or better</td></tr><tr><td>(b)</td><td>Updating status signal in mimic</td><td>:</td><td>1 sec or better</td></tr><tr><td>(c)</td><td>Updating variables in a mimic</td><td>:</td><td>1 sec. or better</td></tr><tr><td>(d)</td><td>Issuance of command to output (without considering process lag)</td><td>:</td><td>1 sec. or better</td></tr></table>			(a)	Calling up a mimic	:	2 sec or better	(b)	Updating status signal in mimic	:	1 sec or better	(c)	Updating variables in a mimic	:	1 sec. or better	(d)	Issuance of command to output (without considering process lag)	:	1 sec. or better
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6.17.14 Displays shall be classified into overview display, group display, point display and trend display. 6.17.15 Printing of logs shall be initiated automatically at prescribed time intervals, or initiated on demand by the occurrence of predefined events. 6.17.16 System shall permit the operator to specify minimum of 5 summary logs each with minimum of 25 points to be printed on demand. 6.17.17 Salient features of the PLC system for I/O handling shall be as follows. (a) Input filters to attenuate noise. (b) Isolation of 1500V AC for the input & output module. (c) Common mode noise rejection for analog inputs of 120 db at 50 Hz. (d) Normal mode noise rejection for analog inputs of 60 db at 50 Hz. (e) LED indicators on each card to show status of input. (f) All the outputs shall be with individual fuse. (g) J/ K type thermocouple mV input where applicable. (h) Pt-100 three/four wire resistance thermometer input where applicable. (i) 24 V DC power supply to field mounted two wires transmitters. 6.17.18 Salient hardware/software features of the CPUs shall be as follows: (a) Watch dog timer : Periodical reset. Alarm and interruption, if not reset within stipulated time. (b) Max. scan time for inputs : 1 second max.		

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(c) Maximum Scan Rate : 1 ms (Per K Word) or better (d) Memory capacity : 25% spare capacity after full utilization. Expandable in multiples of 16 K. (e) Comm. processor : Separate (f) Battery back up for RAM : 360 hrs continuous operations. (g) Diagnostic feature : Periodic, automatic self- diagnostic. 6.17.19 Salient features of the Input/Output modules are as follows. (a) All modules (i) Surge withstand capability : IEC-255.4 (b) Digital General (i) No. of channels/module : 16 (ii) Interrogation voltage : 24V DC or 48 V DC (iii) Status indicator : LED type. (iv) Isolation : Optical (c) Digital Input Module (i) Contact bounce filtering : Adjustable time constant of 15 millisecond. (ii) Diagnostic : Module fault		

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(d) Digital Output Module (i) Output protection : Short circuit Proof & Individual fuse (ii) Diagnostic : Module fault (e) Analog General (i) No. of channels / module : 8 (ii) Isolation : Galvanic/ Optical (f) Hi-level Analog Input Module (i) Type of input : 4-20 mA DC / 1-5V DC (ii) A/D Converter : 11 bits + Sign (or better) (iii) Accuracy : 0.1% or better (iv) Diagnostic : Module fault (v) Powering of transmitter : 24 V DC 2 W type (g) Low Level Analog Input Module (i) Type of input : PT-100; T/C (As required) (ii) C-J-C : On Module (iii) Accuracy : 0.1% or better (iv) A/D converter : 15 bits + Sign (or better) (v) Diagnostic : Module fault		

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(h) Analog Output Module (i) Type of output : 4-20 mA DC (ii) Accuracy : $\pm 0.1\%$ or better (iii) A/D Converter : 11 bits + Sign (or better) (iv) Load : 600 Ohms (v) Diagnostic : Module fault 6.17.20 Bidder shall provide control/work station as below (a) Operator's Station / Engineering Station (PC Based) (i) Processor : 2nd generation core i5 or better (ii) Mother Board : Intel Original (iii) Configuration : Tower/Flat (iv) Internal clock : 2.0 GHz or better (v) Architecture : 32 bit (vi) Video Card : On Board (vii) System Memory : 4 GB or better. (viii) Hard drive : 500 GB or higher (ix) Cache : 6 Mb or better (x) Floppy drive : 3½" (xi) DVD Drive : DVD Read & Write with Dual Layer for both EWS & OWS (xii) Audio controller : 16-bit		

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(xiii) Operating system : Window NT or Better (xiv) Graphic accelerator : 2 GB or better (xv) Communication ports : 04 nos. (min.) with serial port & 04 nos. (min.) with parallel port (USB) (b) Monitor (i) Type : TFT colour monitor (ii) Screen diagonal : 24" flat (iii) Display : XGA or better (iv) Resolution : 1024 X 768 or better (v) Degree of protection : IP-30 (vi) External Controls : Brightness, contrast, Horizontal / Vertical amplification & shift (vii) Power supply : 240 V, 50 Hz, 1 phase (viii) Ambient temperature : 0-50 °C (ix) Humidity : 95% non-condensing. (x) Version : To suit industrial application. (c) Key Board (i) Type : Flat spill proof membrane type or Positive depression type. (ii) Different keys : – Soft and user defined function keys for software/programming including text correction, scan rate alteration,		

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zooming/flashing colour selection etc. – Panel select keys for alarm summary, control loop display, overview, trend, graphic, operator guide message etc. – Standard Alphanumeric keys – Alarm acknowledge keys – Cursor keys – Mode/loop status switching keys – Setting change keys – Print-out command keys – Other keys as required to operate the system (iii) Key lock : Lockable type push button mounted on keyboard (iv) Life Expectancy : 50 million cycles per key (v) Version : To suit industrial application 6.18 <u>OPTICAL FIBER CABLE</u> 6.18.1 This specification defines the minimum general requirements for the Design, manufacture, supply, inspection, installation, testing & commissioning of optical fiber cables and accessories, such as fiber distribution (patch) panels, adapters, connectors, joint boxes, pigtails and other components, as required to complete the system. Bidder shall consider all related activities, such as cable stripping, cable entry in boxes and panels, cable fiber splicing/fusion, cable performance testing and other services, to achieve a properly documented and operational cable network.		

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6.18.2	Fiber Optic Cables shall be installed on cable tray, duct bank, cable trench, as necessary. For outdoor applications the cable shall be armoured with Poly Ethylene sheathing. Cable shall be routed through suitable grade permanently lubricated HDPE protection pipe as per IS 4984, IS 12235 & TEC.G/CDS-08/01 of suitable size @ 53% fill factor.	
6.18.3	The Optical Fiber core shall be of ultra pure fused silica glass coated with UV-cured acrylate suitable to withstand temperature of about 80°C (continuous).	
6.18.4	Fiber optic cable shall be of loose tube design. Typically, fibers shall be housed in-groups of 6 (minimum) within gel-filled buffer tubes to protect against ingress of moisture and vibration. The tubes shall be manufactured with industry standard material like Poly-Butelene Terathylate (PBT). They shall be colour for easy identification. Buffer tubes shall be approachable with industry standard tools and practices. The buffer tubes shall be stranded around the Central Strength Member utilizing Reverse Oscillating Lay (ROL). Blank fillers shall be used as necessary to maintain circular cable structure. Cable shall withstand water penetration when tested with a one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for one hour. No water shall leak through the open cable end.	
6.18.5	The central strength member of the cable shall be Fiberglass Reinforced Plastic (FRP) or other material with equivalent mechanical strength to provide both tensile and anti buckling strength to the cable.	
6.18.6	In addition to central strength member, additional strengthening substance like aramid yarns shall be helically applied over the cable core to provide additional tensile strength to the cable.	
6.18.7	The cable shall be of dual jacket & armoured. Inner sheath consists of a medium density polyethylene (MDPE) jacket extruded over the cable core. Two highly visible ripcords are placed under the jacket to aid in sheath removal. A co-polymer coated steel tape is corrugated and wrapped around the inner jacket to provide additional cable compression strength and rodent protection. The armour is covered with an outer black FRLS MDPE	

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jacket. A ripcord is also placed underneath the armour for easy outer jacket removal. 6.18.8 Minimum bending radius shall be equal or more to 15 D. A continuous strength member shall be provided for the entire length of the cables. Every tube and fiber shall be colour coded to provide easy identification. The outer sheath shall be marked to show fiber type and cable classification at suitable intervals. 6.18.9 Entire length of the cable shall be marked with the following at regular intervals: (a) Manufacturer’s Name (b) Month and year of manufacturer (c) Coded description of the cable based on Telcordia’s (Bellcore) SR-2014 Suggested Optical Cable Code (SOCC). (d) Sheath Identification Number (e) Sequential Length Marking in meter (f) A Telephone Handset symbol to distinguish communication from power cable as per NESC section –35 G. 6.18.10 Fiber optic cable shall provide a long life expectancy of minimum 25 years and shall meet the industrial standard of continuous operation at temperature of 55 °C and humidity to 100% without degradation to optical or mechanical performance. 6.19 <u>OPTICAL FIBER USED IN THE PLANT SHALL GENERALLY CONFORM TO THE FOLLOWING SPECIFICATION.</u> SPECIFICATION FOR G.652 MONOMODE FIBER <table><tr><td>ATTRIBUTES</td><td>VALUE</td></tr><tr><td>(a) Cladding Diameter</td><td>125 m 1.0 m</td></tr></table>			ATTRIBUTES	VALUE	(a) Cladding Diameter	125 m 1.0 m
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(a) Cladding Diameter	125 m 1.0 m					

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(b) Cladding non-circularity $\leq 1.0\%$ (c) Attenuation Coefficient at (i) 1290 nm to 1340 nm < 0.36 dB/km (ii) 1525 nm to 1575 nm < 0.25 dB/km (d) Chromatic Dispersion Coefficient at (i) 1310 nm < 3.5 ps/nm.km (ii) 1550 nm < 18 ps/nm (e) Polarization Mode Dispersion (PMD) < 0.5 ps/ km (f) Mode Field Diameter at (i) 1310 nm 9.2 0.4 m (ii) 1550 nm 10.50 1.0 m (g) Mode Field Concentricity Error ≤ 0.5 m (h) Proof Test $\geq 1\%$ (i) Fiber Curl (ROC) ≥ 4.0 m (j) Macro-bend Test on Fiber at 1550 nm ≤ 0.1 dB 6.20 <u>CABLE ASSEMBLY</u> 6.20.1 Optical Fiber Environmental Splice Enclosure Optical fiber environmental splice joint enclosures shall be re-enterable and rack/wall mountable. The interior splice case shall be equipped to mechanically accommodate single-mode optical fibers connected by the fusion method. Splice case shall be equipped to organize the splice trays and the required service loops of buffered incoming optical fibers and outgoing 'pigtailed' in such a way that allows each completed splice and associated optical fiber to be maintained in an unstrained configuration. Splice enclosure shall be dust and weather proof.		

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6.20.2 Fiber Optic Distribution Patch Panel Fiber optic distribution panels shall be provided as required. Fiber optic distribution panels shall be of a standard wall mounted sheet metal enclosure type. Fiber optic distribution panels shall be equipped to secure optical fiber patch cables and pigtails to prevent damage during all operation and maintenance functions. In general splice enclosure are envisaged. However, if no optical fiber splice enclosures are implemented, than the fiber optic distribution panels shall be equipped with splice trays for storage and protection of fusion splice connections of single-mode fiber optic cable and pigtails. Each fiber optic distribution panel shall be fully equipped with ‘S’ type bulkhead connector sleeves or equivalent. Unused sleeve ports shall be equipped with reusable caps to prevent the intrusion of dust. 6.20.3 Pigtail and Patch Cord All pigtails shall be factory SC-connectorized, and satisfy specified performance for optical links. All unused pigtails (including spares) shall be terminated with the connector to a bulkhead connector sleeve, protected by a reusable cap on the opposite sleeve port, to prevent the intrusion of foreign material or dust. All necessary connector pigtails shall be provided in the lengths required. 6.21 <u>FIBER OPTIC TOOL KIT</u> 6.21.1 Optical Time Domain Reflectometer (a) A recording optical time domain reflecto meter (OTDR) will be utilized to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall be equipped with data storage, printer, help feature, compare trace features and OTDR software. The data storage unit must include a built-in floppy disk drive capable of storing a minimum of 100 test traces. (b) Data traces saved to disk shall include the following labels: (i) Fiber Identification (ID) with a minimum of 10 characters		

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(ii) Cable ID with a minimum of 10 characters (iii) OTDR location with a minimum of 20 characters (iv) Far End location with a minimum of 20 characters (v) Test Operator initials with a minimum of 3 characters (c) The printer shall preferably be internal. The printer shall be able to print data traces within 30 seconds or less. The machine settings used to repeat tests at a later time shall include: index, range, wavelength, average time, pulse width and scale settings. The test results (on printout) shall provide information including: loss, distance, reflectance, date and time. (d) The requirements for the compare trace feature include the ability to recall two historical traces from a diskette and display them simultaneously for analysis and printing. The compare trace must compute and display a single graph representing any differences between two traces. The compare trace must be able to recall historical traces from a diskette and perform the same tests on connected live fibers. The compare trace shall perform a two point loss measurement test for any two particular fibers in a comparison analysis. The losses between the two points on each fiber shall be displayed, and the differences between the two readings clearly shown. (e) The OTDR must be equipped with software to support all of the required functions. The software shall provide for printing of whole set of traces (batch print) with minimal commands eliminating the time spent for printing traces individually. (f) Contractor shall provide all mounting accessories, cables and connectors required to establish data communication. 6.21.2 Fiber Optic Splicer, Terminator And Tool Kit Box Bidder shall provide new unused tools comprise of Splicer and Fusion Joiner and tool kit comprise of cutter, stripper, polishing tool, handheld		

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microscope, heat shrinkable sleeve, scissor, knife etc. as required for maintenance and commissioning. 6.22 <u>TESTS</u> Following minimum test as per any approved standards shall be carried out on the cables: (a) Attenuation And Dispersion Characteristics Tests (b) Proof Tests (c) Macro-Bend Resistance Test (d) Mechanical Tests (e) Low And High Temperature Cable Bend Test (f) Impact Resistance Test (g) Compressive Strength Test (h) Tensile Strength Test (i) Cable Twist Test (j) Cable Cyclic Flexing Test (k) Environmental Characteristics Test (l) Temperature Cycling Test (m) Colour Permanence Test (n) Cable Aging Test (o) Water Penetration Test (p) Lightning Test		

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(q) Routine Test/Sample Test (r) Site Test (Like Continuity & Attenuation)		

CONSULTANT : PROCON ENGINEERS

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7.3.7 Operator's & Engineering Station

- (a) Operator's Station / Engineering Station (PC Based)
- (i) Processor : 2nd generation core i5 or better.
 - (ii) Configuration : Tower
 - (iii) Internal clock : 3.2 GHz
 - (iv) Architecture : 32 bit
 - (v) Video Card : PCI
 - (vi) System Memory : 4 GB or better.
 - (vii) Hard drive : 500 GB or higher .
 - (viii) Cache : 6 Mb or better
 - (ix) Floppy drive : 3½"
 - (x) CD/DVD Drive : CD - Both Read & Write for OS
Both CD & DVD Read & Write for ES.
 - (xi) Audio controller : 16-bit
 - (xii) Operating system : WIN NT or higher.
 - (xiii) Graphic accelerator : Intel HD graphic (1 GB) or better
 - (xiv) Communication ports : 02 nos. (min.) with one pen drive plus other ports as required.
- (b) Monitor
- (i) Type : TFT colour monitor.
 - (ii) Screen diagonal : 24" flat
 - (iii) Display : XGA or better.

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keys. g. Setting change keys. h. Print-out command keys. i. Other keys as required to operate the system. (iii) Key lock Lockable type push button mounted on keyboard. (iv) Life Expectancy : 50 million cycles per key. (v) Version : To suit industrial application. (d) Laser Printer (i) Type Electro-photographic laser, tabletop. (ii) Printer Memory 256 MB (min.) (iii) Speed Monochrome 24 ppm - A4 Color 6 ppm - A4. (iv) Resolution 1200 x 1200 DPI in color. (v) No. of color (Basic) 4 (four) minimum. (vi) Duty cycle Monochrome 75000 pages / month. (vii) Power supply 240 V, 50 Hz, 1 phase. (viii) Ambient temperature 0-50 °C (ix) Humidity 95% non-condensing. (x) Size of paper Letter, A4, Legal, Ledger, A3 (xi) Print media Plain paper, transparencies, thick stock, glossy stock, envelopes.		

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(xii) Accessories a. Adapters b. Connector Cable c. Multiplexer switch (4 point)		
7.3.8	Stackable Managed Switch DCS data highway shall be of high speed Ethernet and full duplex configuration. Network shall be built on the Stackable Managed Ethernet switches for better control of data traffic & performance and future expansion. Switch configuration shall be redundant with seamless changeover without any upset in the process or equipment. Failure reporting shall be available at HMI. MTBF of the switch shall be more than 20 Years. Configuration shall be automatic.	
7.3.9	Furniture Bidder shall include a complete set of furniture for the Control Room, auxiliary plant control room and computer Room of ergonomic design from reputed manufacturer especially designed for computer peripherals. The set of furniture shall include but not be limited to control desk, chair, printer table, computer tables etc, all necessary furniture for Computer Room peripherals, cabinets for storage of manuals/booklets/recorder charts, storage racks for special tools/diskettes and Shift Charge Engineer's desk/chair/side rack etc.	
7.4	<u>SOFTWARE SPECIFICATION</u>	
7.4.1	General The system shall utilize a readily upgradeable, public domain software platform proven for real-time operation environment at the control and monitoring level overlaid with a relational database program. The desirable features are enumerated below. The operating system shall be suitable for real-time operation both at process as well as HMI end.	

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1.0

SCOPE OF WORK

1.1

SCOPE OF SUPPLY

The scope of supply shall include Uninterruptible Power Supply (UPS) System as required for main plant.

(a) UPS System shall comprise the following :

(a)	100% Static inverter banks	:	2.
(b)	100% Converter AC to suitable DC	:	2.
(c)	100% Static switches	:	2.
(d)	Manual bypass switch/breaker	:	2.
(e)	100% UPS System battery banks	:	2.
(f)	100% Float-cum-boost charger	:	2.
(g)	Step-down transformer with associated Switchgear	:	1.
(h)	Voltage stabilizer and back up power source and synchronizing circuit	:	1.
(i)	UPS A.C. Power Distribution Board	:	2.

(b) One (1) set of special tools and tackle.

(c) All inter-connecting cables including those required for inter-connection within UPS equipment as mentioned above. All power cables from UPS AC power distribution board to loads.

(d) Mandatory Spare parts.

(e) List of recommended spare parts for three (3) years satisfactory and trouble-free operation of the equipment for Purchaser's consideration.

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(f) All relevant drawings, data and instruction manuals. 2.0 GENERAL REQUIREMENTS 2.1 CODES AND STANDARDS (a) All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification. (b) Equipment and materials conforming to any other standard which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid. (c) The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules or regulations applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding. 2.2 ANNEXURES 2.2.1 All annexure appended to this specification shall form part of this specification and supplement the requirements specified herein. 2.2.2 This specification shall be read and construed in conjunction with the drawings and annexures to determine the scope of work and terminal points. 2.3 COMPLETENESS OF SUPPLY 2.3.1 It is not the intent to specify completely herein all details of the equipment. Nevertheless, the equipment shall be complete and operative in all aspects and shall conform to the highest standard of engineering, design and workmanship. 2.3.2 Any material or accessory which may not have been specifically mentioned but which is necessary or usual for satisfactory and trouble free operation and maintenance of the equipment shall be furnished.		

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	(e) The equipment shall be self-protecting against all A.C. and D.C. transients, voltage surges, and steady state abnormal voltages and currents. (f) The circuit protection shall be coordinated with UPS short circuit capacity and protective device characteristics so that a fault on any circuit shall result in minimum loss of function. (g) All non-interrupting components of UPS system shall be capable of withstanding the prevailing short circuit current without damage. (h) All circuit interrupting components shall be capable of withstanding and interrupting the prevailing short circuit currents without damage. (i) For continuous operation at specified ratings, temperature rise of the various components of UPS system shall be limited to the permissible values stipulated in the relevant standards and/or this specification. (j) For selecting Battery capacity following data to be considered : (i) Maximum temperature : 50 deg. C (ii) Minimum temperature : 5 deg. C (iii) Design margin : 15%. (iv) Ageing compensation factor : 1.25. (v) Reference for Battery Sizing calculation : As per IEEE Standard. (vi) UPS Capacity : Selected UPS rating (not actual load on UPS) (k) UPS shall have automatic on line battery health checking facility as indicated in Clause No. 3.6 (section – 10, part – B) It shall	

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have connectivity with the plant DCS status monitoring. (l) The chargers, inverters, static switches, regulating transformers and voltage stabilizers should be arranged in such a way that any equipment will be fully isolated for maintenance without affecting in any way the operation of other panels/components. (m) In the A.C. Distribution Board, the Bidder shall provide 10% or minimum one (1) no. Spare feeder of each size and type of the outgoing feeders. (n) UPS shall be sized by the bidder to cater to power the bidder furnished loads and to provide for at least 10% spare capacity to cater to changed load requirements during detailed engineering stage over and above 10% design margin. 2.6.2 System Concept (a) A D.C. power source and an A.C. power source are available to the UPS system. The system is so designed that its load shall be served without interruption as long as one of the above power sources is available within specified limit of voltage and/or frequency. The UPS will consist of two physically separate sets of equipment streams each consisting of the following : (i) One set of converter to convert incoming 240V, 1 Ph, 50 Hz A.C. power to suitable D.C. (ii) One set of suitable Battery Bank to get charged by the above referred converter and to feed the inverter described below. (iii) One set of inverter to take D.C. input from above referred converter - Battery assembly output and to produce high quality 240V, 1 Ph, 50 Hz A.C. output power. (iv) One UPS A.C. Power distribution board with suitable number of output feeders.		

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(v) One no. static switch. (vi) One no. manual bypass switch. (vii) One no. static switch isolator. In addition to above a common bypass stream power supply consisting of suitable transformer, voltage stabilizer etc and synchronizing circuit to parallel it with the inverter output is to provided. One set of synchronizing equipment and high performance static switch will parallel the above two streams and common output will be taken to loads which can accept only single non- redundant power input source. For equipment requiring dual redundant input power source, separate cables will be taken from the individual UPS Power Distribution Boards of the above-mentioned two UPS streams. The system will ensure highest system availability around 99%. (b) Each of the two UPS streams will be of 100% capacity and will normally work, each sharing 50% load. On failure of any stream, its load gets automatically transferred to the other inverter through static transfer switch. (c) If one UPS stream is out of service for any reason then the second UPS stream will be working with 100% UPS load. 2.6.3 Layout Criteria (a) The UPS system will be located indoor in Power House operating floor. The inverter, static switches, chargers and distribution panels shall be located in the UPS room. The batteries shall be located in a separate battery room.		

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The charger, inverters, static switches, regulating transformers & voltage stabilizers should be arranged in such a way that any equipment can be fully isolated for maintenance without affecting in any way the operation of other panels/components. The equipment of the two UPS streams shall be physically isolated with reasonable space between two installations. (b) Battery room ventilation shall be under the scope of the Contractor. (c) Sufficient clear space shall be provided for comfortable attending and removal of individual cells. (d) If both streams fail, its load get automatically transferred to the standby source through static transfer switch. 3.0 SPECIFIC REQUIREMENTS 3.1 STATIC INVERTER (a) The static inverters shall be static type consisting of IGBT PWM type inverter, static filters, integrated control modules including necessary oscillators, voltage regulators, current limiting and surge suppression. (b) The inverter equipment shall include all necessary circuitry and devices to conform requirements like voltage regulation, soft start, transient recovery, protection, automatic synchronization, wave shaping etc. as specified herein. (c) Upon transfer of full load, the inverter output voltage shall not drop below 80% of nominal voltage during the first half cycle after transfer and 90% of nominal voltage in the next half cycle. The recovery to within $\pm 2\%$ of voltage shall be in less than 50 milliseconds. (d) On occurrence of a fault in branch circuit, the inverter shall be capable of clearing the highest rated branch circuit fuse in 4 milliseconds or less.		

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	(e) The inverter shall be protected against overload, short circuit, 100% loss of load, as well as excursions, loss or restoration of D.C. Input voltage and synchronizing voltage. The overload capacity shall be 125% for 10 minutes, 150% for 60 seconds and 300% for 4 milliseconds. (f) The D.C. input current shall never exceed twice the full load current except for a short circuit within the inverter. (g) For any value of the load and load power factor drawn by the equipment served, the inverter shall not impose on D.C. Source any voltage oscillations in excess of 5 volts (RMS total all frequencies) or any current oscillations in excess of 3 percent (RMS total all frequencies) of the D.C. current at full load. (h) The inverter will be self protecting against A.C. and D.C. Transients, voltage surges and steady state abnormal voltage and currents likely to be encountered in the plant.	
3.2	<u>AUTOMATIC SYNCHRONIZATION</u> (a) Inverter equipment shall include stable solid-state oscillator devices designed to automatically maintain the inverter output in phase and in synchronism with the stand-by A.C. source. (b) Facility shall be provided for automatic transfer to internal oscillator operation when the stand-by source frequency is beyond specified limits and the frequency shall be automatically controlled within 50 Hz plus or minus 0.5 Hz when the inverter operates in this mode. (c) Retransfer to stand-by A.C. Source for synchronization shall be automatic after the stand-by source frequency is restored to permissible limits and remains within this limit for an adjustable time delay period (up to 5 seconds). (d) Provision shall be made for stepless adjustment of synch-disconnects frequency range from 50 Hz $\pm$ 0.5 Hz to 50 Hz $\pm$ 2 Hz. (e) Automatic adjustment of phase relationship between inverter output	

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and stand-by A.C. source shall be gradual at a controlled slow rate, which shall not exceed one hertz per second. 3.3 <u>STATIC TRANSFER SWITCH</u> (a) The static transfer switch shall be solid-state type using SCR for automatic/manual transfer of load from "inverter" to "stand-by" source and vice-versa. (b) Stand-by source can be either of the inverter or A.C. source depending on whether both the inverters are supplying 50% load each or one of the inverter is carrying 100% load. (c) The transfer time including sensing shall be less than 4 milliseconds. Further the transition shall be make- before-break in both directions. (d) The capacity of static transfer switch shall be equal to the continuous full-load capacity of the inverter. The switch shall be provided with protective devices in both normal and alternate power source. (e) Static transfer switch shall be furnished with contact to alarm failure of the alternate source or opening of any fuse protecting the static switch. (f) Static transfer switch shall include all necessary circuitry and devices to meet the functional requirements of transfer initiation, transfer inhibit and re-transfer back to normal as detailed below : (g) Transfer Initiation (i) The transfer of static switch from normal 'Inverter' position to 'stand-by' position shall be initiated by one of the following causes. a. Inverter failure and UPS system trouble. b. Inverter output voltage failure. c. Manual push button operation.		

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(ii) The UPS bus shall be monitored by two voltage detectors. One fast acting circuit shall be used for detecting a complete and instantaneous voltage loss while the other slower acting averaging circuit with adjustable trip level shall be employed to detect voltage deviation beyond selected limits. Both voltage detector circuits shall automatically initiate operation of transfer switch. (iii) The static switch shall automatic transfer the load from inverter to stand-by source when the maximum I²t capability of the inverter is reached and when the inverter output drops below 90%. (h) Transfer Inhibit Automatic or manual transfer from inverter to stand-by A.C. source vice versa shall be inhibited when the inverter frequency is not synchronized to the alternate source. (i) Retransfer to Normal (i) The return to inverter mode shall be manual in all cases. (ii) Manual transfer shall be initiated by push button actuation. 3.4 <u>MANUAL BY-PASS SWITCH</u> (a) Manual by-pass switch is used to isolate any static transfer switch for maintenance or repair without interruption to the UPS load. (b) The switch has also the facility of by-passing both the static transfer switches during start-up at the option of the operator. (c) Switch contact shall be make-before-break type. (d) The switch shall have current rating equal to the full load inverter current and necessary short time load carrying and interrupting capacity to meet the requirement of UPS system.		

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(e) Breakers may be used instead of By-pass switch maintaining the same philosophy of operation. 3.5 BATTERY Battery shall be Lead -Acid Plante type. Construction details of the batteries shall be as follows: 3.5.1 Lead -Acid Plante Battery (a) Equipments. (i) DC Batteries shall be stationary lead acid Plante positive plate type conforming to IS: 1652. The battery shall be high discharge performance type. For the purpose of design an ambient temperature of 50°C and relative humidity of 85% shall be considered. (ii) DC Batteries shall be suitable for standby duty. The Batteries shall normally be permanently connected to the load in parallel with a charger and shall supply the load during emergency conditions when AC supplies are lost. Batteries shall be suitable for a long life under continuous float operations and occasional discharges. The batteries shall be boost charged at about 2.75 volts per cell maximum and float charged at about 2.2 V/cell. (b) Construction Features (i) Containers Containers shall be made of transparent glass, hard rubber, suitable robust, heat resistance, leak proof, non absorbent, acid resistant, non- bulging type and free from flaws, such as wrinkles, cracks, blisters, pin holes etc. Electrolyte level lines shall be marked on container in case of transparent containers. Float type level indicator shall be provided in case of opaque containers. The stem portion of the float should be long enough to prevent falling of the float inside the container even		

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	if there is no electrolyte in the container. The marking for the electrolyte level should be for the upper and lower limits. The material of level indicator shall be acid proof and oxidation proof. Container shall be closed/sealed lid type. Lid and sealing compound shall be non-cracking type. The container made of hard rubber and plastics shall be type tested as per IS:1146. All type tests shall be carried out for sealing compound as per IS: 3116. The pole sealing arrangement should be such that no acid particle get entrapped due to acid creep as a result of capillary action and it should be possible to remove and refix the sealing to carry out the maintenance. (ii) Vent Plugs Vent plugs shall be provided in each cells. They shall be anti-splash type, having more than one exit hole shall allow the gases to escape freely but shall prevent acid from coming out. The design shall be such that the water loss due to evaporation is kept to minimum. In addition the ventilator shall be easily removed for topping up the cells and of such dimensions that the syringe type hydrometer can be inserted into the vent to take electrolyte sample. (iii) Plate The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The construction of plates shall conform to latest revisions of IS: 1652 as applicable. The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion The positive and negative post shall be clearly marked.	

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(iv) Sediment Space Sufficient sediment space shall be provided so that cells will not have to be cleaned during normal life and prevent shorts within the cells. (v) Cell Insulator Each cell shall be separately supported on PVC/porcelain/hard rubber insulators fixed on the racks with adequate clearance between adjacent cells. Minimum distance between adjacent cells shall be more than the buldge allowed for two cells in accordance with IS:1146. (vi) Electrolyte The electrolyte shall be prepared from battery grade sulphuric acid conforming to IS:266 and distilled water conforming to IS:1069. The cells shall be shipped dry uncharged. The electrolyte shall be supplied separately. (vii) Connectors and fasteners Lead or Lead coated copper connectors shall be used for connecting up adjacent cells and rows. Bolts, nuts and washers shall be effectively lead coated to prevent corrosion. The thickness of lead-coating of connectors should not be less than 0.025 mm. The lead coating thickness shall be measured in accordance with IS: 6848 (latest edition). All the terminals and cells inter-connectors shall be fully insulated or have insulation shrouds. End take off connections from positive and negative poles of batteries shall be made by single core cables having stranded aluminium conductors and XLPE insulation. Necessary supports and lugs for termination of these cables on batteries shall also be supplied by the contractor. All connectors and lugs shall be capable of continuously carrying the 30 minutes discharge current of the respective Batteries and through fault short circuit current which the battery can produce and withstand for the period		

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declared. (viii) Battery racks Wooden racks/Steel Racks with anti-corrosive epoxy paint for all the batteries shall be provided. These racks shall be made of good quality first class seasoned teak. They shall be free standing type mounted on porcelain/hard rubber/PVC pads insulators. Batteries shall preferably be located in the single tier arrangement. However, batteries having a complete cell weight of lower than 50 Kg could be located in the double tier arrangement. The batteries rack and wooden support for cable termination shall be coated with three (3) coats of anti-acid paint of approved shade. Numbering tags, resistant to acid, for each cell shall be attached on to the necessary racks. The bottom tier of the stand shall not be less than 150 mm above the floor. Wherever racks are transported in dismantled condition, suitable match markings shall be provided to facilitate easy assembly. (ix) Manufacturer's Identification systems The following information shall be indelibly marked on outside of each cell: - Manufacturer's name and trade marks. - Country and year of manufacture. - Manufacturer type designation. - AH capacity at 10 hour discharge rate. - Serial number. Bidder shall be considered, if in case, Indian standards are not available for any equipment, standards issued by IEC/BS/VDE/IEEE/NEMA or equivalent shall be applicable.		

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3.6	<u>FLOAT-CUM-BOOST CHARGER</u>	
3.6.1	Refer Section-10, Part-B, 24V DC Battery & Battery Charger specification.	
3.7	<u>STEP-DOWN TRANSFORMER AND VOLTAGE STABILIZER</u>	
	(a) A three phase to single phase transformer along with associated voltage stabilizer shall be furnished with the UPS system. (b) The transformer and stabilizer shall be sized for 100 per cent UPS load and shall coordinate with the largest branch circuit protection device for feeder short circuit current without sacrificing voltage regulation. (c) The voltage stabilizer shall employ silicon solid state circuitry and shall maintain the specified output voltage for 0 to 100% load with maximum input voltage variation as indicated in the annexure. The make and rating shall be subject to Purchaser's approval.	
3.8	<u>A.C. DISTRIBUTION BOARDS</u>	
	(a) The distribution boards shall be fixed type, of modular design in freestanding gasketed sheet steel enclosure conforming to IP-54. Sheet steel thickness shall be 2 mm minimum. 100% redundant AC distributed boards shall be provided for each UPS. (b) Each module shall be housed in a separate compartment complete with individual front access door. Working height shall be limited to 1800 mm from floor level. (c) A full height vertical cable alley shall be provided in each panel to facilitate module wiring. The alley shall be liberally sized and shall have removable cover at the front. Removable back covers shall be provided at the back of the panels. (d) Switches shall be double pole, air break, heavy duty type, capable of safely making and breaking the full load current of associate circuit.	

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(e) Switch handle shall have position indicator and provision of padlocking in ON & OFF positions. Further it shall be interlocked with access door for safety. (f) Fuses shall be HRC, preferably link type, design to permit easy & safe replacement. Visible indication shall be provided for indication of fuse. 3.9 <u>UPS CABINETS/ENCLOSURES</u> (a) The UPS system components shall be housed in a sheet steel freestanding IP-52 enclosure with all access from the front. Sheet steel thickness shall be 2 mm minimum. (b) The enclosure shall consist of vertical cabinets housing modules in rack type sub-assemblies, connected mechanically and electrically to form a rigid, self-supporting, metal enclosed structure. (c) The modular units shall be mounted in pull out and/or swing trays. Each module shall be capable of being easily removed to provide for the ready inspection of major solid-state devices. (d) Vertical wiring trough shall be provided for the entire height of the UPS cabinet. Cable entry shall be from bottom only. (e) Adequate ventilating louvers and screens shall be provided. The top of the panel shall be protected by a suitable drip cover to prevent entrance of falling liquid and foreign material. (f) If the equipment supplied requires forced air cooling, the cooling system furnished shall meet the following requirement : (i) Two (2) nos. 100% cooling fans shall be provided for each vertical panel. (ii) Completely independent duplicate protection, control and wiring systems shall be provided for the cooling fans for redundancy.		

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(iii) The cooling fans shall be powered from the output of the associated inverter. Normally one fan will be running while the other is on stand-by. (iv) Each cooling fan shall be equipped with an airflow switch having an alarm contact that closes upon failure of airflow. 3.10 <u>ALARMS</u> (a) Solid state audio-visual annunciation system shall be provided for inverters, static transfer switch, and battery charger. (b) Alarm fascia shall be provided on each charger and inverter panel, complete with proper actuating devices, circuitry and legends. (c) The arrangement shall be such that on occurrence of a fault the corresponding window will light up and stays lighted until the fault is cleared and reset button pressed. (d) Each time a window lights up a master relay will get energized to provide group alarm signals for remote DCS alarm system. (e) The requirements of indication/metering/alarms are given in the datasheet-A. (f) Alarm contacts shall be rated 0.5 A at 220 V DC and 5A at 240 V A.C. (g) Electrically independent, potential free alarm contacts for each of the points mentioned in the datasheet-A shall be wired up to the terminal block for Purchaser's use. 3.11 <u>LAMP/SPACE HEATERS/RECEPTACLES</u> (a) The panels shall be provided with : (i) Internal illumination lamp with door switch. (ii) Space heater with thermostat control.		

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(iii) 3-pin 6A receptacle with plug. (b) Lamp, heater and receptacle circuits shall have individual switch fuse units. 3.12 <u>WIRING/CABLING</u> (a) The panels shall be completely wired up. All wiring shall be done with flexible, 1100V grade, PVC insulated wires with stranded 2.5 Sq.mm copper conductors and routed through wiring troughs. Each wire shall be ferruled by plastic tube with indelible ink print at both end having terminal block No., terminal number as per approved wiring diagram. (b) Panels shall have removable gland plate for cable entry. All incoming/outgoing cables shall be terminated in suitable terminal block. (c) Control terminal blocks shall be box-clamp type, minimum 10 Sq.mm. 20% spare terminals shall be furnished. 3.13 <u>NAMEPLATE</u> (a) Engraved nameplates shall be provided for each panel and for each equipment/device mounted on it. (b) The material shall be anodized aluminium/lamicoid, 3 mm thick, with white letters on black background. (c) Nameplates shall be held by self-tapping screws. The size of nameplates shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for panels. (d) Nameplates for panels shall be provided both on the front and rear. (e) Control and meter selection switches shall have integral nameplates. Nameplates for all other devices shall be located below the respective devices.		

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	(f) Instruments and devices mounted on the face of the panels shall also be identified on the rear with the instrument/device number. The number may be painted on or adjacent to the instrument or device case. (g) Caution notice on suitable metal plate shall be affixed at the back of each panel.	
3.14	<u>GROUNDING</u>	
	(a) Normal 3-phase A.C power supply will be grounded at the source. For grounding other than this, isolation transformer shall be furnished with the U.P.S. (b) The inverter D.C. Input and A.C. Output shall be electrically isolated from each other and from cabinet ground. (c) Panels shall have fully rated ground bus with two ground terminals, one at each end. (d) Each terminal shall comprise two-bolt drilling M10 G.I. bolts and nuts to receive Purchaser's ground connection of 50 x 6 mm G.S. flat. (e) Separate electronic grounding shall be provided for UPS system.	
3.15	<u>TROPICAL PROTECTION</u>	
	(a) All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus insects and corrosion. (b) Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entrance of insects.	
3.16	<u>PAINTING</u>	
	(a) The external and internal colour of the panels shall be RAL 7032 and Brilliant white respectively. The panels shall have a matt finish to prevent any glare from surface due to illumination.	

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4.0 TESTS 4.1 All equipment and components thereof shall be subject to shop tests as per relevant IEC/BIS Standards. The tests shall include, but shall not be limited to: 4.2 TESTS ON BATTERY 4.2.1 Refer Section-10, Part-B, 24V Battery & Battery Charger Specification. 4.3 TESTS ON BATTERY CHARGER 4.3.1 Refer Section-10, Part-B, 24V Battery & Battery Charger Specification. 4.4 TESTS ON UPS SYSTEM (a) Type & routine test for various components. (b) Burning test on PCBS - Assembled PCBS shall be tested at 70 deg C for 72 hours in loaded condition. (c) Rapid temperature cycling test at 70 deg C and 0 deg C for 30 minutes at each temperature - 5 such cycles. (d) Functional tests to demonstrate compliance with all specified requirements and published. Specifications such as frequency, regulation, voltage regulation, current limiting, fuse clearing capability of inverters, demonstration of phase and frequency control of inverter for synchronization with range of adjustments transfer and retransfer of static switches under influence of under voltage and over current, tests on chargers, batteries and other system component to confirm compliance with specification. 4.5 Type test certificates of any equipment shall be furnished, if so desired by the Purchaser. Otherwise, the equipment shall have to be type tested, free of charge, to prove the design.		

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5.0	<u>DRAWINGS, DATA & MANUALS</u>	
5.1	<u>TO BE SUBMITTED WITH THE BID</u>	
5.1.1	UPS panels, Battery Charger and Battery layout drawing with dimensions.	
5.1.2	General Arrangement drawing of UPS panels.	
5.1.3	Bill of Material.	
5.1.4	Schematic drawing of UPS circuits.	
5.1.5	Battery cell voltage characteristics and data for different discharge rates.	
5.1.6	Technical leaflets on :	
	(a) UPS System.	
	(b) Battery.	
	(c) Battery charger.	
	(d) Inverter.	
	(e) Static Switch.	
	(f) Manual bypass Switch.	
5.1.7	Duty cycle diagram and battery sizing calculation in the format of IEEE Standard.	
5.1.8	Sizing calculation of UPS system, charger main equipment, viz. SCRs, rectifier transformers etc.	
5.1.9	Type test certificates for similar equipment.	
5.2	<u>TO BE SUBMITTED AFTER AWARD OF CONTRACT.</u>	
5.2.1	Dimensional UPS, battery layout diagram in plan & section.	

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5.2.2	Connection details of take-off terminals.	
5.2.3	Dimensional general arrangement drawings of UPS, battery charger battery clearly showing device dispositions, cable entry, space requirement, etc.	
5.2.4	Sectional views of UPS System panels.	
5.2.5	Panel foundation plan and loading.	
5.2.6	UPS system schematics and wiring diagrams.	
5.2.7	Test reports.	
5.2.8	Detailed bill of materials.	
5.2.9	Any other relevant drawing or data necessary for satisfactory installation, operation, and maintenance.	
5.2.10	Cable schedule & Inter-connection charts.	
5.2.11	Instruction manuals of UPS system.	
	The manual shall clearly indicate method of installation, check-ups, and tests to be carried out before commissioning of the equipment.	
5.3	Tenderer may note that the drawings, data and manuals listed above are minimum requirement only. Tenderer shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment offered are submitted with their bids.	
6.0	<u>SPECIAL TOOLS AND TACKLE</u>	
6.1	The Tenderer shall quote any special tools and tackles needed for his equipment or stated herein.	

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<u>RATINGS & REQUIREMENTS</u> <u>DATA SHEET-A</u>		
SR. NO.	ITEM	DESCRIPTION
1.0	<u>STATIC INVERTER</u>	
1.1	Application	UPS System for control system, MMI, receiver instruments, devices mounted in supervisory control desk /panel, PLCs and other system/sub-system requiring UPS power.
1.2	Type	static IGBT PWM type.
1.3	Duty	Continuous.
1.4	Enclosure	Sheet steel, IP-52.
1.5	Cooling	Natural convection or forced cooling using redundant fans.
1.6	Ambient temperature	as per General Electrical Specification.
1.7	Inverter capacity	To be decided by the Bidder.
1.8	Overload capacity	300% for 4 m secs.
		150% for 60 secs.
		125% for 10 mins.
		110% for continuous.
1.9	Voltage	
	(a) Inverter input, Battery output	To be decided by the Bidder.

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SR. NO.	ITEM	DESCRIPTION
	(b) Nominal output	240 V, 50 Hz, 1-phase.
1.10	Voltage Regulation:	
	(a) Steady state (0-100% load at all input voltages and all power factors)	± 1.5%.
	(b) Transient voltage (On application or removal of 100% load)	± 10%.
	(c) Time to recover from transient to normal voltage	50 milliseconds.
1.11	Wave form:	
	(a) Nominal frequency	50 Hz.
	(b) Frequency range for all conditions of input supplies, loads and temperature occurring simultaneous or in any combination (automatically controlled)	± 0.05 Hz.
	(c) Synchronization limits (for maintenance of synchronism between inverter and standby A.C source)	49 Hz to 51 Hz (factory set).
	(d) Field adjustment range for (c) above	50 ± 0.05 Hz to 50 ± 2 Hz.
	(e) Total Harmonic Content	5% maximum at rated load.
	(f) Harmonic content for any single harmonic	3% maximum.

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SR. NO.	ITEM	DESCRIPTION
1.12	Rated output current at rated output voltage with current limit not operating :	
	(a) Current	200%.
	(b) Duration	100 milliseconds.
1.13	Efficiency at full load (Watt output/ watt input)	90% or better.
1.14	SCR derating from peak voltage and peak rating	50%.
2.0	<u>STATIC SWITCH</u>	
2.1	Type	Solid-state, SCR.
2.2	Duty	Continuous.
2.3	Enclosure	Sheet Steel, IP-52.
2.4	Cooling	Natural convection or forced cooling using redundant fans.
2.5	Ambient Temperature	50 Deg. C.
2.6	Capacity	
	(a) Continuous	Equal to full load capacity of the inverter.
	(b) Overload	300% for 4 m secs.
		150% for 60 secs
		125% for 10 mins
		110% for continuous

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SR. NO.	ITEM	DESCRIPTION
	(c) Peak	1000% of continuous rating for 5 cycle.
2.7	Normal Voltage	240V, 50 Hz, 1-phase.
2.8	Transient Voltage Tolerance	340V peak above the nominal line voltage.
2.9	Transfer Time	less than 4 m secs.
3.0	<u>MANUAL BY-PASS SWITCH / BREAKER</u>	
3.1	Type	Maintained, make before break.
3.2	Voltage	600V.
3.3	Rated Current	To meet the requirement as specified in clause no.: 3.4 UPS specification.
4.0	<u>BATTERY</u>	
4.1	Application	UPS Battery
4.2	Ambient Temperature	
	(a) Maximum	50 Deg. C.
	(b) Minimum	5 Deg. C.
4.3	Type	Lead acid 'Plante' type
4.4	Nos. of Cells per Battery	To be decided by the Bidder.
4.5	Battery nominal voltage	220V.
4.6	Battery capacity in AH at 27 °C- 10 hrs. discharge for plante	Bidder to compute AH capacity considering 100% UPS load for 30 minutes followed by 60% UPS load for 30 minutes. Discharge end cell

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SR. NO.	ITEM	DESCRIPTION
		voltage will be 1.85V/cell for Lead Acid plante type after 10 hrs .
4.7	Method of working	
	(a) Float charge (maximum)	2.2 Volt / Cell for Lead acid plante type.
	(b) Boost charge (After complete discharge)	2.75 Volts / Cell for Lead acid Plante type.
4.8	Mounting	Wooden racks for Lead Acid plante type.
4.9	Connection	Cables
4.10	Battery Size (AH Capacity)	Battery sizing calculation shall be done in line with IEEE standard considering temperature correction factor, design margin and compensation for age.
5.0	BATTERY CHARGER	
5.1	Charger	Float + Float-cum-Boost.
5.2	Type	Solid-state, full wave fully controlled. 3 Phase Bridge.
5.3	Duty	Continuous.
5.4	Enclosure	Sheet Steel, IP-52
5.5	Cooling	Natural convection or forced cooling using redundant fans.
5.6	Ambient Temperature	50 Deg. C.
5.7	A.C. input	

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SR. NO.	ITEM	DESCRIPTION
	(a) Supply	415V, 3-phase, 50 Hz, 4 wire.
	(b) Voltage variation	±10%.
	(c) Frequency variation	± 5%.
	(d) Combined volt frequency Variation	10% (absolute sum).
	(e) Short-circuit level	50 KA
	(f) System earthing	Effectively earthed.
5.8	D.C. output	100% UPS load plus restoring fully discharged battery to full charge condition in 8 hours.
5.9	Blocking Diode, Peak inverse voltage	800 V (minimum).
5.10	Performance Requirement	
	(a) The output voltage of the charger shall be regulated within ± 1% of the set value for any load variation from 0 to 100% and A.C input voltage and frequency variation as indicated above	
	(b) The ripple content in charger D.C. output shall be limited to less than ±1% with battery and less than ± 2% without battery.	

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SR. NO.	ITEM	DESCRIPTION	
6.0	<u>DISTRIBUTION BOARDS</u>		
6.1	Type	Fixed, Modular.	
6.2	Enclosure	Sheet Steel, IP-52.	
6.3	Mounting	Free standing (can be attended from both front & back).	

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