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SUB – SECTION – IIIC - 01

BASIC DESIGN CRITERIA

BASIC DESIGN CRITERIA

1.00.00	GENERAL REQUIREMENTS
1.01.00	In addition to requirements specified under this Section-VI, Part-B, all C&I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification.
2.00.00	**PROVENNESS CRITERIA**
2.01.00	All equipment, systems and accessories furnished under this specification shall be from the latest proven product range of a reputed experienced manufacturer whose successful performance has been established by a considerable record of satisfactory operation in coal fired utility power stations.
2.02.00	Also refer sub section IA, Part A of technical specification.
3.00.00	**RELIABILITY AND AVAILABILITY**
3.01.00	Each component and system offered by the Bidder shall be of established reliability. The minimum target reliability of each piece of equipment like each electronic module/card, Power supply, Peripheral etc. shall be established by the Bidder, considering its failure rate/mean time between failures (MTBF), meantime to repair (MTTR), such that the availability of the complete DDCMIS is assured for 99.7%.
3.02.00	When more than one device uses the same measurement or control signal, the transmitter and other components/ module shall be fully equipped to provide all signal requirements. All the 4-20 mA output signals from transmitters/other control system shall be able to drive minimum 500 Ohms load resistance. The system shall be arranged so that the failure of any monitoring device or control components or spurious intermediate grounding in the signal path shall not open the signal loop nor cause the loss or malfunction of signal to other devices using the same signal.
3.03.00	To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level to satisfy the availability criterion mentioned above. For the protection system, independent sensing devices shall be provided to ensure adequate safety of plant equipment.
4.00.00	**STANDARDISATION AND UNIFORMITY OF HARDWARE**
4.01.00	Bidder shall ensure that various C&I instruments /equipment like vibration monitoring system, 4-20mA electronic transmitters / transducers, Temperature elements and other instruments/ local devices etc. that are being furnished by the Bidder, are of the same make, series and family of hardware to the extent possible so as to ensure smooth and optimal maintenance, easy interchangeability and efficient spare parts management.
4.02.00	Bidder to ensure that the width and depth of all the DDCMIS cabinets shall be 800mmX 800mm.
5.00.00	**OPERABILITY & MAINTAINABILITY**
5.01.00	The design of the control systems and related equipment shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved. 'Fail Safe' operation signifies that the loss of signal, loss of excitation or failure of any component shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips are avoided / minimized.

5.02.00 The types of failure that shall be taken into account for ensuring operability of the plant shall include but not be limited to:

—	Failure of sensor or transmitter.
—	Failure of main and/or redundant controller/other modules.
—	Loss of motive power to final control element.
—	Loss of control power.
—	Loss of instrument air.

5.03.00 The choice of hardware shall also take into account sound maintainability principles and techniques. The same shall include but shall not be limited to the following:

—	Standardization of parts.
—	Minimum use of special tools.
—	Grouping of functions.
—	Interchangeability.
—	Malfunction identification facility/self-surveillance facility.
—	Easy modular replacement.
—	Fool proof design providing proper identification and other features to preclude improper mounting and installation.
—	Appropriate de-rating of electronic components and parts.

5.04.00 The equipment shall employ latest state of the art technology to guard against obsolescence. In any case, Contractor shall be required to ensure supply of spare parts in line with relevant clause of GCC for spares. In case, the Bidder feels that certain equipment/component *(barring HMI hardware and networking components)* is likely to become obsolete, the Bidder shall clearly bring out the same in his Bid and indicate steps proposed to deal with such obsolescence. For HMI hardware and networking components, refer sub section IIC , Part A of technical specification. Further For HMI hardware and networking components bidder *shall inform the Employer in case of obsolesce so that Employer can take appropriate actions as necessary (outside the tenure of the contract).*

6.00.00 ENVIRONMENTAL CONDITIONS

6.01.00 Instruments, devices and equipment for location in outdoors/indoor/air-conditioned areas shall be designed to suit the environmental conditions indicated below and shall be suitable for continuous operation in the operating environment of a coal fired utility station and also during periods of air conditioning failure without any loss of function, or departure from the specification requirements covered under this specification.

Ambient Temperature (outside cabinets)	Pressure	Relative humidity#	Atmosphere	Required protection Class of panels/ cabinets / desks to be provided by contractor.
Outdoor Location				
55 degree C max. / 4 degree C min.	Atmosphere	100 % Max./ 5 % min.	Air (dirty)	IP 55
Indoor Location				
55 degree C max. / 4 degree C min.	Atmosphere	95 % Max./5 % min.	Air	IP 54**
Air-Conditioned Areas				
24 +/- 5 degree C normal/50 degree C max.*	Atmosphere	90% Max. / 10%min.	Air	IP 22***
* During air conditioning failure for a short period of time.				
**For non-ventilated equipment/ control system enclosures. For ventilated equipment/ control system enclosures, protection class shall be IP 42.				
***With a suitable canopy at the top to prevent ingress of dripping water.				
# For instruments: as per OEM standard for intended application.				
For Hazardous areas the protection class shall be in accordance with the requirements of the relevant NEC code for the location.				
PCs, OWS, EWS, Servers, Network Switches, Printers, mini UPS and other peripherals, maximum temperature limit shall be 35 Deg. C. For LVS the same shall be around 25 Deg. C For the remote I/O cabinets mounted in non-AC areas, panel AC shall be provided.				

6.02.00 All equipment / instruments envisaged for sea water applications, shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor).

6.03.00 For coastal areas, all equipment / instruments/ accessories shall be provided with durable epoxy coating for housings and all exposed surfaces of the equipment / instruments/ accessories.

6.04.00	For coastal areas, all impulse piping / air supply piping / local instrument enclosures and racks/ accessories shall be provided with durable epoxy coating for all exposed surfaces.
6.05.00	For coastal areas, all conduits / cable sub trays / cabling accessories shall be provided with durable epoxy coating for all exposed surfaces.
7.00.00	**GROUNDING SYSTEM** All panels, desks, cabinets shall be provided with a continuous bare copper (or chromated steel for DDCMIS panels, as per OEM Standard practice) ground bus. The ground bus shall be bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels. The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length as applicable). Shield on instrumentation cables shall be grounded on panel side. Suitable shielding terminals shall be furnished on Copper flat forming system ground. Alternatively, Manufacturer's standard & proven solution, which is functionally equivalent shall also be acceptable subject to employer's approval. The Bidder shall submit with the offer recommended grounding scheme required for his system. The exact grounding scheme shall be finalized during detailed engineering.
8.00.00	**It is preferred that Instruments to be supplied under this package not to be of nucleonic type. However, if it is required to provide Radioactive source based equipments/ Nucleonic devices/ Nucleonic gauges by the Contractor, following shall be met: -** 1. Contractor shall be responsible for selecting the proper type of nucleonic Source and sizing of the source for the specified application. 2. The Nucleonic gauge (source container) must be type approved by AERB. 3. Source housing shall have a statutory warning sign printed on it which shall be visible from distance. 4.(i) The supplier of radioactive source based equipments/ nucleonic devices/ nucleonic gauges shall clearly indicate the nucleonic source used in such equipment/ device, strength of source, half-life of source, useful life of the instrument and any other details related to source required for AERB NOC. (ii) Contractor/ Supplier of nucleonic device/gauge should facilitate all support required by Employer for timely acquiring required valid license from the regulatory authority AERB. Contractor/ Supplier of nucleonic device/gauge should provide documents which are required by Employer in the AERB NOC process of nucleonic source. (iii) The complete procedure for submitting the electronic application on eLORA portal of AERB should be provided by the Contractor/ Supplier of nucleonic device/gauge. (iv) Contractor/ Supplier of nucleonic device/gauge should provide the required source disposal undertaking letter/ agreements as per requirement of AERB. (v) Contractor shall furnish agreement from OEM & their Indian counterpart to take back the disused nucleonic source/gauge after the useful life of nucleonic source/ gauge is served. Cost towards disposal of radioactive source shall be borne by the STPP.

(vi) Letter for acceptance of disused Nucleonic source/gauge after useful life of source shall be furnished by the Contractor/supplier/OEM from Atomic Energy Regulatory Agency of respective country from where source is procured.

(vii) Complete procedure vetted by OEM should be submitted for taking back of the disused nucleonic source/gauge after the useful life of nucleonic source/ gauge is served.

(viii) Also, No objection certificate from the corresponding Atomic Energy Regulator Agency for export of radioactive source to India shall be obtained by Contractor, OEM/their Indian counterpart.

5. The Contractor shall supply all essential tools, suitable radiation survey meters and accessories as per regulatory guidelines of AERB.

6. The Contractor shall submit plot plan of the site clearly marking the source location on the plot plan. The Contractor shall also submit a suggested security plan.

9.00.00 **CONTROL & MONITORING PHILOSOPHY**

This clause explains the Control & Monitoring philosophy to be adopted for this project The Control & Monitoring philosophy envisages control mainly from:

(a.) Central Control Room (CCR)

(b) Centralized Control Room for Offsite Area (adjacent to main CCR)
(c) CHP control room.
(d) FGD Control room.

In very few cases, local operation facilities have been provided to take care of very specific operators needs

9.01.00 **Control and Monitoring from CCR**

The Main Plant equipment (namely SG & Auxiliaries, TG & auxiliaries, power cycle/LP piping, ECW system & Circulating Water system (CW) , FOPH and its Unloading System , IAC/PAC, Cooling Tower fans, Fire water & Booster system etc. for this project is envisaged to be controlled mainly from the Large Video Screens (LVS) in association with the operator workstation (OWS) mounted on the Unit Control Desk (UCD) located in the Central Control Room (CCR) under all regimes of operation i.e. start-up, shutdown, load manoeuvring, load throw off & emergency handling. The control room is envisaged at operating floor in Control Tower in Main Plant building (TG Hall).

9.02.00 **Control & Monitoring of the off-site from Centralized Offsite Control Room**

The control, monitoring & operation of the off-site areas including AHP System, Water System including DM Plant, PT Plant, CW Chlorination, CPU Regeneration, Raw Water pumps, FGD System shall be carried out from Centralized Offsite Control room. This control room shall be located adjacent to CCR at operating floor in Control Tower in Main Plant building (TG Hall).

9.03.00 **LOCATION OF CONTROL EQUIPMENT**

The equipment envisaged in the Control Equipment Rooms, SWAS room, UPS / Charger Room and Battery rooms is as follows:

1 Control Equipment Room (CER) is envisaged at the operating floor i.e. control tower in Main plant building (TG Hall). It shall have various system cabinets such as BOP DDCMIS cabinets, SG C&I system cabinets, TG C&I system cabinets, vibration

monitoring system cabinets. Control equipment room for common plant systems like Ash handling system, Coal handling system, Water treatment system, Makeup water system etc. shall be near respective MCC. Remote RIO rooms shall be provided on as required basis and their location shall be finalized during detailed engineering.

2 Programmer Room: Programmer Room is envisaged to be located near the CER. This shall house the servers/ other workstations & Engineer station for DDCMIS (SG, TG and BOP C&I systems), various PCs.

3 SWAS Room. SWAS room for every units shall be at 0.0 meters in Main Plant building.

4 UPS, Charger Room and Battery Room: UPS, charger & battery room shall be located at Mezzanine floor in control tower in Main plant building (TG Hall) and shall house UPS, 24 V DC chargers, DC distribution boards, AC distribution boards etc. Batteries for UPS & 24 V DC systems shall be housed in battery room, adjacent to UPS/Charger room.

SUB–SECTION – IIIC - 02

DISTRIBUTED DIGITAL CONTROL, MONITORING & INFORMATON SYSTEM (DDCMIS)

DISTRIBUTED DIGITAL CONTROL MONITORING & INFORMATION SYSTEM (DDCMIS)

1.00.00	**General Requirements**	1. Indicated specifications are functional. It is not the intent or purpose of this specification to specify all individual system components since the Contractor has full responsibility for engineering and furnishing of a complete system. 2. Contractor shall meet system performance and parametric requirements as stipulated under Performance Guarantees under Part-A, Section-VI, Sub-Section-IV of specifications. 3. The Authorization to shipment tests shall be performed in line with the Chapter-III-E, Part-B, Section-VI.
2.00.00	**System Configuration**	DDCMIS shall consist of the following: • Control System (including its Measurement system). • Human-Machine Interface and Plant Information System (HMIPIS) • System Programming & Documentation Facility • Data Communication System • Integrated LVS based Annunciation functions • Time synchronization with Master clock • Basic DDCMIS configuration shall be as indicated in drawing No. 0000-999-POI-A-001 • Contract Quantities of the C&I System shall be as per Part-A
3.00.00	**System Expandability**	1. System shall have Modular System Design for easy system expansion. 2. System shall have the capability and facility for expansion through the addition of new control loops, groups / subgroups, logics in control system, controller modules, I/O cards, peripherals like Large Video Screen (LVS), operator workstations (OWS), printers etc.
4.00.00	**Online Maintenance**	1. It shall be possible to remove/replace various modules online (like redundant controllers, I/O module, interface module etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. 2. On-line removal/insertion of controller, I/O modules etc. shall in no way jeopardize safety of plant and personnel.
5.00.00	**Fault Diagnostics**	1. It shall include on-line self-surveillance, monitoring and diagnostic facility so that a failure/malfunction can be diagnosed automatically. 2. In case the faults are not acknowledged / rectified within certain interval, then the same shall be reported to predefined users. 3. Failure of HMIPIS bus/unit LAN, system bus, Local/Remote comm. Bus 4. Software faults. 5. These faults shall typically be reported as color change on system status display and messages on programmer station/ LVS/ OWS as well as through local indication. The diagnostic system shall ensure that the faults are detected before any significant change in any controller output has taken place. 6. HMIPIS shall include on-line self-surveillance, monitoring and diagnostic facility so that a failure/malfunction in any of the nodes, networking device as well as communication medium can be diagnosed on the programmer/Engg. Workstation/OWS.
6.00.00	**Fault Tolerance & Controllability**	1. DDCMIS shall be designed to prevent abnormal swings due to loss of Control System power supply, failure of any Control System component, open circuits/short circuits, instrument air supply failure

		etc. Control system output shall be either stay put or fully open / closed on failure of any of these as required for safety of plant / personnel. 2. I/O modules shall have protection so that any fault in sensor & its wiring up to I/O module like open / short circuit, earth fault affects only that channel of I/O module. 3. No single failure either of equipment or power source shall be capable of rendering any part/system/sub-system of DDCMIS inoperative to any degree. 4. No single failure in HMIPIS shall lead to non-availability of more than one OWS or one LVS. In such an event, It shall be possible to operate the entire plant in all regimes of operation including emergency conditions from each of the available OWS / LVS. 5. No single failure, whatsoever in any part of DDCMIS result in loss of communication except communication between HMI and control system, for which loss of communication up to a maximum of five seconds is acceptable. However, during this period, the control system shall remain fully functional and this event shall not create any disturbance/malfunction whatsoever.
7.00.00	**Redundancy Requirements**	Following shall be redundant with automatic change-over (including the associated software), as a minimum • Controller, Comm. Controllers, HMIPIS bus/Unit LAN, System bus, Local/Remote communication bus. • Power supply arrangement (feeders/modules) • Output modules. (for which redundancy is specified in part-A-Contract quantities for DDCMIS). • Servers/information workstations.
8.00.00	**Signal Exchange**	Signal exchange between various functional groups of each control systems shall be implemented through redundant system bus.
9.00.00	**System Spare Capacity**	1. For Control system spare capacity Annexures to IIC, Part A, Section VI of technical specification. 2. For HMIPIS spare capacity – refer HMIPIS contract quantity in Part-A Subsection IIC: Scope of supply Section VI of technical specification
11.00.00	**Power supply**	1. Control System Power supply shall be regulated 24 V DC complying following requirements: • Isolation between input & output side and distribution • Multiple voltages as required by various modules as well as integration/supply voltage to field devices • Diode Auctioneering of dual voltages • Power supply fault monitoring (Over voltage, under voltage, loss of input) for each feeder of power supply for system / marshalling/ relay and HMIPIS cabinets.
12.00.00	**Measurement Functions of Control System**	1. Input / output modules in the Control System shall be separate from controller hardware. 2. FIELDBUS ((Foundation Fieldbus/ Profibus) Interface: Foundation Fieldbus/Profibus interface modules, power supply, field cables (armored) and other accessories shall be provided. The design of fieldbus interfacing scheme, from field to Controller shall comply with all requirements of latest version of standards for Foundation Fieldbus/Profibus viz. IEC 61158. Redundant host/ master card and redundant power supply along with diagnostic module shall be provided.

13.00.00 **Analog Signal Conditioning & Processing**

1. Minimum conditioning & processing functions to be performed are as follows:
   - Galvanic isolation of input and output signals for which power supply source is other than the measurement system of the control system.
   - Transmitter power supply with per point fuse protection or current limiting and power supply monitoring
   - Monitor sensor wire break/open circuit/short circuit and take suitable actions in logic/loop. (This will include blocking of trip signals in case of RTD failure.)
2. Analog signals for Control purpose:
   - To be acquired, validated, processed and their respective Controller data base updated at a maximum interval of 250 milli seconds.
   - Fast acting control loops: Above functions as per process requirement.
   - For information only: Above functions shall be performed at an interval of 1 second.
3. HMI database updation: Shall not take more than 1 second.
4. For Unit DDCMIS, the analog 4-20 mA input cards shall have input resistance >= 250 ohm inside the card / FTA. 4-20 mA DC signal will only be used for control purpose and superimposed HART signal will be used for configuration, maintenance, diagnostic and record keeping facility for electronic transmitters and Analyzers etc.

14.00.00 **Binary Signal Conditioning & Processing**

1. Binary inputs shall be wired either in form of changeover type contacts (i.e. 'NC' + 'NO' together) or non-changeover type Contact ('NC' or 'NO') depending on the requirement, as defined in Part-A of specification.
2. Minimum processing functions:
   - 24 VDC power supply for contact interrogation for all potential free contacts with per point fuse protection or suitable current limit feature/ isolation through opto-coupler.
   - Contact bounce filtering. (The field contact which is changing state must remain in the new state for the filter delay time to be reported as one event). The filter delay time should be suitable for the field input & its scan rate.
   - Facility for automatic pegging the binary signal to logic one/zero or last correct value in case of failure of binary input module.
   - Binary signals shall be acquired validated, processed, alarm checked, and their data base updated within one second.
   - It shall be possible to manually disable any binary input either through deleting from scan or substitution from HMI.
   - The non-coincidence monitoring shall be provided for binary inputs for all changeover signals.

15.00.00 **Multiple Measurement Scheme**

1. Triple / Dual measurement schemes shall be provided for triple / dual redundant sensors used in closed loop and open loop controls.
2. Individual transmitter signals, their status and selected value for control/ measurement shall be available on LVS/OWS in the CLCS displays and the popups.
3. The triple / dual measurement schemes for closed loop control shall provide median / average outputs. The operator shall be able to select any of the transmitters or the median/average value from the LVS/OWS.
4. The sensors for multiple measurement schemes for open loop

		controls shall always be in service (except when gone Bad) and operator shall not be able to select / deselect any of the sensors. Further, measurement scheme shall be implemented considering safety / availability aspects.
16.00.00	**Wiring Scheme for inputs to Control System**	1. Each of the triple redundant / dual redundant binary & analog inputs shall be wired to separate input modules. 2. The on-off status of HT drives and synch type breakers shall be wired to two input modules in parallel. 3. If triple/dual analog sensors are required both in CLCS and OLCS for control purpose, then all of these triple/dual sensors shall be wired to the controller where CLCS loop is configured. 4. If based on the same set of sensors, any protection action is required in OLCS (e.g., protection stop of drive) in another controller(s), then CLCS Controller shall provide three digital outputs for each such controller from three separate output modules (at defined LVM-Limit Value Monitor blocks inside Controller). The three such digital outputs of CLCS controller shall be acquired in each of the OLCS controllers in three separate digital input modules. 5. If triple/dual/single binary sensors are required in OLCS in multiple controllers for protection function in these controllers, each of these sensors shall be shared among these controllers. Each of these sensors shall be directly shared from marshalling TBs without any 'active' multiplying hardware ('active' defined as hardware which requires a separate power supply for its functioning). 6. The input sharing scheme shall be subject to Employer's approval during detailed engineering. The inputs/outputs for such sharing is already included in the Contract quantities in Part-A.
17.00.00	**Remote I/O modules and Cubicles**	1. Remote I/O signals shall be connected to the respective functional groups through redundant extended I/O bus as indicated in the Contract quantities for DDCMIS. 2. The hardware independence of functional groups mentioned elsewhere in specification shall be applicable for remote I/O as well. 3. Remote input/output modules may be located in harsh environment, the modules shall be designed in such a way to work continuously under the harsh environment expected to be encountered in these areas (high temp, dust level, humidity etc.). 4. It shall be ensured that extending of I/O bus of functional group in field does not result in false signaling /noise pickups. 5. Power supply arrangement for these cubicles shall be similar to DDCMIS system cabinets.
18.00.00	**I/O Module details**	Maximum number of inputs/outputs to be connected to each type of module: • Analog input module – 16 • Analog output module – 16 • Binary input module – 32 (one changeover contact implies 2 inputs) • Binary output module – 32 • Analog input & output (combined) module – 16 • Binary input and output (combined) module – 32
19.00.00	**Control System Requirements**	1. The number of Functional Groups (FGs) which are derived from the guidelines are the minimum required. For each of the FGs, separate sets of controllers, I/O modules, communication controllers, power packs/ modules etc. shall be provided. 2. Mixing of hardware of two or more FGs shall not be acceptable.

		3. Splitting of any functional group in more than one FGs due to any limitation in Contractor's system (e.g. limitation in handling number of inputs/outputs including spare capacity, limitation in implementation of number of functional blocks including spare blocks etc.) shall be acceptable, subject to Employer's approval. 4. After splitting of the functional groups, each FG must have its own set of controllers, I/O modules, etc. 5. It shall be ensured that failure of any set(s) of hardware of any FG does not affect other FG(s) and data communication between other FG(s) and HMIPIS. 6. The system shall have the flexibility to easily reconfigure any controller at any time without requiring additional hardware or system wiring changes and without disabling other devices from their normal operation mode. 7. Modifications shall not require switching off power to any part of the system. 8. The Control System shall have on-line simulation & testing facility 9. The application programs for the functional controllers shall be software based which shall be maintained even through power supply failure. 10. Independent and dedicated controllers (main and its 100% standby) shall be provided for each of the functional group (FG) of Control System except for the cases where triple redundant controllers are to be used as per these specifications. 11. There shall be an automatic and bumpless switchover from the main controller to its corresponding backup controller in case of main controller failure and vice versa without resulting in any change in control status. 12. In case of switchover from main controller to the 100% hot backup controller, the back-up controller shall work as the main controller without any effect on process control.
20.00.00	**Binary Controls / Open Loop Control System (OLCS)**	1. OLCS shall include sequence control, interlock & protection for various plant auxiliaries/valves/dampers/drives etc. 2. The sequence control shall provide safe and automatic startup and shutdown of plant and of plant items associated with a plant group. 3. OLCS shall be arranged in the hierarchical control structure consisting of unit level, group level, subgroup level & drive level (as applicable). 4. The group level shall control a set of functional sub-groups of drives. Appropriate start-up and shut down commands shall be issued to the sub-group control and various check-backs shall be received from sub-groups or drives. 5. Sequence Control: The sequence initiating command for the unit & group level shall be issued from LVS/OWS. • The steps shall be executed in predetermined order according to logic criteria and monitoring time consisting of the interlock & protection requirements and check back of previous step which shall act as preconditions before the sequence control can execute the command for that step. • Each step shall have a "waiting time" implying that the subsequent step would not be executed unless the specified time elapses. A monitoring time shall also be defined as the maximum time required in executing the commands of any step and the time required for appearance of check back signals. In case, this is not completed within the specified time, a message shall be displayed, and program will not proceed further.

		• Manual intervention shall be possible at any stage of operation and the sequence control shall be able to continue at the correct point in the program on return to automatic control. Protection commands shall have priority over manual commands, and manual commands shall prevail over auto commands. • Open or close priority shall be selectable for each drive • The sequence startup mode shall be of the following type: I. Automatic Mode II. Semi-Automatic Mode III. Operator Guide Mode/Test Mode 6. For the drives, the command shall be provided through O/P module to the coupling relays in MCC/SWGR/Actuator/Relay Cabinets as applicable and inputs (status, SWGR & process) shall be acquired through input modules. (Redundancy in drive outputs shall be provided for drives, as quantified in Part-A). 7. The output modules shall have the feature that ensures that in case of failure, all the outputs are driven to zero. The 24V DC command outputs to drives for ON/OPEN, OFF/CLOSE shall be separate and independent and inverted outputs shall not be employed. Live +24V DC outputs shall be provided to MCC/SWGR/ actuator as applicable when command is to be issued. Keeping +24V DC extended to the relays for these outputs continuously & extending ground/negative when command is to be issued, is not acceptable except some of the auxiliary plants as to be decided during detailed Engineering. 8. For inching type of drives, position transmitter power supply and monitoring of position transmitter signal shall be provided. 9. The sequence interlock & protection requirements shall be finalized during detailed engineering and the same shall be subject to Employer's approval. 10. The drive function i.e. basic interlock & protection logic of the drive shall be implemented in redundant controllers. The drive function shall ensure that protection signals for the safety of the drive shall be effective under all conditions and under all modes of operation. The different commands shall be performed according to the priority of protection 'Off', Protection 'On', manual and automatic. The standard functions like running time monitoring, status signaling, alarm/drive annunciation, tagout / maintenance mode etc. shall be performed in drive function. The drive function shall prevent hunting of the actuator in the presence of both open & close commands for actuators of the valves & dampers. The drive function shall be implemented in dedicated standard software functional block (drive macros). 11. It shall be possible to control all common system drives (i.e. common for more than one units), from all or some of the units.
21.00.00	**Modulating Controls / Closed Loop Control System (CLCS) Functions**	1. CLCS shall continuously act on valves, dampers or other mechanical modulating devices such as hydraulic couplings etc. The system shall be designed to give stable control action in steady state condition and for load changes in step/ramp over the load range of 40% to 100% MCR. 2. The controller capability shall, as a minimum, include (i) P, PI, PD and PID control functions and their variations (ii) cascade control (iii) feed forward control (iv) On-Off control, (v) Ratio and bias control, (vi) Logical operation. Other advanced control strategy like adaptive & predictive control etc. can be considered for important loops like Furnace Draft, combustion control, FW flow control etc. in addition to SH/RH temperature control. 3. The control loop shall have enough flexibility and various features to

perform feed forward, balancing of controller, increasing the response to achieve the desired process parameter within prescribed time frame.

4. The control system shall be bumplessly transferred to manual on the conditions of Control power supply failure, Failure of redundant controllers, Field input signal not available, Analog input and / or deviation exceeding preset value, etc. as a minimum and as finalized during detailed engineering.
5. Analog output (positioning signal) of 4-20mADC shall be provided from CLCS to the respective microprocessor-based positioner E/P converters / electrical actuators as applicable. Redundancy in drive outputs shall be provided for drives as quantified in Part-A. CLCS shall also provide all the necessary outputs for indicators and other devices as specified in Part-A with output loop resistance of 500 ohms for each channel of the output module.
6. System shall be such that when permissible limits are exceeded, an automatic switchover from an operation governed by maximum efficiency, to an operation governed by safety and availability is affected.
7. For safety reasons, switchover logics associated with the modulating control loops shall be performed within the same controller. Modulating control loops shall be provided with standard features to interface overriding commands from OLCS/SG/TG Protection System like open, protection open etc.

22.00.00 **Human Machine interface and Plant Information System (HMIPIS) requirements**

Operator interface to the Control System

The following functions shall be provided as a minimum:

1. All OWS/LVS of the HMIPIS shall be fully interchangeable i.e. all operator functions including control, monitoring and operation of any plant area or drive shall be possible from any of the OWS/LVS at any point of time without the necessity of any action like downloading of additional files.
2. Simultaneous operation (availability of popup window/faceplate) of multiple drives of control system shall be possible from a single display.
3. The system shall have built-in safety features that will allow/disallow certain functions and entry fields within a function to be under password control to protect against inadvertent and unauthorized use of these functions. Assignment of allowable functions and entry fields shall be on the basis of user profile. The system security shall contain various user levels with specific rights which shall be as finalized by the Employer during detailed engineering. However, no. of user levels, no. of users in a level and rights for each level shall be changeable by the programmer (Administrator). The users created for a particular user level shall be specific to a DDCMIS. Hence, a user of one DDCMIS shall not be able to exercise the same privileges in other DDCMIS(s). The rights of each user shall contain two types of privileges as follows:-
    a) Privileges for the DDCMIS
    b) Privileges for the Operating System features.
4. Typically following user levels shall be available:
    a) Operator
    b) Supervisor
    c) Maintenance Engineer
    d) Programmer
    e) Shift Incharge / Station Incharge / other Monitoring users.

5. The system shall have functionality to configure view only privilege of any sub-system from HMI of any other sub-system. In case Cross HMI operation is applicable as per Part-A, it shall be possible to enable/disable operation of any valve or drive or area belonging to any sub-system from the HMI of any other sub-systems by a supervisory command through station LAN. Such control shall be based on a pre-engineered list and as per pre-predefined priority hierarchy. In case, cross HMI operation privilege is not available for a particular drive/area and still an operation is attempted for the drive/area then a suitable regret message should be displayed in HMI to the operator. It shall be possible to modify the list at site under Maintenance Engineers/ Administrator's right.

The Contractor shall implement all necessary logics & selection facility in Control System/HMIPIS for the same with safeguard to prevent multiple operations simultaneously. Status & other signals related to the drive and the selection by any other user shall be made
available to other users.

The following functions shall be provided:

a) Calculations: Basic calculations like time of max./min., number of transgressions of a point in a band etc. shall be provided. Same can be implemented in control system also. These calculated points shall be capable of being assigned to any functions like any other scanned point.
b) Displays such as mimics, bar chart displays, X-t plots with various update rates using the data from historian, X-Y plots (with superimposed operating curves).
c) Control related displays like faceplates for different types of drives, sequence displays, drive level displays (pop-ups giving details of auto/ protection/ permissive condition/ faults), control type display (giving details of A/M selection, tagout / maintenance mode, process value, set point, deviation, command output, position feedback etc). Further, CLCS displays giving the single line diagram of the control loop shall be provided.
d) System status displays: This will provide an indication of the faults in a graphical form.

LVS/OWS Annunciation Display

1. The LVS/OWS annunciation will replicate in software the salient features of conventional hardware annunciations facia (for permanent viewing i.e., not operator changeable) while presenting more flexibility. This annunciation shall include both the process alarms as well as system alarms. The top area of the OWS and LVS (around 20-25%), shall be reserved for these displays.
2. The annunciation system shall be implemented as an in-built function of DDCMIS. The field contacts shall be acquired through DDCMIS only. The annunciation points will be presented on topmost area of mimics display. The annunciation area will be divided in three (3) "alarm bands". The annunciation sequence shall be as discussed and finalized during detailed engineering.
3. Bidder shall implement the annunciation functionality as described below as a minimum.
4. There will be one alarm for each alarm window. Grouped alarms shall be provided only for pre-defined system / field faults like non-coincidence, monitoring etc. The alarm text is to be displayed only when that alarm is present. A "tool-tip" will be associated with each alarm window, which will show tag no. of alarm point when cursor is brought over alarm window.

5. Hooters/Speakers of different audio types shall be available for reporting new alarms and resetting of alarms (corresponding to slow flash) etc shall be available. All flashing windows shall flash together (synchronized) in any screen. Suitable means shall be provided to distinguish new alarms and return to normal messages.
6. Annunciation points shall be distributed on various stations based on process area. That is, each annunciation point will be assigned screen no.(s) and an alarm band no. A particular point can be assigned more than one station also.
7. No fixed space will be reserved for any alarm on any of the band. Once a particular alarm band is full, the new alarm in that band will be reported by automatic shifting of the older alarm(s) on left side of band one by one in FIFO fashion. Scroll buttons shall be provided on both the sides to view the alarms in a particular band after the particular band is full.
8. The scroll button will fast flash when scrolled alarms are fast flashing, will slow flash when alarms are slow flashing and will be steady when alarms are steady. When scrolled alarms are of mixed type, the scroll bar will flash with highest flashing rate of scrolled alarms.
9. When operator right clicks on LVS alarm area, he will get a menu with following options (i) acknowledge all- to acknowledge all new alarm(s) (ii) reset all- to reset all alarm(s) returning to normal (iii) acknowledge point- to acknowledge the particular point in alarm (iv) reset- to reset the particular point in alarm (v) Root Cause – To link to Alarm Analysis result for that particular tag (vi) “configuration utility”- to view and edit alarm list, tag nos., etc of all points in all stations (vii) closing the annunciation display. This menu can be dragged & placed anywhere on station screen. The actions (i), (ii), (iii), (iv) and (v) can be done by operator but action (vi) & (vii) will be permitted only to Programmer. The hooter sounds will be different for each of the Unit of power plant, when there is common control room for multiple Units.
10. Bidder shall provide suitable “configuration utility” for viewing and modifying list of all alarms (process and system) to be displayed on all annunciation area, band color, text color, flashing color and frequency, font, etc.

Displays On large Video Screen

LVS based overview displays shall be provided, which shall be overlaid across all the LVS for viewing as video wall.

1. Facility of separate individual pop-up window for 30 critical alarms (to be decided during detail engineering) over the active mimic display, other than LVS annunciation band, in OWS/ LVS OWS is to be provided. The pop-up window should require operator intervention to close. Pop-up window of one critical alarm should not overlap with any other critical alarm pop-up. The size of the pop-up window, color of description and size of font shall be decided during detail engineering.

2. Facility of time activated logs (Daily & Shift logs), event activated logs (Post trip log) shall be provided. At any point of time, log/ report can be demanded by operator. Maintenance data log shall be provided for total running timer & other maintenance related statistics. This shall also include standby running hours.

Historical storage and retrieval system (HSRS)

Complete HSRS functionality shall be implemented in server/information workstation (Please refer Part-A for redundancy requirements). The data shall be saved online on hard disk and transferred to the portable storage

		device like DVD periodically for long term storage. Provision shall be made to notify the operator when the portable disk is required to be replaced with a fresh disk. The Hard disk capacity shall be sufficient to store at least One (1) year data Suitable facility for retrieval of data shall also be provided. The data to be stored in the above system shall include alarm and event list, periodic plant data (tags computed in control system as well as computed in HMIPIS) including data required for Residual life assessment, logs/reports etc. The data/information to be stored & frequency of storage and retrieval shall be as finalized during detailed engineering.
23.00.00	**Programmer's Station (Program Development/ Modification, System Maintenance And Documentation Facility)**	1. The structuring/configuration/modification of Control loops/logics in Control system and program development/modification in HMIPIS shall be possible from fully graphic displays using familiar & conventional functional blocks. 2. Any modification done in Control System and HMIPIS shall be suitably logged so that it can be traced to the user log-in ID and time of change. **Control system structuring / configuration / tuning facilities** 1. Structuring/configuring and tuning facilities shall be provided for structuring/ modification, storing/loading, testing, tuning, monitoring, etc. of all the microprocessor-based controllers of the control system. 2. It shall be possible to configure the system with ease without any special knowledge of programming or high-level languages. 3. On-line tuning of the control loops shall be possible without causing any disturbance in the execution of the control loops. Provision to store and retrieve on immediate and long-term basis the system configuration, data base etc. on some device such as floppy disk shall be included. Facility shall be provided to reload/down-load the system or controller module from the already stored data, on-line. 4. Facility for modification shall be user-friendly. For example, modification of logics/loops etc., zooming for better display, stretching etc. should be possible. It shall be possible to add/modify, delete blocks in logics/loops on-line **System Documentation Facility** 1. The system shall have the facility to generate the associated documentation for both the Control System & HMIPIS with all required software and hardware tools for viewing and printing drawings and documents. 2. Workstation based system documentation facility shall be provided to generate retrieve store & all system documentation, logic, control loops, cable interconnection, etc.
24.00.00	**System Software Requirements**	1. The Contractor shall provide all licensed software packages required by the system for meeting the intent, functional and parametric and performance requirements of the specification. 2. All licenses shall be valid for the continuous service life of the plant. The software licenses shall be provided for the project (e.g. organization or site license) and shall not be hardware/machine-specific, except the operating system licenses, in the event of non-machine specific license not being supported by the operating system supplier. Necessary documentary evidence to establish the same shall be submitted by the DDCMIS supplier 3. As a customer support, the Contractor shall periodically inform and upgrade the Anti-Virus / IPS/IDS software of the workstations/servers/switches/firewall till completion of the warranty period and also till the completion of the AMS period.

		4. DDCMIS supplier to periodically provide list of qualified operating system patches/ service packs and software patches of other third party software (like Office, Adobe etc. as applicable, except antivirus and IPS/IDS) for use on its system during the continuous service life of the plant, subject to availability of the same by the manufacturer of the software. 5. As a customer support the DDCMIS supplier should periodically inform and provide software/firmware fixes/patches for bugs, deficiencies, security vulnerability (including those reported in US-CERT, CERT of the country of origin of DDCMIS OEM, CERT of respective DDCMIS OEM) for DDCMIS, till continuous service life of the plant.
25.00.00	**Data Communication System**	1. The Data Communication System shall include a redundant System Bus for major subsystems with hot back-up. Other applicable bus systems like cubicle bus, local bus, I/O bus etc. shall be redundant except for backplane buses which can be non-redundant. 2. Redundant communication controllers shall be provided to handle the communication between each functional group of controllers of Control System and the System Bus with feature of bumpless changeover between the two. 3. The following buses shall be fiber-optic only • System bus from locally mounted control system cabinets/OWS to central location. • I/O Bus from remote I/Os to centrally located system cabinets. 4. The redundant buses shall be physically separate and shall be routed separately.
26.00.00	**Grounding**	1. All panels, desks, cabinets shall be provided with a continuous bare copper ground bus, bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels. 2. Further, for connection of shields of the field instrumentation cables, a separate shield bus independent of the ground bus shall be provided, which shall be connected to the earth risers by means of independent cables.
27.00.00	**System Cabinets / Panels**	1. All DDCMIS system modules, power supply components, other control devices (except field mounted sensors/transmitters) which are required for completeness of the system shall be housed in cabinets furnished by the Contractor. System cabinets housing electronic modules and power pack supplies of DDCMIS system shall be supplied. 2. Electrical hardware cabinet for items required for synchronization (like auxiliary. PTs and synchronizing check relay and guard relay as well as auxiliary relays on as required basis etc.). 3. In case Bidder's system design requires the termination cabinet independent from system cabinet, the marshalling cabinets can be combined with the termination cabinet. 4. In case, the termination arrangement is part of the system cabinet, independent marshalling cabinets shall be provided. 5. The HMIPIS cabinets can be clubbed with Control System Cabinets for small areas where only 24V dc power supply is used. 6. Termination of field cables directly to control system cabinet is not acceptable. 7. Hardware like network components, power supply distribution etc. shall be suitably housed in cabinets/enclosures. In network cabinets suitable arrangements shall be provided to ensure that the network components are visible in door closed condition (e.g. Glass doors

		etc.), as approved by Employer.
28.00.00	**Marshalling, Relays & Relay Cabinets**	1. System cabinet(s) and corresponding marshalling and termination cabinet(s) shall be a single shipping section, so that the internal wiring from field terminal to the module is done completely at the factory itself. 2. The system cabinets shall be furnished with side panels even within a shipping section. 3. Marshalling cabinets and relay cabinets shall be separate from system cabinets for terminating inputs from field, MCC / SWGR etc. for further wiring to control system and for terminating outputs from control system to MCC / SWGR etc. 4. In case DDCMIS supplier provides system cabinets with suitable partition to create separate marshalling area on the rear side of the system cabinet, ensuring that dust ingression does not take place in system area, the same can also be accepted subject to Employer's approval during detailed engineering stage. 5. Contractor shall design the cabinet internal arrangement, floor cutout and cable gland plate such that all the cables entering or leaving the cabinet can be properly glanded in the gland plate. In case, glanding is not possible Contractor shall indicate in his proposal his suggested procedure for cable entry and securing the cable at place. 6. The terminals used for terminating the spare cores/ pairs of field cables shall not be employed for terminating the spare channels of I/O modules/ FTMs. Guidelines are as follows: • 8 level cage clamp type of termination block shall be used in marshalling/ termination panel. • Minimum 4 pair Instrumentation Cables shall be used for connection between field / JB and DDCMIS marshalling cabinet and all the cores of 4 pairs or its multiples to be terminated in the marshalling panel (including spare cores) sequentially as per color coding philosophy indicated in the corresponding Tender Drawing. When more than 4 pair cable is used, the same is to be terminated in consecutive marshalling posts. No core/ bundle shall be left unterminated in the marshalling panel. • In MFT and Turbine protection and governing system, Contractor's standard and proven practice for cable type and cable termination scheme shall also be acceptable. 7. The protection class of cabinets and environmental rating shall be as defined in Basic Design Criteria. Temperature rise inside cabinet shall not be more than 10 deg C with respect to ambient temperature in any condition. Dual blowers/fan with blower/fan failure alarm shall be provided in each cabinet with proper enclosure. Suitable louvers with wire mesh shall be provided on the cabinet. Contractor shall furnish detailed calculation of heat dissipation of various components housed in the cabinet, during detailed engineering to ensure that temperature rise is limited as specified above. Further, temperature sensor (RTD) shall be provided in each system cabinet to monitor temperature inside cabinet and suitable alarms shall be configured to indicate high temperature inside the cabinet. 8. The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed

engineering.

9. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is 600 mm or above, double doors shall be provided.
10. Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish color shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. As an alternative, single coat of anodic dip coat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.
11. The Bidder shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory applied painted surface of each item of equipment.
12. The finish colors for exterior and interior surfaces shall conform to following shades: Front & Rear-RAL 9002; End panel side- RAL 5012. Internal color shall be same as external color.
13. Cabinets shall be designed for a grounded installation on the building structure. Any isolation from the building ground which is required by equipment design shall be provided internal to the cabinet.
14. All alarm contacts located within cabinets as well as inputs/outputs from other related system shall be suitably terminated in the cabinets.
15. All the relays provided by Contractor shall be electromechanical type suitable for control supply of 24V DC meeting following specification requirements:

Sl. No.	Description	1 COC Slim Relay(< 7mm)	2 COC Heavy Duty Relays
1	Application	for Signal Exchange and 24 V DC Solenoids	Other applications like Electrical Interface, Trip PB contact multiplication etc.
2	Operating Voltage	24 V DC	24 V DC
3	Complete Relay with base Width	<7 mm	-
4	No. of Contacts	One changeover contact	Two changeover contacts
5	Contact material	AgNi/ AgSnO	AgNi/ AgSnO /Ag Alloy
6	Contact Rating	Min 6 A at 24 V DC/ 240 V AC	*Min 5 A at 240 V AC & 0.2A at 220 V DC
7	The Coil burden of relays	<2.5 W at 24 V DC	<2.5 W at 24 V DC
8	Relay Working voltage range / Release Voltage shall be in line with IEC 61810	80% to 110% of rated voltage/ 5% or higher of rated voltage	80% to 110% of rated voltage/ 5% or higher of rated voltage
9	Relay shall be capable		

	to meet requirement of fast switching applications : a. Operating time b. Release time	a. Max 10 ms b. Max 10 ms	a. Max 40 ms b. Max 60 ms
10	Relay Electrical Life	Min 50000 operations at rated load	Min 100000 operations at rated load
11	Relay Mechanical Life	Min 5x106 operations	Min 107 operations
12	Relay base with integral terminal blocks Mounting	DIN Rail	DIN Rail
13	Relay/ Relay base shall be provided with a freewheeling diode	Y	Y
14	Relay/ Relay base shall have LED indication for coil activation.	Y	Y
15	Reverse Polarity Protection	Y	Y
16	Relay connection type	Screw less connection like Push in/ Cage clamp/ Spring type	Screw/Push in/ Cage clamp/ Spring type
17	Jumpering provision	Relay base shall have provision for plug-in jumpering without need for additional wiring	-
18	Standard Compliance	Relays along with base shall comply to CE, UL, ROHS, IEC61810 standards.	Relays along with base shall comply to CE, UL, ROHS, IEC61810 standards.
19	Operating Temperature	Relay : 0-80 Deg C Complete relay with base : 0-60 Deg C	Complete relay with base : 0-45 Deg C
20	The Insulation of the Relay Module between the coil & contact	4 kV at 50Hz for 1min	2kV at 50Hz for 1min
21	Manual test lever/ latching provision	NOT to be provided	NOT to be provided

Notes :

1. * For Trip PB contact multiplication, contacts of these relays will be wired to switchgear and rating of contacts shall be 1A at 220V DC.
2. Relays along with base shall be from the same manufacturer.
3. These relays shall be mounted in relay cabinets except for cases where number of relays is very less (Less than 40). In the cases where the number of relays is very less the same can be mounted in

		termination/marshalling cabinets. All the contacts of relays shall be wired upto the cabinet terminal block.
29.00.00	**HART System**	1. The Contractor shall provide HART management software in a dedicated PC station for each of the Unit DDCMIS for centralized configuration, maintenance, diagnostics & record-keeping for all electronic transmitters, temperature transmitters, control valves and analyzers with HART protocol. 2. All cables/links for connecting system described above shall be provided by the Contractor on as required basis within quoted price. Software licenses as applicable shall be provided for HART Maintenance system as provided for other software listed at the relevant clause in this chapter.
30.00.00	**Requirement for SOE functionality (Refer Scope of Supply and Services for applicability)**	1. The system shall monitor SOE inputs with a resolution of one millisecond at all times, for all inputs including spare inputs. Input card shall be equipped with digital filters with filter delay of minimum 4 ms (identical for all points) to eliminate contact bounce such that field contact which is changing state must remain in the new state for successive 4 ms to be reported as one event. The start of data collection for SOE report shall be reported to OWS within 1 sec of SOE data collection initiation. Time stamping of SOE inputs/points shall be performed in the control system. 2. In addition to above, facility for adding a field adjustable software delay on a per point basis shall be provided. 3. The system shall also include provision for historical storage and retrieval of SOE reports for 3 months period. 4. The SOE reports shall also include a list of major equipment trip in chronological order and include the points that initiated SOE collection. The SOE report shall be available on each of OWS/LVS of unit DDCMIS 5. The inputs for SOE shall include: a) hardwired inputs in input cards b) calculated points/generated points of Control System c) In case the Contractor's system cannot use the internally calculated point (i.e. 'b' above) for SOE monitoring, all required I/O modules shall be provided within quoted price. 6. All the SOE inputs shall also be available for interlock/protection functions. 7. The common requirements specified for all binary inputs in sub-section IIIC-02 shall be applicable for SOE inputs also. 8. SOE in other subsystems of DDCMIS shall also be integrated into this system. 9. SOE reports shall be stored in the HSRS like other logs/reports.
31.00.00	**System Documentation**	The Contractor shall furnish detailed system and equipment documentation as approved during detailed Engineering and included elsewhere in the contract for DDCMIS. It shall include detailed system and components description covering the installation, operation, care, and maintenance of all system components. All final system documentation for DDCMIS hardware and related software shall be furnished. The same shall be complete, accurate and fully representative of the supplied system and its elements. All documentation/catalogues etc., shall be furnished in English language.
32.00.00	**Warranty**	1. The Bidder shall provide an unlimited warranty on all equipment and

		software during the Defect liability period. This warranty shall include repair, replacement or correction of identified software or hardware discrepancies at no cost to Employer. 2. The Bidder shall provide warranty spares and an exhaustive list of warranty spares including components for system hardware and instrumentation and peripherals based on (and keeping adequate margin over) normally experienced failure rate shall be submitted by the Bidder for Employer's review regarding adequacy of the same. The warranty spares as per the list mentioned above will be dispatched by the Bidder along with the main equipment consignment. The Bidder shall also provide expandable items for the warranty period. 3. In case of any hardware failure which hampers normal operation, the Bidder during the warranty period must provide on-site technical expertise to repair/rectify the problem within a week and if any component is not available at site, the Bidder must arrange to supply these components at site within additional 48 hours. If a software problem is identified, this problem shall be corrected within two weeks. 4. After six months of DDCMIS operation the Bidder shall provide the list of parts and expendables utilized for the period. The same information will be provided at the conclusion of the warranty. 5. In order to discharge the warranty responsibility, the bidder shall include in his proposal lumpsum price for the provisions of a team of service personnel at Site who will be fully qualified to perform the required duties throughout the warranty period of one year. The Bidder shall deploy at least one engineer, one supervisor and two technicians in the team. The Employer shall approve the exact nos. & composition of team members. In case, the team is unable to rectify hardware or software problems, the Bidder shall depute and/or station additional specialist to rectify the problem to ensure 99.7% availability of system. The availability of system shall be calculated as per Sub-section-IV, Part-A, Section-VI of specifications.
33.00.00	**Annual Maintenance Service (AMS)**	1. The Bidder shall provide maintenance services of complete DDCMIS System under a comprehensive Annual Maintenance Service (AMS) for period of Three years after Warranty period. 2. The AMS shall cover total maintenance of all hardware & software coming under the scope of DDCMIS and shall include free repair/replacement of all cards/ modules/ peripherals/ cables/ components etc., correction of software problems and supply of expendable items. The Bidder shall ensure 99.7% availability of the system with the AMS. For that purpose, contractor may maintain adequate no. of staff at site as per his own assessment if considered necessary to ensure availability. 3. Further, Bidder may note that during the AMS he will be allowed to use Employer's mandatory spares and has to replenish the same within three months' time or before completion of AMS period whichever is earlier. However, if in the opinion of the Bidder, more spares than those included in the mandatory spare list are required to meet the availability requirement, then Bidder shall stock the same. 4. The Bidder shall prepare detailed list of faults corrected and parts, expendables utilized during AMS period and shall furnish the same to Employer, properly documented at the end of AMS period. Further, during AMS period the details as required by Employer/ Project Manager shall be made available by Bidder's personnel.

34.00.00	**Remote Service Center**	Bidder shall provide the necessary hardware & software required for connecting the DDCMIS system to Bidder's remote service center, through which the diagnostics & fault analysis of the DDCMIS system can be carried out. The Remote Service Center functionality shall be a part of station LAN architecture. This shall include the control system and unit HMI, however the diagnostic of bought out items like LVS, LAN switches, Master & Slave Clock etc. are excluded. The method of connection shall be as per Bidder's standard practice with Two-Factor Authentication (2FA). Virtual Private Networks (VPN) technology shall be used for data integrity and confidentiality. The type of VPN (SSL, IP Sec, SSL), no. of bits for encryption etc. shall be decided during detailed engineering. Further, this access shall be strictly under request control & record of such access shall be made available to the Employer's designated personnel. Also, it should be ensured that the hardware at the other end of the Remote access connection (i.e. at the contractor's works) shall be standalone/isolated (i.e. not connected to any network). However, it is preferred to have the connection through a single point in the plant's DDCMIS system. The fixed charges & running cost till warranty period shall be included in the Quoted Price. The running cost thereafter shall be included in the AMS price.
35.00.00	**Testing & Commissioning Tool**	The testing and commissioning tool is intended to be used for test operation of any drive, in absence of DDCMIS during initial commissioning (e.g. fan trial run, etc.) While the tool shall be used for all type of drives envisaged in the specification, it is designed to be operated for one drive at a time. Portable trolley mounted system completed with necessary hardware for operating the drives and monitoring its parameter shall be supplied. Detailed engineering documents and operating procedures shall be submitted during detail engineering.

ANNEXURE IIIC-02A

SG C&I CONTROL SYSTEM

The SG C&I system comprising of Burner Management system (BMS), Secondary Air Damper Control (SADC), Soot Blowers Controls, Aux. PRDS control, Atomizing Steam/Air Pressure Control, Mill Reject system, Fuel oil header pressure/flow control, Mill fire control, mill lube oil system control, SCAPH drain tank controls, Start Up System Controls, Start Up Drain and vents controls, NOx Control system etc. The BMS shall comply with the requirements stipulated in NFPA 85. The Master Fuel Trip (MFT) Sub Group of BMS shall comply with *EN50156-1:2015 clause 10 and shall m*eet the requirements of SIL-2 or better, as per IEC 61508, with 2 out of 3 configuration (refer tender drawing no. 0000-999-POI-A-002) . The BMS shall be provided with automatic self-monitoring facility. All modules to be used in this system shall be of fail-safe design. Any single fault in primary sensor, I/O modules, multifunction controllers, power supply, instrumentation cables etc. should not result in loss of safety function. All faults should be annunciated to the operator at the time of its occurrence. Contractor shall implement first-out logic in each MFT channel and for each HT drive to indicate the first cause of protection/trip.

TG-C&I System

1. Steam Turbine and Generator (TG) C&I system comprising of Turbine Protection System Function (TPS) including generator mechanical protection system, Turbine Electro-hydraulic Governing system, Turbine Stress Evaluation / Control System (TSCS) and turbine supervisory system, Speed measurement and its associated protection system, Gland steam pressure control, turbine oil temperature control for Main and BFP Turbine, Automatic online Turbine Testing (ATT), Automatic Turbine Run up/Shut down System (ATRS), Vacuum system, HP/LP Bypass Control System, Turbine -Generator control system for Seal oil, primary water, Generator gas temperature control, Turbine Extraction NRV control ,complete BFP turbine and its auxiliaries OLCS and CLCS controls, MDBFP and it's auxiliaries OLCS and CLCS controls. Miscellaneous turbine related start Up Drain and vents control etc. PI also refer FG guidelines specified in Annexure C, Part A of technical specification.

2. Bidder shall provide all the required primary sensors etc. required for protection system as per his standard and proven practices. All trip signal inputs required for the safety of the turbine shall be based on 2 out of 3 logics except vibration and TSI measurements which shall be as per the standard and proven practice of contractor. Further, the design and operation requirements, as mentioned under relevant mechanical section shall also be taken into consideration in the offered system.

3. The FGMO/RGMO implementation to be done as per the latest Indian Electricity Grid Code (IEGC) requirement issued by Central Electricity Regulatory Commission (CERC). The exact implementation of FGMO/RGMO shall be discussed & finalized during detailed Engg. Further, in case CERC issues new guidelines with regards to FGMO/RGMO after detailed Engg and before completion of AMS and warranty period. The same shall also be implemented by the Contractor in consultation with Employer. Provision of injecting external frequency test signal in control system for primary frequency response testing shall be in the contractor's scope.

4. Other Miscellaneous TG system controls: -

   (1.) Condenser on load tube cleaning (as applicable), Debris Filter (as applicable) & SCS controls (as applicable)

   (2.) Turbine lub oil purification with provision of local control

Central lub oil purification along with clean oil/ dirty oil pump with provision of local control. However, Central Lub Oil Purification system being a common system can also be included in Standalone DDCMIS.

1.00.00	**Requirements for HMI Hardware (Refer sub section- scope of supply & services for applicability of this annexure)**
1.01.00	**HMIPIS Hardware**
1.01.01	All the peripherals shall conform to the following minimum requirement, but the exact make & model shall be as approved by Employer during detailed engineering. The Servers/Workstations/PC Stations/Laptop to be provided by the Contractor should be latest available in the market, with maximum possible configuration of memory & storage and 4K resolution graphics capability for the offered make and model at the time of supply to prevent early obsolescence and shall be subject to Employer's approval. The software packages including OS, Application software as per the functional requirement and Anti-Virus Software with IPS# to be included with the Servers/Workstations/PC Stations/Laptops shall also be the latest version available at the time of supply. Additional softwares viz. Latest MS OFFICE professional (for PC stations), Microsoft Visual Studio (only for Programmer PC), Adobe Acrobat professional (for PC stations) shall also be the latest version available at the time of supply.
1.01.02	The actual size of the Main and Bulk Memory shall be sufficient to meet the functional and parametric requirements as specified with 25% additional working memory and 50% additional bulk memory over and above the memory capacity required for system implementation.
1.01.03	Power Fail Auto Restart (PFAR) facility with automatic time update shall be provided.
1.01.04	For Servers and Historians / Station LAN Server/ Programming station/NMS Server the hardware shall conform to the following minimum requirements: 1. Min three no. redundant; hot swappable; Hard Disk with RAID 5 implementation. Usable Hard disk capacity shall be sufficient for the application and to store at least one (1) year historical data, wherever required. 2. Redundant Hot swappable Power supply
1.01.05	Quantity of Monitor, Keyboard and Mouse (as indicated in Part-A) has to be supplied in total for the stations placed in Programmer room of Unit Area. For all other stations Monitor Keyboard and mouse are to be provided as per Bidder's standard Practice.
1.01.06	One intelligent SNMP manageable mini-UPS (online) for 30 minutes backup shall be provided, with all accessories and software for remote monitoring facility, with each server and PC station. # if anti-virus software cannot be provided as per standard practice of the DCS OEM, suitable mitigating controls like whitelisting to be provided.
1.01.07	**Large Video Screen (LVS)** 1. 80 inch, Laser illuminated Large video screens with latest state of art Digital Light Processing (DLP) technology based (requiring minimum maintenance during O&M) rear projection double tier configuration of minimum 1920 x 1080 pixels resolution (of each screen), anti-glare screens (having Half Gain Horizontal and Vertical Viewing angles of ± 36° and ± 34° respectively) control units (graphical generators), Master controller, Matrix switcher (12 inputs and 12 outputs), Video switcher (16 inputs and 4 outputs) &

	associated accessories shall be supplied. LVS will have Input signal interfacefor Video signals to receive & project pictures from CCTV, Employer's live camera, VCP, Flame Camera with signal types DVI//DP/HDMI. Each cube should be capable of taking two inputs and also two outputs. The output of the video switcher will be connected to video wall through Master controller. Provision shall be provided for provision of expansion of one screen on each side of the LVS wall. 2. The hardware/software of the control unit shall be such that the command execution time of any control command from the LVS shall be same or better than the execution time from the OWS as stipulated under 'Guarantee under category-III, Sub-section-IV, Part-A, Section-VI of specifications. If during any stage of the contract, the command response times as stated in specifications are not achieved, the contractor shall upgrade the hardware/software of the control unit in order to achieve the same at no extra cost to the Employer. 3. Master controller unit shall be provided for controlling the entire video wall in Unit Control Room LVS. It shall be capable of projecting HMI displays over a part of screen to multiple screens. Any configuration of windows shall be possible. Facility for overlays shall be provided.
1.01.08	**Graphical Interface Unit** GIU of 10-11" size with a color TFT display & keypad and provisions for programming, having functionality of Graphics display including alarms and operator guidance messages and Interface with respective DDCMIS. GIU shall be installed in a suitable enclosure complying IP-55 protection class (IP-65 for extremely dust prone areas).
1.01.09	**Printers** Three type of heavy-duty printers viz. A3 Color Laser Printer, A4 Color Laser Printer and Line Impact Dot Matrix Printer shall be provided. The printing speed of A3 and A4 Color Laser Printers shall be minimum 6 ppm and 4 ppm respectively for A4 size paper. The printing speed of Line Impact Dot Matrix Printer shall be minimum 1000 LPM. The A3, A4 Color Laser Printers and Line Impact Dot Matrix Printer shall have capability of printing at least 50000, 30000, 50000 pages/month respectively.
1.01.10	**Switches:** Secondary switches and Layer-3 switches shall be managed type with 10/100/1000 Base TX ports (STP) as per requirement with 20% spare, support for SNMP v1, v2, v3, RMON, VLAN, Multi link Trunk support (IEEE 802.3ad – Link Aggregation), Broadcast/multicast storm control, Support for stacking with high throughput. Secondary switches shall have Gigabit Ethernet Port as per requirement with 20% spare and Layer-3 switches shall have minimum 15 nos. Fiber Gigabit Ethernet Ports with 20% spare. In addition, Layer-3 switches shall have non-Blocking wire speed, hot swappable dual redundant Power Supply, support for RIP, OSPF, BGP, VRRP, PIM and DVMRP Multicast Routing, shall be IPv4 and IPv6 ready, support MACsec in hardware (IEEE 802.1AE), with additional features of 10 GB module support for future upgradeability and Expandability/stackability through a dedicated high-speed expansion port. Layer-3 switches shall be routable, remotely manageable, and configurable. Common Criteria Certification for secondary switches and Layer-3 switches: The offered product series or its operating system series must have achieved EAL (Evaluation Assurance Level) Certification of EAL2+/NDPP or higher in the Common Criteria for Information Technology Security Evaluation (ISO/IEC 15408) for computer security certification.

One intelligent SNMP manageable mini-UPS for 30 minutes backup shall be provided with all accessories and software.

1.01.11 **Firewall:**

Next generation Firewall (NGFW) shall have features of Packet filtering, Stateful inspection and deep packet inspection, high availability and load balancing, data encryption support for 3DES, AES 128-256 bit, support for NAT, PAT and policy based NAT/PAT with min. number of concurrent sessions of 500000, min. new sessions per second processing of 20000, min. firewall throughput of 4 Gbps, min. 3DES/AES VPN throughput of 400 Mbps. The firewall shall be capable of forwarding logs to any external server for log repository.

Common Criteria Certification: The offered product series or its operating system series must have achieved EAL (Evaluation Assurance Level) Certification of EAL4 or higher in the Common Criteria for Information Technology Security Evaluation (ISO/IEC 15408) for computer security certification.

1.01.12 **IPS/ IDS Features:**

To inspect all inbound and outbound network activity and identify suspicious patterns that may indicate a network or system attack from someone attempting to break into or compromise a system on the Station LAN Network, the IDS/IPS will be provided as per the Station LAN configuration. The IPS/IDS feature shall be inclusive of host based and network-based intrusion protection with threat protection, malware/botnet protection and Web/URL filtering feature.

1.01.13 **Network Management Software (NMS):**

The network management software should contain graphical user interface (GUI) management, automated discovery and display of Ethernet topology and devices, monitor traffic flow through the device, view a device image indicating which ports are active and which modules are installed. If a particular network device is down, it should give the tools like ping /telnet options in the same screen to further diagnose the problem. It should also contain real-time activity and utilization statistics and graphical trends, facility of providing pre-defined actions like e-mail, SMS etc. upon any event generated in the network, facility of viewing logical graphs of devices like routers, web servers, according to the needs. Device status, Port Status, CPU utilization, Memory Utilization, All port utilization including uplink ports shall be monitored.

For monitoring the parameters mentioned above, the NMS workstation should be connected to all HMIPIS switches/firewalls through management LAN which is a separate LAN from the redundant Station LAN.

1.01.14 **KVM Switch**

Necessary KVM switches for controlling multiple operator workstations/LVS workstations (up to four nos.) from single keyboard/mouse/video placed at UCD in Control Room shall be supplied. For quantity of switches refer Part A. These switches are intended to be used only for keyboard multiplexing.

For extension of keyboard & mouse cables from PC rack to control desk, necessary converters shall also be provided, if required. These shall be supplied on as required basis within the quoted price.

1.01.15 **Matrix KVM Switch**

A matrix KVM switch for accessing multiple Servers, Gateway, Workstations etc, via multiple user consoles placed in the Programmer Room in Server Rack. User consoles shall also be located in the same room. These switches will be used for Keyboard, Video and Mouse multiplexing. The matrix KVM solution should be such that the native display resolution of workstation shall be maintained at the monitor and should take care of skew compensation (if applicable). The KVM switch sizing should consider 20% spare capacity and associated spare server & user consoles. Refer Part-E drg. no 0000-999-POI-A-006. For quantity of switches refer Part-A.

The types of Video, keyboard, and Mouse connectivity of each shall be finalized during detailed Engg. All the converters and cables required for completeness of the system shall be in scope of this package. The computer connections (CPU end), user consoles and applicable cables/converters for all ports of KVM switch (both used and unused) shall be supplied by the Contractor.

1.01.16 **Fine pitch LED display**

A full HD fine pitch LED wall with minimum full HD resolution with pixel pitch of 4 mm or lower is to be provided. Fine pitch LED display shall be provided with LED Control & Video Processing system of the same make as that of LED screen. The fine pitch LED display shall have LED configuration of RGB 3 in 1 SMD with refresh rate of 1920 Hz or better, contrast ratio of 3000:1 or better, grayscale processing capacity of 12 bit or better, brightness suitable to area of installation, dimming capability of 256 levels having Half Gain Horizontal & Vertical Viewing Angle of H 140 deg & V 120 deg or better.

The fine pitch LED display shall be designed for operating in external harsh environment having temperature range of 0 to 60 Deg C and operating humidity of 10 to 99 %. The display cabinet should comply to IP-54 for back side and the IP-65 for the front side. The display wall shall be designed for visibility in all weather conditions to facilitate 24x7 operation for high availability.

The display shall conform to Quality Management System 9001:2015, Occupation health & Safety Management System - OHSAS 18001:2007, ISO 27001, Environmental Management System 14001: 2015.

To manage content, distribute and collaborate, a controller shall be provided. The controller shall have memory support of 8 GB (Expandable Up to 32GB) with support for JPEG, PNG, BMP, MP2, MP4, 3GP, AVI, MOV, WMV, MP3, WMA, AAC media formats. The controller shall also be provided with RS232/USB control port, DVI/HDMI input, RJ45 output and Wi-Fi ((802.11 AC (2.4 GHz & 5 GHz)) & Ethernet connectivity. The controller shall have PIN-protected guest access, POE support AES encryption and dual network management.

The content shall be managed through simplified user interfaces with capability to create playlists, schedule based on day, date, time and send them over the network for playout based on schedule & sequencing. It shall have feature for Emergency Override. The software for the same shall be loaded on suitable hardware to be supplied by the vendor.

LED screen should be mounted as per the site requirement with proper earthing of the structure. The structure should be made from mild steel and painted black along with antirust coating. OEM should have in house facility for structure design in India.

Fine pitch LED displays shall be installed at identified locations as per the scope defined in Part A.

1.01.17 Indoor LED Television

85-inch smart LED television shall be provided having 4K resolution in 16:9 aspect ratio with wall mounting fixtures with Built-in Dolby audio speakers with Subwoofer (supporting formats like WAV, MP3, WMA, M4A, AAC, AC3). The television shall have USB, HDMI, RJ-45, RS-232, Wi-Fi, Bluetooth, RGB, RF connectivity and shall support video formats viz. 3GP, AVI, MP4, WAV, FLV, WMV, RM, DAT, MPEG, MOV, VOB, TS, PS, ASF, PNG, JPEG, BMP.

1.01.18 Interactive Display board

86 inch or better, Backlit LED (IPS) based interactive display board shall have 4K Ultra-HD (3840 x 2160) resolution with 16:9 aspect ratio. The display board shall have brightness of 350cd/m2 or better, contrast ratio 1100:1 or better, response time 8 ms and refresh rate of 60 Hz. The display board shall have min. estimated lifetime of 30000 Hrs. and shall have capability of displaying 1.07 billion (10-bit) colors.

The touch technology will be based on Infrared touch having 20 touch points of accuracy of ±1.5 mm or better and capability of finger and stylus touch with a response time less than 60 ms. The screen shall have 4mm Thick Toughened Glass (Anti-glare).

The interactive board shall support Android, Windows (Windows 7 and above), Mac, Linux OS (operating system) and shall have internal storage of 16 GB. The interactive board shall also have features of Gesture support, Device mirroring and OPS compatibility.

The interactive board shall have 2 nos. stylus, 3 nos. USB 2.0, 3 nos. USB 3.0, 2 nos. touch USB, optical, HDMI, Audio output and HDMI, HDCP v2.2, Audio in, Analog-RGB, RS 232 inputs. The interactive board shall also have capability of internet connectivity over ethernet (RJ-45 LAN) and Wi-Fi (USB dongle) - IEEE 802.11 a/b/g/n/ac (2.4GHz/5GHz).

Special Requirements

1.00.00 **Software for determination of optimum Controller parameters**

The programming station shall be equipped with a system/software to calculate the tuning constants i.e. P, I and D values of control loops automatically. Facility shall be provided to conduct open loop test (i.e. controller in manual mode) and closed loop (i.e. controller in auto mode) tests on control loops through GUI based user interface. It shall be possible for the user to adjust the step size of disturbance, sample time, duration of test. Facility shall be provided to choose the type of process being tuned i.e. PI, PID etc, controller type i.e. regulating or tracking, and the type of process being controlled i.e. integrating, non integrating. Further it shall also be possible to calculate the tuning constants by capturing process changes during normal process disturbance (without conducting any test). The calculation of tuning constants shall follow internationally accepted tuning procedures. The system shall be provided with facility to monitor the performance of control loops during normal operation of the plant and display important statistics and performance indices about the loops e.g. average absolute error, peak overshoot, no. of set point crossings, controller output saturation etc. and recommend retuning of the loop based on these parameters.

2.00.00 **(A) PERFORMANCE CALCULATIONS (CLASS I)**

The Class I calculations are generally for the purpose of detecting & alarming unit malfunctions. These shall be executed at the scan cycle of the inputs, for the calculation.

These shall include cold reheat steam approach to saturation temp, super heater spray outlet approach to saturation temp., turbine steam-metal temp. differences, turbine metal temp. rates of change, feed water heater terminal temp. difference, feed water heater drain cooler approach, excess air deviation from standard, feed water heater temp. deviation from standard, any saturation temp. rate of change, metal temp. difference for SH 'Y' and RH 'Y' piece etc.

(B) PERFORMANCE CALCULATIONS (CLASS II)

Class-II Performance Calculations (which is the Plant / equipment efficiency calculation) for various equipment along with heat rate deviation & revenue calculation, availability tariff, etc. shall be provided as per list given below: -

Boiler efficiency

Gross turbine-generator heat rate

Gross unit heat rate

Net unit heat rate

H.P. turbine enthalpy drop efficiency

I.P. Turbine enthalpy drop efficiency

L.P. turbine enthalpy drop efficiency (using dry exhaust)

Feed water heater performance terminal temperature difference.

Feed water heater performance drain cooler approach

Condenser performance

Deaerator performance

Economizer performance

BFP performance

Air Preheater performance

Fan efficiency

Unit availability calculations

Deviation from expected values from each calculation.

In addition to the above, the net unit heat rate vs. load profile shall be calculated using the last values of heat rates at different load interpolating the results. Facility shall be provided for entering unit constraints like a particular mill not available by the operator.

3.00.00 MESSAGING SYSTEM

It shall be possible to send predefined messages either periodically or on occurrence of certain events in the form of

a) operator guidance message to LVS/OWS

b) e-mail messages to various clients on the station LAN

c) messages to preselected mobile nos (around twenty numbers)

In case the faults as per Clause 1.05.00 of IIIC-02 are not acknowledged/rectified within a certain interval, then the same shall also be reported to users through messaging system.

A configuration utility shall also be provided for the above providing facilities of configuring the events, grouping of events areas wise, priority of events within a group and configuring user groups to which the event/event group can be assigned etc.

Adequate security in the system shall be built in the system to avoid any unauthorized access to DDCMIS system.

4.00.00 TREND ALARMS

Facility of Trend alarms shall be provided in DDCMIS for slowly varying process parameters, so that appropriate corrective actions are taken in time. These alarms shall be suitably provided in OWS/LVS, which will be decided during detailed Engg. Stage.

5.00.00 **Alarm Analysis**

DDCMIS shall provide fault alarm analysis guiding the operator to the most likely cause of fault. The alarm system shall be designed in such a manner that main auxiliaries tripping can be traced to the originating cause.

6.00.00 **Software package for Merit order rating program**

Merit order rating calculation for this package shall be provided by the contractor. The units shall be grouped on the basis of regional grid being fed by them, and MOR program shall be capable of running separately for each such group. The grouping of units shall be customizable allowing regrouping, at any point of time, as per requirements.

The contractor however shall develop his own algorithms, which shall be finalized during detail engineering with approval from Employer.

Necessary signal exchange between this package and other sub-system covered under this package shall be provided, as defined in Part-A.

7.00.00 **Automatic Unit Startup & Shutdown with Single command**

It shall be possible to perform automatic unit startup & shutdown by issuing single command from the LVS/OWS. It is envisaged to start up the complete unit through single push-button operator action. Thus, the unit level shall control all the Control System Blocks and issue appropriate startup & shutdown commands to various blocks of DDCMIS of unit and receive corresponding check backs / feedbacks. All signals/points to HMIPIS for implementation of sequence, drive & other displays shall be made available from Control System.

8.00.00 **Replay Software for Trip/Disturbance analysis**

A software-based trip/disturbance analysis utility shall be provided. The utility shall have the capability to acquire point information of last 48 hrs. from the Station LAN server or Unit historians on a continuous basis (FIFO) and using the acquired data, replay the actual plant mimics with auto updation every second. It shall be possible to select the time interval for which the data is to be replayed. Process alarms, commands from OWS/LVS, UCD commands, GIU commands etc. during the selected time interval shall also be suitably displayed for ease of analysis. Actual no. of points which is to be configured shall be decided during detailed engineering.

9.00.00 **Other functions of Control System**

9.01.00 The major auxiliaries / logics to be controlled from control system have been indicated in Part-A of specification. The exact implementation of the logics, drive functions, monitoring etc will be to meet actual process requirements and as finalised during detail engineering stage. If control of electrical system is included (refer part-A) then functions such as open/close or on/off etc. of various electrical systems such as breakers and isolators, Raise/ lower for equipment like transformers tap changer, synchronization of electrical breakers, etc. shall be provided. Control and all the operation, in case of electrical system, shall be performed through LVS/OWS.

9.02.00	The major control loops to be controlled from Control System have been indicated in Part-A of specification. However, exact implementation of these control loops shall be finalised during detailed Engg. Stage in consultation with main equipment supplier. The Contractor shall furnish his standard & proven implementation practices for similar control loops in power stations. The Contractors shall be responsible for final implementation of control loops which shall meet all specification requirements.
9.03.00	The measurement system of control system should be capable of acquiring data from various equipment & system in digital form through serial port, field bus / profibus, Ethernet connection using industry standard protocols. The control system shall include requisite modules for accepting such signals. Examples of such signals will be from remote I/O signals (through extended I/O bus), field bus/profibus type temperature transmitters, fault/diagnostic signals from vibration monitoring system, UPS/DC system etc. Requirement of such ports is indicated at Part-A.

Security Policies/Procedures and Security Audits:

To enforce network security in the Station LAN & the HMI of all DDCMIS, security policies and procedures are to be followed by the Contractor during the tenure of the Contract & by Employer's site personnel thereafter. This shall also include the Switchgear Relay network integrated to the Switchgear DDCMIS.

For checking compliance to the above security policies & procedures, periodic security audit by a certified auditor (as per CERT-IN panel or CERT of country of origin of DDCMIS supplier)) is to be arranged by the Contractor during ATST, at the time of trial operation/PG test of C&I package and every year during AMS period. However only during ATST, the security audit for Switchgear Relay network integrated to the Switchgear DDCMIS shall be done on prototype ring and hardware arranged by the contractor during Station LAN FAT. At the time of trial operation/PG test of C&I package and every year during AMS period the security audit for Switchgear Relay network shall be carried out on the actual installation at site. This shall include vulnerability assessment of the workstations/ servers and penetration testing of the Station LAN through the firewall from a node outside the network. Suitable actions based on the findings of the security audit shall be carried out by the Contractor.

These security policies/procedures envisage formation of an Information Security team which shall comprise of vendor's personnel deputed at site during tenure of the contract and STPP personnel thereafter. All the responsibilities of information security team must be discharged by vendor's team during tenure of the contract and STPP team thereafter. Even though different roles have been identified for the individual members of the information security team more than one role can be performed by the same person. It may be noted that following policies/procedures are only the operation guidelines and advisory steps to ensure maximum data security.

The following security policies shall be followed. Details of the same shall be provided during detailed engg.

1. Information Security Policy
a) Information Security Team Policy
b) Firewall Policy
c) Information Identification and Classification Policy
d) Security Policy Review Policy
e) Information Labeling and Handling Policy
f) System Planning and Acceptance Policy
g) Capacity Management Policy
h) Media Handling Policy
i) Information Security Awareness Policy
j) Third Party Access Policy
k) Change Control Policy
l) Anti-Virus Policy
m) System Access Policy
n) Monitoring Policy
o) Incident Handling Policy
p) Information Backup and Restoration Policy
q) Network Access Policy
r) User Access Management Policy

1.00.00	**GENEREAL REQUIREMENTS FOR FIELDBUS INSTRUMENTS AND ACTUATORS, IMC** This section provides the basic guidelines for the design and implementation of Fieldbus (Foundation Field Bus/ Profibus) based control system.
1.01.00	The requirements given herein are minimum requirements to be considered by Contractor to ensure uniformity in basic design and shall not be considered as final requirements. The Fieldbus design shall be further validated by contractor and approved by Employer during detailed engineering and any variation/ changes required based on DDCMIS system requirements and actual field installation, operational philosophy etc. shall be considered by contractor without any implications.
1.02.00	The fieldbus segment design shall be finalized and validated based on functional requirements as per: • Process requirements (P&IDs/ operational requirements). • Loop response time of different loops device communication time i.e. cycle time for fast and slow loops with scheduled and unscheduled organization as per project. • Area classification requirements (e.g. hazardous or safe). • Fieldbus devices specifications (maximum current drawn from bus, block execution speeds, power conditioner suitable for field barrier, etc.) • Length of segments. • Instrument location plans with elevation details. • Host-system documentation showing configuration rules or restrictions. • For Foundation Fieldbus & Profibus PA chicken foot/ branch/ or combination of both topology shall be provided. For Profibus DP, Bus/ Line topology in Redundant mode shall be provided. That is, for Profibus DP redundant cables connected to redundant ports of devices shall be provided. Suitable field bus segment design shall be considered keeping the safety & integrity of the system intact so that the cabling, marshalling, junction boxes and system performance shall be optimized. • Profibus DP network termination shall be designed such that absence of power supply to terminating device in network does not affect other devices in the network. The Contractor shall furnish details and this shall be finalized during detailed engineering stage. • For all fieldbus devices GSD/DD and DTM files are to be provided and configured/ tested in the DCS for proper interfacing and diagnostics. • The fieldbus power supply (FF/ Profibus PA trunk power supply etc.) shall be fed through a redundant bulk power supply (DC/DC converter), separate from power supply of conventional system. However, complete segment design like device allocation, topology shall be decided during detailed engineering.
1.03.00	Contractor to provide all standard functional blocks for all Foundation Fieldbus/ Profibus devices as per latest FF/ Profibus version and standard guidelines. Fieldbus components including power supply, terminators, isolators, etc. provided by Contractor shall comply to IEC 61158 and other standard Fieldbus guidelines.
1.04.01	Redundant FF host/ DP master card and redundant power supply along with advance diagnostic module shall be provided. DP master/ FF host shall be standard product from offered DDCMIS family. Third party modules for DP Master/ FF Host shall not be acceptable. All required libraries to execute various tasks like data acquisition, control/protection etc. shall be provided.
1.04.02	In fieldbus system following spare capacity in each FG shall be provided:

Sr. No (1)	Item (2)	Sub-Item (including description) (3)	Spare Capacity (4)	Spare Space (5)
1	Foundation Fieldbus	Wired-in space for mounting FF Host modules along with space for FF power supply backplane / base / rack for future expansion.		20 % of Engineered quantity of Host modules
		Spare capacity in the redundant bulk power supplies for fieldbus system	20 % over and above Engineered capacity	-
		FF Segment Loading (Limited to a maximum of 12 nos. devices with a minimum voltage across each device of 11 V DC)	Out of each segment capacity calculated as per column (3), spare capacity of 2 nos. as a minimum for future expansion per segment shall be provided	-
		Spare spur in the field mounted FF Segment Distributor	Minimum 2 nos. in each Segment Distributor	-
2	Profibus DP	Wired in space for Redundant DP masters with required backplane / rack / base for expansion		Space for 1 set
		Capacity in redundant DP masters	20 % of Engineered DP segment capacity for DP devices	
3	Profibus PA	Wired-in space for mounting PA segment modules along with required backplane / rack / base for future expansion		20 % of supported PA segment modules by each DP/PA coupler/link
		Capacity in the redundant DP / PA coupler / link modules and corresponding DP masters for future expansion	20 % over and above engineered capacity	-
		Spare capacity in the redundant bulk power supplies for fieldbus system	20 % over and above designed rating	-

		PA Segment Loading (Limited to a maximum of 12 nos. devices with a minimum voltage across each device of 11 V DC)	Out of each segment capacity calculated as per column (3), spare capacity of 2 nos. as a minimum for future expansion per segment shall be kept	-
		Spare spur in the field mounted Profibus PA Segment Distributor	Minimum 2 nos. in each Segment Distributor	-
4	Controller(s) / system module(s)	These shall have spare hardware and software capacities, over and above engineered capacities, to cater to spare requirements defined above, for applicable items of S.No.1,2,3 along with their spare capacities defined in column (4) & (5)		

The spare functional capacity of controller defined in Annexure-C to sub-section-IIC, Part-A of Technical Specification will be applicable for both conventional and fieldbus-based system (combined together).

1.04.03 The contractor shall present complete implementation scheme, including wiring scheme during detailed engineering stage for review and approval by Employer.

1.05.00 Fieldbus cable (specifically used for Foundation Fieldbus/ Profibus PA and Profibus DP) shall be individually shielded twisted pair, with round steel wired amour (SWA) complying with IEC 61158, Type A. The cable construction shall meet EN 50288-7 standard for physical properties and the outer sheath shall be of PVC-TM53 as per EN 50290-2-22. Continuous operating temperature of Fieldbus cable shall be minimum 90 Deg C. The contractor shall furnish comparison of major electrical and physical properties of offered cables w.r.t specified standards to establish compliance of offered cables with this technical specification.

For laying of fieldbus cables, cable trays envisaged for instrumentation cable with all the accessories shall be used by the contractor. Minimum 300 mm spacing to be kept between the fieldbus trays and other high voltage cables to avoid any interference.

Fieldbus Junction boxes made of SS 316 and specially designed for fieldbus application shall be provided from fieldbus component manufacturer on as required basis. These Fieldbus JBs shall house field mounted fieldbus components like distributers, tee, etc. These Fieldbus JBs shall have suitable cover and gasket and shall have protection class of IP-66 or better. SS Cable glands and blind plugs shall be provided by the Contractor.

1.06.00 Comprehensive Fieldbus Maintenance and Diagnostic software shall be provided. This software shall be capable of collecting complete diagnostic information from fieldbus network and all fieldbus devices and presenting in user friendly interface for detailed diagnostic and troubleshooting of the system. It shall be possible to completely configure parameters of fieldbus network and fieldbus devices from centralized system through this software. This software shall have feature of providing data related to maintenance of fieldbus devices as available through fieldbus system. This system/ software shall have provision to get updated to latest version/ release of various fieldbus devices.

1.07.00 During FAT suitable arrangement shall be made by Contractor to test Fieldbus modules including field devices as per approved FAT procedure.

1.08.00	The contractor shall use fieldbus segment design tool / software to design complete network verifying various design parameters like device voltage, total cable length, spur length, system power requirements etc. the contractor shall provide device voltage calculations for all segments, based on calculation in software package. All these calculations shall be handed over during detailed engineering in electronic format in a way that Employer can thoroughly verify design basis/ calculations carried out by Contractor.
1.09.00	Suitable short circuit protection, surge protection, grounding requirements shall be provided for all devices, so that fault in one device shall not impact the availability of other devices in the segment.
1.10.00	All required diagnostic and configuration tools/ handheld devices shall be provided for configuration and troubleshooting of devices and network.
1.11.00	**Specific requirements for Profibus DP based interface with IMCs (Intelligent Motor Controllers)**
1.11.01	All IMC modules in LV SWGR/ MCC are to be interfaced with DDCMIS through Profibus DP protocol.
1.11.02	All requisite hardware & software for seamless integration and interface of Profibus DP based IMC modules with fieldbus based DDCMIS system, even if not explicitly indicated in the Technical Specifications are to be supplied and engineered.
1.11.03	DDCMIS System design shall ensure adequacy of built-in redundancy such that no single component failure leads to the failure of a part / total system.
1.11.04	The total no. of IMC modules in one Profibus DP segment and their response time shall be governed by Process requirement and other relevant clauses specified elsewhere in the Technical Specifications. The same shall be finalized during detailed engineering and submitted to the Employer for prior approval before implementation. However, the total no. of IMC modules per segment shall in no case exceed 24.
1.11.05	All IMCs modules in a Profibus DP segment shall be linked to each other in a Daisy chain fashion using PG/PG connectors.
1.11.07	All active electronic components / modules like OLMs / Y-links etc. required for the interface of Profibus based IMCCs with DDCMIS system to be installed in the CER / MCC /RIO room, shall be powered by redundant 24V DC feeders from chargers installed at the respective CER / RIO room
1.11.08	The loss / power supply failure of any IMC shall not disrupt the network including the last IMC module in the segment. To meet this functional requirement any additional component / power supply shall be provided by the contractor.

Advance Process Control Detailed Specifications:

1.0 General Requirements:

1. This Functionality need to work in conjunction with Indian Grid Code changes for Primary frequency Response & Secondary frequency response i.e. RGMO & AGC.
2. The above APC software is to be implemented in closed loop. This can be implemented as integral to DDCMIS or standalone software with interfacing with DDCMIS (over Modbus TCP/IP) or a combination of both. In case, it is not offered integral to DDCMIS, then as a min. one (1) no. additional Operator station of APC (to be placed in unit control room) and one (1) additional no. engineering station (to be placed in programmer room) are to be provided for each Unit.
3. Contractor's scope under this package shall include but not be limited to design, testing, supply, installation, commissioning of APC (Advanced Process Control) software for each unit along with required hardware, interface software and training as per specifications laid down in this tender document.
4. The Contractor shall also provide all the related services for design, development/configuration, implementation, installation of software and control scheme, performance testing, training, warranty, AMC etc.

The Contractor to also upgrade/update the APC solution at the time of DDCMIS upgrade/update

1. The requirements for APC are indicated on functional basis in the specification. Contractor shall be responsible for engineering, selection and connection of all components and subsystems to form a complete system whose performance is in accordance with functional, hardware and other requirements of these specifications. It is not the intent or purpose of this specification to specify all individual system components since the Contractor has full responsibility for engineering and furnishing of a complete system to meet the objectives laid down in this specification.
2. The offered APC software should utilize latest hardware and software versions. In addition to the hardware for APC (servers, workstations, controllers etc), furniture including tables and chairs shall also be provided on as required basis. Controllers/ Electronic modules, if provided, shall be housed inside modular racks/panels. The exact arrangement shall be subjected to Employer's approval. All software including modelling, optimization software etc. as required are to be provided. Software license requirements shall be inline with that specified for DDCMIS software.
3. Contractor shall depute experienced personnel for the commissioning of the APC.

2.0 Functional Requirements:

Advanced Process Control (APC) shall consist of the following:

1. **Combustion Optimization**

   The combustion optimization APC software needs to tuned to optimize for both scenarios
   (i) Heat rate, (ii) NOx. The facility to select the desired objective among the two should be selectable by Operator from DCS workstation/APC work
   station. The SAT shall be conducted by selecting Heat rate as optimization objective.

2. **Soot Blowing Optimization**

   Soot blowing optimization, when put in closed loop, should raise an alarm to operator in DCS at least 30 min prior to carrying out Soot blowing operation, to provide sufficient time to ensure local monitoring, as required.

3. Suitable interfacing with DDCMIS to be provided for collecting data and sending commands back to DCS for changing the bias/setpoints/controller outputs of the closed loop controls in the DDCMIS. In case the APC software solution is not integral to DDCMIS, the Bidder shall be responsible for designing cyber security architecture for connecting to DCS. This will include providing Modbus aware multi-port hardware firewalls for each unit, for communication with each DCS. Further, latest antivirus software with IPS, shall be provided for all workstations
4. Typical outputs from the APC shall include Aux. air damper bias, Overfire air damper bias, burner tilt bias, Feeder bias, FG O2 SP bias, Fuel Master SP bias, CMC Load SP to TG bias etc. For SH/RH steam temperature, the outputs shall be either spray demand bias or direct output switchover. Exact details shall be finalized with the Employer during engineering stage.
5. The Contractor shall take into account all regimes of the operation of the units during the design of his APC system. Further, all constraints of the units shall be taken into consideration during the APC design.
6. The APC software should have adaptive control features i.e. it should take into account actual unit conditions and constraints for giving the bias/set-points/control outputs. The APC model should be self-tuning to automatically adjust to actual unit conditions and constraints.
7. **Fail safe design**: APC implementation should ensure fail safe design with 'start/stop' functionality, tracking functionality and bumpless transfer to DDCMIS and alarm to operator in case of any malfunction. Suitable setpoint and bias tracking functions also to be implemented. APC ON/OFF should be available to DCS OWS/LVS OWS.
8. **GUI for the APC**: The APC should be capable of handling online changes in control objectives (constraint limit changes/ priority changes/ setpoint or range target changes) without switching off the APC. Status of Optimizer, its KPI, Trends for process values, APC parameters etc., alarm page for showing alarms generated by APC software.
9. Historization of APC inputs calculated values and outputs i.e all CVs, MVs and DVs (CVs – Controlled variables, MVs – Manipulated variables and DVs – Disturbance Variables).
10. Snapshot of best achievable performance (i.e. Heat rate) in each set of conditions to be available in the APC software.
11. KPIs of APC being generated in APC software shall also to be transferred to DCS over the interface link for further transfer to Station LAN and PI, as required.
12. **User level security**:

a) The software shall support advanced security methods to provide protection against unauthorized access, disclosure, modification, and use. The Contractor shall describe the security provided by the software for user login and roles.

13. **Location**: The APC equipment i.e. servers, workstations, controller along with the furniture shall be located in the CCR/CER/Programmer room of respective Units.
14. **Remote connectivity:** In case APC is not integral to DDCMIS, the Contractor shall provide the necessary hardware & software required for connecting the APC system to APC Vendor's remote service center, through which the diagnostics & fault analysis of the APC system can be carried out. In no case tuning of the model is allowed from remote when APC is in ON mode. The other requirements shall be as per remote service center requirement of DDCMIS at Part-B, clause 14.00.00.

3.0 **SAT (Site Acceptance Test) for Performance Testing:**

Site acceptance test shall be conducted for evaluating the performance of the APC software.

1. Site Acceptance Testing Setup: The SAT shall be done after completion of commissioning of the software (including interface testing, checking of fail-safe

implementation etc.). SAT would be conducted by comparing performance between APC Off and APC On scenarios. Details of the test shall be approved by Employer's during details engineering.

2. Contractor to also demonstrate the Combustion optimization APC software capability of reducing NOx. However, it will be reverted back to heat rate objective after demonstration.
3. Suitable precautions to be taken to ensure that there is no equipment/unit outage due to the conductance of the SAT.
4. Suitable measures to be taken during the testing period to ensure similar operating conditions between APC ON duration and APC OFF duration like coal quality, mill combination, ambient conditions etc., as finalized during detailed engg.
5. In regard to any dispute arising during the testing, the decision of Employer's test team shall be final and binding on the Contractor.
6. Following broad functionalities are to be met during SAT.

APC Solution	Condition	Monitored Parameter (s) (On versus Off)
SH/RH Temperature Excursion Reduction & Faster Ramp up/Ramp Down	At different loads with different ramp rates coal conditions during mill changeover, Soot blowing etc.	Improvement in Parameter excursion of SH, RH Temp, MS Pressure between On versus Off from Setpoint.
Combustion Optimization & Soot blowing Optimization	At different steady loads with different coal conditions	Improvement in Heat Rate using delta heat rate method

* Improvement % shall be mutually decided during detailed engg.

The delta heat rate for evaluating Combustion optimization will be as per below formula:

$$\%Delta\ HR\ for\ \text{Combustion Optimization} =$$
$$A1*(MSTAPC\ ON - MSTAPC\ OFF) +$$
$$A2*(RHTAPC\ ON - RHTAPC\ OFF) +$$
$$A3*(SH\ spray\%APC\ ON - SH\ spray\%APC\ OFF) +$$
$$A4*(RH\ spray\%APC\ ON - RH\ spray\%APC\ OFF) +$$
$$A5*(O2\%APC\ ON - O2\%APC\ OFF) +$$
$$A6*(FGTAH\text{outlet}APC\ ON - FGTAH\text{outlet}APC\ OFF) +$$
$$A7*(Unburnt\ C\%\ in\ Fly\ AshAPC\ ON - Unburnt\ C\%\ in\ Fly\ AshAPC\ OFF) +$$
$$A8*(Unburnt\ C\%\ in\ Bottom\ AshAPC\ ON - Unburnt\ C\%\ in\ Bottom\ AshAPC\ OFF) +$$

The delta heat rate for evaluating Soot blowing optimization will be as per below formula:

$$\%Delta\ HR\ for\ Soot\ blowing =$$
$$A1*(MSTAPC\ ON - MSTAPC\ OFF) +$$
$$A2*(RHTAPC\ ON - RHTAPC\ OFF) +$$
$$A3*(SH\ spray\%APC\ ON - SH\ spray\%APC\ OFF) +$$
$$A4*(RH\ spray\%APC\ ON - RH\ spray\%APC\ OFF) +$$
$$A5*(O2\%APC\ ON - O2\%APC\ OFF) +$$
$$A6*(FGTAH\text{outlet}APC\ ON - FGTAH\text{outlet}APC\ OFF) +$$
$$A9*(SBflowAPC\ ON - SBflowAPC\ OFF)$$

Weightages, A1 to A9 shall be decided during detailed engineering.

4.0 **Warranty and AMS of APC**:

Comprehensive warranty of complete APC system (hardware & software) from the completion of the SAT shall be provided inline with the terms & conditions of warranty of DDCMIS. This shall also include services every quarter for tuning of the APC software including the models.

Comprehensive on-site hardware/software Annual Maintenance Service (AMS) shall be provided inline with the terms & conditions of AMS of DDCMIS. This shall also include services every quarter for tuning of the APC software including the models However, the Contractor should depute APC expert every six months for a period of min. three days during AMS in order to check the proper and effective functioning of the system.

5.0 **Training**:

1. Developer/ Administrator level training: The Contractor shall provide detailed training to Employer's eight (8) engineers at the works of the APC technology provider, for a period of one week, which will ensure complete self-sufficiency in implementing, operating, troubleshooting, and maintaining the complete APC solution. At the end of this training, the participants shall be able to tune the settings of the APC software to account for plant/equipment characteristics change or modification in the objectives of the APC solution.
2. User level training: The Contractor shall provide user level training to fifty (50) nos of Employer's operation personnel at site for 2-3 working days. The training shall be held in two batches, one batch for each stage. This training needs to be conducted before the commissioning activity of the APC of the respective stage.

Training Material shall be provided to each of the participants of the above courses.

SUB–SECTION – IIIC – 03

MAIN EQUIMENT RELATED CONTROL AND INSTRUMENTATION SYSTEM

CONTROL AND INSTRUMENTATION SYSTEM

1.00.00

i) Turbine supervisory system (TSS) including vibration analysis system, vibration monitoring system, axial shift (minimum 3 sensor), eccentricity measurement system, relative shaft vibration (both for turbine & generator), differential expansion (of HPT, IPT & LPT), overall expansion (of HPT & IPT), bearing vibration, computed absolute shaft vibration (from relative shaft vibration and bearing vibration), phase marker etc. for Main Turbine.

BFP Drive turbine & Turbine Driven BFP supervisory system including vibration analysis system, vibration monitoring system, axial shift (minimum 3 sensor), differential expansion, overall expansion, bearing pedestal vibration, relative shaft vibration, etc for BFP Turbine.

Test calibration jigs for site calibration of all sensors of TSS shall be provided. Hardware and software provisions for diagnosis and analysis of plant auxiliaries vibration as indicated under Annexure C, Part A of technical specification.

ii) Vibration Analysis system: For all vibration measurements indicated above and BFP Drive Turbine & Turbine Driven BFP vibration measurements, a Microprocessor/ computer based system shall also be provided with the following features as minimum:

(a)	On-line spectrum/harmonic analysis.
(b)	Identification of the exact nature of failure resulting in increase in bearing vibration and direct message on the Display unit indicating the exact nature of fault e.g. mal-alignment, shaft crack, bearing looseness etc through use of intelligent software packages.
(c)	Storage and comparative analysis of vibrations
(d)	Generation / analysis of Bode Plot/ Orbit Plot and time waveform/ Nyquist plot/ shaft centre line plot/ cascade and water fall plot.
(e)	In addition to the vibration analysis and diagnostics system's specification requirement specified, facility for adding rules for fault shall be provided. Facility shall be provided for protecting the rules.

The vibration analysis system shall have provision to be connected to Employer's local IT LAN through a cyber secured Defense in Depth architecture through Demilitarized Server to Employer's local IT LAN using required Firewalls and Intrusion Prevention System.

iii) Complete hardware and software system for turbine stress computation, fatigue analysis for all affected critical components of the turbine, computation of Residual Life Analysis and long term storage of the relevant monitoring of turbine critical components.

iv) Auto synchronizer for Turbo-Generator including Test kit for Auto synchronizer for Turbo-Generator. Auto synchronizer test kit is the simulation kit required for complete functionality checks including sourcing of incoming & running voltages with varying frequency & magnitude in OFF-LINE mode.

v) Load Transducers, Hardware & Software based Load shedding Relays (if applicable).

2.00.00 **Ash Dash Board**

Contractor shall provide Ash Dash board in AHP DDCMIS for the complete ash handling system which displays the following using sensors/instruments specified in tender drawings/ elsewhere in this specification:

a) Ash generated quantity (calculated value) based on coal flow from boiler and ash content input from coal analyser/manual feeding.

b) Ash quantity calculated value in each of the IM Silo, Bottom ash silo, HCSD silo, Main fly ash silo, Fine ash silo, Classifier silo, Fine fly ash hopper, Coarse fly ash hopper, buffer hopper, ESP first to third field hoppers, Intermediate surge hoppers. This shall be calculated using level transmitter signal and silo/hopper dimensions and Fixed/manually fed value of ash density.

c) Ash feed quantity from IM silo to conveyor. This shall be calculated using belt scale signal.

d) Ash unloaded quantity from Bottom ash silo. This shall be calculated using belt scale signal.

e) Ash unloaded quantity from HCSD silo, main fly ash silo and Fine fly ash silo. This shall be calculated using mass flow meter signal.

f) Above shall be calculated on hourly, 8 hourly and 24 hourly basis and archived in AHP system.

g) All critical status/ alarm which shall help early detection of any problem in ash evacuation and transportation system us-ing sensors/instruments specified in tender drawings/ else-where in this specification. Necessary logic shall be developed to generate such status/ alarm.

SUB–SECTION – IIIC – 04

MEASURING INSTRUMENTS (PRIMARY & SECONDARY)

1.00.00	**MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)**
1.01.00	Measuring instruments/equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Refer Sub-section Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards and shall be subject to Employer's approval.
1.02.00	Every panel-mounted instrument requiring power supply shall be provided with easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
1.03.00	All transmitters, sensors, switches and gauges for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided on as required basis within quoted lump sum price. The Contractor shall furnish all Instrumentation / Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering.
1.04.00	The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.
1.05.00	All instruments envisaged for sea water applications, shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor). For Chlorine application: Instruments shall be provided with wetted parts (e.g., diaphragm seal, etc.) made of Hastelloy C. Also, filled liquid shall be Fluorolube oil/ Inert Hydrocarbon / CTFE etc., for these applications. For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g., diaphragm seal, etc.) made of Tantalum.
1.06.00	For coastal areas, all instruments shall be provided with durable epoxy/ polyurethane coating for housings and all exposed surfaces of the instruments.
1.07.00	The instruments which are proposed to be used for PG test as indicated in the tender P&IDs shall meet the minimum requirements specified in ASME PTC or subsequent clauses in this chapter whichever is better.

2.00.00 **SPECIFICATION FOR ELECTRONIC TRANSMITTERS**

2.01.00 **SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF PRESS AND DP BASED FLOW / LEVEL MEASUREMENTS**

Microprocessor based 2 wire loop powered electronic transmitter with 4-20 mA DC HART/ Fieldbus (Foundation Fieldbus /Profibus PA complying to IEC 61158.) output signal shall be provided.

Range	Accuracy (For calibrated Range)	Turndown (For span)	Stability (% of Calibrated range)
<=400mmwc	0.1%	20:1	+/-0.2% for 1 year
>400mmwc	0.060%	50:1	+/-0.25 % for 10 year
>250 kg/cm2	0.065%	10:1	+/- 0.15 % for 5 years
static pressure >420 kg/cm2	0.1%	10:1	+/- 0.2 % for 5 years

Above parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only.

Transmitter shall have weatherproof IP-67 metallic housing with durable corrosion resistant coating, integral digital display with self-indicating diagnostics, Plug and socket type electrical connection for HART and ½ "NPT (F) for Fieldbus type Transmitter, calibration using HART/Fieldbus calibrator, 2/3/5 Valve non integral manifold and rack with canopy. For HART transmitter SIL 2 certification is required. Overpressure shall be 150% of max. operating pressure.
For primary air and flue gas applications, DPT shall be provided for pressure measurement below range of 2000 mmWC.
For corrosive, viscous, solid bearing, slurry type process fluids, suitable diaphragm seal shall be provided. Parts below seal shall be removable for cleaning. Entire volume shall be completely filled with inert liquid suitable for instruments. LVDT type transmitter is not acceptable.

2.02.00 **GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER**

Type	Microprocessor based 2 wire type (loop powered), HART protocol compatible Guided wave radar transmitter.
Principle	TDR (Time domain reflectometry)
Probe Type & Material	(i) Coaxial probe of SS316/316L. If required, probe shall be suitable for overfill prevention. (ii) Rod probe, cable probe of SS316/SS316L can be used for applications wherever coaxial probe is not suitable.
Output signal	4-20 mA DC along with superimposed digital signal (based on HART protocol), suitable for over fill prevention.
Accuracy	+/- 0.5% of calibrated span or minimum 5mm.
Power supply	24 VDC +/- 10%.
Housing	Weatherproof as per IP-65, metallic housing with durable corrosion

	resistance coating.
Adjustment/ calibration	Using handheld HART calibrator/ centralized PC based system (as applicable).
Zero & span adjustment	Continuous, temper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc.
Display	Integral digital display.
Load Impedance	500 ohms (minimum).
Electromagnetic compatibility	Shall meet EN 61326-1 (2021) and AmdtA1, class A equipment/EN 50081-2 & EN 5008 1-2 & EN 50082-2
Mounting	(i) External cage shall be provided wherever side mounting is required. External cage and other mounting accessories to be provided by the contractor. (ii) Wherever top mounting is required, all mounting accessories, stilling well (as required) etc., shall be provided by the contractor. (iii) All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations.

Note: Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.

2.03.00 Ultrasonic Type level Transmitter

S.No.	Features	Essential/Minimum requirement
1.	Type of Transmitter	Non-contact Microprocessor based 2 wire type (loop powered), HART protocol compatible Ultrasonic transmitter.
2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).
3.	Accuracy	+/- 0.5% of calibrated span or minimum 5mm.
4.	Power supply	24 V DC +/- 10%.
5.	Temperature compensation	To be provided within transducer.
6.	Housing	Weatherproof as per IP-65, metallic housing with durable corrosion resistance coating.
7.	Adjustment/calibration/ maintenance	Using handheld HART calibrator/ centralized PC based system (as applicable).
8.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc.
9.	Sensor Material	Corrosion resistant material to suit individual

		application requirement.
10.	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also, transmitter shall have adjustable damping circuitry.
11.	Range	Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc.
12.	Display	Integral digital display
13.	Diagnostics	Loss of echo alarm etc.
14.	Load Impedance	500 ohms (minimum).
15.	Electrical Connection	Plug and socket
16.	Accessories	• All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations. • All mounting accessories required for erection and commissioning shall be provided. • For hazardous area, explosion proof enclosure as described in NEC article 500

Note:

1) Contractor can also provide Radar type transmitter as per above specification in place of ultrasonic transmitter subject to approval by Employer during detailed Engineering. Sonic frequency-based transmitters can also be provided under “ultrasonic transmitters” category for fly ash silo level.

2) Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer’s approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.

3) For applications where transmitter location is not accessible, the transmitter shall have separate sensor unit and electronic unit for such applications. It shall be possible to mount the electronic unit at accessible location.

2.04.00 HART Handheld Calibrator

Handheld calibrator shall be provided for adjustment/calibration/maintenance of the HART/Foundation Fieldbus/Profibus/Profibus Pa compatible transmitters. The handheld calibrator shall be suitable for all types of transmitters supplied in the package. If one type of handheld type calibrator is not suitable for communicating with all types of transmitters, then separate handheld calibrator will be provided for that specific type of transmitter.

3.00.00 **Temperature Elements and accessories**

3.01.00 **Thermocouple**

Sr. No.	Features		Essential/Minimum Requirements
1	Type of Thermocouple.	:	16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature Range (ungrounded separate junction type).
2	No. of element	:	Duplex
3	Housing/Head	:	IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well.
4	Insulation and sheathing of Thermocouple	:	Swaged type mineral (magnesium oxide) insulation and SS316 sheath.
5	Calibration and accuracy	:	As per IEC-584/ ANSI-MC-96.1 (special limits of errors/ class1) for T/C.
6	Accessories	:	Thermo well and associated fittings
7	Standard	:	IEC-584/ ANSI MC 96.1 for Thermocouple and ASME PTC-19.3-2016 for Thermo-well

3.02.00 **Resistance Temperature Detector (RTD)**

Sr. No.	Features		Essential/Minimum Requirements
1	Type of RTD.	:	Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
2	No. of element	:	Duplex
3	Housing/Head	:	IP-65/Diecast Aluminum. Head of TE to be provided with sufficient space and arrangement

				to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well
	4	Insulation and sheathing of RTD	:	Mineral (magnesium oxide) insulation and SS316 sheath,
	5	Calibration and accuracy	:	As per as per IEC-751/ DIN-43760 Class-A for RTD
	6	Accessories	:	Thermo well and associated fittings
	7	Standard	:	IEC-751/ DIN-43760 for RTD and ASME PTC-19.3-2016 for Thermo-well.

NOTES:

1) The specifications for RTDs of winding/ bearings of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However, the type of RTD shall be Pt100.

2) The specifications of temp elements for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

3.03.00 Metal Temperature Thermocouples

Measuring Medium	Metal Temperature
Material of Thermocouple.	Chrome Aludel Type K
Type of Thermocouple	Duplex with ungrounded separate hot junctions
Insulation	Mineral Insulation (Magnesium Oxide).
Thermocouple wire gauge	18 AWG
Protective sheath	SS 321
Protective sheath dia.	6 mm OD (minimum)
Calibration & accuracy	As per IEC-584/ ANSI-MC-96.1 (special limits of error) for T/C
Mounting accessories	1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310. Adjustable gland fitting for connection at the junction box end as per manufacturer's standard.
Cold end sealing	SS pot seal with colour coded PTFE Insulated flexible tails.

		Sealing compound- Epoxy resin. Length of PTFE insulated flying leads shall be minimum 750 mm.
	Minimum bending radius	30 mm
	Length of T/C	On as required basis considering location of measurement point and the JB/TTJB location.

Notes:

1) The specification for thermocouples of bearings metal temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However, type of thermocouples shall be K-type.

2) For boiler metal temperature applications, considering the location of installations and response time, manufacturer's standard and proven specification for metal temperature measurement can also be accepted subject to employer's approval. The manufacturer shall submit adequate supporting documents for establishing their standard and proven practice.

3.04.00 **Thermo well** (for all process temp. elements)

(a) Shall be one-piece solid bored type of 316 SS of step-less tapered design. (As per ASME PTC 19.3, 2016)

(b) For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.

(c) For Air & Flue gas 316 SS protecting tube with welded cap. (However, contractor shall provide better material for Flue gas service if required based on the specified boiler design parameters).

(d) For furnace zone, impervious ceramic/Incoloy protecting tube along with Incoloy supporting tubes and adjustable flanges.

3.05.00 **Not Used**

3.06.00 **TEMPERATURE TRANSMITTER**

Minimum technical requirements shall be as follows:

Single input/Dual input temperature transmitter shall be 2-wire loop powered directly from 4-20mA input cards of DDCMIS. Transmitter shall be fully compatible with thermocouples and RTDs being provided. It shall be capable to handle Pt-100 RTD, Thermocouple –K, R & S types (selectable through HART/Fieldbus terminal/calibrator). Temperature compensation for T/C shall be performed in the transmitter itself.

In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output. Transmitter shall be HART/Fieldbus (Profibus PA/Foundation Fieldbus complying to IEC 61158)compatible, have EMC compatibility as per EN 61326, weather proof IP-67 metallic housing with durable corrosion resistant coating, plug and socket type electrical connection for HART and 1/2" NPT(F) connection for Fieldbus , integral digital

display with self-indicating diagnostics, operating ambient temperature of 85 deg C without display & 70 deg C with display, suitable for 2 inch pipe mounting in enclosure/rack . Composite Accuracy shall be as follows: RTD =<0.25% of 0-250 deg C span, T/C -K type =<0.2 % of 0-600 deg C span, CJC accuracy (for T/C) shall be < 1 deg C.

Notes:

1. Dual input temperature transmitter shall have bumpless changeover facility to second sensor in case first sensor fails. This changeover is to be alarmed in control system.
2. Composite accuracy is to be calculated as summation of all applicable accuracies of temperature transmitter for converting sensor input to output (e.g., A/D accuracy, basic accuracy, digital accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of temperature elements specified.
3. Above mentioned parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only.
4. Dual input temperature transmitters can also be accepted in place of single input TT.

3.07.00 **Din rail temperature transmitter** 4-20mA HART based suitable for mounting on DIN-rails in JBs. The specifications of the JBs shall be same as indicated in Subsection INST CABLE with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail. Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category. Accuracy of Din rail should be: RTD =<0.4% of 0-250 deg C span, T/C -K type =<0.4 % of 0-600 deg C span, CJC accuracy (for T/C) shall be < 1 deg C. Oher specifications shall be as mentioned in clause 3.06.00. Exact applications shall be as defined in PART-A of specifications.

3.08.00 **Multi Input Temperature transmitter (Temperature Multiplexer)**

For only information related temperature inputs fieldbus based Multi input temperature transmitters can be provided. Transmitters shall be capable of withstanding ambient temperature up to 85 deg C. Maximum number of inputs per such temperature transmitter shall be eight. One (1) no. input shall be kept as spare wired up to TBs of field mounted panel in each multi-input TT. These shall be installed in field mounted panels with minimum IP 55 protection class. Exact applications shall be as defined in PART-A of specifications.

4.00.00 **ELECTRICAL METERING INSTRUMENTS**

Electrical metering instruments shall be furnished in accordance with the following general specifications. Application standard for electrical metering instruments shall be as per IS: 1248- 2003 (Revised). The size of each instrument shall be as approved by Employer during detailed engg. All metering instruments shall be flush panel mounting type.

4.01.00 (a) Frequency meters for Synchronization purposes: Accuracy: ± 1.5% of full scale.

(b) Synchroscope: Accuracy class: 0.5 or better.

(c) Voltmeters: Accuracy: ± 2.0% of full scale or better.

4.02.00 Synchronizing Relays

Synchronizing check relay with necessary ancillary equipment shall be provided which shall permit breakers to close after checking the requirements of synchronizing of incoming and running supply. The phase angle setting shall not exceed 10 Degree and this angle shall be adjustable and shall take the account the circuit breaker closing period. This relay shall have a response time of less than 200 milliseconds when the two system conditions are met within preset limits and with the timer disconnected. The relay shall have a frequency difference setting not exceeding 0.45% at rated value and at the minimum time setting. The relay shall have a continuously adjustable time setting range of 0.5-3 secs. Additionally, a guard relay shall be provided to prevent the closing attempt by means of synchronizing check relay when control switch is kept in closed position long before the two systems are in synchronism. The Control Voltage shall be 220V DC and PT input Voltage shall be 110 V AC.

4.03.00 Auxiliary PTs for Measurement & Synchronization

Applicable Standard	IS: 3156
Rated Voltage	110V
Insulation Level	660V grade
Frequency	50 Hz
Mounting	Panel Mounting
Test Voltage (Power frequency)	2.5 KV for 1 min.
Operating temperature	(-) 40 Deg C to (+) 85 Deg C
Primary Voltage	63.5 V to 115V
Secondary Voltage	63.5 V to 115V
Class of accuracy	1
Burden	25 VA
Class of Insulation	E or better

5.00.00 IMPACT HEAD TYPE FLOW ELEMENT

The impact head type element shall be tubular insert type with four impact ports facing upstream direction, located precisely for determination of average flow velocity and shall be of SS 316 L.

Accuracy shall be 1.0% of actual value or better. Repeatability shall be + 0.1% of actual value or better.

The elements shall be supplied complete with mounting hardware; end support plugs and CS valve manifold (1/2" NPT connection) for instrument connections. All pertinent data

including instrument tag no. for the flow element shall be punched on a stainless-steel plate and affixed to the element.

Flushing arrangement shall be provided.

For quantity and line size etc., refer Part-A.

Dual path transit time clamp-on Ultrasonic Flow meter may also be used for measurement of CW flow.

6.00.00 CONTINUOUS EMISSION MONITORING SYSTEM (CEMS): -

AS PER CONTRACTOR'S STANDARD AND PROVEN PRACTICE FOR MEETING SYSTEM AND

LATEST CPCB REQUIREMENT.

Total NOx values shall be reported as NO2 i.e., NOx = NO + NO2 = NO X 1.53 + NO2 = NOx as NO2.

6.01.00 Common Requirements for all Analyzers

1.	Type	Microprocessor based with self-indicating type diagnostic feature. Output signal: 4-20 mA DC galvanically isolated. Digital signal transmission: RS232/ RS485 Modbus Protocol/ Ethernet TCP/IP protocol shall be provided in CEMS analyzers for bidirectional communication of stack emission data to Employer's cloud server.
2.	Display	Digital display with reading in engineering units. Display of the measurement values as well as all the information required for checking/maintenance of the analyzer.
3.	Ambient temp.	0-50°C unless defined otherwise.
4.	Calibration	Auto & Manual (from Remote). CEMS analyzer should have inbuilt zero and calibration check capability.
5.	Power Supply	To be arranged by Contractor subject to Employer's approval.
6.	Others	ii) All the calibration gases (certified cylinder) required for one-year continuous operation shall be provided. The calibration gas container material shall not contaminate the calibration gas.
7.	Location of probe	SO2/NOx/CO/CO2-On stack at elevation complying to CPCB regulators requirement. Particulate Matter (Dust Density) & Flow measurement -On stack at CPCB regulators requirement. High temp O2 –SH zone Low temp O2: - ECO outlet, AH outlet and ID inlet.

		Mercury: - On stack at elevation complying to CPCB regulators requirement.
8.	Location of the analysers (other than insitu type)/Analyser Panel.	AT 0' Mtrs near stack for CEMS analyzers except particulate matter and mercury analyzer. For particulate matter and mercury preferred location is '0' meter near stack. Remote display cum configuration unit for particulate matter and mercury analyzer should be provided at '0' meter near stack in the analyzer panel in case analyzer is kept near the sample point due to technical limitation.
9.	Compliance to standards	USEPA, TUV, MCERTS or equivalent standards
10.	Type of Technology	For Hot extractive sampling type and Dilution extractive sampling type system – The components involved in sample handling system shall be sourced from Original Analyzer Manufacturer (OAM) approved reputed suppliers having successful trouble-free operation duly certified by Original Analyzer Manufacturer (OAM). Further, Sample handling system design shall be vetted by Original Analyzer Manufacturer (OAM). Necessary documents shall be furnished during detailed engineering in order to establish the above requirement. Technical expert of OAM shall witness testing of sample handling system and validate it. Alternatively sampling handling system assembled at Original Analyzer manufacturer (OAM) works shall also be accepted.

6.02.00 **Specific requirements for Hot-extractive sampling type SO2, NOx, CO2 & CO analysers**

Specification Requirements	**SO2 Analyzer and NOx Analyzer cum monitor (combined)**	**CO2 ANALYZER**	**CO Analyzer**
Principle of Measurement	Radiation absorption	NDIR absorption	NDIR absorption
Measurement Range	0-100 / 0-1000 mg/Nm3 (selectable)	0 to 25% (selectable)	0-100/ 0-1000 mg/Nm3 (selectable)
Accuracy	+/- 1% of lowest measurement range or better	+/- 1% of Span or better	+/- 1% of lowest measurement range or better
Minimum detection limit	$\leq$ 0.5% of lowest measurement range	$\leq$ 0.5% of lowest measurement range	$\leq$ 0.5% of lowest measurement range
Filter	Ceramic 3.5 Micron	Ceramic 3.5 Micron	Ceramic 3.5 Micron

Accessories for purging system	Purging system including Auto Scavenging facility shall be provided	Purging system including Auto Scavenging facility shall be provided	Purging system including Auto Scavenging facility shall be provided
Sample gas inlet temperature to analyzer	Temperature of the sample gas inlet to analyzer shall be controlled before analyzer as per manufacturer standards**.**	Temperature of the sample gas inlet to analyzer shall be controlled before analyzer as per manufacturer standards**.**	Temperature of the sample gas inlet to analyzer shall be controlled before analyzer as per manufacturer standards**.**

6.03.00 **Specific requirements for Dilution Extractive type SOx / NOx / CO2 & CO Analyzers-** In case this type of system is provided, it shall be AS PER CONTRACTOR's STANDARD AND PROVEN PRACTICE for meeting system and LATEST CPCB REQUIREMENT.

6.04.00 **Specific requirements for In-situ (Path) type SO2, NOx, CO2 & CO analyzers**

Specification Requirements	**SO2/NOx Analyzer cum monitor**	**CO2 Analyzer cum monitor**	**CO Analyzer cum monitor**
Principle of Measurement	Differential Optical Absorption Spectroscopy	Differential Optical Absorption Spectroscopy	IR absorption
Measurement Range	0-100 / 0-1000 mg/Nm3 (selectable)	0-25% (selectable)	0-100/ 0-1000 mg/Nm3 (selectable)
Accuracy	+/- 1% of lowest measurement range or better	+/- 1% of lowest measurement range or better	+/- 1% of lowest measurement range or better
Minimum detection limit	$\leq$ 0.5% of lowest measurement range	$\leq$ 0.5% of lowest measurement range	$\leq$ 0.5% of lowest measurement range
Accessories for purging system	Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure.	Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure.	Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure.
Temperature compensation	Automatic temperature compensation to be provided	Automatic temperature compensation to be provided	Automatic temperature compensation to be provided

6.05.00 **Specific requirements for Particulate Matter (Dust density) monitor**

Specification Requirements	PARTICULATE EMISSION (Dust density Stack Opacity) monitor
Type of Instrument	Extractive type with reheating or dilution.
Principle of Measurement	Scattered Light measurement
Measurement Range	0-50 mg/Nm3 / 0 - 300 mg/Nm3 (Programmable)
Accuracy	+/- 2% of lowest measurement range or better
Filter	To be provided
Accessories purging system	Purging system to be provided.
Temperature compensation/measurement	Temperature compensation to be provided, if applicable.
	First site Calibration of the instrument should be done based on the results of an extractive IsoKinetic Test by the Contractor.

6.06.00 **Specific requirements for Continuous On-line Mercury Analyzer**

S.NO.	PARAMETER	DETAILS
1	Measurement Principle	Atomic Absorption Spectrometry/ Atomic Fluorescence spectrometry.
2	Range	0-35 microgram/Nm3
3	Accuracy	+/- 1% of Span or better
4	Minimum detection limit	1 microgram/Nm3

6.07.00 **Specific requirements for Low temp O2 and High temp O2 Analyser cum monitor**

Specification Requirements	Oxygen Analyzer cum monitor (High temp.)	Low Temp. O2 Analyzer cum monitor
Type of Instrument	Non-heated In-situ dry type	Heated In-situ type
Principle of Measurement	Partial pressure using Zirconium Oxide Cell	Partial pressure using Zirconium Oxide Cell
Measurement Range	0.01% to 10% oxygen	0 to 25% oxygen programmable up to min 0.5% of O_2

Accuracy	+/-1% of Span or better	+/-1% of Span or better
Process Temperature Range	600-1600 deg.C	0-450 deg.C
Filter/protection	Cell shall be protected using ceramic boot	Suitable filter to be provided
Temperature	Yes, With R/B type thermocouples.	Automatic temperature control of heating circuit through thermostat.
Probe Length	Approx. 900mm or 3 feet	Approx. 2000 mm or 6 feet

6.08.00 ULTRASONIC FLOW METER FOR FLUE GAS FLOW IN STACK

Type	Microprocessor based with self-indicating type diagnostic feature. Output signal: 4-20 mA DC galvanically isolated. Digital signal transmission: RS232/ RS485 Modbus Protocol/ Ethernet TCP/IP protocol for bidirectional communication of stack emission data to Employer's cloud server.
Mounting Style	Transducers on the duct/stack
Transducer type and material	Single pair of Corrosion resistant material to be provided
Flow measurement	Instantaneous Flow rate as well as totalized flow
Display/Indication	Flow meter with LCD screen backlight based local display and keypad. If required, transmitter shall be suitably located away from the sensor for better access and visibility.
Recording / Totalizing/Logging Facilities	To be provided
Protection class	IP-65 or better
Ambient temperature	-20 deg to +60 deg C
Accuracy	<+/- 2% of span or better

NOTES: -

01. Hot extractive sampling type/ Dilution extractive type SO2/NOx/CO/CO2 systems shall be provided with dual sample probes along with all required accessories Also, healthiness status/alarm/indication of permeation-based dryer shall be provided in analyzer panel.

02. If the SOx, NOx, CO2 & CO (if sampling/dilution type) analyzers, mercury analyzer do not meet the environmental conditions specified at cl. 7.00.00 of Sub Sec IIIC-01, Section-VI, Part-B, all weather Local Panel fitted with integral Air Conditioner located in non-air conditioned area shall be provided for housing analyzers etc.

03. For O2 Analyzer, the construction of the sensor shall be such that joints between dissimilar materials are avoided to prevent formation of cracks.

6.09.00 Connectivity with DDCMIS and provision for bidirectional communication with Employer's Cloud Server

1. 4-20mA signals from all the above analyzers/ flow meters/ stack gas temperature, stack pressure, stack gas moisture, stack gas O2 shall be wired to DCS of respective unit.
2. RS232/ RS485 Modbus protocol/ Ethernet TCIP/IP protocol for bidirectional communication with Employer's Cloud Server as defined in Sub-section-IIC-C&I/ Section-VI/ Part-A.

All the accessories and cables required for connecting analyzers outputs to DCS and provision of bidirectional communication as defined above shall be provided by Contractor on as required basis.

7.00.00 VIBRATION MONITORING SYSTEM:

Microprocessor based vibration monitoring system shall be provided for fan/pumps/motors etc. qty. of which shall be as indicated in Part A.

The Vibration Monitoring System shall be furnished on a system basis including, vibration transducers, phase marker sensor with low noise flexible cables in flexible conduit, terminated in local terminal boxes, necessary pre-amplifier/electronics mounted in local weatherproof boxes, vibration monitors, mounting racks and cabinets etc. The vibration monitoring system shall include all power supplies, interconnecting cabling, calibration equipment, indicators, integrating units, signal conditioning devices and all other accessories, erection hardware required for monitoring of Vibration at each point. The contractor shall provide the vibration pads.

Contractor can offer up to Four Channel Vibration monitors. The allocation of channels shall be such that loss of one monitor shall not affect more than one side of the bearing of one machine. In the case of more than two channel Vibration monitors being provided by the Contractor, then one spare monitor shall be provided mounted in the panel to take care of immediate replacement of any failed monitors. Offered vibration monitors shall be modular in construction, plug in type.

Eddy current / **piezoelectric type** transducers shall be used. The sensors shall be either proximity or velocity or accelerometer type. However, the finally selected sensor type shall also depend on recommendation of the equipment manufacturer & suitable for application requirement which shall be finalized during detail engineering and without any extra price. Transducers shall be furnished in weatherproof housing suitable for field conditions. Cables/cabling from transducers local JB to Vibration Monitoring system in Control Room/Control Equipment Room shall be provided by the Contractor.

Vibration monitoring system shall give one no. buffered output of 4-20 mA DC and two no. of buffered raw signal for each point monitored and one no. of buffered raw signal for each phase marker sensor. The 4-20mA signal shall be suitable for use as an input to DDCMIS, linear in proportion to vibration velocity or displacement. Raw buffered signal(s) shall be suitable for archiving and analysis. Monitor shall provide vibration indication calibrated in velocity units along with provisions of changing to displacement unit (field-programmable) for each measurement point in both horizontal & vertical planes. Monitor shall have (field-programmable) provision of changing the vibration indication values from

RMS to Peak-Peak/0-Peak or vice versa. The generation of alarm and trip signals is not envisaged in vibration monitoring system, the same shall be derived in DDCMIS. However, in case of vibration-initiated protection of equipment's, OEM standard and proven practices shall also be considered.

The Vibration monitor with power supplies shall be mounted in a separate self-standing cabinet to be in Control Equipment Room for the main plant auxiliaries and in respective offsite area control rooms for offsite auxiliaries as applicable. Contractor shall feed the vibration monitoring cabinet from redundant 24 V DC feeders from the respective 24 VDC chargers in the contractor's scope.

Contractor shall also provide redundant DC-DC Converters for ensuring regulated and desired voltage levels to the VMS power supply modules in each vibration monitoring cabinet.

The power supply arrangement for monitors shall ensure that failure of one power supply shall not affect any monitoring function in the system. Also, any power supply failure /earth fault in any of the monitors will be isolated without affecting other monitors/ common power supply. If 230 V AC UPS power supply is required for panel PC/ desktop PC, UPS/Mini UPS for the same shall be provided by the contractor.

The functional requirement for vibration monitoring system shall include but not be limited to the following:

- Vibration monitor front face status indications shall be available for indications of healthy conditions of pick-up circuit, monitor circuit and power supply. On sensor

  fault/wire break in the sensor circuit, the system shall have the feature of identifying the same through suitable means like the signal forced to a value less than 4 mA. In case, such a feature is not available then suitable contact shall be provided from the monitor for sensor fault.

- The facility shall be available for online functional checking of monitors.

- All vibration monitoring equipment shall be functionally tested for circuit continuity and output response. All the components & interconnection cables shall be tested to ensure compliance with the specification requirements & all other applicable codes & standards.

In case it is the proven standard practice of a Contractor to provide vibration monitoring PC with TFT LCD monitor, instead of dedicated monitors with the signal conditioning equipment in control equipment room, the same shall also be acceptable. However, all relevant functional requirements detailed above shall be met and the system shall be subject to Employer's approval.

8.00.00 **NOT USED**

9.00.00 **NOT USED**

10.00.00 **AMBIENT AIR QUALITY MONITORING STATION (AAQMS)**

AS PER CONTRACTOR's STANDARD AND PROVEN PRACTICE for meeting system and LATEST CPCB REQUIREMENT.

10.01.00 SPECIFICATIONS OF CONTINUOUS MONITORING AMBIENT AIR ANALYSERS

10.01.01 Oxides of Nitrogen (NO-NO2-NOX) Analyzer

1.	Principle		Chemi-luminescence
2.	Measurement		NO, NO2, NOx in Ambient Air
3.	Display		LCD
4.	Ranges		0-1000 PPB in multi-ranges (minimum four selectable ranges) Preferably as below:
			0-100 PPB, 0-200 PPB, 0-500 PPB and 0-1000 PPB
5.	Minimum Detectable Limit		1 PPB
6	Calibration		Built-in Calibration Facility
7	Consumables and spares		Recommended requirements of 3 years of continuous operation
8	Digital Signal Transmission		RS 232 link. Analyzer shall be capable to transfer all the data through RS 232 link to a PC based data logger.

10.01.02 Sulphur Dioxide (SO2) Analyser

1.	Principle		UV Fluorescence
2.	Measurement		Sulphur Dioxide in Ambient Air
3.	Display		LCD
4.	Ranges		0-1000 PPB in multi-ranges (Minimum four selectable ranges) Preferably as below:
5.			0-100 PPB, 0-200 PPB, 0-500 PPB and 0-1000 PPB
6.	Minimum Detectable Limit		1 PPB
7.	Calibration		Built-in Calibration Facility
8.	Consumables and spares		Recommended requirements of 3 years Continuous operation
9.	Digital Signal		RS 232 link. Analyzer shall be capable to

	Transmission		transfer all the data through RS 232 link to a PC based data logger.

10.01.03 Continuous ambient air measurement of TSP, PM 10 & PM 2.5

	Principle		Contractor shall provide two no's SPM analyzers in each AAQMS station for continuous measurement of suspended particulate matter. Each analyzer shall be designed for measurement of TSP, PM 10 & PM 2.5 Additional sampling arrangement for PM 2.5 shall also be provided and it shall be possible to easily connect it to the Analyzer normally measuring TSP.
			The system shall have provision for removal of moisture from the sample, wherever applicable.
	Measurement Range		0-2000 microgram per cubic meter (microgram/m3) in programmable multi-ranges
	Display		LCD
	Roll length		Approximately 30 meters
	Measurement result		1 hour average ~~of~~ or shorter

10.01.04 Multi-Gas Calibration System

To cross check the built-in-calibration facility of the Analyzers / Monitors. The Multi-Gas Calibration System shall meet the US EPA or TUV/UAB of Germany, Envt Canada, Envt Japan, EEC etc. requirements.

10.01.05 Mercury Analyzer

1.	Principle	Atomic Absorption/Atomic Fluorescence
2.	Measurement	Elemental Mercury in ambient air
3	Display	LCD
4	Range	0.5-2000ng/m3 / 5-10000 ng/m3 (selectable)
5	Calibration	Built-in calibration facility

10.01.06 **Ozone Analyzer**

1	Principle	UV Photometric / Chemiluminescence
3	Display	LCD
4	Ranges	0-100 ppb to 0-10 ppm.
5	Minimum detectable limit	0.6 ppb (RMS)
6	Linearity	1% of Full-Scale
7	Calibration	Built-in Calibration facility
8	Consumable and Spares	Recommended requirement of 3-year continuous operation

10.01.07 **Carbon Monoxide (CO) Analyzer**

1	Principle		NDIR spectroscopy
	Display		LCD
	Ranges		0-1 PPM to 0-100 PPM selectable.
	Minimum detectable limit		0.05 ppm
	Linearity		1% of Full-Scale
	Calibration		Built-in Calibration facility
	Consumable and Spares		Recommended requirement of 3-year continuous operation

10.02.00 **SPECIFICATIONS OF METEOROLOGICAL SENSORS**

10.02.01 **Specifications of Wind Speed Sensor**

1.	Principle		Frequency proportional to wind speed
2.	Range		0-60 m/ sec
3.	Accuracy		2 % of full scale
4.	Threshold		0.3 m/ sec
5.	Operating Temperature		0 to 50 deg C

10.02.02 Specifications of Wind Direction Sensor

1.	Principle		Potentiometric type Sensor (Resistance proportional to Wind direction)
2.	Range		0-360 deg
3.	Accuracy		2 % of full scale
4.	Threshold		0.3 m/ sec
5.	Operating Temperature		0 to 50 deg C

10.02.03 Specifications of Air Temperature Sensor

1.	Principle		RTD (Platinum) Resistance proportional to temperature
2.	Range		0-50 deg C
3.	Accuracy		+ 0.2 deg C
4.	Operating Temperature		0 to 50 deg C
5.	Radiation Shield		Non-aspirated Radiation Shield

10.02.04 Specifications of Relative Humidity (Rh) Sensor

1.	Principle		Thin film capacitance type sensor
2.	Range		0-100% RH
3.	Accuracy		3 % for range 10% to 90%
4.	Sensitivity		0.2% RH
5.	Operating Temperature		0 to 50 deg C
6.	Radiation Shield		Non-aspirated Radiation Shield

10.02.05 Specifications of Solar Radiation Sensor (Solarimeter)

1.	Principle		Thermopile/Thermo couple based with Appropriate Wind Shield
2.	Range		0.3 to 60 microns
3.	Measurement Range		0-1500 watt/m2
4.	Accuracy		+ 3.5 %

5.	Operating Temperature		0 to 50 deg C

10.02.06 **Specifications of Rain Gauge**

1.	Accuracy		+ 1 % to + 5% for rainfall rates Ranging from the lowest to 125 mm/hr or more
2.	Sensitivity		0.5 mm
3.	Operating Temperature		0 to 50 deg C

10.02.07 Meteorological Mast

One Meteorological Mast of telescopic type and of specified so that height of the Meteorological Sensors from the Ground Level (GL) is 10 meters. The Mast is required for mounting the Meteorological Sensors. Material of Construction of the Mast shall be metallic and robust and shall be resistant to atmospheric corrosion

11.00.00 NOT USED

12.00.00 SPECIFICATION FOR CORIOLIS FLOW TRANSMITTER

Type	Coriolis
Material of Wetted Parts	316 SS or better (Hastelloy C-276 or better for slurry application)
Material of Housing	304L SS
Accuracy	± 0.2% of Rate
Repeatability	± 0.1% of Rate
Output	4-20 mA DC, HART Compatible
Power Supply	230 VAC or 24VDC operated
Instrument Temperature range	0-200 degree Celsius (0-150 degree Celsius for applications having process temperature upto 100 degree Celsius)
Others	Drain / purging arrangement shall be provided as per standard practice.

Notes: Coriolis Mass flow meter upstream of Burners shall be sized to measure minimum flow corresponding to one burner operation and maximum BMCR rating flow with 25% margin.

The offered Coriolis type flow transmitter shall be suitable for intended application. Contractor shall submit flow and sizing calculation for Employer's approval. For each type of Coriolis type flow transmitter general arrangement and assembly drawing and cable wiring diagram shall be submitted for Employer's approval.

13.00.00 SPECIFICATION FOR FLOW ELEMENTS

13.01.00 Orifice Plate

Features	Essential/Minimum Requirements
Type	Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042, ISO 5167
Material	316 SS
Thickness	3 mm for main pipe diameter up to 300 mm and 6 mm for main pipe dia. above300 mm.
Tappings	Flanged weld neck or D & D/2 with 3 pairs of tapping (as applicable). Root valves to be provided in all the tappings. However, for flow elements in CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.
Beta Ratio	0.34 to 0.7

13.02.00 Flow Nozzle

Features	Essential/Minimum Requirements
Type	Long radius, welded type as per ASME PTC-19.5 (Part-III) or BS-1042, ISO 5167
Material	ASME SA182-GRADE 316L. The material of Flow nozzle shall be A182F91/F92, where pipe material is A335P91/P92.
Tapping	Flanged weld neck or D & D/2 with 3 pairs of tapping (as applicable). Root valves to be provided in all the tappings. However, for flow elements in CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.
Beta Ratio	Around 0.7

13.03.00 Venturi (For Liquid applications)

Features	Essential/Minimum Requirements
Type	Rough Welded (for Pipe dia between 200mm to 1200mm) or Machined (for Pipe dia 50mm to 250mm) as per ISO 5167-4:2003,
Tapping	3 pairs of tappings for each Venturi as per ISO 5167-4:2003, However for some areas like CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.
Beta Ratio	0.4 to 0.7

13.04.00 **NOT USED**

14.00.00 NOT USED

15.00.00 PROCESS ACTUATED SWITCHES

FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS		
	Pressure/ Draft Switches/ DP Switches	Temperature switches	Level switches
Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum	Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (5 m minimum, to suit application)	Capacitance types, float type, conductivity type, RF type, Ultrasonic type as per suitability to the application.
Material	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS
End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard
Over range/ proof pressure	150% of maximum operating pr.	-	150% of maximum operating pr.
Repeatability	+/- 0.5% of full range		
No. of contacts	2 No.+2NC. SPDT snap action dry contact		
Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS)		
Elect. Connection	Plug in socket.		
Set point adjustment	Provided over full range.		

Dead band adjustment	Adjustable/ fixed as per requirement of application.		
Enclosure	Weather and dust proof as per IP-65, metallic housing.		
Accessories	Siphon, snubber, chemical seal, pulsation dampeners as required by process	Thermo well of 316 SS and packing glands	All mounting accessories
Mounting	Suitable for enclosure/ rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-
Power Supply (Wherever required)	As per Contractor's Standard practice.		

Notes: -

1) Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low-pressure applications.

3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.

4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

5) For ESP Level Switches following requirements are to be met:
   i) ESP Level Switches calibration shall not be affected by changes in ambient temperature.
   ii) Active build up compensation to be provided to sense and auto correct the effect of ash deposition on level probe.
   iii) Self- -diagnostic features like health status, maintenance requirement, instrument failure, false alarm etc. to be provided.

   The manufacturer shall submit adequate supporting documents, catalogues for establishing the above features.

16.00.00 **LEVEL SWITCHES FOR ESP, ECO & APH HOPPERS**

Measuring principle for level switches in ESP and Economizer / APH hoppers shall be either Radio frequency (RF) based or Vibrating rod based.

16.01.00 **TYPE : RADIO FREQUENCY (DIGITAL TYPE)**

a. ELECTRONIC CONTROLLER

	Input supply voltage	: 240VAC ±10%
	Relay out put	: 2 NOS. + 2NC SPDT
	Contact rating	: 5A AT 240VAC & 0.25 AT 220V DC
	Enclosure protection	: IP 67 or better
	Set point	: SINGLE SET POINT
	Enclosure housing	: CAST ALUMINUM
	Ambient temperature	: -10 TO 50 °C
	Local indication (optional)	: Numeric led display of real time value of sensitivity with keypad for setting
	Electrical connection	: Suitable no. of connections as per design
	B. SENSING PROBE	
	Material	: Stainless steel – 316 (active & shield)
	Mounting	: As per application
	Temperature	: 200°c (max.) for ESP & 400 deg C (max.) for ECO / APH hopper
	Enclosure protection	: IP-67
	Enclosure housing	: Cast Aluminum
	Insulation	: PTFE for ESP & Ceramic for ECO / APH
	Baffle for Protection	: To be provided if required.
16.02.00	**TYPE**	**: VIBRATING ROD TYPE**
	Transducer type	: Integral type with sensor and measuring system in the same unit fully buffed.
	Housing	: Pressure Die Cast Aluminum, Weatherproof, powder coated, IP67 or better.
	Output	: 2NO, 2NC DPDT Relay Output (rated at 6A, 230V AC for non-inductive load)
	Power Supply	: Universal (18 to 55 V DC and 90 to 265 V AC at 50 Hz)
	Switching	: Normal Switching
	Mounting	: Threaded G 1.5” (BSP) SS 304
	Vibrating Rod	: Sensing rod – 155 to 162 mm, SS316 make
	Temperature	: 200°c (max.) for ESP & 400 deg C
	Extension Material	: SS 304

Baffle for Protection : To be provided if required.

17.00.00 SOLENOID VALVES

Solenoid valves shall fulfil the following requirements:

a. Type 2/3/4-way SS 316/Forged Brass (depending on the application subject to Employer's approval during detailed Engg.)

b. Power supply: 24 V DC ± 10%.

c. Plug and socket electrical connection.

d. Insulation: Class 'H'

e. IP Class: IP65

18.00.00 REVERSE ROTATION INDICATOR (RRI)

Reverse rotation indicator comprising of proximity sensors, processing electronics with output of 4-20mA (corresponding to speed) interconnecting cables, speed display in rpm, normal, reverse indication and required channel alarm contact shall be provided. The contact rating shall be 60VDC, 6VA (or more if required by Control system). The exact details of the RRI shall be strictly as approved by Employer during detailed engineering. The power supply of RRI is to be arranged by the Bidder.

19.00.00 WATER SYSTEM RELATED SPECIAL INSTRUMENTS (DM PLANT, CPU PLANT, PT PLANT, ETC)

19.01.00 ANALYSER INSTRUMENTS:

For Technical specification of Cation/Specific Conductivity, pH, Sodium, Silica, Turbidity, Total Dissolved Solids (TDS) and Concentration analyzers, please refer Specification of Analyzers, Part-B, Sub-section IIIC-13, SWAS chapter of this specification. Specification of concentration analyzer shall be similar to Conductivity analyzer except range which shall be as per process requirements.

19.02.00 Residual Chlorine Analyser

a An automatic chlorine residual analyzer of amperometric type shall be provided along with the chlorinating plant for monitoring the residual chlorine content of cooling water. The analyzer shall be suitable for accurate residual measurement in open/closed systems. The measurement accuracy shall not be affected by presence of treatment chemicals as chromates, phosphates, de-former highly polluted water, change in temperature etc.

b Circulating water as sample to residual chlorine analyzer shall be taken from hot circulating water pipe work before entry to cooling towers. Exact location and layout of sampling arrangement shall be finalized during detailed engg. stage. Bidder shall provide necessary pumping system (with 100% standby) for meeting the analyzer requirements, if needed. All the drains shall be terminated up to the nearest plant drainage system.

19.03.00 All the outdoor field instruments such as analyzers/transmitters/meters etc. shall be provided with suitable Free-standing cabinet(s)/panel/rack so that the equipments are protected against rain/ sunlight etc.

19.04.00 Parshall Flume

The Bidder shall provide all the control and Instrument devices including primary sensors, transmitters, flow indicator cum integrator / totalizer and shall include all required accessories for the flow measurement of raw water through the clarifier. The system shall be of reputed make and acceptable to the owner.

Level measurement shall be based on ultrasonic/radon technology. The flow compensation is to be implemented in the transmitter itself. The transmitter shall provide 4-20 mA DC in direct proportion to flow and shall be able to drive a load impedance of 500 ohms minimum

Accuracy shall be +/- 1 % or better.

All the mounting hardware and accessories required for erection and commissioning of the same are to be provided by the contractor. Mounting fittings material shall be SS316. All weather canopy is to be provided for electronics/sensor to protect the same from rain/ sunlight etc.

The Type makes and models no. shall be subject to Owner's approval.

19.05.00 Electronic Flowmeter

The electronic flow meter shall include flow sensor and flow indicator cum integrator / totalizer and shall include all required accessories for satisfactory operation. The flow meter shall be based on full bore electromagnetic principle and shall be electronic type of proven design, make and model acceptable to the owner.

The Bidder shall submit all necessary technical literature and details of selection criteria of the instrument offered to substantiate the model selected. The Bidder shall also furnish list of similar installation along with feedback on satisfactory performance of the instruments.

The flow meter shall meet or exceed the following requirement:

(a)	Output	:	4-20 mA DC Isolated output
(b)	Accuracy	:	± 0.5% of calibrated span or better *
(c)	Repeatability	:	± 0.2% of calibrated span or better
(d)	Power Supply	:	240V AC ± 10%, 50 HZ ± 5%/ 24 V DC, to be arranged by the contractor.
(f)	Protection class	:	IP-65
(e)	Flow tube		SS304
(f)	liner		Hard Rubber

The flow meter shall provide local indication for instantaneous flow. It should also be possible to get local display for daily and monthly discharge. The flow meter shall indicate totalizer/ integrator to get the daily and monthly discharge as stated above.

20.00.00 AC PLANT RELATED SPECIAL INSTRUNMENTS

20.01.00 HUMIDITY SENSOR

Sensor	:	Capacitance type
Accuracy	:	+/-3% R.H
Range	:	0-100% R.H
Output	:	4-20 ma

Time constant : 2 mins.

Output from the sensor is to be connected to respective control system. Contractor can also provide combined instrument for measurement of humidity and temperature subject to Employer's approval during detailed engineering. In all such cases, 4-20 ma outputs, each for temperature and humidity measurements are to be provided.

20.02.00 TEMPERATURE/ HUMIDITY INDICATOR

Sensor	:	RTD for(Pt 100) for temperature
	:	Capacitance Type for Humidity (specs for humidity and temperature shall be as mentioned above)
Display	:	Combined enclosure with two three-digit seven segments LED display with decimal point after two digits. LED height shall be 4 inches, clearly legible from a distance of at least 10 meters.
Range	:	0-60 Deg C for temperature.
	:	0-95.0 % for Relative Humidity.
Accuracy	:	Better than +/_0.5 % for Temperature
	:	Better than +/_2.5 % for Relative Humidity
Mounting	:	Tabletop/ wall mounting.
Power supply	:	240 V AC, 50 Hz.
Output	:	4-20 mA signal each for temperature.
Qty.	:	15 nos. each of temperature & Humidity indicators (combined indicators for Humidity and temperature is also applicable).

One Set of output signal is to be connected to respective control system. Apart from displaying the temperature/humidity values on indicator.

21.00.00 Limit switches

For offsite plant (except PT, DM, Chlorination, chemical treatment, Liquid effluent treatment) application Limit switches shall be silver plated with high conductivity and non-corrosive type. Contact rating shall be sufficient to meet the requirement of DDCMIS subject to a minimum of 60 V, 6 VA rating. Protection class shall be IP 55.

For main plant application limit switches are to be provided as per contractor standard and proven practice.

For PT, DM, Chlorination system, chemical treatment, Liquid effluent treatment plant, limit switches of manual valves and solenoid operated on-off valves shall be of inductive proximity type and shall be mounted inside the enclosure: pl. refer the minimum specification requirement below .

Operating voltage Range	10-40 V DC
Sensing system	Inductive Proximity type, 2 Wire
Sensor Contact Type	NO
Reverse polarity and short circuit protection	Yes
IP Class-Sensor	IP67
IP Class-Enclosure (Switch box)	IP67
Cable entry-Enclosure (Switch box)	2no-1/2" NPT
Casing material-Sensor	Brass /SS
Enclosure (Switch box) Housing material	FRP or SS
Operating Ambient temp(sensors)	-5 to 70 deg C
Max allowed Voltage Drop across sensor	5 V
Standard applicable	EN 60947-5-2 or equivalent.

22.00.00 SPECIFICATIONS OF EFFLUENT QUALITY MONITORING SYSTEM (EQMS)

22.01.00 COMMON REQUIREMENTS FOR ALL ANALYSERS

Sno	Features	Minimum Requirement
1.	Output signals	Analog 4-20 mA DC galvanically isolated.
2.	Zero & span Adjustment	To be provided with range selection facility
3.	Ambient temp	50 deg.C
4.	Sample Temperature	40 deg.C
5.	Indication	Digital Alphanumeric Display of reading in engineering units shall be provided.
6.	Type of Electronics	Microprocessor based with self-diagnostic
7.	Others	All interconnection tubing and cabling between sensor and analyzer / analyzer panel etc. to be provided. All chemical reagents required for EQMS analyzers for entire AMS period is to be supplied in phased manner depending on shelf life.
8.	Location of the Temp & flow measurement	Effluent Treatment plant outlet (Exact location to be decided by contractor in consultation with site)
9.	Location of the Analyzer cabinet/enclosure	
10.	Accessories	All the accessories required for mounting the

		sensor/analyzer is to be provided
11.	Digital Signal Transmission	Each analyzer shall have a provision for bidirectional soft connectivity over Modbus/RS232/RS485 with employer's central cloud server in addition to 4-20 ma connectivity to DDCMIS.
12.	Compliance to standards	Latest regulatory requirements of CPCB/SPCB/other regulatory/statutory body prevailing at the time of award of the contract.

22.02.00 CONDUCTIVITY ANALYSER

Type	Continuous flow through type
Measuring Range	0 – 60000 µS/cm for sea water application 0-5000 µS/cm for other application
Response Time	<= 5 sec (90% of full scale)
Temperature Compensation	Automatic
Power	To be arranged by the contractor
Accuracy	<= +/- 1 %

22.03.00 pH ANALYSER

Type	Cell flow through sample
Measuring Range	0-14 units of pH
Temperature Compensation	Automatic
Power	To be arranged by the contractor.
Accuracy	<= +/- 1 %

22.04.00 BOD BIOLOGICAL OXYGEN DEMAND / COD CHEMICAL OXYGEN DEMAND ANALYSER

Principle	COD/BOD measurement by: Option A. Total Organic Carbon (TOC) measurement complying to US EPA 415.1 / 415.2 or equivalent standard for effluent / sewage / wastewater. Option B. UV-VIS spectrometer measuring absorption in UV-VIS spectrum.
Measuring Range	0-50 mg/L for BOD, 0-500 mg/L for COD
Response Time	<= 15 min
Power	To be arranged by contractor
Cleaning	Self-cleaning (Automatic)
Accuracy	+/- 3%

22.05.00 OIL IN WATER ANALYSER

Principle	UV Fluorescence
Measuring Range	0 to 30 mg/l
Response Time	<= 60 sec
Power	To be arranged by the contractor.
Cleaning	Self-cleaning (Automatic)
Accuracy	+/- 5 % of full scale

22.06.00 TOTAL SUSPENDED SOLIDS – TSS ANALYSER

Principle	Light reflection principle
Measuring Range	0-500 mg/l
Response Time	<= 5 min
Power	To be arranged by bidder (Refer terminal point)
Cleaning	Self-cleaning (Automatic)
Accuracy	+/- 5%

22.07.00 ENCLOSURE/CABINETS / PANELS FOR EQMS AND ANALYSERS OF PT, LET, CHLORINATION, DM/RO, CWT AND CPU PLANT

The enclosure shall accommodate all EQMS Analyzers. The enclosure of all analyzers shall provide protection from dust, humidity, precipitations, sunlight and environmental pollution. The material for the enclosure shall be of steel plate (SS304) with minimum 2 mm thick frame and minimum 2 mm thick steel (SS-304) sheet of protection IP 65 or better with safety lock of good quality. The lighting provision in the cabinet is to be provided. The cabinets shall be designed such that the wet section and dry section are separate, the exact details shall be finalized during detailed engineering. The panel shall be free standing type constructed of suitable 3 mm thick channel frame of SS and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel and extended beyond the ends of the rack.

In order to ensure the healthy operation of the installed electronic modules, cards, analyzers, etc. inside the enclosure during continuous operation, the EQMS enclosure shall be provided with Air conditioner unit.

23.00.00 3D type Acoustic Frequency Wave Based Level Scanner System for Coal Bunker, Fly Ash Silo and ESP Hopper (First to Third Field)

Complete Level Monitoring System comprising of Acoustic Frequency Based 3D Level measurement system Scanners and all other accessories required to make the system complete and fully functional shall be provided on as required basis for continuous level measurement and monitoring of level of each coal bunker, each Fly Ash Silo and each ESP Hopper (First to Third Field of ESP) complying with following requirements:

S. No.	Feature	Requirements
1	Type	One Set of Non-Contact 3D type Acoustic Frequency Waves Based Level Scanner for each Coal Bunker, each Fly Ash Silo and each ESP Hopper (First to Third Field)
2	Protection Class	IP-65 or better
3	Housing and Antenna	Diecast Aluminum
4	Accuracy	1% or better
5	Measurement Range	Empty to Full (Coal Bunker, Fly Ash Silo and ESP Hopper as applicable)
6	Power Supply	24V DC For 3D Level Scanner
7	Local Indicator (Applicable for Coal Bunker and Fly Ash Silo)	For Each Bunker Bay, One Set of Local Indicators mounted at Tripper Floor for respective coal bunkers in that Bay. One Set of Local Indicators for Fly Ash Silos. Above Local Indicators shall display Average Level of each Coal Bunker/Fly Ash Silo. Local Indicator shall be mounted inside an Enclosure with Transparent Window for Viewing. Degree of Protection of Enclosure – IP55 or Better
8	4-20 mA signal shall be hardwired to corresponding DDCMIS for displaying Average Level of each Coal Bunker, each Fly Ash Silo and each ESP Hopper in the First to Third Field of ESP. Contractor shall provide all required hardware and software to display a) Coal bunker level on OWS located at Main Plant CCR/CR & CHP CR, b) Fly Ash Silo level on OWS of AHP CR and c) ESP hopper level in first to third field of ESP in OWS of Main Plant CCR/CR and ESP CR	

23.01.00 **NOGS (Naturally Occurring Gamma Sensor) Based Level Scanner System for Buffer Hopper and ESP Hopper (First to Third Field)**

Complete Level Monitoring System comprising of NOGS based Level measurement system monitoring the level of each Buffer Hopper (as applicable) and each ESP Hopper (First to Third Field of ESP) complying with following requirements:

S. No.	Feature	Requirements
1	Type	One Set of non-contact Level Transmitter working on NOGS technology based, Level sensor for each Buffer Hopper and each ESP Hopper (First to Third Field).
2	Protection Class	IP-66 or better
3	Housing	Diecast Aluminum
4	Operating Principle	Detects the Gamma Ions/ Radioactivity from Fly Ash to measure continuous Level (Naturally Occurring Gamma Ray Sensor) inside ESP and Buffer Hopper. No Radioactive Source is used. Only Detector is used, and Coal Fly Ash is the source of Gamma Ions / Radioactivity.
5	Accuracy	+/- 0.5 % to +/- 1%
6	Ambient Temperature	-20º C TO 85º C
7	Operating Pressure	1 Atm
8	Power Supply	24V DC (Charger based supply) / 230 V AC (UPS supply)
9	Output	4 – 20 mA (Continuous Level) / 2 Relay Contacts
10	Mounting & Local Display	To be Mounted Outside the Buffer / ESP Hopper & LCD Display with Touch Buttons
11	4-20 mA signal shall be hardwired to corresponding DDCMIS for displaying Average Level of each Buffer hopper and each ESP Hopper in the First to Third Field of ESP. Contractor shall provide all required hardware and software to display a) Buffer hopper level on OWS located at Main Plant CCR / CR and AHP CR. b) ESP hopper level in first to third field of ESP in OWS of Main Plant CCR/CR and ESP CR.	

24.00.00 DEPOSIT MONITOR

S. No.	Feature	Details	
1	Standard	AS per NACE standard RP0189-2002	
2	Type	Online, Annular flow, scale deposition	
3	Measurement	Deposit weight and average weight per unit surface area	
4	Observation	1. Online Visual Offline- Quantitative by weighing heat transfer surface	
5	Accessories: -		Qty
	(i) Flow Switch		1 Nos
	(ii) Flow meter (Rota meter)		1 Nos
	(iii) Manual Flow Control valve		1 Nos
	(iv) Skin temperature Sensor		2 Nos
	(v) Temperature Controller		1 Nos
	(vi) Digital Temperature Indicator		2 channels

	(vii) Electric heater (Electrical resistance heating element)		2 Nos
6	Power Supply	230VAc	
7	Electric heater protection	(a). No water Flow (b). Outlet temperature more than set point.	

25.00.00 BIO-FOULING MONITOR

S. No.	Feature	Details	
1	Standard	AS per NACE standard RP0189-2002	
2	Type	Online, Loss In static pressure due to friction in the direction of flow	
3	Cooling water Sample Bypass tube/pipe for DP measurement	Stainless Steel	
	Measurement	Differential pressure	
4	Accessories: -		Qty
	(i) Flow Meter		1 Nos
	(ii) Manual Flow Control valve		2 Nos
	(iii) Differential pressure transmitter (Across the tube)		1 No.
	(iv) Pressure gauge (At Inlet)		1 No.
	(v) Strainer (To Eliminate suspended solids) Eliminate suspended solids		

26.00.00 CORROSION METER

S.no.	Feature	Details
1.	Type of electronics	Microprocessor based
2.	Zero & span Adjustment	To be provided
3.	Ambient temp.	50°C
4.	Display	LCD
5.	Range Corrosion rate Imbalance (Pitting Index)	 : 0.01 to 150MPY : 0.01 to 100 pitting units
6.	Accuracy	: < ± 2% of reading
7.	Enclosure Type / Material	Weather and Dust proof (IP 65)
8.	Mounting	All weather Local Panel fitted with integral Air Conditioner are to be provided by the Contractor.

Sensor Probe Specification Requirement

S.no.	Feature	Details
a)	Type	: Linear Polarization Resistance Probe (LPR)
b)	Electrodes	: 2 electrode/3 electrode
c)	Spares	Three sets of spare electrodes for LPR probes

27.00.00 **ONLINE ORP MONITOR / ANALYSER**

ORP Sensor

S.no.	Feature	Details
a)	Type	: Cell - flow through
b)	Accuracy	: < ± 1mv
c)	Range	: -1400mv to +1400mv
d)	Electrode	: Platinum

Monitor / Analyzer Specification: -

S.no.	Feature	Details
1.	Type of electronics	Microprocessor based
2.	Zero & span Adjustment	To be provided
3.	Ambient temp.	50°C
4.	Display	LCD
5.	Enclosure Type / Material	Weather and Dust proof (IP 65.
6.	Output signals Analog	4-20 mA DC
7.	Error / fault Diagnostic	To be provided.
8.	Power supply	For power supply and distribution, refer scope / and terminal point part of the specification. Conversion / distribution from the terminal point shall be done by contractor.
9.	Load	500 Ohms minimum
10.	Mounting	All weather Local Panel fitted with integral Air Conditioner are to be provided by the Contractor.

28.00.00 **ORP/PH PORTABLE METER**

Sensor Probe Specification Requirement

S.no.	Feature	pH	ORP
b)	Electrode	: Glass	: Platinum
c)	Accuracy	:< ± 1% of reading	: < ± 1mv
d)	Range	: 0-14 pH	: -1400mv to +1400mv
e)	Temperature Compensation	Automatic	

Portable meter

S.no.	Feature	Details
1.	Type of electronics	Microprocessor based
2.	Measurement	Ph & ORP
3.	Ambient temp.	50°C
4.	Display	LCD
5.	Enclosure Type / Material	IP 67
6.	Power source	Batteries
7.	Battery life	>=200 hrs

SUB–SECTION – IIIC - 05

ELECTRICAL POWER SUPPLY SYSTEM

ELECTRICAL POWER SUPPLY SYSTEM

1.00.00 ELECTRICAL POWER SUPPLY

1.01.00 The requirements of Electrical Power Supply system are specified herein on system basis. The Contractor shall be responsible for engineering and furnishing a complete and operational system fully meeting the intent and requirements of this specification including tender drawings and Employer approved drawings during detailed engineering. All equipment and accessories required for completeness of this system shall be furnished by the Contractor whether these are specifically mentioned herein or not. All the equipments and sub systems offered shall be from reputed experienced manufacturers. All system cabinets, enclosures, & distribution boards shall be manufactured, assembled, wired and fully tested as a complete assembly as per the requirements of this specification at the manufacturer's works.

The Contractor shall furnish all required equipment cubicles and wiring required for conversion and/or stabilization of the power sources provided by the Employer to all other levels which may be necessary for meeting the individual requirement of equipment/system furnished by him including the panel/desk mounted equipment.

1.02.00 The power supply system shall be designed to meet the electrical power requirements of various C&I systems including DDCMIS. The Power Supply System shall be designed to give the voltage at approximate mid level of the tolerance band of the power supply modules/packs of Control System, when the charger is feeding the load. This shall also take in consideration the voltage drop in cables from DCDB to the control panels. In case the Power Supply Output of a charger exceeds the voltage band tolerated by the power supply modules/packs of Control System, provision for safe tripping of that charger is to be ensured.

1.02.01 Bidder may specifically note that the KVA rating of UPS system shall be guaranteed at 50 deg.C ambient temperature and load power factor of 0.8 lagging. In case the Bidder's standard UPS KVA ratings are applicable at a lower ambient temperature (say 40 deg.C) than specified 50 deg.C temperature, the Bidder shall consider derating factor of at least 1.5%/deg.C for arriving at the specified UPS capacity at 50 deg.C ambient temperature so that required capacity is ensured at 50°C. The Contractor shall demonstrate the above stated capacity at 50°C during shop testing.

1.02.02 The Bidder may note that for UPS of capacity above 25 KVA, the following should be followed: -

(a) Both the inverters shall not be housed in single cubicle.

(b) Both the chargers shall not be housed in single cubicle.

One inverter and one changer can be housed in one common cubicle i.e. there will be two such cubicles per UPS system if the same is standard and proven practice of the Bidder.

1.02.03 Bidder may note that in case the calculated UPS rating is not same as one of the standard KVA rating of the single UPS system, the next higher standard rating of the manufacturer shall be selected and provided. Bidder may specifically note that UPS of manufacturer's non-standard rating shall not be acceptable. Furthermore, it may be noted that to attain the calculated UPS rating, paralleling of multiple UPS systems of lower ratings will not be accepted.

1.02.04

Contractor to note the following in regards to the UPS Power Supply distribution for unit loads:

a.) Unit HMIPIS Loads: For the HMIPIS loads which accept dual power supply, redundant feeders to be extended up to loads through a local PDB. The PDB shall have redundant bulk feeders from ACDB-1 & 2 as incomers and required number of redundant feeders as output for the loads. For the HMIPIS loads which accept only single power supply feeder, redundant feeders from ACDB-1 and 2 shall be through a Static Switch based change over mechanism. The Static Switch shall be mounted in a local PDB.

b.) Unit Non-HMIPIS Loads: Separate, independent and dedicated feeder directly from the ACDB-1 and 2 shall be used for feeding these specific loads like each Gravimetric Feeder, Acoustic Pyrometer, Furnace Flame Viewing System, HEA Ignitors at each oil elevation, each Air motor solenoid valve for Air Pre-Heaters, Acoustic Steam Leak detection System & ERV/EBV(as applicable)**.**

1.03.00

The DC Power Supply for various sub-systems shall consist of one or more of the following configurations. The applicable configurations are as indicated in Part-A of contract quantities: -

(A) NOT USED.

(B1) DC power supply system for UNIT (SG, TG & BOP) Area: DC power supply system shall comprise of two sets. Each set shall consist of 1 x 100% microprocessor controlled, intelligent, modular rectifier banks, Controller –one for each rectifier bank, 1 x 100% batteries for one (1) hour duty, 1 X 100% DC distribution board. 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS)–common for both the sets.

Contractor has the option of supplying either Nickel Cadmium type batteries or Lead Acid Plante type batteries for this configuration.

The specifications for this DC Power Supply System shall be as per Cl.No.2.01.00 to 2.03.00 and specifications for Battery shall be as per Cl. No 4.00.00 for Ni-Cd type Batteries & 5.00.00 for Lead Acid Plante type Batteries.

(B2) DC power supply system for areas other than Unit (SG, TG & BOP): DC power supply system shall comprise of two sets. Each set shall consist of 1 x 100% microprocessor controlled, intelligent, modular rectifier banks, Controller –one for each rectifier bank, 1 x 100% Nickel - Cadmium batteries for one (1) hour duty, 1 X 100% DC distribution board. 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS)–common for both the sets.

The specifications for this DC Power Supply System shall be as per Cl.No.2.01.00 to 2.03.00 and specifications for Battery shall be as per Cl. No 4.00.00 for Ni-Cd type Batteries

(C) DC power supply system shall comprise of 2 x100% power supply unit along with 1x100% sealed maintenance free lead Acid batteries for 30 Min back up and DC Distribution Board. DC power supply unit along with batteries shall be housed in a single panel. The power supply unit shall be capable of charging the batteries and feeding the load simultaneously. The DC distribution board shall have redundant feeders for critical loads.

The specifications for this configuration shall be as per Cl.No.2.04.00.

(D) DC power supply system shall consist of one set of 24 VDC redundant power supply system with battery back up as per the process requirement. In case power supply module/power packs with 24 VDC output are used, the input power supply to the same can be either of 24 VDC/110 VAC/230 VAC/220 VDC, to be finalized during detailed engineering. The specifications for this configuration shall be as per manufacturer's standard

Bidder shall clearly bring out in the proposal the redundancy features along with configuration diagram, single line diagram & data sheets etc. and this shall be finalized and subject to Employer's approval during detailed engineering.

1.04.00 NOT USED.

1.05.00 The UPS Power Supply for various sub-systems shall consist of one or more of the following configurations. The applicable configurations are as indicated in Part-A of contract quantities.

Bidder shall clearly bring out in the proposal the redundancy feature along with configuration diagram, single line diagram and data sheets etc. & this shall be finalized subject to employer's approval during detailed engineering.

(A) UPS System shall consist of 2 x 100% parallel redundant chargers and inverters with input isolation transformers, 1 x 100% battery bank for one (1) hour, Bypass line transformers & voltage stabilizer, static switch manual bypass switch, 2 x 100% ACDB, 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) and other necessary protective devices and accessories.

Contractor has the option of supplying either Nickel Cadmium type batteries or Lead Acid Plante type batteries for this configuration.

The specifications for this UPS configuration shall be as per Cl.No.3.00.00 to 3.05.00 and specifications for Battery shall be as per Cl. No 4.00.00 for Ni-Cd type Batteries & 5.00.00 for Lead Acid Plante type Batteries.

(B) UPS system shall consist of 1 x 100% charger and inverter with input isolation transformer, 1 x 100% Ni Cd Battery Bank for 1 hour, Bypass Line Transformers and Voltage Stabilizer, static switch, manual bypass switch, 2 x 100% ACDB, 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) and other necessary protective devices and accessories.

The specifications for this UPS configuration shall be as per Cl.No. 3.00.00 to 3.05.00 and specifications for Battery shall be as per Cl. No 4.00.00 for Ni-Cd type Batteries.

(C) On line UPS with remote monitoring having a battery backup of 30 min. The batteries for UPS System shall be Sealed Maintenance Free type and shall be as per Control System Vendor's standards.

1.06.00 For distribution of UPS Supply in Main Plant Area, Contractor shall provide PDBs. The number of PDB's shall be as per Part-A of contract quantities.

PDBs which are to be used for the distribution of UPS Supply for HMI peripherals shall have Static Switches mounted inside the PDB for change over. PDBs which are to be used for the distribution of UPS Supply for all other loads shall have Auto Change over circuitry without static switches implemented inside the PDBs. For distribution of UPS Supply in the offsite areas, separate PDBs are not envisaged.

	Each PDB shall be provided with input feeder monitoring through potential free contact wired to DDCMIS. The output feeders from the PDB shall be provided with separate fuse & MCB's. 10% spare feeders (min. 1 no.) with MCB & fuses for each rating shall be provided in Bidder's each PDB. The PDBs provided for distribution of UPS loads shall be as per following guidelines. (a) For Main Plant HMI Loads, half of the HMI load shall be distributed through one set of static switches with input from both the ACDB's while the other half of the HMI load shall be distributed through other identical set of static switches. (b) For offsite Area HMI & other loads which accept redundant inputs shall be fed directly from redundant ACDB feeders. The loads which accept only single input feeder shall be divided between the two ACDB's such that even in event of unavailability of one ACDB, half of the devices/peripherals are available. (c) For distribution of UPS Supply for common loads in centralized offsite control room of AHP and WS adjacent to main CCR in control tower, Contractor shall provide UPS power supply from both the units and shall be distributed through static switches.
2.00.00	**DC POWER SUPPLY SYSTEM (24 V),**
2.01.00	Microprocessor based, Intelligent, Modular Power Supply The minimum capacity of the modular power supply inclusive of 10% design margin shall be as indicated in Part A of the specification.
2.01.01	Microprocessor based, Intelligent, Modular Power Supply shall be sized for continuous duty to meet 100% load requirements and keep the connected battery fully charged in float mode. The minimum capacity inclusive of 10% design margin shall be as indicated in Part-A of the specification. Either of the bank of rectifier modules shall be able to re-charge the fully discharged battery within 8 hours. It shall also be possible to discharge batteries periodically manually. Each rectifier bank shall be provided with N+1 rectifier modules and the maximum numbers of rectifier modules shall not be more than 25 Nos. However, the exact number of rectifier modules shall be as finalized by the Employer during Detailed Engineering. The exact sizing of the rectifiers in one bank shall be subject to Employer approval during detailed engineering. It shall be ensured that all rectifier modules in one rectifier bank shall be of same rating and not more than three ratings of rectifier modules shall be used in various rectifier banks. Provision for manual boost charging with isolation of loads shall be provided.. While sizing, the temperature derating factor as applicable, is to be considered for arriving at the rating of the modules as per Bidder's manufacturing standard if the modules are rated for lower than the 50 deg. C ambient. For the rectifier bank, matching controller along with applicable software shall be provided to meet system requirements under all modes of operation."
2.01.02	The rectifier module shall be microprocessor controlled, IGBT/ Power MOSFET based, high frequency with active load sharing, designed for single and parallel operation with battery and shall have automatic voltage regulators for a close voltage stability even when AC supply voltage and DC load fluctuates, effective current limiting features, front access design, programmable temperature compensation feature for battery charging and filters on both input and output to minimise harmonics. The rectifier module output regulation shall be ± 1% or better from no load to full load with an input power supply variation of ± 10% in voltage and

	± 5% in frequency. In addition to indications/display on charger panel, alarms shall also be provided by employing RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for use in DDCMIS. Further isolated 4-20 mA signals shall be provided for important parameters like rectifier bank voltage, rectifier bank current, battery voltage, battery current, DCDB Voltage, DCDB current etc. The list of alarm output & 4-20 mA signals shall be as approved by Employer during detailed engineering. Necessary provision shall be done in DDCMIS end also.
2.01.03	The rectifier module shall be fed from 415V AC, 50 HZ, 3 phase, 3 wire system.
2.01.04	"Float/Boost" charge functions shall be provided with alarm/indications.
2.01.05	The rectifier module circuitry shall be of fail-safe design and failure of any component should not result in any rectifier bank output voltage to increase beyond acceptable limits of the C&I system being fed from it.
2.01.06	The rectifier module shall be current limited for circuit protection and protection of battery from overcharge. The current limit shall be continuously programmable.
2.01.07	The rectifier module shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energised.
2.01.08	The full load efficiency of rectifier module at nominal input and output shall be at least 90%. The ripple content shall be limited to +/- 0.5 % of output voltage.
2.01.09	The Controller shall be microprocessor controlled for monitoring & control of rectifier modules with features viz. Auto/Manual battery discharge test, battery reserve time prediction, energy management, float/boost mode control etc.
2.01.10	All Software as required for smooth operation and monitoring of rectifier modules in conjunction with Controller & BHMS shall be provided by the Contractor.
2.02.00	**DC Distribution Board (DCDB)** Redundant DC feeders (one from each DCDB) shall supply each of the connected loads. The exact design, rating & number of feeders of the each redundant DCDB shall be as finalised during detailed engineering and as approved by Employer. However, 25% spare feeders (min. 1 no.) with MCB and fuses for each rating shall be provided in each DCDB.
2.03.00	**Battery Health Monitoring System (BHMS)** BHMS, wherever applicable, shall include microprocessor based hardware and software to monitor the condition of each battery cell of 24 V DC systems & UPS battery banks on-line. With BHMS it shall be possible to measure & analyse the minimum and maximum voltage values of each battery-cell so that any damage to battery shall be prevented by pro-active maintenance. BHMS shall communicate with the DDCMIS and provide alarms as finalized by Employer during detailed engineering. Contractor to ensure that the configuration of the BHMS system being supplied along with the batteries of 24 V DC Charger System and UPS System shall meet the technical requirements of the type of batteries supplied along with these power supply systems.

2.04.00	Power Supply shall be sized to meet connected load requirements and keep the connected battery full charged in Float/ Boost mode. The rectifier module output regulation shall be ± 1% or better from no load to full load with an input power supply variation of ± 10% in voltage and ± 5% in frequency. In addition to indications/display on the panel, potential free contacts for alarms like O/P voltage high & low, AC Input supply failure, battery feeding the load etc shall also be provided for use in respective control system i.e., PLC/Remote IO etc . Further isolated 4-20 mA signals shall be provided for important parameters like rectifier module voltage, rectifier bank current, battery voltage etc. The list of alarm output & 4-20 mA signals shall be as approved by Employer during detailed engineering. The exact design, rating & number of feeders of the DCDB shall be as finalised during detailed engineering and as approved by Employer. However, 25% spare feeder (min. 1 no.) with fuses for each rating shall be provided in each DCDB.
3.00.00	**UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM** The minimum capacity of the UPS at load factor of 0.8 lagging inclusive of 10% design margin at 50 deg c shall be as indicated in Part-A of the specification. The UPS system shall meet the following requirements as a minimum. If UPS KVA rating is applicable at a lower ambient temperature than specified 50 deg.c, the bidder shall consider a derating factor of at least 1.5%/deg.c for arriving at the specified UPS capacity at 50 deg.c ambient. The UPS shall have an overload capacity of 125 % rated capacity for 10 minutes and 150 % rated capacity for 10 seconds. The inverter shall have sufficient capability to clear fault in the maximum rated branch circuit, limited to 8 percent of finally selected ups capacity.
3.01.00	**Chargers**
3.01.01	The chargers shall be self regulating, solid state silicon controlled, full-wave rectifier type designed for single and parallel operation with battery and shall have automatic voltage regulators for close voltage stability even when AC supply voltage fluctuates, effective current limiting features and filters to minimise harmonics. The Battery should be directly connected to the Controlled Rectifier and no intermediate component between Battery and controlled rectifier is allowed. In event of mains failure, Battery should feed the inverter directly without any intermediate component. The charger should be capable to fully charge the required batteries as well as supply the full rated load through inverter. Furthermore the charger should be able to re-charge the fully discharged battery within 8 hours. The charger output regulation shall be ± 1% from no load to full load with an input power supply variation of ± 10% in voltage and ± 5% in frequency. In addition to indications/display on charger panel, alarms along with relevant analog measurements shall also be provided by employing RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for use in DDCMIS. The list of alarm output & 4-20 mA signals shall be as approved by Employer during detailed engineering.
3.01.02	The charger shall be current limited for charger circuit protection and protection of battery from overcharge shall also be provided. The current limit shall be continuously adjustable. The chargers shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energised.
3.01.03	The chargers shall be fed from 415V AC, 50 HZ, 3 phase, 3 wire system. Charger design shall ensure that there is no component failure due to fluctuations of input supply or loss of supply and restoration.

3.01.04	The minimum full load efficiency at nominal input and output shall be 90%. The ripple content shall be limited to +/- 2 % of Charger output voltage.
3.01.05	The UPS battery shall have sufficient amp-hour capacity to supply the steady state KVA rating of the UPS specified for 60 minute, irrespective of the actual load on UPS.
3.01.06	The UPS system shall be capable of operating without D.C. battery in circuit under all conditions of load and the performance of various components of UPS like inverter, charger, static switch etc. shall be guaranteed without the battery in circuit.
3.01.07	The UPS system design shall ensure that in case of failure of mains input power supply to one of the chargers, the other charger whose mains input power supply is healthy, shall feed to one or both the inverters as the case may be as per manufacturer's standard practice & continue to charge the D.C. battery at all load conditions. The Bidder should note that this situation should not in any way lead to the discharge of the D.C. Battery.
3.02.00	**Static Inverters** The static inverter shall be of continuous duty, solid state type using proven Pulse Width Modulation (PWM)/Quasi square wave/step wave technique. Ferro-resonant types Inverters are not acceptable. The nominal voltage output shall be 230 Volts. single phase ,50 Hz. The inverter equipment shall include all necessary circuitry and devices to conform to requirements like voltage regulation, current limiting, wave shaping, transient recovery, automatic synchronization etc. The steady state voltage regulation shall be +/-2% and transient voltage regulation (on application/removal of 100% load) shall be +/-20%. Time to recover from transient to normal voltage shall not be more than 50 mSec. Frequency regulation for all conditions of input supplies, loads and temperature occurring simultaneously or in any combination shall be better than ± 0.5% (automatically controlled). The total harmonic content shall be 5% maximum and content of any single harmonic shall be 3% maximum. The inverter efficiency shall be at least 85% on full load and 80% on 50% load. The synchronisation limit for maintenance of synchronisation between the inverter and stand by AC source shall be 48-52Hz, field adjustable in steps of 1 Hz.
3.03.00	**Static Switch and Manual Bypass Switch** The static switch shall be provided to perform the function of transferring UPS loads automatically without any break from (i) faulty inverter to healthy inverter in case of failure of one of the two inverters and (ii) from faulty inverter to standby AC source in case of failure of both the inverters. The transfer time shall be ¼ cycle maximum in synchronous mode. Manual bypass switch shall be employed for isolating the UPS during maintenance. Continuous and overload capacity of the switches shall be equal to 100% of the continuous and overload rating of each inverter. Peak Capacity shall be 1000% of continuous rating for 5 cycles.
3.04.00	**Step Down Transformer and Voltage Stabiliser** One 415V three phase to 230V, single phase transformer along with associated voltage stablizer shall be furnished with each UPS system. The transformer and stablizer combination shall convert Employer furnished 415V ± 10% three phase plant auxiliary AC supply to 230 V ± 2%, single phase standby AC Power Supply source. The transformer shall be of low impedance air-cooled type and its KVA rating and

	percentage impedance should be selected so that extremely fast fault clearance is achieved. The overload capacity of the transformer and voltage stabilizer shall not be less than 300% for 200 millisecond duration. The voltage stabilizer shall employ servo-controlled circuitry and shall maintain the specified output voltage for 0-100% load with maximum input voltage variations as indicated above. The efficiency of the stabiliser shall be 95% or better. The type and other details shall be subject to Employer's approval.
3.05.00	**AC Distribution Board (ACDB)** The details of the AC distribution board, i.e. exact, rating and number of feeders etc. of the 2x100% ACDB shall be as indicated in Part-A of the specification and as approved by Employer during detailed engineering . ACDB shall be designed to cater to the requirements of both Employer's System and Contractors systems.
4.00.00	**Batteries**
4.01.00	Nickel Cadmium Batteries
4.01.01	The batteries shall be heavy duty Nickel-cadmium type and shall be sized for one hour of full load operation during non-availability of AC supply / chargers. The Ni-Cd batteries shall **strictly** conform to the latest edition of **IS: 10918** including all applicable official amendments and revisions as on date of opening of techno-commercial bid. For sizing calculation, an aging factor of 0.8 and a temperature correction factor as per manufacturer's standard at 4 deg. C electrolyte temperature (Based on temperature characteristics curve to be submitted by the Contractor at a temperature of 4 deg. C), Capacity factor, float correction (if applicable) shall be taken into consideration. The sizing of the battery shall be as approved by Employer during detailed engineering. The Contractor shall typically consider a voltage drop of 2.5V from battery room to DCDB and DCDB to load, while sizing the battery for 24 V DC Charger System and 4V from battery room to the inverter input while sizing the battery for UPS System.
4.01.02	Connectors and Fasteners Nickel plated copper connectors shall be used for connecting adjacent cells and PVC insulated flexible copper cables shall be used for inter-row / inter-tier / inter-bank connections. Bolts, nuts and washers shall be Stainless Steel / Nickel coated steel to prevent corrosion. All the terminals and cells inter-connectors shall be fully insulated or have insulation shrouds. 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 60 minutes discharge current of the respective batteries and fault short circuit current which the battery can produce and withstand for the period declared.
4.02.00	**Lead Acid Plante Batteries**
4.02.01	**Codes & Standards**
4.02.02	All standards, specification and codes of practice, referred to herein, shall be the latest edition including all applicable official amendments and revisions as on date of opening of techno-commercial bid.

In case of conflict between this specification and those (IS Codes Standards etc.) referred to herein, the former shall prevail. All works shall be carried out as per the following standards and codes:

IS : 266	Specification for sulphuric acid
IS : 1069	Specification for water for storage batteries
IS : 1146	Specification for rubber & plastic containers for lead acid storage batteries.
IS : 1652	Specification for stationary cells and batteries, lead acid type (with plante positive plates).
IS : 3116	Specification for sealing compound for lead acid batteries.
IS : 8320	General requirements and methods of tests for lead acid storage batteries.
IS : 6071	Specification for synthetic separators for lead acid batteries.
	Indian Electricity Rules
	Indian Electricity Acts

4.02.03 Equipment complying with other internationally accepted standards such as IEC, BS, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards alongwith copies of all official amendments and revisions in force as on date of opening of techno-commercial bid and shall clearly bring out the salient features for comparison.

4.02.04 **GENERAL TECHNICAL REQUIREMENTS**

4.02.04.01 Equipments

DC Batteries shall be stationary lead acid Plante positive plate type conforming to IS:1652. The battery shall be high discharge performance type shall be sized for one hour of full load operation during non-availability of AC supply / chargers. For the purpose of sizing Temperature Correction Factor as per manufacturer's standard at 4 Deg C electrolyte temperature, relative humidity of 95%, aging factor of 0.8 and Capacity Factor shall be considered. The Contractor shall furnish relevant charts, curves, tables etc. in support of the various factors considered during battery sizing.

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 2.7 volts per cell maximum and float charged at about 2.25 V/cell:

The number of cells for the 24 V DC Charger System and UPS System shall be decided during detailed engineering.

4.02.04.02	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. All the terminals and cells inter-connectors shall be fully insulated or have insulation shrouds.
4.02.04.03	Contractor to note that DCDB/ACDB for common DC / AC loads shall be located in Unit-1. These DCDB/ACDB shall be powered from the 24 V DC Charger Systems (Diode ORing) & UPS Systems (Static Switch based change-over system) of 2 different Units to ensure their powering in event of unavailability of any one of the units. Scheme for the same shall be finalized during Detailed Engineering.
5.00.00	**AUXILIARY EQUIPMENTS**
5.01.00	All required auxiliary equipment/materials as finalised during detailed engineering shall be furnished with each rectifier bank, UPS & battery bank and shall include as a minimum various meters (AC/DC voltage/current, kVA, power factor, frequency meters etc), circuit breakers, selector switches, push buttons indicating lights, ground detector system, battery accessories like (inter cell connectors, inter step connectors, battery racks etc.) isolated 4-20 mA signals for important parameters and potential free contacts for important alarms shall be provided for use in DDCMIS.
6.00.00	**Battery Racks** The battery racks shall be constructed from high strength good quality mild steel sections. Battery Racks should either be epoxy painted or epoxy powder coated with three (3) coats, with acid resistant grade of pigment as per approved coating process to provide a non-peel able protective coat. The racks shall be of single tier/ two tier construction depending on the final layout based on space availability.
7.00.00	**SITE TESTS** The Contractor shall also carry out the site tests on equipments/systems as decided during detailed engineering.
8.00.00	**TRAINING** Contractor shall provide training on UPS & 24V DC Power Supply system for Employer's personnel. Please also refer Part-C, Section-VI of technical specifications.

SUB–SECTION – IIIC - 06

PROCESS CONNECTION

AND PIPING

PROCESS CONNECTION AND PIPING

1.00.00 **PROCESS CONNECTION PIPING**

Process connection & piping including all impulse piping, sample piping, pneumatic piping/tubing, valves, valve manifolds, fittings and all other accessories required for proper installation & completeness of impulse piping system, sampling piping system and air supply system shall be provided by the Contractor on as required basis.

The rating of material of impulse pipes, tubes, fittings, valves and their installation thereof shall conform to the latest edition of standards as per following table:

Impulse Pipes, Tubes (Material, Rating)	ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70
Valves (Material, Pr. Class, Size)	ASTM A182/ASTM A105 as per ASME 16.34
Fittings (Size, Rating, Material)	ANSI B31.1, ANSI B31.1a, ASME B16.11-2009
Installation Schemes	BS 6739-2009, ANSI/ISA 77.70

Instrument air filters cum regulator set with mounting accessories shall be provided for pneumatic device requiring air supply.

1.01.00 All transmitters and switches (except for fuel oil applications) shall be suitably grouped together and mounted inside

(i) Local Instruments Enclosures (LIE) in case of Open Areas of the Plant like Boiler Area, Coal Handling, Chimney Area, FGD area, CW Pump House, DM Plant, PT Plant, Ash Handling Plant etc.

(ii) Local Instrument Racks (LIR) in case of covered areas like Turbine Area, Generator Area etc.

(iii) Local Indicators/Gauges shall also be suitably grouped in Local Instrument Racks

In case grouping is not possible and these are to be installed individually, canopy with suitable mounting arrangement shall be provided.

All electric actuators, pneumatic control valves, Junction Boxes, Solenoid boxes and Local control panels which are not installed inside building, suitable canopy shall be provided and design of canopy shall be approved by Employer during detailed engineering.

1.02.00 Local Instrument Enclosures (LIEs) and Local Instrument Racks (LIRs) complete with all fittings, mountings & accessories, drains and Utility Lighting, Cable & Grounding cable etc. shall be provided by the Contractor on as required basis. The Degree of Protection of LIE and JB of LIE/LIR shall be IP-55. The instrument racks shall be constructed from 1.6 mm sheet plate and shall be free standing type constructed of suitable 3 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel and extended beyond the ends of the rack.

1.03.00 All temperature transmitters shall be suitably grouped together and mounted inside (i) Enclosures in case of open areas of the plant like Boiler Area, Coal Handling, Chimney Area, FGD area, CW Pump House, DM Plant, PT Plant, Ash Handling

Plant etc. and (ii) Racks in case of covered areas like Turbine Area, Generator Area etc. on as required basis. In case grouping is not possible and temperature transmitter is to be installed individually, canopy with suitable mounting arrangement shall be provided.

1.04.00 For skid mounted instruments and instruments integral to equipments, process connection and piping can be in line with bidder's standard and proven practice.

1.05.00 Contractor shall furnish "Certificate of Compliance" of erection of PCP as per approved documents.

1.06.00 PAINTING COLOR SCHEME FOR IMPULSE PIPING

S. No.	Area / Equipment	Impulse Pipe Ground Color		Identification Tag/Band		
		Color	RAL	Color	ISC No.	RAL
1)	Air	Grey	9002	Sky Blue	101	
2)	Water	Grey	9002	Sea Green	217	
3)	Steam	Aluminum		Signal Red	537	3001
4)	Air Steam Mixture	Aluminum		Sky Blue	101	
5)	Gas	Grey	9002	Canary Yellow	309	
6)	Oils	Grey	9002	Light Brown	410	
7)	Pulverized Fuel	Grey	9002	Silver Grey	628	
8)	Fire Installations	Fire Red	536 (ISC) 3001 (RAL)	White		9010
9)	HP Dosing	Grey	9002	Dark Admiralty Grey	632	
10)	LP Dosing / acid / alkali Piping	Grey	9002	Signal Red	537	
11)	Ash Piping	Grey	9002	French Blue	166	

Note: Ground color indicated against each piping shall be followed in case piping is not insulated /cladded.

SUB–SECTION – IIIC-07

INSTRUMENTATION AND POWER SUPPLY CABLES

INSTRUMENTATION CABLE, CONTROL & POWER SUPPLY CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL (CABLE SUB-TRAYs ETC

Specification of Instrumentation cable

1.00.00 Common Requirements

S. No.	Property	Requirement
1	Operating Voltage	225 V (peak value)
2.	Codes and standard	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.
3.	Continuous operation suitability	At 205 Deg C for Type-C cables & heat resistant cables (PTFE F & G instrumentation cables) At 70 Deg C for all other type of cables.
4.	Marking :- a.*Progressive automatic on-line sequential marking of length in meters to be provided at every one meter on outer sheath.* *b.*Marking to read 'FRLS' to be provided at every 5 meters on outer sheath except for Type-C cable	
5.	Allowable Tolerance on overall diameter	+/- 2 mm (maximum) over the declared value in data sheet
6.	Variation in diameter	Not more than 1.0 mm throughout the length of cable.
7.	Color	The outer sheath shall be of blue color.
8.	Others	Repaired cables shall not be acceptable.

1.01.00 Specific Requirements

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable	PTFE - F & G instrumentation cable
A. CONDUCTORS					
Cross section area	0.5 sq. mm				
Conductor material	ANSI type KX	ANSI type SX	Annealed bare copper	ANSI type KX	Annealed bare copper
Colour code	Yellow-Red	Black-Red	As per VDE-815	Yellow-Red	As per VDE-815

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable	PTFE - F & G instrumentation cable
Conductor Grade	As per ANSI MC 96.1		Electrolytic	As per ANSI MC 96.1	Electrolytic
No & dia of strands	7x0.3 mm (nom)				
No. of Pairs	2	2	2/4/8/12/16/24/ 48	2	2/4/8/12/16/24/ 48
Max. conductor loop resistance per Km (in ohm) at 20 deg. C	As per ANSI MC 96.1		73.4	As per ANSI MC 96.1	73.4
Reference Standard	As per ANSI MC 96.1		VDE : 0815	As per ANSI MC 96.1	VDE : 0815
B. INSULATION					
Material	Extruded PVC type YI 3			Teflon	Teflon
Thickness in mm (Min/Max)	0.25/0.35			0.4 / 0.50 (nominal)	0.4 / 0.50 (nominal)
Volume Resistivity (Min) in ohm-cm	1 x 10^{14} at 20 deg. C & 1x10^{11} at 70 deg. C.			2.8x 10^{14} at 20 deg. C & 2x10^{11} at 205 deg. C.	2.8x 10^{14} at 20 deg. C & 2x10^{11} at 205 deg. C.
C. PAIRING & TWISTING					
Max. lay of pairs (mm)	50				
Single layer of binder tape on each pair provided	Each core printed with number or Numbered binder tape to be provided on each pair		Yes	Each core printed with number	Each core printed with number or Numbered binder tape to be provided on each pair
Bunch (Unit Formation) for more than 4P	N.A		To be provided	NA	To be provided
Conductor /pair	N.A.		To be	NA	To be

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable	PTFE - F & G instrumentation cable
identification as per VDE0815			provided		provided
D. SHIELDING					
Type of shielding	Al-Mylar tape				
Individual pair shielding	No		To be provided for F-type cable	No	To be provided for PTFE F type cable
Minimum thickness of Individual pair shielding	No		0.028mm (28 micron)	No	0.028mm (28 micron)
Overall cable assembly shielding	To be provided				
Minimum thickness of Overall cable assembly shielding	0.055 mm (55 micron)				
Coverage / Overlapping	100% / 20%				
Drain wire provided for individual (F Type)/overall shield	Yes, Size- 0.5 sqmm,No of strands-7,Dia of strands-0.3mm,Annealed Tin coated copper				
E. FILLERS (if applicable)					
Non-hygroscopic, flame retardant	To be provided				
F. OUTER SHEATH					
Material	Extruded PVC compound YM1 with FRLS properties			Teflon (i.e. extruded FRP)	Teflon (i.e. extruded FRP)
Minimum Thickness at any point	1.8 mm			0.4 mm	0.4 mm
Nominal Thickness at any point	>1.8 mm			0.5 mm	0.5 mm
Resistant to water, fungus, termite & rodent attack	Required				

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable	PTFE - F & G instrumentation cable
Minimum Oxygen index as per ASTMD-2863	29 %			N.A.	N.A.
Minimum Temperature index as per ASTMD-2863	250 deg.C			N.A.	N.A.
Maximum Acid gas generation by weight as per IEC-60754-1	20%			N.A.	N.A.
Maximum Smoke Density Rating as per ASTMD-2843	60% (defined as the average area under the curve when of smoke density test plotted on a curve indicating light absorption vs. time as per ASTMD-2843)			N.A.	N.A.
Reference standard	VDE207 Part 5,VDE-816			VDE207 Part 6 ASTM D2116	VDE207 Part 5,VDE-816
G. Electrical Parameters					
Mutual Capacitance Between Conductors At 0.8 Khz (Max.)	200 nF/km		120 nF/km for F 100 nF/km for G	200 nF/km	120 nF/km for F 100 nF/km for G
Insulation Resistance (Min.)	100 M Ohm/Km				
Cross Talk Figure (Min.) At 0.8 Khz	60 dB		60 dB	60dB	60dB
Characteristic Impedance (Max) At 1 Khz	N.A.		320 OHM FOR F-TYPE 340 OHM FOR G-TYPE	N.A.	320 ohm for F-type 340 ohm for G-type
Attenuation Figure At 1 Khz (Max)	N.A.		1.2 db/km	N.A.	1.2 db/km

Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable	PTFE - F & G instrumentation cable
H. COMPLETE CABLE					
Complete Cable assembly	Shall pass Swedish Chimney test as per SEN-SS 4241475 class F3.			N.A.	N.A.
Flammability	Shall pass flammability as per IEEE-383 read in conjunction to this specification			As per manufacturer's standard subject to employer's approval	As per manufacturer's standard subject to employer's approval
I. CABLE DRUM					
Type	Non-returnable wooden drum or steel drum.				
Length	1000 m ± 5% for up to & including 12 pairs 500 m ± 5% for above12 pairs				

Note: Heat resistant instrumentation cable shall have specification as per above column **"PTFE - F & G Instrumentation cable"** and cable shall be suitable for continuous operation at 205 Deg. C

2.00.00 SPECIFICATION OF OPTICAL FIBER CABLES (OFC)

2.01.00 Optic Fiber cable shall be 4/8/12 core, Electrolytically chrome plated corrugated steel taped (ECCST), fully water blocked with dielectric central member for outdoor/indoor application so as to prevent any physical damage. The cable shall have multiple single-mode or multi mode fibers on as required basis so as to avoid the usage of any repeaters. The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacturer, progressive automatic sequential on-line marking of length in meters at every meter.

2.02.00 The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling viz. Dielectric central member, Loose buffer tube design, 4 fibers per buffer tube (minimum), Interstices and buffer tubes duly filled with Thixotropic jelly etc. The cable shall be suitable for a maximum tensile force of 2000 N during installation, and once installed, a tensile force of 1000 N minimum. The compressive strength of cable shall be 3000 N minimum& crush resistance 4000 N minimum. The operating temperature shall be – 20 deg. C to 70 deg.C

2.03.00 All testing of the fiber optic cable being supplied shall be as per the relevant IEC, EIA and other international standards. Spliced / Repaired cables are not acceptable.

2.04.00 Bidder to ensure that minimum 100% cores are kept as spares in all types of optical fibre

cables.

3.00.00 **SPCIFICATION OF CONTROL & POWER SUPPLY CABLES**

Refer Electrical sub-sections

4.00.00 **INSTRUMENTATION CABLE INSTALLATION AND ROUTING**

4.01.00 Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows:

From 11 kV/6.6 kV/3.3 kV tray system	-	914 mm
From 415V tray system	-	610 mm
From control cable tray system	-	305 mm

4.02.00 The cables emanating from redundant equipment/devices shall be routed through different paths. The above segregation of cables & wiring for redundant equipments/devices shall be in accordance with IEEE-Std-422.

4.03.00 Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs, except for pre-fabricated cables .

4.04.00 Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815.

4.05.00 Internal Panels / System cabinets wiring and termination of signal cables at DCS marshalling shall be as per standard and proven practice of contractor

5.00.00 **CABLE LAYING AND ACCESSORIES**

Laying of Optic Fiber cables (OFCs) :

Outside Building Area – to be laid necessarily inside covered cable tray of 100 mm with support from trestle structure

Inside Building area- to be laid on separate cable sub trays

While Buried – in separate buried trench approx. 1 meter depth to be laid in 2 " rodent proof HDPE conduits covered with sand, brick, laid breadth -wise and soil along the pipe line.

While crossing roads- to be laid in rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete.

While crossing canals/ rivers – to be laid in rodent proof HDPE conduits with hume pipe

Laying of Network Cable (UTP/ STP) ,Flame Scanner ,TSI:

Outside Building Area – to be laid necessarily inside separate covered cable tray of 100 mm with support from trestle structure

Inside Building Area- to be laid necessarily inside separate covered cable sub-trays.

6.00.00 **FIELD MOUNTED LOCAL JUNCTION BOXES (AS PER STANDARD AND PROVEN**

Practice of vendor

(i)	No. of ways	12/24/36/48/64/72/96/128 with 20% spares terminals.
(ii)	Material and Thickness	4mm thick Fiberglass Reinforced Polyester (FRP).
(iii)	Type of terminal blocks	Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm^2. A M6 earthing stud shall be provided.
(iv)	Protection Class	IP: 55 min. for indoor & IP-65 min for outdoor applications.
(v)	Grounding	To be provided.
(vi)	Color	RAL 7035

11.00.00 **CONDUITS AND CABLE TRAYS TO BE PROVIDED AS PER STANDARD AND PROVEN PRACTISE OF CONTRACTOR.**

SUB–SECTION – IIIC-08

CONTROL VALVES AND ACTUATORS

CONTROL VALVES, ACTUATORS & ACCESSORIES

1.00.00	**CONTROL VALVES, ACTUATORS & ACCESSORIES**
1.01.00	**General Requirements**
1.01.01	The control valves and accessories equipment furnished by the Bidder shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & pressure vessel code, Indian Boiler Regulation (IBR), ISA, and other standards specified elsewhere as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA" or acceptable equal standards. All the Control Valves, their actuators and accessories to be furnished under this Sub-section will be fully suitable and compatible with the modulating loops covered under the Specification.
1.01.02	All the control valves and accessories offered by the Bidder shall be from reputed, experienced manufacturers of specified type and range of valves. Ceramic lined control valves shall be provided as per standard and proven practice of QFGDM.
1.01.03	For special type of control valves such as combined pressure and temperature control valves for Aux PRDS application, separator drain control valves, HP Bypass System refer to the corresponding mechanical sections.
1.01.04	Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.
1.02.00	**CONTROL VALVE SIZING & CONSTRUCTION**
1.02.01	The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.
1.02.02	The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA handbook on control valves. While deciding the size of valves, Bidder shall ensure that valves outlet velocity as defined in ISA handbook does not exceed 8 m/sec for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Bidder shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which will be subject to Employer's approval during detailed engineering.
1.02.03	Control valves for steam and water applications shall be designed to prevent cavitation, wire drawing, flashing on the downstream side of valve and down stream piping. Thus for cavitation service, only valve with anti cavitation trim shall be provided. Detailed calculations to establish whether cavitation will occur or not for any given application shall be furnished. For flashing services, valve with hardened trim shall be provided.
1.02.04	Control valves for application such as SH Spray Control, RH spray Control, Heavy Oil Heating, pressurizing and Control system, HP/LP heater Emergency level control, Emergency Make-up to condenser hotwell, GSC minimum flow, Deaerator Drain to Condenser Hotwell, Condensate spill to condensate reserve tank, condenser normal make-up and valve gland sealing supplying pressure control, CEPS minimum flow control, BFP circulation control valve shall have permissible leakage rate as per leakage Class V. All other control valves shall have leakage rate as per leakage Class-IV as per ANSI / FCI /70.2,2006 or equivalent.
1.02.05	The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and

trim design and not by use of silencers except for few cases as per contractor's standard and proven practice subject to employer's approval.

1.02.06 Control valves for steam and water application shall be provided with rangability of 30:1 for all services except for applications wherein control valves are envisaged to be operated in lower range like Reheater spray and superheater spray system wherein control valve with rangability of 50:1 shall be provided

2.00.00 VALVE CONSTRUCTION

2.01.00 All valves shall be of globe body design & straightaway pattern with single or double port, unless other wise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit.

2.02.00 Valves with high lift cage guided plugs & quick-change trims shall be supplied.

2.03.00 Cast Iron valves are not acceptable.

2.04.00 Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Employer. Bonnet joints of the internal threaded or union type will not be acceptable.

2.05.00 Plug shall be of one-piece construction cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.

2.06.00 All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing or with extra deep gland packing, which shall be equipped with lantern rings to admit pressurized water for gland sealing.)

2.07.00 Valve characteristic shall match with the process characteristics.

2.08.00 Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 deg. C.

2.09.00 Flanged valves shall be in accordance to ANSI B 16.5.

3.00.00 VALVE MATERIALS

Sr. No.	Service	Body material	Trim Material
1	Non-corrosive, non-flashing and non-cavitation service except DM water	Carbon steel ASTM-A216 Gr. WCB for design fluid temperature below 275 Deg. C Alloy steel ASTM-A217Gr. WC6 for design fluid temperature above 275 Deg. C and upto 400 Deg. C Alloy steel ASTM-A217Gr. WC9 for design fluid temperature above 400 Deg. C	316SS stellited with stellited faced guide posts and bushings.
2.	Severe flashing/cavitation services	Alloy steel ASTM-A217 Gr. WC9	440 C
3.	Low flashing/cavitation service	Alloy steel ASTM-A217 Gr. WC6	17-4 PH SS

4.	DM water service	316 SS	316 SS

NOTE: (a) Valve body rating shall meet the process pressure and temperature requirement as per ANSI B16.34.

(b) Severe flashing / cavitation services includes as a minimum all control valves whose downstream piping is connected to condenser or flash tank.

However, Bidder may offer valves with body and trim materials better than specified materials and in such cases Bidder shall furnish the comparison of properties including cavitation resistance, hardness, tensile strength, strain energy, corrosion resistance and erosion resistance etc. of the offered material vis-a-vis the specified material for Employer's consideration and approval.

4.00.00 END PREPARATION

Valve body ends shall be either butt welded/socket welded, flanged (Rubber lined for condensate service) or screwed as finalized during detailed engineering and as per Employer's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure-temperature class equal to or greater than that of the control valve body.

5.00.00 VALVE ACTUATORS

All control valves shall be furnished with pneumatic actuators except for pressure and temperature control valve for auxiliary PRDS application (electro-hydraulic / pneumatically operated) and separator drain control valve (electro-hydraulic type).The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously.

Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified.

The travel time of the pneumatic actuators shall not exceed 10 seconds.

6.00.00 CONTROL VALVE ACCESSORY DEVICES

6.01.00 All pneumatic actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, microprocessor based electronic Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.

7.00.00 SPECIFICATIONS FOR MICROPROCESSOR BASED ELECTRONIC POSITIONER

1	Environment	a) Protection class.	IP-65 Minimum
2	EMC & CE Compliance	Required to International Standard like EN/IEC.	EN50081-2 & EN50082 or equivalent.

3	Accessories	In-built Operator Panel	Display with push buttons for configuration and display on the positioner itself (Password protected/Hardware lock).
		Hand Held Calibrator	(i) Universal HART Calibrator to be provided for conventional positioners. (for quantity, refer Part-A. Contract quantities of the specification). (ii) Fieldbus compatible calibrator to be provided for fieldbus based positioners. (for quantity, refer Part-A)

7.01.00 **POSITIONER WITH INTRINSIC PARTIAL STROKE TEST (PST) FACILITY**

FGD Bypass Damper is very critical for the safe evacuation of flue gas when FGD is not in operation. Normally it shall be in CLOSED condition most of the times when FGD is in operation. But during emergency need, if it fails to OPEN, it can lead to high furnace pressure and subsequent MFT. Therefore, a PARTIAL STROKE TEST for the Bypass damper to be carried out in AUTO at regular intervals.

A timer is set to conduct partial stroke test weekly (programmable). When timer is due, an alarm message is sent to both Main Unit Control Room and FGD Control Room: "FGD PARTIAL STROKE TEST SCHEDULED". A soft Push Button is to be provided in the Main Control Room only. Once the Operator presses the PB, the timer is reset and "FGD PARTIAL STROKE TEST INITIATED "message should flash in both Main Unit CR and FGD CR.
An analog output command shall be sent to the FGD Bypass Damper for programmable opening. Once the Damper OPENS to the predetermined Set Point, a close command is issued to close the damper (approx. 10% opening PFT SP is to be given and for CLOSE Limit switch is to be used). After getting, the close feedback "FGD PARTIAL STROKE TEST SUCCESSFUL" message is flashed. This test should complete successfully within a scheduled time. If it does not, "FGD PARTIAL STROKE TEST FAIL" alarm shall be flashed in both Unit CR and FGD CR. Scheme shall be finalised during detailed engineering.

Contractor shall provide ***positioner*** with intrinsic ***Partial Stroke Test (PST)*** facility to achieve the above functionalities for the FGD Bypass Damper with all suitable pneumatic and electrical connections.

All other or better specifications of Positioners shall be applicable to PST positioners as mentioned in Section – VI, Part-B, Control Valves, Actuators & Accessories, Sub-Section-IIIC-08, Clause 7.00.00.

8.00.00 **TEST AND EXAMINATION**

All valves shall be tested in accordance with the quality assurance programme agreed between the Employer and Contractor, which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following:

8.01.00 Non Destructive Test as per ANSI B-16.34.

8.02.00 Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test.

8.03.00 Valve closure test and seat leakage test in accordance with ANSI-B 16.34/ FCI 70.2 standard and as per the leakage class indicated above

8.04.00 Functional Test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.

8.05.00	CV Test: Please refer Cl No. 1.00.00 & 3.00.00 OF Sub-section- IIIC-10 (Type test requirements), Control Valves. Bidder shall furnish all the control valves under this main plant package as finalized during detailed engineering stage without any price repercussions whatsoever depending on the process requirements. All the control valves provided by the Bidder for this project shall meet the specifications requirements specified herein. Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.

SUB–SECTION – IIIC-09

PROGRAMMABLE LOGIC CONTROLLER SYSTEM

PROGRAMMABLE LOGIC CONTROLLER FOR AUXILIARY SYSTEMS

1.00.00	**General Requirements**	1. Contractor shall provide complete Control and Instrumentation system with all accessories, auxiliaries and associated equipment's and cables for the safe, efficient and reliable operation of the plant auxiliary systems as indicated under Scope of Supply & Services at Sub-section IIC, Part-A, Section VI. 2. For certain systems where PLC is integrally mounted on the equipment, Contractor's standard and proven practice shall also be taken into consideration. This shall be finalized during detailed engineering. 3. All electrical devices like switches/ transmitters/ controller/ analyzer/ solenoid valves which are located in the hydrogen generation plant shall be made intrinsically safe by providing suitable type of transformer isolated barrier/ Zener barrier of standard make in case it is a standard and proven practice of the bidder. Otherwise such instruments shall be provided with explosion proof enclosure suitable for hazardous areas described in National Electric Code (USA), Article 500, Class-I, Division-I or EN60079-14or shall comply with the essential requirements of ATEX directives. All fittings, cable glands etc. for the above requirement shall be strictly as per NEC recommendation article, 500 to 503
2.00.00	**Standards for Compliance**	• Requirement specific to programmable controllers: Functional characteristics, Immunity, Resistance, Safety etc.: IEC / EN 61131-2 and IEC / EN 61010-2-201 • IEC-61131-3 [Programming Language Standard] / IEC-61804 [Standard for EDDL] / IEC-61499 • ISA S 71.01 [Environmental Conditions for Process Measurement and Control Systems: Temperature and Humidity] • ISA S 71.01 [Environmental Conditions for Process Measurement and Control Systems: Temperature and Humidity]
3.00.00	**System Requirements**	1. Control system shall provide safe operation under all plant disturbances and on component failure so that under no condition the safety of plant, personnel or equipment is jeopardized. 2. It shall be possible to remove / replace online, various modules (like Controller, I/O module, interface module, etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. 3. All Electronic modules of PLC shall have conformal protective coating as per G3 / GX classification in accordance with ISA S-71.04 standard. The conformal coating version shall be a standard product from the manufacturer's factory. The hardware that is being conformal coated locally shall not be acceptable. 4. The system design shall be modular and scalable to facilitate easy system expansion. Further it shall ensure that no single failure in the system results in loss of system operation.
4.00.00	**Processor**	1. Two (2) numbers, one as primary and another as hot standby. It shall be based on dual core multi-function microprocessor technology as a minimum and shall carry the latest error correction (ECC) technology. 2. Controllers shall be fully redundant operating in Hot-standby mode.Either controller can serve as primary or backup. The primary and standby CPU sections should be connected over a dedicated redundant link (with extremely high transmission speed (in GBPS)) to ensure true redundancy.
5.00.00	**Memory**	Integrated flash memory based on Maintenance free battery-less design on

		its mother board. Internal Memory shall be non-volatile, based on latest semiconductor (NAND flash) storage technology and scalable (min. 8 MB) for programming, process application and data storage. In case of non-scalable memory based design, minimum 32 MB shall be provided. In case of a battery based design, Lithium or Ni-Cd battery for 360 hours backup to be provided. CPU memory shall have minimum 30% spare capacity for future use.
6.00.00	**I/O racks and modules**	Modular design. All input/output cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching of power supply. In general, all Output cards shall be sourcing type and Input cards shall be sinking type.
7.00.00	**Analog Signal Conditioning**	1. Galvanic isolation of input and output signals for which power supply source is derived from source external to the control system power supply. 2. Transmitter power supply with per point current limiting or fuse protection for loop powered transmitters. 3. Monitor sensor wire break/open circuit/short circuit and take suitable actions in logic/loop. (This will include blocking of trip signals in case of RTD failure). 4. All analog outputs shall be short circuit proof.
8.00.00	**Isolation between I/P, O/P and controller**	1.5 KV with opto couplers.
9.00.00	**Diagnostics & Indication**	1. Channel Level Diagnostics (with reverse polarity, wire break, short circuit & optical /galvanic isolation) for DI / DO, AI & AO shall be provided. Each individual Channel healthiness shall be monitored at workstation / GUI level. 2. Individual signal status of each Input / Output, power supply status shall be indicated on the module faceplates.
10.00.00	**Fail safe mode**	1. On power supply failure / both PLCs failure / communication failure etc. the output shall be automatically switched over to fail safe mode. 2. In case of such failures, operating drives / equipment shall be tripped or kept running as per a pre-determined programmable requirement finalized during detailed engineering.
11.00.00	**Fusing philosophy**	Individual fuses with blown fuse indicator for each output. Individual fuses for each input/ group of inputs, keeping in view of system availability.
12.00.00	**Switching Capacity**	Output modules shall be rated to switch on/off coupling relays of 3VA at 24V DC and solenoid valves at 110 V AC. Coupling relays shall be provided in HT/LT Switchgears.
14.01.00	**Data Communicatio n Sub-System**	The communication sub-system shall be a digital communication bus, based on standard Ethernet technology as its infrastructure backbone that provides a high speed data transfer rapidly and reliably between the operator station, process I/O devices and other devices connected to it. Based on existing IEEE 802.3 Ethernet standards, the network system shall be compatible with commercial off-the-shelf Ethernet products. HMI network between controllers and HMI devices shall be a minimum 100 Mbps redundant Ethernet control network (based on TCP/IP) to ensure high availability. Similarly, the redundant I/O bus /

		ring network shall be based on Ethernet technology (TCP/IP) with minimum 100 Mbps data transmission speed using suitable protocols to ensure 50 ms or better recovery time.
14.02.00	**Integration with Station LAN**	1. The PLC system shall be OPC compliant and shall be provided with necessary hardware and software for successfully establishing dual redundant fiber optic connectivity with DDCMIS Station wide LAN using bidirectional OPC communication through OPC DA / UA protocol. 2. Suitable OPC server and client software and sufficient no. of licenses shall be procured by the contractor for fully meeting the intent as stated above. 3. Redundant Ethernet switches to be supplied for output to Station wide LAN shall be 24V DC operated, managed switches. 4. The PLC system shall have interface and be able to communicate with several Open Industrial standard communications viz. HART, Profibus / Foundation Fieldbus, Modbus Serial / TCP-IP, ASI, OPC DA / OPC UA.
14.03.00	**Power Supply**	1. Two (2) nos. 415V AC feeders shall be provided for each PLC control panel / desk and remotely located I/O panels. 2. 24 V DC power supply system for PLC shall comprise of 2 x 100% power supply unit (power pack) along with 1 x 100% sealed maintenance free lead acid batteries for 30 minutes back up and DC distribution board, the whole assembly housed in a single panel. Power supply unit shall be capable of charging the batteries and feeding the load simultaneously. The DC distribution board shall have redundant feeders for critical loads. 3. Redundant power supply system for CPU, I/O system, interposing relays shall be provided. Power distribution shall be performed in such a way that any single power supply failure shall not cause loss of operation of any module. Power conditioning and isolation shall be performed to eliminate ground loops. The redundant power supply arrangement for Interposing relays shall be separate from the power supply arrangement for CPU / I/O modules. 4. PLC internal power supply modules shall be capable of accepting input voltage in the range of 18 to 32 V DC and give a stable 24V DC output. 5. Single phase 230V AC power supply for PC / monitor & printer units shall be derived from the incoming feeders provided, preferably from within the 24V DC power supply cabinet to be fed through mini-UPS. Surge protected power sockets shall be considered for powering the PC, monitor and printer units.
14.04.00	**Command Hierarchy**	Protection commands shall have priority over manual commands and manual commands shall prevail over auto commands.
15.00.00	**Time Synchronization system**	The PLC processor should be capable of receiving clock signals from Master Slave Clock system of the Owner in either NTP, DCF77 or IRIG-B format.
16.00.00	**System Reaction time**	Less than 100 msec. from input signal to output signal including logic processing. Display response of maximum 1 sec for control related displays. 2 to 3 secs for other displays.
17.00.00	**Programming functionalities**	1. PLC shall be function block based besides ladder logic complying with IEC 61131-3 standard for programming languages. The programming language shall be based on object model approach, it should be user friendly with graphical user interface and shall not require knowledge of any specialized language. Further along with IEC 61131-3,

		programming language confirming to IEC 61804 / IEC 61499 shall also be acceptable. All standard libraries of FBs as per IEC 61131-3 shall be provided. 2. Adequate testing procedure shall be available to verify new logic prior to activating it in the on-line program. Further facility to simulate and test logic before on-line loading shall be available in the programming / configuration software.
19.00.00	**HMIS (Human Machine Interface System)**	1. Operator shall be able to access all control / information related data under all operating conditions including a single processor / computer failure in the HMIS. 2. The operator functions for each OWS shall as a minimum include Control System operation (A/M selection, raise/lower, set point/bias change, on/off, open/close operation, mode/device selection, bypassing criteria, sequence auto, start/stop selection, drive auto selection, local-remote/other multi-position selection etc.); alarm acknowledge; call all kind of displays, logs, summaries, calculation results, etc.; printing of logs & reports; retrieval of historical data; and any other functions required for smooth operation, control & management of information as finalized during detailed engineering. 3. The system design shall provide for non-disruptive repairs of faulty equipment and on-line, non-disruptive system expansion in the field. 4. The system shall support notification of a service disruption and recovery including computer name of failed server. 5. Normal/Test/Program/Off facility shall be provided. In test mode all outputs shall be blocked. Manual intervention shall be possible at any stage of operation
20.00.00	**Long time storage and retrieval**	Minimum 1 year's long term historical data shall be available.
21.00.00	**Software**	1. Industry standard operating system like UNIX/WINDOWS (latest version) etc. to ensure openness and connectivity with other system in industry standard protocols (TCP-IP/ OPC etc.) shall be provided. 2. Contractor shall provide all system / application soft wares with locks and passwords for PLC functioning like Real Time Operating System, File management software, screen editor, database management software, input/output scanning, acquisitions, condition processing, control and communication, operator interface of monitors, display trends, curves, bar charts, historical storage/ retrieval and alarm functions for meeting the intent, functional and parametric requirements of the specification. Complete set of documents for modifications / editing / additions/ deletions of features in software. Comprehensive list of all application/ system software.
22.00.00	**Accessories**	Industrial grade furniture shall be provided along with Control desk / OWS / printer which shall be aestheticallydesigned and finalized during detailed engineering.
23.00.00	**Software license& Upgrades**	1. The Contractor shall provide software license for all software being used in PLC based control system including HMI. The software licenses shall be provided for the project and shall not be hardware/machine specific. All licenses shall be valid for the continuous service life of the plant. 2. As a customer support the Contractor shall periodically inform the designated officer of the Employer about the software upgrades / new releases that would be taking place after the system is commissioned and in service, so that, if required, same can be procured and installed

at site.

24.00.00 **OWS / EWS & printers**

1. Operator workstations (OWS) shall perform control, monitoring and operation of all auxiliaries / drives interacting with PLC based control system. It shall be possible to use the same system as EWS. The quantity of PCs, its associated peripherals and printers shall be finalized during detailed engineering. GIU shall be provided for CSU.
2. All cables/links for connecting system described above shall be provided by the Contractor on as required basis within quoted price.

25.00.00 **Remote I/O panels**

Contractor shall provide Remote Input /Output modules housed in free-standing cabinets / racks (with suitable redundant datalink to the central PLC system) as finalized during detailed engineering. These Input / Output modules of the RIOs shall be designed to continuously work under the environment expected to be encountered in assigned areas without any air-conditioning support.

26.00.00 **PLC system security and Cyber security**

The PLC system shall comply with IEC-62443 standards for Industrial Automation and Control System security. The system may preferably be Achilles level 2 / ISA Secure EDSA / Equivalent certified.

27.00.00 **Spare Requirement**

1.	Spare channels in input / output modules fully wired up to cabinets' TBs	10% of as Engineered
2.	Wired-in "usable" space in each of the system cabinets for mounting electronic modules wired up to corresponding spare terminals in system cabinets. (Empty slots between individual modules / group of modules, kept for ease in maintenance or for heat dissipation requirement as per standard practice of Contractor shall not be considered as wired-in "usable" space for I/O modules.)	For 20% of as Engineered modules
3	Wired-in "usable" space for modules Terminal assemblies (if any in the offered system), corresponding to the I/O modules shall be provided	20% for above mentioned 20 % blank space
4	Spare capacity in Processor / Controller to handle additional inputs / outputs of each type over and above implemented capacity.	30% spare functional capacity
5	Communication Controllers & Data communication system each	30% spare functional capacity of as Engineered
6	Spare relays & isolators of each type and rating mounted and wired in cabinets' TBs	20% of as Engineered

28.00.00 **Type Test Requirement - PLC**

PLC type test shall be provided as specified in the Type Test Requirements chapter of technical specifications.

SUB–SECTION – IIIC-10

TYPE TEST REQUIREMENTS

1.00.00 **TYPE TEST REQUIREMENTS**

1.01.00 General Requirements

1.01.01 The Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. If the bidder proposes a different standard/code from that indicated at clause no 2.01.00 and at table 3.00.00, same is acceptable provided the equivalence of the proposed standard is established by the bidder. A list of such tests are given for various equipment in table titled 'TYPE TEST REQUIREMENT FOR OTHER C&I SYSTEMS' at the end of this chapter and under the item “Special Requirement for Solid State Equipments/Systems”.

(a) Out of the tests listed, the Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests.

(b) For the rest, submission of type test results and certificate shall be acceptable provided.

i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment.

ii. There has been no change in the components from the offered equipment & tested equipment.

iii. The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening.

(c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account.

1.01.02 The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.

1.01.03 For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.

1.01.04 The Bidder shall indicate in the relevant BPS schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only be payable after conduction of the respective type test in presence of authorize representative of Employer. If a test is waived off, then the cost shall not be payable.

2.00.00 **SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS**

2.01.00 The type test reports which are to be submitted for each of the C&I systems(indicated in clause 2.01.01) shall be as indicated below:

i) Surge Withstand Capability (SWC) for Solid State Equipments/ Systems

All solid state systems/ equipments shall be able to withstand the electrical noise

and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI / IEEE C37.90.1.. Hence, all front end cards/ devices which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI / IEEE C37.90.1. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to compliance to ANSI / IEEE C37.90.1, the system shall comply to IEC-61000-4-4, IEC-61000-4-5 and IEC-61000-4-18.

ii) Dry Heat test as per IEC-60068-2-2 or equivalent.

iii) Damp Heat test as per IEC-60068-2-30 or IEC-60068-2-78 or equivalent.

iv) Vibration test as per IEC-60068-2-6 or equivalent.

v) Electrostatic discharge tests as per IEC 61000-4-2 or equivalent.

vi) Radio frequency immunity test as per IEC 61000-4-6 or equivalent.

vii) Electromagnetic Field immunity as per IEC 61000-4-3 or equivalent.

2.01.01 **C&I Systems-**

Sl. No	Item	Remark	Test To Be Specifically Conducted	NTPC's Approval Req. On Test Certificate
1	Control System of DDCMIS		No	Yes
2	PLC, excluding its HMI	Not applicable for integral PLCs and PLCs which are governed by standard practice of OEM	No	Yes
3	VMS System (Applicable for each module of VMS)		No	Yes
4	Main Turbine & BFP Drive Turbine TSI System (Applicable for each module of TSI System)		No	Yes
5	Vibration Analysis System (Applicable for each module of Vibration Analysis System)		No	Yes

6	TG related Special modules like Auto synchronizer, Load transducer module and speed measurement module		No	Yes
7	Master Clock		No	Yes

Note:

Type Tests are to be conducted only for the items, which are being supplied as a part of this Package.

3.00.00 **TYPE TEST REQUIREMENT FOR OTHER C&I SYSTEMS**

Sl. No	Item	Test Requirement	Standard	Test To Be Specifically Conducted	NTPC's Approval Req. On Test Certificate
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
1	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	Yes
2	Instrumentation Cables Twisted & Shielded*				
	-Conductor	Resistance test	VDE-0815	No	Yes
		Diameter test	IS-10810	No	Yes
		Tin Coating test (Persul-phate test)	IS-8130	No	Yes
	-Insulation	Loss of mass	VDE 0472	No	Yes
		Ageing in air ovens**	VDE 0472	No	Yes
		Tensile strength and elongation test before and after ageing**	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes
		Shrinkage	VDE 0472	No	Yes
		Bleeding & blooming	IS-10810	No	Yes
	-Inner sheath***	Loss of mass	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Cold bend/ cold impact test	VDE 0472	No	Yes
		Hot	VDE 0472	No	Yes

		deformation			
		Shrinkage	VDE 0472	No	Yes
	-Outer sheath	Loss of mass	VDE 0472	No	Yes
		Ageing in air ovens**	VDE 0472	No	Yes
		Tensile strength and elongation test before and after ageing**	VDE 0472	No	Yes
		Heat shock	VDE 0472	No	Yes
		Hot deformation	VDE 0472	No	Yes
		Shrinkage	VDE 0472	No	Yes
		Bleeding & blooming	IS-10810	No	Yes
		Colour fastness to water	IS-5831	No	Yes
		Cold bend/ cold impact test	VDE-0472	No	Yes
		Oxygen index test	ASTMD-2863	No	Yes
		Smoke Density Test	ASTMD-2843	No	Yes
		Acid gas generation test	IEC-60754-1	No	Yes
	-fillers	Oxygen index test	ASTMD-2863	No	Yes
		Acid gas generation test	IEC-60754-1	No	Yes
	-AL-MYLAR shield	Continuity test		No	Yes
		Shield thickness		No	Yes
		Overlap test		No	Yes

-Over all cable	Flammability Test	IEEE 383	No	Yes
	Swedish Chimney Test	SEN 4241475	No	Yes
	Noise interference	IEEE Trans-actions	No	Yes
	Dimensional checks	IS 10810	No	Yes
	Cross talk	VDE-0472	No	Yes
	Mutual capacitance	VDE-0472	No	Yes
	HV test	VDE-0815	No	Yes
	Drain wire continuity		No	Yes

* 1.0 All cables to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last Ten years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

2.0 In case the Contractor is not able to submit report of the type test(s) conducted within last Ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests either in an independent laboratory or at manufacturer's works in presence of Owner's representative under this contract free of cost to the Owner and submit the reports for approval.

**These tests shall be carried out as per VDE0207 Part 6 & ASTMD-2116 for TEFLON insulated & outer sheathed cables

***Applicable for armoured cables only

3 DC Power Supply System (Applicable for each model and rating)

1)The Type Test reports for offered rectifier module and the controller module irrespective of the rectifier bank shall be acceptable

Surge Withstand Capability(SWC)	(ANSI / IEEE C37.90.1)or (IEC-61000-4-4, IEC-61000-4-5 and IEC-61000-4-18).	No	Yes
Dry Heat Test	IEC-60068-2-2 or equivalent	No	Yes

		Damp Heat test	IEC-60068-2-30 or IEC-60068-2-78 or equivalent	No	Yes
		Vibration test	IEC-60068-2-6 or equivalent	No	Yes
		Electrostatic discharge test	IEC 61000-4-2 or equivalent	No	Yes
		Radio frequency immunity test	IEC-61000-4-6 or equivalent	No	Yes
		Electromagnetic field immunity	IEC 61000-4-3 or equivalent	No	Yes
		Degree of Protection	IS-13947 or equivalent	No	Yes
4	Battery ##	As per standard (col 4)	IS-10918 (Ni-Cd Batteries)	No	Yes
			IS-1652 (Lead Acid Plante Batteries)	No	

5 UPS (Applicable for each model and rating)

1) Type Test reports of same series of UPS with similar PCB's cards and controllers as the target UPS system shall be acceptable.

2) For Dry heat, Damp heat and vibration, the tests conducted on individual PCB's shall be acceptable.

Surge Withstand Capability(SWC)	(ANSI / IEEE C37.90.1)or (IEC-61000-4-4, IEC-61000-4-5 and IEC-61000-4-18).	No	Yes
Dry Heat Test	IEC-60068-2-2 or equivalent	No	Yes
Damp Heat test	IEC-60068-2-30 or IEC-60068-2-78 or equivalent	No	Yes
Vibration test	IEC-60068-2-6 or equivalent	No	Yes

		Electrostatic discharge test	IEC 61000-4-2 or equivalent	No	Yes
		Radio frequency immunity test	IEC-61000-4-6 or equivalent	No	Yes
		Electromagnetic field immunity	IEC 61000-4-3 or equivalent	No	Yes
		Degree of protection test	IS-13947	No	Yes
		Fuse Clearing Capability	Approved procedure	No	Yes
		Short Circuit current capability	IEC 60146-2	No	Yes
6	Public Address System				
	IP based PA system components	As per Standard	IEC 60268-16	No	Yes
7	Control Valves	CV test	ISA 75.02& 75.11	No	Yes
8	Flow Nozzle Orifice plates	Calibration	ASME PTC BS 1042	No	Yes

The contractor shall submit for Employers approval the reports of all the type test as per latest IS-10918 carried out within last ten years from the date of Bid opening and the test(s) should have been either conducted at an independent laboratory or in presence of owner's representative. The complete type test reports shall be for any rating of Battery in a particular group based on plate dimensions being manufactured by supplier.

Note:

Type Tests are to be conducted only for the items, which are being supplied as a part of this Package.

SUB–SECTION – IIIC-11

CONTROL DESK, PANELS AND FURNITURE

1.00.00 **CONTROL DESK & PANELS**

1.01.00 **GENERAL**

1.01.01 All control desk, panels, LVS panel etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, grounding, ventilation, space heating, anti-vibration pads, internal piping & accessories as required for completeness of the system The bottom of desk & cabinets shall be sealed with bottom plate, compression cable glands (double for field and single for inside rooms) and fireproof sealing material to prevent ingress of dust and propagation of fire. The exact color shall be finalized during detailed engineering.

1.01.02 The design shall conform to the EN ISO 11064 (Ergonomic design of control room), Part-1,2 and 3.

2.00.00 **CONTROL DESK & PANEL**

Control Desk (CD)

2.01.01 Control desk **shall be Modular, non-welded construction** free standing table top type with **front &** back **cover** constructed of **1.6** mm thick CRCA steel plates**.** The tabletop of the control desk shall be arc-shaped for mounting **TFT** monitors **& mice for SG, TG, BOP (irrespective of scope of supply) and synchroscope**. **TFT monitors and synchroscope shall be provided with adjustable mounting arrangement.** The work surface of control desk shall be 30mm thick with the top 12mm of Acrylic Solid Surface **(ASS)** and the remaining 18mm of laminated medium density fiber board**. Work surface shall be made of two different colors at same level and seamlessly joined in each section**. **The structure frame shall consist of extruded aluminum top and bottom horizontal beams. Vertical & Horizontal supports, minimum 2.5mm and 2mm thick respectively, have to be provided for the structure frame. Extreme side legs shall be illuminated type and should complete the overall form and aesthetics of the desk. It shall have concealed cable & wire way management system.** PA system hand sets, telephone sets, very few PB stations and lamps shall be mounted on the control desk on mosaic grid structure . Sliding keyboard trays shall be provided on the CD. All operator monitors & mice for SG, TG, BOP shall be mounted on this CD. The cabling / wiring between OWS & CPU's, power supply cables etc. shall be aesthetically routed and concealed from view. Profile and construction of the Unit Incharge Desk shall be same as that of CD. Provision for Operator Work Station and PA system/ telephone handset etc. shall be provided

2.02.00 **Hardwired devices on Control Desk (CD) (draw out section)**

CD shall be provided with a draw out section where hardwired devices shall be mounted on a mosaic grid mosaic portion for mounting backup.. The mosaic grid tiles shall be of 24 mm x 48 mm (or 25 mm x 50 mm) size, made of heat and flame retardant, self extinguishing and non-hygroscopic material with flat matt finish without glare and non reflecting type. Unit Control desk draw-out sections shall have wiring arrangement suitable for ease of termination and maintenance. For this, all back up consoles/ devices shall be factory wired to terminals mounted on desk. Further connection to marshalling cabinets of DDCMIS shall be done through a common terminal box which shall be located suitably in the cable vault area. Any other better arrangement meeting the above intent is also acceptable subject to employer's approval during detailed engineering.

2.03.00 **Control Desk Devices**

Push buttons, LEDS , indicators, raise lower PB, trip PB, acknowledge PB, release PB, emergency trip PB (4NC), test PB, hand switches, mimic tile etc shall be furnished for each generating unit as required basis to be mounted on the draw out section of Unit Control Desk of each unit . For design philosophy of draw out section of process side & electrical side, refer clause 4.00.00 of this sub section. Turbine Trip Push button(s), Steam Generator Trip Push button(s), Fire Protection Push button(s) and any other Trip Push button (PB) as recommended by OEM of Turbine & Steam Generator to be provided.

2.04.00 **Furniture**

2.07.01 **Bidder sh**all provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe. Each module shall have transparent cover and adjustable partition. It shall have locking provision for security. The components shall be suitable for integration/fabrication without any welding technology.

1. Work Station furniture

   Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (inkjet or A4 laser) etc. is to be provided..

2. Server Rack

   Server rack shall be provided to mount programmer stations, PC based systems (of rack type and tower type), Matrix KVM switcher, Mini UPS etc. in Programmer room. Suitable arrangement for Ventilation and cooling shall be built in.

3. PC rack

   PC rack shall be provided to mount CPUs of workstations/PCs of OWS/LVS etc in Control Room.

4. Chairs

   Industry standard Ergonomic revolving chairs with wheels, with provision for breathable mesh design backrest with adjustable lumbar support, adjustable armrests, adjustable headrest, adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back. Chair shall have Steel-strengthened cushion seat and twin wheel castor of glass filled nylon. The exact details shall be finalized & approved by Employer during detailed engineering.

5. Tables

   a Industry standard computer tables shall be provided & shall be as approved by Employer during detailed Engineering.

b Conference Room standard tables shall be provided with acrylic coat for good finish. Details shall be finalised & approved by Employer during detailed engg.

6. Almirahs

Steel Almirahs shall be provided for keeping documents in the documentation room.

7. Keypad

Keypads shall be provided for the storing of keys of relevant areas in the respective control rooms

8. Lockers

Suitable lockers shall be provided in the room adjacent to the control room for storing of personal articles of control room personnel & also for documents.

3.00.00 LVS PANEL

3.01.00 An arc shaped Large Video Screen (LVS) panel shall be supplied for mounting large video screens in number of tiers in various Control rooms as specified at Part-A of specification. An indicative typical sketch of Control Room Concept showing LVS & OWS is given in drawing no. 0000-999-POI-A-061Rev.B. The profile, dimensions and the general arrangement shall be finalized & approved by Employer during detailed engineering.

4.00.00 UNIT CONTROL DESK - DESIGN PHILOSOPHY OF DRAW OUT SECTION FOR PROCESS SIDE AND ELECTRICAL

4.01.00 The draw out console of unit control desk is provided as a back-up panel that shall be used for safe shutdown of the unit, during emergency and non-availability of operation from HMI. Broadly, the console contains the control and status feedback of critical drives that are required to be controlled for safe shutdown of the boiler and turbine. Essentially, the control of drives required for stopping fuel injection into boiler and safe coasting down of turbine and TDBFPs shall be provided on the console.

4.02.00 Based on above, the console shall contain:

4.02.01 Emergency stop command button for HT drives (along with ON/OFF status) listed below:
a) Individual Mills
b) Individual ID fans
c) Individual FD Fans
d) Individual PA fans
d) Individual BFPs (including TDBFPs)
e) Individual CEPs

4.02.02 Start stop push button for LT drives (along with individual drive ON/OFF/ Fault status) listed below, as applicable as per actual equipment available in the process:
a) Boiler circulating water pump (BCWP)
b) Equipment cooling water pumps (ECW) of both SG and TG area
c) Scanner cooling air fans (both AC and DC)
d) Main turbo generator DC EOP, DC JOP, DC SOP
e) Main turbo generator AC LOP, AC JOP, AC SOP
f) TDBFPs DC EOP
g) TDBFPs AC AOP, AC JOP

	h) MDBFPs AC AOP i) APH AC drives and air motor
4.02.03	Start stop push button for Valves (Motorized/hydraulic/pneumatic operated) (along with individual valve Open/Close/Fault status) listed below, as applicable as per actual equipment available in the process: a) Main Steam line STOP VALVEs b) Super-heater, re-heater and separator outlet spray line block valve c) LOTV, HOTV, LORV, HORV d) BCWP emergency cooling water line inlet valve e) BCWP cooling line drain valve f) TDBFPs emergency stop valve g) Main turbine turning gear valve h) TDBFPs turning gear valve
4.02.04	Digital indicators for following critical measurements: a) Separator level b) Furnace pressure c) Turbine speed d) D/A level e) Hotwell level f) Condenser vacuum g) MW/MVAR/Excitation current h) Generator H2 Pressure, Seal Oil DP i) Feed water flow j) Condensate Flow k) Lub Oil and jacking oil pressure of Main turbo generator l) Lub Oil and jacking oil pressure TDBFPs
4.02.05	Status of following critical equipment: a) MFT/NO MFT b) Boiler Firing/ No Boiler firing c) All Mills, Feeders and HAG ON/OFF status d) Fuel oil pumps ON status e) APH electric and air motor ON status
4.02.06	Miscellaneous control button such as a) LPBP trip-1 and LPBP Trip-2 b) Release and Lamp test push buttons
4.03.00	The drives/valves push buttons (including Release and Lamp test push buttons), indicators, status feedback shall be segregated on the draw out console layout, based on DDCMIS from which the drive/valve shall be controlled.
4.03.01	24V DC power supply shall be sourced from SG,TG, BOP chargers with diode orring to form 24 VDC bus in BOP Relay Panel, for operating emergency stop buttons. All the relays required for this purpose shall be located in the same Relay Panel of BOP system.
4.03.02	For HT drives listed in 2.01.01, pressing of the release and emergency stop push button of the drive, shall energize two set of relays. The release and emergency stop button contacts shall be wired in series in the relay panel. One set of relay's contact shall be directly wired to SWGR and interrogated by the switchgear control supply, which shall cause the drive trip. Other set of relay's contact shall be interrogated as a Digital Input SOE by DDCMIS card, for UCD push button operation and shall issue stop command from DDCMIS.
4.04.00	The control of LT and MOVs (listed in 2.01.02 and 2.01.03) is envisaged through DDCMIS. The DDCMIS shall interrogate the start/stop contact of the drive/valves push buttons and

	shall issue start/stop command to corresponding drives/switchgear when corresponding Release PB is pressed. This logic shall be implemented through logic in respective DDCMIS.
4.05.00	The backup operation of critical breakers (10% of total) of each unit are envisaged from draw out section for electrical for each unit.

SUB–SECTION – IIIC - 12

STEAM AND WATER ANALYSIS SYSTEM (SWAS)

STEAM AND WATER ANALYSIS SYSTEM (SWAS)

1.00.00 STEAM AND WATER ANALYSIS SYSTEM (SWAS)

1.01.00 The system shall be designed in accordance to the recommendations of latest versions of ASME PTC 19.11, ASTM D 1066, ASTM D 3370 and ASTM D 5540.

1.02.00 The Contractor shall be fully responsible on system basis, for proper engineering, selection of hardware, manufacture, testing, installation, commissioning and satisfactory functioning of complete and fully operational steam and water analysis system meeting the intent of this specification. All system components and accessories required for completeness of this system shall be furnished by the Contractor although these may not be individually specified herein. All system components shall be completely assembled, piped, wired and tested at the factory and shall be ready for installation when received at the project site.

1.03.00 All piping, tubing, fittings, sample sink and other wetted parts in the sampling and analyzing system shall be of ASTM A182/213/312-316SS Grade material for the service approved by the Employer. No plastics or rubber shall be permitted except within analysers as recommended by the manufacturer.

1.04.00 Information and alarm signal from SWAS system including analyzers/monitor output signals, chiller system etc. shall be hooked up to DDCMIS for monitoring purpose.

1.05.00 All sample tap-off shall be designed for collecting the isokinetic sample complying the code ASTM D1066 (refer Sub-section-A-03 Steam Generator & Auxiliaries Including ESP Chapter, Part-B of technical specification).

2.00.00 SWAS

2.01.00 Unit-wise SWAS panels viz. Primary Sample conditioning rack (at Boiler Floor and Deaerator Floor), Secondary Sample conditioning panel (Wet panel in SWAS Room) and analyzer panel (Dry panel in SWAS Room) complete with valves, fittings, wiring etc.

2.02.00 The above panels shall be physically separate from each other and shall be mounted in the air-conditioned SWAS room located at 0.0m level. The specification of SWAS panels including material, thickness, dimensions, colors, foundation, layout and general arrangement shall be as per SWAS manufacturer's standard and proven practice.

2.03.00 Primary cooling of all samples having temperature in excess of 45°C shall be provided through an individual sample cooler (primary cooler). The primary coolers shall use condensate quality (DM) plant equipment cooling water. The design, construction materials and technical features of the primary and secondary cooler shall be as per SWAS manufacturer's standard and proven practice. However, the sizing of the coolers should consider total sample flow plus 500ml/min grab sample & a fouling factor of 0.2. All the pipes, fitting & valves required for cooling water for the primary coolers (supply and return lines) from Employer’s tapping points shall be in Contractor’s scope. Provision shall be made for heat exchanger shell drain duly valved and piped to waste drain header to be supplied by the Contractor. The Contractor shall also provide pipe from the waste drain header to the nearest building drain. Thermal protection devices as per ASME PTC 19.11 to be provided in the sample lines at the primary cooler outlets.

2.04.00 Each sample stream with the required flow rate and pressure of 2 kg/cm2 shall be finally cooled to 25°C±1°C or to a preset temperature required by the analyzer through an individual secondary cooler before passing the sample to the respective measuring cells and analyzer even in case, the corresponding analyzer is rated for higher sample temperature. The capacity calculation (considering fouling factor of 0.2) shall be subject to Employer's approval during detailed engineering. The secondary cooler shall also use condensate quality chilled water at 20°C. Chilled water for secondary cooler shall be provided by packaged refrigeration

unit (chillers) to be furnished by the Contractor. All samples will be passed through cartridge type filters before being cooled in respective secondary coolers. Secondary cooler shall be protected by a relief valve on the cooling water jacket of each cooler in addition to a relief valve at the cooling water header. Provision shall be made for heat exchanger shell drain duly valved and piped to waste drain header to be supplied by the Contractor.

2.05.00 Contractor to also provide automatic pressure reducer downstream of Primary coolers in each sample piping to ensure constant flow in each pipe in all regime of operation of Unit (from 0MW to rated MW).

2.06.00 **Chiller System**

(1) 2x100% capacity water cooled chillers shall be provided by Contractor. The specification of chiller system shall be as per SWAS manufacturer's standard and proven practice.

(2) Each chiller unit shall be designed with sufficient refrigeration capacity to ensure each sample stream temperature to 25°C±1°C when all streams are simultaneously at maximum flow rate and maximum temperature. The chiller capacity shall have a provision of 25% spare capacity for future samples.

(3) Suitable temperature monitoring and control systems shall be provided for maintaining the chilled water temperature at chiller outlet at 20°C or at a designed preset value and within the desired band.

(4) NOT USED

(5) The condenser shall be water cooled, cleanable shell and tube with water regulating valve. The cooling water shall be arranged by Contractor from Equipment Cooling Water System. All the pipes, fittings & valves required for to take the water to the chiller shall be provided by the Contractor.

(6) Chiller shall be of the direct expansion type with refrigerant tubes inside a shell, completely insulated and to be constructed in accordance with the ASME code for unfired pressure vessels.

(7) The chiller system shall be provided with 100% redundant chilled water pumps with suction and discharge pressure gauges and temperature gauges; Chilled water circulation pump with 100% standby facility; Storage tank automatic water make up with manual by-pass facility, temperature indicator, level gauge and drain and overflow connection, in addition to any other instruments/equipments required for smooth, convenient operation of the system, which shall also be furnished by the Contractor.

2.07.00 (1) The sample shut off valves, blow down valves and pressure reducing valves shall have stellite spindle tip and shall be suitable for an operating pressure of 400bars and an operating temperature of 400°C.

(2) The back pressure regulating valve shall be globe type Conoflow make or equivalent and shall be suitable for a pressure range of 0-50psi. The back pressure of the regulating valve is adjusted to the required set point by the range spring. .

2.08.00 Sample Patch Board

A quick disconnect patch board area shall be furnished on the SWAS panel. The patch board shall allow sample to be routed to any analyzer through quick disconnect valve at patch board on the sample conditioning panel.

2.09.00 Grab Samples

Grab sample valves on the front of SWAS panel shall be provided to direct grab samples to trough through grab sample nozzles or to the drain header.

2.10.00 Sample Sink

A continuous sink, located at the place of grab sample analysis, shall be provided. The sample sink shall be connected to waste drain header. Sample sink shall contain an integral stainless steel ledge to accommodate sample container. DM water connection shall be provided for cleaning of sample containers

2.11.00 The specification and arrangement of sample patch board, grab samples and sample sink shall be as per SWAS manufacturer's standard and proven practice.

3.00.00 SPECIFICATION OF ANALYSERS

3.01.00 Field proven reputed international make microprocessor based monitors/analyzers with LCD display and with necessary fault diagnostic features shall be employed. The power supply to all the analysers/ monitors shall be supplied by Contractor from his UPS system with all necessary switches, fuses, wiring/cabling and other required accessories etc. for distribution to individual requirements.

3.02.00

Minimum specifications of analysers						
Requirements	**Conductivity**	**PH**	**Phosphate**	**Chloride**	**Turbidity**	**Degassed Cation Conductivity**
Type	For Hotwell, Two removable Type of Cells, For Others, Continuous Flow Through Type	Cell Flow Through sample	Colorimetric	Continuous Flow Through Type with Chloride & Sulphate Responsive Electrodes	Light reflection principle	Continuous Flow Through Type for continuous measurement of Specific conductivity, cation conductivity and degassed conductivity values
Accuracy	≤ ± 1%	≤ ± 1%	≤ ± 5% of reading	≤ ± 5%	≤ 2% for range 0-50 NTU, ≤ 5% for range 50 – 200 NTU	≤ ± 1% of Reading
Response Time (90 % of Full Scale)	≤ 5 sec.		≤ 16 min.		≤ 5 min.	≤ 5 sec.

Range*	0-1, 0-10, 0-100 micro-mho/cm (freely programmable) for Specific Conductivity. 0-1 micro-mho/cm log scale for Cation conductivity	6-11 pH freely programmable	0-10 ppm freely programmable	0-1000 ppb/ As per process requirement freely programmable	0 – 100, 0- 200 MTU, programmable	0-1, 0-10, 0-100 µS/cm,(freely program0mable) Separate 4-20mA outputs for transmitting Specific conductivity, Cation conductivity and Degassed Cation Conductivity values to DDCMIS.

Minimum specifications of analysers …….continued

Requirements	**Hydrazine**	**Silica**	**Sodium**	**Dissolved O2**	**Total Iron (Dissolved + Un-dissolved with digestion system))**
Type	Automatic Continuous Electrochemical Type	Continuous Colorimetric Type	Continuous Flow Through sample	Continuous Flow Through sample DO analyser with optical DO sensor	Continuous Flow Through sample
Accuracy	≤ ± 5%	≤ ± 5% of reading	≤ ± 10% of reading	≤ ± 5% of reading	<±5 % of reading
Response Time (90 % of Full Scale)	≤ 3 min.	≤ 15 min. (including sample switching)	≤ 4 min.	≤ 30 sec.	≤ 30 min. (including sample switching)
Stability	Calibration Once in a Month		Calibration Once in a Month		
Range*	0-50, 0-100 ppb freely programmable	0-50, 0-100 ,0-500 ppb freely programmable	0-1,0-10, 0-100 ppb freely programm-able	0-20,0-200 ppb freely programmable	2-500ppb freely programmable or as per the process requirement.
No. of Streams	Single	Multi stream with sequencer/ stream selector (min. 4 streams)	Multi stream with sequencer/ stream selector (min. 4 streams)	Single	Multi stream with sequencer/ stream selector (min. 4streams)

NOTES:	All the analysers/cells shall have open Corrosion resistant drain to waste header.
	The material of flow cell for all analysers shall be SS316.
	Analysers/ monitors/ cells shall be suitable for operating under the conditions specified. Cell life of the sensor shall be mentioned in the datasheet.

	Dual cation exchange column shall be provided for cation conductivity.
	For Hot well conductivity measurement, the Contractor shall provide direct insertion / withdrawal type conductivity cell whereas for all other samples it shall be flow-through type. Monitors for hot well conductivity shall be suitable for field mounting.
	Samples where pH, DO & conductivity is being measured, Rotameter shall installed after analyser to avoid ingress of Oxygen.

3.02.00 Contractor to furnish the open chemistry for all the analyser reagents being supplied under this package. Constitution of chemicals along with percentage of chemicals so that preparation / formulation can be done and checked at site LAB. Contractor to also provide the procedure for testing of reagents and shelf life of the chemicals. All the reagents and pH electrode sensors shall be supplied as separate BBU items.

3.03.00 Contractor to provide piping arrangement in Wet Panel with remote operated (From Unit-DDCMIS) three way isolating valve (solenoid operated) for manual rinsing of all the Cation columns with DM water during non-availability of main sample and during shut down condition. Tapping for DM water shall be taken from discharge of Make-up water pump. Necessary piping, valves, instruments for monitoring of DM water flow shall be in the scope of contractor.

4.00.00 **SAMPLE PIPING SYSTEM**

4.01.00 All sample piping shall be 3/4" NB seamless type, conforming to ANSI B36.19. The schedule number shall be suitable for the particular application.

4.02.00 All fittings shall be socket welding type and of material ASTMA182 F316H conforming to ANSI B 16.11.

4.03.00 Suitable identification tags shall be provided for easy check up and for proper connections.

4.04.00 The valves to be used in sample piping shall be of stainless steel conforming to ASTM A182. The pressure temperature ratings shall be as per ANSI B16.34. The valve design shall be such that the seats can be reconditioned and stem and disc can be replaced without removing valve body from the line. The specification of End size, Pressure class, Type, End preparation, Body, etc. for different type of valves are specified in SWAS table in Clause No. 4.06.00 of Subsection IIIC-09, Section-VI, Part-B.

4.05.00 **Material Specifications for Sample Pipe Lines**

THE PIPING TO BE FURNISHED AND INSTALLED FOR WATER AND STEAM ANALYSIS SYSTEM SHALL BE AS INDICATED BELOW:

	Piping System	Material
1.	Piping from the sample inlet bulk head fittings to the shut off valves	Stainless steel, ASTM A 213, Type 316H, 16 BWG tubing
2.	Piping for the high pressure samples and sample blow down piping	Stainless steel, ASTM A 213, Type 316 H. 14 BWG tubing
3.	Blow down header	Stainless steel, ASTM A 312, Type 304 Schedule 160

4.	Miscellaneous drains receiver holder	Stainless steel, ASTM A 312, Type 304 Schedule 40
5.	Piping from the shut-off valves to the terminal points including branch piping and the closed cooling water grab sample piping	Stainless steel, ASTM A 213, Type 316 H, 16 BWG tubing
6.	Closed cooling water piping except grab sample and water purge line	Carbon steel, ASTM A 53 Gr. A, Schedule 40.
7.	Sample through drain piping and waste header piping	Carbon steel, ASTM A 53 Gr. A, Schedule 40.

4.06.00 **SWAS Valve Table:**

S. No.	Service / Location	End Size	Pr. Class	Type	End Preparation	Body
1	Sample Shut off valve	0.38	6000	Globe	SW	316SS
2	Sample blow down valve	0.38	6000	Ball valve	SW	316SS
3	Solenoid valve	--	--	2 way	--	316SS
4	Pr. reducing Valve	0.38	--	Needle	Tube	316SS
5	Safety relief Valve	0.25	3000	Relief	Tube	316SS
6	PI and FI isolation valve	0.25	3000	Needle	Tube	316SS
7	Back pr. regulating valve	0.25	300	C.W.	SCR	316SS
8	Grab	0.25	300	3-way	Tube	316SS
9	Quick	--	--	ball	--	316SS
10	Individual P.C. and S.C. inlet & outlet valve					316SS
11	P.C. I\L & O\L header & chilled water I\L & O\L isolation valve	--	--	Gate	--	316SS
12	Safety relief valve at each PC & SC and cooling water header	--	--	Relief	--	316SS
13	High Pressure reducing valve	--	--	--	--	316SS
14	Isolation valve before primary cooler	--	--	Needle	Tube	316SS

5.00.00 Contract quantities

Refer Annexure C to part A, Section VI of technical specifications.

SUB–SECTION – IIIC-13

PUBLIC ADDRESS SYSTEM

1.01.00	**Public Address system- General Requirements**
1.01.01	The Contractor shall be responsible for selection, design, engineering, manufacturing, testing at manufacturer's works/ site, erection, installation and commissioning of public Address system meeting the intent and functional requirement of specifications.
1.01.02	The Bidder's scope shall also include successful demonstration of performance testing specified herein complete in all respects. All the items, including public Address system erection hardware, racks, cables, cable trays, conduits, etc. as required, for the proper installation (conforming to IS:1881, IS:1882) to make the IP based PA system complete and functional are under Contractor's scope on as required basis. All equipment, accessories and facilities required for completeness of this system shall be furnished by the Contractor within the quoted lump sum price, whether these are specifically mentioned herein or not.
1.01.03	The equipment furnished under this section shall meet the requirements of all-applicable codes and standards as specified in Part-C, Section-VI or their equivalent international codes and standards.
1.01.04	The Public Address System (PAS) offered by the Bidder shall be from reputed manufacturer who should have designed, manufactured, tested and commissioned a distributed amplifier type industrial Public Address systems as specified in thermal power plants or large industrial installation as on the date of bid opening.
1.01.05	The system shall be adequately protected from signal and power line noise and meet the Surge Withstand Capability (SWC) requirements of ANSI C37.90 A/IEEE standard 472-1989 or equivalent. Equipment shall be self-protecting against transients in the input ac supply
1.01.06	The Bidder shall guarantee satisfactory performance of the equipment under stipulated variations of voltage and frequency. The design and manufacture shall be such that equipment/components of same type and rating shall be interchangeable.
2.00.00	**POWER SUPPLY ARRANGEMENT** – AS PER CONTRACTOR'S STANDARD AND PROVEN PRACTICE MEETING THE SYSTEM REQUIREMENT
3.00.00	**SYSTEM DESCRIPTION**
3.01.00	**DESIGN AND TECHNICAL REQUIREMENTS**
3.01.01	The PA system shall be designed as standalone IP based network architecture. The system shall be based on centralized control together with distributed nodes permitting speech broadcasts and pre-recorded messages /alarm tones etc. The PA system shall be designed such that no single failure shall disrupt the availability of complete system. One server shall be located at Unit CER and another server shall be located at CHP CR. For more details refer drg no. 0000-999-POI-A-071A, Part-E.
3.01.02	The call stations and standalone amplifiers shall be individually IP addressable. Any conversion of the analog field call station to IP mode by separate attachment of the intelligent module/ unit shall not be acceptable. Each call station should be able to selectively call another call station without manual intervention of any other equipment. The design shall be such as to provide highly intelligible full duplex voice communication even in areas of high background noise (up to 80 db).

3.01.03	PA System Management Software: The software shall be able to work with the latest windows version. All software utilized shall be latest and upgraded version.
3.01.04	Built in Diagnostic features: Active fault reporting concerning all aspects of PA system shall be extended to PC Stations which shall record the system malfunction messages with time & date stamp.
3.01.05	The system shall be able to accept potential free contacts from other systems (like fire alarm system, security system and access control system etc.) for predefined actions (like fire or security alarm announcement on call stations (configurable) etc.) For implementation of the same, 10 nos. potential free contacts per unit, 10 nos. potential free contacts for CHP and 10 nos. potential free contacts for common plant area shall be considered.
3.02.00	**Communication within a zone**
3.02.01	Party calls and group/conference calls shall be in full duplex mode.
3.02.02	Unless requested, announcements/communication within a zone shall not be audible in other zones.
3.03.00	**Inter Zone Communication**
3.03.01	Minimum one no. indoor desktop mounted call station in each zone shall be Master Control Unit. Any interzone communication shall be possible through this master control unit.
4.00.00	**CALL STATION**
4.01.00	Each Call Station shall have LCD indicator, 10 digit dial pad & 2 special keys, Pre-amplifier & power amplifier, Indication for 'Power Supply On' and 'Network Connection Healthy' as a minimum.
4.02.00	The outdoor wall/column mounting type call station shall be dust-tight and weather proof, with appropriate protection against direct rain, ingress of dust and moisture conforming to IP-65 degree of protection as per IS/IEC:60947-1, outdoor wall/column mounting type. The indoor desk-top mounting type call station shall have a degree of protection of at least IP-32. All call stations and their components shall be capable of continued satisfactory operation at an ambient temperature at 55 Deg C.
4.03.00	The call stations in the noisy areas like Turbine hall, BFPs, Mill area, etc. shall be housed in Acoustic hoods. The design noise level within the hood shall be limited to a maximum of 60dB SIL.
4.04.00	The indoor desk mounting type call stations shall preferably be PoE powered and the same shall be IEEE 802.a.f compliant.

4.05.00 **Standalone Amplifier**

Multiple loudspeakers spread across a zone shall be used along with a standalone amplifier. This amplifier shall be IP based and health monitoring of the associated loudspeakers shall be provided.

5.00.00 **SERVER**

5.01.00 The server shall be based on state of art VOIP technology. The server should support protocols including SIP or equivalent, TCP, IPV4/ IPV6, Codec G.722, SNMP, RTP, NTP etc. Suitable built in IP security such as firewall, SSH, HTTPS etc. shall be provided in server. The required no. of all hardware/software licenses to meet the Employer specifications shall be supplied by the Contractor.

6.00.00 **MASTER CONTROL UNIT**

It shall have minimum 40 direct access keys with LED indication, a goose neck type Microphone and a hand receiver unit attached to it.

7.00.00 **NETWORK SWITCH**

7.01.00 AS PER Contractor's standard and proven PRACTICE meeting the SYSTEM REQUIREMENT

8.00.00 **CABLES AND JUNCTION BOXES-** AS PER CONTRACTOR'S STANDARD AND PROVEN PRACTICE MEETING THE SYSTEM REQUIREMENT

9.00.00 **TECHNICAL PARTICULARS**

Amplifiers- solid state, class-D, push-pull type, in built with call station fully conforming to IS:

10426 or equivalent international standard.

Band width (± 3 db)- 100-16000 Hz.

THD-< 0.5% at 1 KHz at rated output.

Signal to Noise Ratio- Min. 80dB

Microphones-Band width (±3 db): Codec G.722, 200-7000Hz

Loudspeakers- IP-52 degree of protection as per IS/IEC:60947-1,

Outdoor- wall/column mounted Horn Type, Capacity-105 dB for broadcast,

95dB for call mode, 15 W (RMS)

Indoor- wall/column mounted Cone Type, Capacity-85dB , 4W (RMS)

SUB – SECTION – IIIC - 14

CLOSE CIRCUIT TELEVISION (CCTV) SYSTEM

1.00.00	**CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM**
1.01.00	**General Requirements**
1.01.01	The intent of the specification is to define the functional & design requirements for the CCTV System meant for gathering video information from the various areas of the power plant. The Contractor shall be responsible for selection, design, engineering, manufacture, testing at manufacturer's works/site, installation of all the equipments supplied as covered in this specification and commissioning of the system meeting the intent & functional requirements of the specification. All the cables, cable trays, power packs, erection hardware (viz. junction boxes, brackets glands, nut-bolts, conduits etc.) are also included in Contractor's scope.
1.01.02	The Contractor shall guarantee satisfactory performance of the equipment under stipulated variations of voltage and frequency.
1.01.03	The design and manufacture shall be such that equipment / components of same type and rating are interchangeable.
1.01.04	The number of camera units, servers, network switches, wireless equipment etc. and their locations are listed at Annexure-C to Part A of technical specifications.
1.01.05	Any other equipment, module, software required for the safe and satisfactory operation, control, protection, monitoring, testing and maintenance of the system shall also be included by the Bidder within the lump sum quoted price.
1.01.06	The equipment furnished under this section shall meet the requirements of all the applicable International codes and standards as specified in Part-C, Section-VI or their amendment Codes and Standards. Camera certification has to be CE/FCC/UL or equivalent.
2.00.00	**POWER SUPPLY ARRANGEMENT**
2.01.00	The CCTV System along with all its components i.e. network switches, storage devices, servers, LAN switches, cameras etc. shall be powered from UPS system such as UNIT UPS, CHP UPS, AHP UPS etc. Contractor shall also provide local power distribution boxes as required for sub-distribution of UPS supply.
2.02.00	For cameras to be located in remote areas where the UPS power supply can not be extended due to voltage drop etc., then such cameras can be grouped and fed from mini UPS. Individual mini UPS shall be provided for the cameras which can not be grouped. Contractor shall also provide local power distribution boxes as required for sub-distribution of supply from these mini-UPS to cameras.
2.03.00	If the offered equipment is operating at voltage level other than what has been specified in Sub-Section: Power Supply, Part-B, Section-VI, the Contractor shall provide all required hardware, within lump sum quoted price to make the offered system compatible with specified power supply arrangement.
3.00.00	**DESIGN AND TECHNICAL REQUIREMENTS**
3.01.00	The CCTV system shall be designed as a stand alone IP based network architecture. For more details refer drawing nos. 0000-999-POI-A-072 & 0000-999-POI-A-072A.Exact topology of network architecture (Star /Ring / any other topology) for CCTV system shall be decided during detail Engineering, however, failure of any single cable should not result in

	loss of more than five camera signals in a zone. System shall use video signals from different cameras at different locations, process the video signals for viewing on monitors at different locations and simultaneously record all the video streams using H.264 or better compression technique. Joystick and mouse-keyboard controllers shall be used for Pan, Tilt, Zoom and other functions of desired cameras.
3.02.00	The complete system shall be divided into the Zones as defined in Part-A. Each zone shall have the Set of Cameras with Housing, Pan, Tilt and zoom Control , Required nos. of Workstations, Monitors, key board, joysticks etc., Set of camera management/database servers for management of cameras in that zone and for storage and recording all the video signals and audio signals from each of the cameras within the zone and Set of network switches to control and integrate the above etc.. Apart from these items , Wireless equipment and its accessories shall also be provided wherever applicable.
3.04.00	The camera and database servers shall offer both video stream management, video stream storage management. These servers shall also manage and store configuration information/database for the whole system. Recording frame rate & resolution in respect of individual camera shall be programmable. It shall be possible to view and record at different resolutions and frame rates and this shall be individually programmable on every camera. The system shall ensure that all configuration information, video recordings, and user database etc., is automatically replicated on the standby camera/database server(s) so that in the event of failure of one server, the performance of the system is not affected. It shall be possible to take back-up of system configuration and database on portable media device and restoring the same if required.
3.05.00	System shall ensure that once recorded, video can not be altered.
3.06.00	Camera server shall be provided with sufficient storage space to store recordings (video and audio both) of all cameras at 25/30 FPS at 1920X1080 for a period of Fifteen (15) days or more using necessary compression techniques. All recordings shall have camera ID, Location, Date and time of recording.
3.07.00	Facility shall be provided to select a camera or a group of cameras in a zone for recording in CIF, 2CIF,4 CIF, HD(720P) & Full HD (1080P) resolution.
3.08.00	It shall be possible to export selected portion of recording to portable media devices. The exported clip shall be in commonly used movie file formats e.g. MPEG, AVI and no special software shall be required to view the same.
3.09.00	Server software shall allow the clients seamless operation of all cameras regardless of the actual connection to different recording servers. Software shall allow the client applications to interact with all the camera/database servers simultaneously and allow simultaneous display of live video/recorded video regardless of the zone in which the client is connected.
3.10.00	The system operation would be of covering the complete view of the areas with pan / tilt, zoom, propositioning of the cameras and with programmability to monitor any camera on any monitor either manually or automatically in a defined switching. The system shall be suitable for installation and shall be able to work successfully in dust prone thermal power plant environment.
3.11.00	The system shall be able to accept potential free contacts from other system and use the same for predefined actions (like zoom/pan/tilt of cameras, bringing out pre-defined views on predefined monitors etc.) This feature shall be extensively used for linking fire related signals. For implementation of the same, 25 nos. potential free contacts per unit, 25 nos. potential free contacts for CHP and 25 nos. potential free contacts for common plant area shall be provided interfaced with CCTV system panels. This functionality can be provided as a part of camera or through separate network compatible alarm panel with integration to CCTV software.

3.12.00	There shall be an interface to Plant security system through L3 switch of the CCTV system, so that the camera feeds of the CCTV system can be viewed in the Security Operation Centre (SOC) of the plant located near main gate & also cameras of security system can be viewed by operators, if needed. Cables & associated accessories between L3 switch of CCTV system & network switch of SOC will be in vendor's scope.
3.13.00	The camera & Video Management Software shall be ONVIF compliant.
3.14.00	Employer intends to listen the sound of the selected camera surroundings with minimum noise level alongwith the video. Any hardware/software required to meet this functionality shall be supplied.
4.00.00	**DETAILED DESCRIPTION OF THE SYSTEM COMPONENTS:**
4.01.00	**Application Software for Video Monitoring, Recording & Management.**
4.01.01	The application software shall be used to display, store, control & manage the entire surveillance system.
4.01.02	It shall be possible to control all cameras i.e. PTZ , auto/manual focus, selection of presets, video tour selection etc. The software shall support flexible 1/2/4 windows split screen display mode or scroll mode on the display monitors for live video.
4.01.03	It shall be possible to define priority based camera control rights for each camera or a group of cameras. The users shall be defined on a hierarchical basis with a minimum of three levels. A higher priority user can take control of camera being controlled by a lower priority user. In addition the user shall have facility to request access of any camera and if the existing situation permits the user shall be able to control the camera.
4.01.04	The software shall be programmable with at least 50 sequences that can run independently of each other in either forward or reverse direction. The sequences shall support simultaneous switching on multiple image panes or monitors. The sequences shall also support camera prepositions for each camera on each sequence step.
4.01.05	The system administrator shall have rights to add/delete/configure users with rights. It shall be possible to view the rights of each user or the cameras which can be viewed / controlled by each user. It shall also be possible to add/delete cameras, configure cameras, assign priorities to users, configure alarm monitors etc. It shall also be possible to configure user groups with different rights and assign users to user groups. The system shall support unified log-in through out the system and it shall be possible for any user to log-in from any location/client and access cameras/recordings and other features as permissible depending on his or her rights assigned to his or her log-in.
4.01.06	The system shall have different recording modes i.e. continuous, manual, programmed, event activated etc. on date, time camera wise. It shall be possible to configure each mode using user friendly tools. It shall be possible to search and replay the recorded video date, time, camera, event wise.
4.01.07	The system shall have alarm interface capability. When an alarm occurs in the Camera/Database Server, the live video output of the camera associated with that alarm shall be switched directly to a predefined monitor/monitors. On screen controls shall be provided to achieve remote operation i.e. PTZ operation of cameras.
4.01.08	The software for clients shall preferably work on a browser based system . It shall be possible to play back recorded video at different speeds i.e. 1/4X to 16 X. The system shall support multiple live video on single monitor in different configurations like 1, 2, 4 etc.
4.01.09	It shall be possible to retrieve recorded video without much delay for any date/time interval.
4.01.10	The system shall support video analytics in respect of the following 1. Video motion detection

2. Object tracking

3. Object classification & Tracking

The feature can be an integral part of camera or a part of camera server..

4.01.11 The system shall be able to provide complete system diagnostics. System shall have the spare capacity to add minimum five nos. client workstations with functionalities of viewing live video/recorded video, PTZ controls of cameras, viewing site maps etc.. Software licenses for the same shall be supplied

4.01.12 The software shall support video loss and network loss alarm feature.

4.02.00 Cameras:

4.02.01 All the cameras shall be color, suitable for day and night surveillance and network compatible. There will be two types of cameras viz. PTZ & Fixed. PTZ cameras shall be high speed integrated dome type.

4.02.02 Detailed technical specification cameras (High Definition (HD) is given below.

Image Device	1/2.8-1/3" Progressive scan CMOS
Lens	For PTZ cameras: 4.45-4.7 /89-94.0 mm focal length For Fixed Cameras: Varifocal Lens f=8-50 mm, CS-Mount
Optical Zoom/ Digital Zoom for PTZ cameras	20x or better/12x or better
Number of Pixels/Effective resolution	1920X1080 (Full HD)/2 MP at 25/30 IPS
Sensitivity(at 6dB)	For PTZ cameras: color mode 0.6 lux , B/W mode 0.04lux @30IRE, F1.6 For Fixed Cameras: 0.21 Lux color & 0.05 Lux B/W(at 30IRE) , F1.2
Horizontal Angle of view for PTZ cameras	55.4 deg(wide)- 3.5 deg (Tele) minimum
Iris Range	For PTZ cameras: F1.6-F2.9 For Fixed Cameras: 1.6 to 360
Back Light Compensation	Required
White Balance	Automatic with mode selection options
Electronic Shutter	1/50 to 1/10000 Auto
S/N Ratio	>50dB
Audio	Full Duplex or 2-way
Automatic Gain Compensation	Up to 18 dB
IR cut-filter	Yes
SD/SDHC/SDXC in Fixed Camera (For Local alarm recording & scheduled local recording)	Yes ,minimum 32 GB capability
Alarm Input/output	For PTZ cameras: Minimum 2 Alarm I/Ps & 1 alarm output For Fixed Cameras:: Minimum One Alarm I/P & One Alarm O/P

Pan , Tilt for PTZ cameras	360 Deg Continuous ,90 deg

4.03.00 **Camera Housing& Mount**

4.03.01 All the cameras and accessories are to be housed in Weather Proof IP 65 environmental housing made of aluminum and Sun shroud. The housing, with heater and blower installed, shall provide protection for camera/lens assemblies in the ambient temperature range of - 0 deg. C to 50 deg. C. The camera mount should be of the same make as that of camera and suitable for the model no. offered as specified by the manufacturer and should be an integrated unit

4.03.02 **Work Station and Camera/Database Server**

For hardware specification please refer specification of Operator work stations given in sub-section-DDCMIS. However RAM and hard disk/storage memory shall be sized to meet functional requirement as stipulated in this section.

4.05.00 **Network Switch:**

All the network switches shall be of high quality and shall be sized to meet the functional requirements as specified. The common switch to which all networks are connected shall be Layer-III switch/router. All the interconnecting cables between network switches shall be fiber optic only. All fiber optic cables shall be terminated directly to network switches through optical fiber port without using media converters. Bidder to ensure that minimum 100% cores are kept as spares in all type of optical fiber cables.

5.00.00 **CABLES :**

5.01.00 Cables shall be of FRLS PVC sheathed cables for use in CCTV and shall conform to latest edition of Indian/International standards. Fiber optic cables are to be provided wherever indicated in the drawing no. 0000-999-POI-A-072 & 0000-999-POI-A-072A (as applicable). The remaining cables can be as per CCTV supplier's standard. For details of Fiber Optic cables, refer subsection INST CABLE. However, only Four (04) core Optical fibre cable shall be used for CCTV system network Architecture.

Annexure-II

1.00.00 Drone based Surveillance (DBS)

a) Drone(UAEV) should be purchased on name of employer & necessary ID as mandated by GOI has to be taken. Employer will take necessary statutory clearance(if any) for use of the same for Drone based surveillance within Plant premise.

b) Drone should support 1 cm position accuracy.

c) Drone must have 4K or better resolution camera for high quality pictures & video taking. It must have 2 nos. of chargers & minimum Four(4) sets of batterys.

d) Drone should support Self deployment and landing i.e No pilot required mode of operation. User shall be able to define path of flight through Mobile/Drone control terminal & Drone should complete the path survey & return to its place of origin.

e) Drone should be supplied with Remote Control module and Drone operation & control software which can be loaded in Android/iOs device (in employer scope).

f) Bidder to provide training from qualified personnel for Drone operation to employers personnel. Training man days shall be 10 nos.

g) Following features has to be supported by DBS Geofencing, return home, GPS redundancy, emergency landing parachute, Automatic payload and battery exchange, Multiple payloads

h) Drone has to be Industrial grade, Durable, corrosion resistant and weatherproof & should be suitable for continuous operation both in Scheduled mode as well as On-demand mode.

i) Continuous flight time should be minimum 30 minutes.

j) It should support multi payload configuration. Payload for Drone cameras must support up to 2 KGs.

k) Drone must have universal ports.

l) It must support Forward Vision system for Obstacle Sensing of range 0.7 to 30 meters.

m) IP rating of Drone should be IP 43 or better.

n) Bidder to supply mobile (Android/iOS) based APP for entire control & operation of DBS.

o) Operating Frequency Should be 2.4 -2.483 GHz & 5.725-5.85 GHz

Further, Specification of Drone will be decided during detail engineering in line with extant law (if any) specified by Government of India.

SUB–SECTION – IIIC - 15

NOT USED

SUB–SECTION – IIIC – 16

WIRELESS INSTRUMENTS & SYSTEMS

1.00.00	**WIRELESS FIELD INSTRUMENTS & SYSTEM**
1.01.00	This section provides the basic specification for the design, engineering, manufacture, inspection, testing, supply, installation, commissioning and implementation of Wireless network along with wireless field transmitters and devices in 2.4 to 2.4835Ghz (ISM Band). The requirements given herein are minimum requirements to be considered by Contractor.
1.02.00	Codes and Standards: All wireless transmitters, wireless devices and its accessories in the network shall comply with Wi- HART as per IEC62591 or ISA100.11a as per IEC62734.
1.03.00	The total wireless network design, engineering, installation, field testing and commissioning and in coordination with Control system contractor shall be in Contractor's scope. Any statutory requirements and coordination with statutory authorities required for wireless frequencies / system shall be in Contractors scope. All licenses, software and networking items required for establishing this connectivity will be in the scope of the contractor.
1.04.00	Wireless Network Instrumentation shall be considered for monitoring purpose only. The contractor will carry out site survey for more clarity of geographical area, topology, structure. All the instruments supplied and the Wireless gateway components shall be suitable as per area classification . Any special tool required for configuration/calibration to be supplied by contractor. The exact applications for wireless devices shall be indicated in PART-A of Specification.
1.05.00	Contractor to submit end user certificate for six months successful operation of offered wireless field instruments in any industrial application on the date of bid opening. For this purpose experience of family/series of wireless field instruments will be considered in place of exact model.
2.00.00	**DESIGN REQUIREMENTS:**
2.01.00	WIRELESS NETWORK SHALL BE A SECURE AND ROBUST NETWORKING TECHNOLOGY OPERATING IN THE 2.4GHZ INDUSTRIAL, SCIENTIFIC, AND MEDICAL (ISM) RADIO BAND. THE TOPOLOGY TO BE FOLLOWED FOR CONFIGURING THE WIRELESS PATH SHOULD BE SUCH THAT COMMUNICATION SHOULD SUSTAIN EVEN AFTER FAILURE OF ONE.
2.02.00	device/transmitters/router/repeater. That is, no single failure in the offered system shall lead to loss of communication from any wireless field transmitter to DDCMIS, except that process information of failed transmitter would not be available. For achieving same redundant Gateway/Manager with redundant access point/remote antenna with best available switch over time as per protocol followed (ISA or Wi-HART) shall be provided. Wireless instrument shall be connected to network in such manner that failure of any individual device/instrument/router/repeater should not affect functionality and communication of any other instrument/device. Network Security shall follow standard IEEE 802.15.4. The contractor shall take all necessary actions to ensure security of wireless network installed at site. The update rate/scan time for the field transmitter shall be 5 seconds or better.
2.03.00	Gateways/Manger will be cabinet mounted inside RIO/System cabinet. Remote antenna / access points (as applicable) with surge protection facility shall be suitable for mounting outside the RIO/Control room building. Contractor shall consider and supply interconnection cable on as required basis for this purpose.

2.04.00	Gateway/Manager shall be provided with complete hardware/software enabling full functionality such as configuration of the network, enabling/scheduling communication between host application and wireless field devices, peer to peer communication, device communication routing, network diagnostics to monitor and report the health of the Wireless Network .Wireless Gateway/Manager shall be provided by the Contractor with Modbus over Ethernet/RS-485 serial link for establishing connection with Control system.2.09.00Wireless Gateway/Manager shall be provided connectivity with Network PC to be supplied by Contractor, where gateway/manager's software will be installed/accessed for purposes such as configuration/monitoring/diagnostics. When more then 10 nos. of wireless instruments are being supplied, Wireless Field Calibrator with necessary Hardware/Software including laptop/adapter shall be provided for the configuration/ diagnostics of wireless instrument in field. If more than one set of gateway is required for catering to the number of wireless instruments, then gateways should be multi-dropped for further interfacing with DDCMIS as finalized during detailed engineering. Diagnostic data shall be available on Network PC which shall include status, configuration, calibration, path reliability and stability, battery health and signal strength etc. for each device and network.
2.05.00	The Wireless devices network shall be designed in such a way that continuous communication with gateway is established. It shall be Contractor's responsibility to supply adequate amount of repeaters/routers in field based on Contractor's recommendations for wireless network design ensuring network reliability and continuous communication. Such devices (repeaters/routers) shall be provided on as required basis and no additional cost will be payable for these.
2.06.00	Contractor to note that wireless networks of Wireless HART and ISA 100.11a may coexist in the same area. Therefore, network design shall be such that there is no interference or compromise in performance of the network of one type because of the presence of the other. The interchangeability and interoperability of wireless instruments of different vendors within respective protocol (Wi HART or ISA100.11.a) shall be ensured.
2..07.00	Contractor shall consider additional 2 Nos. of router/repeaters over and above the wireless network design requirements for addition of wireless instruments at new location during detail engineering / future expansion. Each wireless network shall be designed considering 20% future expandability. Contractor to carry out field visit after 06 month of successful commissioning of the complete wireless system to evaluate the performance and take corrective actions, if require, at site.2.17.00
3.00.00	**WIRELESS FIELD INSTRUMENTS INCLUDING ROUTER/ REPEATERS**
3.01.00	For Pressure Transmitters/Differential Pressure Transmitter/Level Transmitter (DPT type)/Flow Transmitter (DPT type)/Temperature transmitter, in place of requirement of 2-wire HART protocol output, following shall be considered: Protocol shall be Wi-HART or ISA100.11a, Battery Powered Native wireless device without Integral display with Battery conservation feature. For multi input temperature transmitter display is no transmitter display is not applicable. Update rate/Scan rate of 5 seconds or better. Integrally mounted antenna /Internal within Sensor Housing antenna/ Extended antenna. Antenna type shall be finalized during detailed engineering as per actual requirement as per frequency 2.4Ghz ISM Band adapter. Security as per IEEE 802.15.4. Replaceable Battery. Field configurable. Self Diagnostics at local display. All other requirements and features shall be as per Measuring instruments chapter, Section IIIC-03 of Part B of Technical specification. In future wireless requirement may be extended for other field instruments depending on availability and other technical consideration.

4.00.00	**BATTERY**
4.01.00	Field Wireless devices shall be power sourced by low power battery. The shelf life of the battery shall be minimum 5 years. In addition to one battery supplied with each wireless instrument/ device, 2 nos. of additional batteries for each wireless instrument/ device shall also be provided. For multi- input transmitters (with 4 or more nos. of inputs), 4 nos. of additional batteries for each device shall be provided. The supply of battery to site shall be in two phases so that shelf-life of batteries is maintained. Battery status/remaining life /drain indication / alarm shall be available in system as part of diagnostics / maintenance data.
5.00.00	**UTILITIES**
5.01.00	Gateway shall be fed from 24VDC power supply available in RIO/Cabinets.
5.02.00	If any additional 24VDC/230VAC power supply is required, it shall be provided through feeder from available 24VDC/230VAC system.
6.00.00	**ENGINEERING, INSTALLATION, TESTING AND COMMISIONING**
6.01.00	Contractor shall provide services of his technical team well versed, trained and experienced wireless technology design, engineering, implementation and documentation for large industrial applications. Necessary site survey shall be done to finalize all network devices.
6.02.00	Contractor's responsibility at site shall include all activities necessary to be performed to complete the job including:
6.02.01	Receipt of all items and related hardware, and checking of completeness of supply. In case of installation of gateway/manger in cabinet of control system in RIO/CER cabinets, verification of all components and accessories duly installed & wired.
6.02.02	Installation of all repeaters / routers, antennas, configuration and loop checking of all wireless transmitters etc., Termination of all cables to control room, ferruling/tagging of interconnecting cables in RIO/ Control room. All civil works like grouting, fixing etc. and patch up work where Contractor is likely to remove the plaster and shall make holes in the walls, floor or ceiling for the installation of Contractor supplied items like antennas, repeater / routers etc. .
6.02.03	Checking of interconnections, hardware configuration, overall system functioning. Liaison with Contractor's remote support, as required. Liaison with Contractor's remote support, as required. Liaison with contractor remote support as required, field testing, Integration of wireless system with DDCMIS, FAT, Commissioning of complete wireless system, SAT.
7.00.00	**FACTORY ACCEPTANCE TEST (FAT)**
	In addition to visual test and BOM check, the following functional tests shall be carried out by the Contractor at their works during FAT. Performance test including reliability, stability and path redundancy of the Wireless system considering routers / repeaters and minimum nos. of wireless transmitters as finalized during detailed engineering. (The transmitters shall be arranged by the Contractor at their works for demonstrating this performance test). Update rate verification in the system considering above transmitters. Redundancy, synchronization and seamless switchover of the Gateways/Managers and access points for redundant application. Capabilities of network manager/gateway software.

8.00.00 SITE ACCEPTANCE TEST (SAT)

The Employer will take over the system from the Contractor after the final acceptance test, which is defined as successful uninterrupted operation of the integrated system for four weeks with desired performance. Contractor's personnel shall be present during the test. Any malfunctioning of the system components shall be replaced/repaired by Contractor as required. Once the system failure (loss of two or more devices leading to loss of communication in whole system) is detected, the acceptance test shall start all over again from the beginning.

9.00.00 DOCUMENTATION

Datasheets for all devices like sensors, transmitters, repeaters/routers, gateway/access point, cables. Features of software to be installed in Network PC; redundancy feature
User guide and User manuals. Certification for Explosion proof/ intrinsically safe (where required) Certification for use of wireless system/signals.

10.00.00 ANNUAL MAINTENANCE SERVICES

10.01.00 The requirements specified below are applicable for warranty (defect liability period) and 3 years AMS period.

10.01.01 The Contractor's scope shall also include providing Post Warranty Maintenance for 3 years after completion of warranty period of the offered wireless systems and all associated components as per specification. The AMS shall include tools and tackle as required; travel, boarding & lodging of service engineer. In the event of any malfunction of the system hardware/system software, experienced service engineer shall be made available at site within 48 hours on the receipt of such information from Employer.
Employer personnel will work on system day-to-day basis and wherever possible, Employer shall inform the type of failure of hardware/ software to Contractor based on diagnostic available with the system. However Contractor shall be fully responsible to attend and rectify the root cause and the failure within 48 hrs. Contractor may utilize the spares available with Employer, if necessary and available with Employer at site, which are part of mandatory spares supplied with system as per this specification. However, the consumed spares shall be replenished to Employer within 2 months' time.

10.02.00 The services under Post Warranty Maintenance Agreement, shall broadly comprise of the following:

10.02.01 Periodic Maintenance Site visits, minimum four (4) times in a year (total days expected 16 in a year), schedule of visits to be discussed and finalized jointly between Contractor and client after placement of order/ delivery. It shall include inspection of general healthiness of the system, study and advice on daily maintenance, inspection of Hardware & Software, if any problem is reported, running of test programs, on-line servicing and solving reported problems. System shall be checked online.

10.02.02 Software Maintenance/ Support Contractor shall maintain the existing operating & application software for any debugging requirements to have consistent performance of the system.

10.02.03 Emergency Service In the event of any malfunction of the wireless system hardware/system software during this period, Service Engineer must report at site within 48 hrs. of report of failure. The system must be brought back within 48 hours after reporting at site.

10.03.00 Contractor shall note that while carrying out the Annual Maintenance Contract activities, Employer's engineers shall associate with the Contractor. On-job training of these associated engineers shall be covered under this scope. This shall include all items being supplied by Contractor, including any bought out items but not limited to the following:
Labour, at no additional cost, to repair any system devices, to provide tests, and adjustment to system devices.

SUB–SECTION – IIIC – 17

ELECTRIC ACTUATORS

ELECTRICAL ACTUATORS

1.00.00	**General Requirements**	Actuators shall be designed for valve operation to ensure proper function in accordance with specifications given below and complying to EN15714-2 or equivalent. All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.
2.00.00	**Modulating duty electric actuators**	These shall be provided as per standard practice of OEM of equipment, meeting other requirements of specifications. The examples of such applications are Blade pitch actuators of ID/FD/PA Fans, Scoop tube actuator of BFPs etc. **For specific applications, refer Part A of technical specifications for which clause 5.00.00 of this section will apply.**
3.00.00	**Electrical actuators for valves / dampers / gates (other than covered in 2.00.00)**	These actuators shall be Non-Intrusive type electric actuators. The interface of these actuators with DDCMIS shall be of two types viz. with Hardwired interface and with Fieldbus interface. The common requirements of both these type of actuators are specified at clause 2.00.00, specific requirements of Non-Intrusive hardwired actuators are specified at clause 3.00.00 and specific requirements of Non-Intrusive fieldbus actuators are specified at clause 4.00.00. The applications where these two types of actuators are to be provided is specified in Part-A of Technical Specifications.
4.00.00	**Common Requirements for Non-Intrusive Electric Actuators**	
4.01.00	**Type**	1. The actuators shall have integral starters with built in SPP (Single Phasing Preventer). 415 V, 3 phase 3 wire power supply shall be given to the actuator from switch board as applicable through a switch fuse unit. Control voltage of the motor starter shall be 110 V AC / 24 V DC, derived suitably from 415V power supply. 2. The actuators shall be Non- Intrusive electric actuator. All actuator settings including torque, limit shall be possible without opening the actuator cover and LCD indication shall be available integral to actuator body
4.02.00	**Rating**	1. Supply Voltage & frequency: 415V +/- 10%, 3 Phase, 3 Wire & 50HZ +/-5%. 2. Sizing: Open/Close at rated speed against designed differential pressure at 90% of rated voltage. For ON/OFF type: Three successive open-close operations or 15 minutes, whichever is higher. For inching type: 150 starts per hour or required cycles, whichever is higher
4.03.00	**Construction**	1. Enclosure: Totally enclosed weatherproof, minimum IP-68 degree of protection. 2. Manual Wheel: Shall disengage automatically during motor operation.
4.04.00	**Motor**	Type: Squirrel cage induction motor suitable for Direct On-Line (DOL) starting Enclosure: Totally enclosed, self-ventilated Insulation: Class F. Temperature rise 70 Deg C. over 50 Deg C ambient. Bearings: Double shielded, grease lubricated antifriction Earth Terminals: Two Protection: Single Phasing Protection, Over-heating protection through Thermostat (as applicable) and wrong phase sequence protection shall be

		provided over and above other protection features standard to bidder's design. Suitable means shall be provided to diagnose the type of fault locally.
4.05.00	**Position / Torque Transmitter**	The Position/ Limit measurement shall be done using absolute encoders which will give information of position/ limit in both the directions. Electronic measurement of torque shall be provided.
4.06.00	**Local Operation**	It shall be possible to operate the actuator locally also. Lockable local/remote selection shall be provided on the actuator.
4.07.00	**LCD Display**	A local LCD display shall be provided to give information regarding actuator alarms, status and valve position indications as a minimum in local.
4.08.00	**Wiring**	Suitable voltage grade copper wire.
4.09.00	**Terminal Block**	For power cables, the grade of TBs shall be minimum 650V.
4.10.00	**Accessories**	All required accessories (if applicable) for calibration / settings/ configuration of various parameters of actuator shall be provided. For quantities, please refer Part A of technical specifications.
4.11.00	**SIL Certification**	All actuators shall be certified for SIL 2 or better.
5.00.00	**Specific Requirements for Non- Intrusive Hardwired Actuators**	
5.01.00	**Interfaces**	For ON-OFF and INCHING type actuators interface with the control system shall be through hardwired signal only. • Open/Close command, open/ close status and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided hardwired. • The actuator shall be able to accept open/close command at 24V DC with max. 2.5VA load from control system. Accordingly, suitable isolated interface in the actuator shall be provided. • Open/close command termination logic shall be suitably built inside actuator. • For typical wiring diagram Refer Tender Drawing No. 0000-999-POI-A-063 (Except plug & socket connector, if not applicable) • For INCHING type actuators, hardwired analog position signal (4-20mA) derived from absolute encoder to be provided for actuator position.
5.02.00	**Terminal Box**	Suitable terminals/ connectors, integral to actuator, for terminating instrumentation & power cables shall be provided. Necessary glands for power cables and instrumentation cables shall be provided.
5.03.00	**Training**	Contractor shall provide training on Non-Intrusive hardwired Electric Actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.
6.00.00	**Specific Requirements for Non-Intrusive Fieldbus Actuators**	
6.01.00	**Interfaces**	For ON-OFF and INCHING type actuators interface with the control system shall be through fieldbus network. a) Open/ close commands, open/ close feedback status, disturbance

signal etc. shall be available to the Control System through the fieldbus network along with diagnostics. The detailed diagnostics including the actuator operating data shall be available to the DDCMIS through the fieldbus network.

b) All actuators shall be Foundation Fieldbus/ Profibus compatible. However the exact protocol shall be based on finalized protocol of DDCMIS. If Profibus DP protocol is envisaged then actuator shall have two (redundant) Profibus DP ports for connecting the redundant Profibus DP cables. That is if one profibus cable is cut or not working/ not available, then complete actuator functionality shall be available through the second redundant cable without any manual intervention. Also, for Profibus DP cable connection, suitable connector integral to the actuator, or external devices/ accessories (mounted inside minimum IP65 protection class enclosure) shall be provided so that the actuator can be isolated online from the profibus network without disturbing the Profibus communication of other actuators of the segment.

c) Open/close command termination logic shall be suitably built inside actuator.

d) For all actuators GSD and DTM files are to be provided which shall be configured/ tested with DCS for proper interfacing and diagnostics.

6.02.00 **Terminal Box** Suitable terminals/ connectors, integral to actuator, for terminating fieldbus cables and power cables shall be provided. Necessary glands for power cables and armored fieldbus cables shall be provided.

6.03.00 **Training** Contractor shall provide training on Non-Intrusive Fieldbus Electric Actuator along with detail training on Foundation Fieldbus/ Profibus interface used in actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.

7.00.00 **Specific Requirements for Modulating duty Electric Actuators**

Sl No.	Description	Requirement
1.	Duty	Continuous duty / Modulation,
2.	Operating Ambient Temperature	-20 to +60 Deg C or better
3.	Enclosure Protection	IP 68
4.	Resolution/ Precision	0.1%- 0.2% or better of total travel
5.	Supply Voltage & frequency	415V +/- 10%, 3 Phase, 50HZ +/-5% or 230V +/- 10%, Single Phase, 50Hz +/- 5%
6.	Motor Suitable for	Continuous Duty
7.	Motor insulation Class	F
8.	Analog Control	4-20mA, (24VDC)
9.	Position Transmitter	4-20mA (24VDC)
10.	Integral Starter	Yes
11.	Terminal Block	For power cables, the grade of TBs shall be minimum 600V
12.	Accessories (if	for calibration / settings/

	applicable)	configuration of various parameters of actuator shall be provided
13.	Hand wheel	Yes
14.	Standard Compliance	EN 15714-2 Class D or equivalent

SUB–SECTION – IIIC – 18

NOT USED

SUB–SECTION – IIIC – 19

NOT USED

SUB–SECTION – IIIC – 20

CCR DESIGN GUIDELINES

CENTRAL CONTROL ROOM (CCR) DESIGN GUIDELINES

1.00.00 The Contractor shall provide an integrated design **on single point responsibility covering Control room design, HVAC, Firefighting, Lighting, Architectural finishes and associated civil works, Video wall paneling, Colour coordination, Acoustics, Human factor Engineering complying ISO 110064, Fire fighting** for a modern state-of-the-art control room and its adjacent areas. The Contractor shall develop computerized models for the control room covering layout, colour scheme, selection of material, requirement of various material, etc.

2.00.00 The equipment which will be present in the control room or in the adjacent areas are as follows: -

a. Control room – operator desk along with monitors, **two** tier of Large Video Screens (LVS) mounted on LVS panel (with suitable cladding), PC racks behind LVS panels, Unit in-charge desks along with monitors, a few PCs and printers etc. with associated furniture.
b. Programmer's room– Required quantities of PCs and workstations and network devices with associated furniture.
c. Shift in-charge room – Office tables, lockers, Workstations with associated furniture.
d. Documents room, spares room, Locker room, pantry, toilets, small offices along with lobby, visitor room, conference room etc.
e. Other miscellaneous areas.
f. Furniture like Computer tables, Chairs and other furniture related to Central control room, Programmer room.
g. Other aspects like false ceiling, glass / glazing partition wall, wall tiles, floors, floor tiles and finish etc. for above areas.

3.00.00 **Technical Details**

3.01.00 The Control Room design shall take into consideration the control/operation/monitoring devices being employed and the relevant international standards like DIN/VDE/VDI/IEC/EN. As a minimum the following aspects shall be considered at the time of design:

- Illumination

- Acoustics

- Colour coordination

- Ergonomic aspects

- Environmental conditions

- Conducive Ambience

-Fire Fighting

-Health & Safety of personnel

-Cable Management

- Materials

- Support facilities

3.01.01 **Illumination**

The lighting shall take into account the requirements of Large Video Screen (LVS) operation and shall ensure that there is no reflection from the LVSs. Automatic adjustment of intensity based on ambient conditions shall be provided, suitable for normal human eye.

It shall be ensured that the operational area viz. the control desk is adequately illuminated. There should be no glare from the monitors on the control desk.

Emergency lighting shall also be provided.

3.01.02 **Acoustics**

Suitable arrangements on the ceiling, wall & floor like sound absorbers etc. shall be provided to ensure that the continuous sound level does not exceed 30 dBA; and perceived ambient noise does not exceed 55 dBA. The reverberation time shall not exceed 0.5 sec.

Acoustic curtain between control desks of two units.

3.01.03 **Colour Coordination**

Contractor shall ensure full coordination of the colour of various components of the control room viz. walls, false ceiling, floor, control desk & other furniture which shall be aesthetically appealing. A comprehensive proposal for the colour coordination shall be furnished to employer during detailed engineering for approval.

3.01.04 **Ergonomic Aspects**

The desk along with LVS shall be designed keeping in view aesthetics, ergonomic considerations, anthropometrics, anthropotechniques to ensure ease of operation with maximum comfort.

Furniture

Specifically designed furniture for the operating personnel shall be provided ensuring comfortable and fatigueless operation with proper colour coordination with the rest of the control room / other rooms.

3.01.05 **Environmental Conditions**

Contractor shall elaborate suitable air conditioning system design requirement for Central Control room to ensure proper environmental conditions for the operating personnel & equipment.

Contractor shall also ensure other environment aspects like Fountains, plants, landscape outside Control room.

3.01.06 **Conducive Ambience**

The Control room environment shall be conducive for safe, healthy and comfortable presence of the operating personnel for long periods without any unease/discomfort.

3.01.07 **Fire Fighting**

The Control room shall be equipped with all necessary fire fighting facilities.

3.01.08 **Health & Safety of personnel**

The control room design shall ensure that health and safety aspects of personnel are taken care.

3.01.09 -**Cable Management**

All the cables shall be supported, concealed and properly laid in walls/floors/ceiling

3.01.10 **Materials**

Suitable new aesthetic and durable materials shall be suggested for false ceilings, walls, tiles, floors etc in line with latest practices all over the world, keeping in view of other factors like illumination, colour contrasts etc. along with recommended finishing work.

3.01.11 **Support facilities**

The design shall take care of other associated facilities with a view to the working pattern of a 24 x 7 power plant control room.

4.00.00 **Other Equipment**

Control Room shall be equipped with necessary support facilities and equipment such as conference rooms, document rooms, pantry, dining room, tea/coffee/water dispenser, toilets, lockers, automatic opening doors etc for smooth and comfortable working of the operating personnel.