CLAUSE NO.	BIDDER'S NAME	
	f) Characteristic impedance max.	.....
	15. Continuous operating temp. (deg.C)	.....
	16. Whether complete cable assembly flame retardant as per IEEE-383	Yes/No
	17. Whether complete cable assembly passes Swedish chimney test as per SEN 4241475 (F3)	Yes/No
	18. Identification	
	a) Length of the cable marked at every meter	Yes/No
	b) FRLS marked at every 5 meter	Yes/No
	c) Each core of the pair numbered	Yes/No .....
	d) Conductor identification details for pairs 3) Numbering	1) Colour ..... 2) Band .....
	e) Details of cable markings	.....
	19. Test Voltage	Core to Core Core to Shield
	a) High voltage test (Dielectric strength)	
	i) Voltage (KV)	.....
	ii) Duration (min)	.....
	b) Resistance to direct current test	
	i) Voltage (KV)	.....
	ii) Duration (min)	.....

CLAUSE NO.	BIDDER'S NAME	
	20. Cable cross-sectional drawings for each type of cable furnished at	Page No ..... Sec No .....
	21. Confirm that cables are included under Bidder s scope on as required basis	Yes/No .....
	22. Confirm that prefabricated cables shall have 10% spare cores not connected to connector	Yes/No .....
	23. Technical literature furnished at	Page No. .....Sec No.....
	24. i) Length of single coil in a drum	.....
	ii) Termite proof seasoned wood drum provided	Yes/No
	iii) Gross weight	.....
	iv) Net weight	.....
	v) Identification marks provided	Yes/No
7.03.02	Cable Termination as per Sub-Section-Inst. Cable, Part-B, Section-VI provided	Yes/No
7.03.03	**Internal Wiring for Control Desk/ Electronic System Cabinets**	
	1. Conductor size and number of strands	.....
	2. Conductor material	.....
	3. Insulation :	
	a) Conductor insulation material FRLS	Yes/ No .....
	b) Conductor insulation thickness	.....
	c) Applicable design standard for conductor insulation	.....

CLAUSE NO.	BIDDER'S NAME	
	4. Voltage grade	.....
	5. Reference standard	.....
	6. Technical literature furnished at	Page No .....Sec No.....
7.03.04	**Cabling accessories & Electrical Field Construction Material**	
	a) Confirm that all conduits, conduit supports, junction boxes/terminals blocks (with spare terminals as specified) and all electrical field construction material for the works included under Tech. specification, shall be furnished by the Bidder on as required basis	Yes/No .....
	b) Confirm that fire proof sealing to prevent entry/ prepagation of fire/ dust through floor slots have been provided for all application	Yes/No .....
	c) Confirm that two (2) new sets of cable termination accessories required for cabling maintenance work shall be supplied	Yes/No .....
	d) List of items covered in (c) above with Techincal Specification furnished at	Page No ..... Sec no. .....
7.04.00	Type test procedures as per VDE 0472, IS 10810, VDE 0815 & other relevant standards enclosed	Yes/No
7.05.00	**Cable Support System**	
7.05.01	**Cable Trays, Tray Covers & Accessories**	
	1. Makers Name, Country of manufaturer	.....
	2. Type of cable tray	.....
	3. Type of cable support system	.....

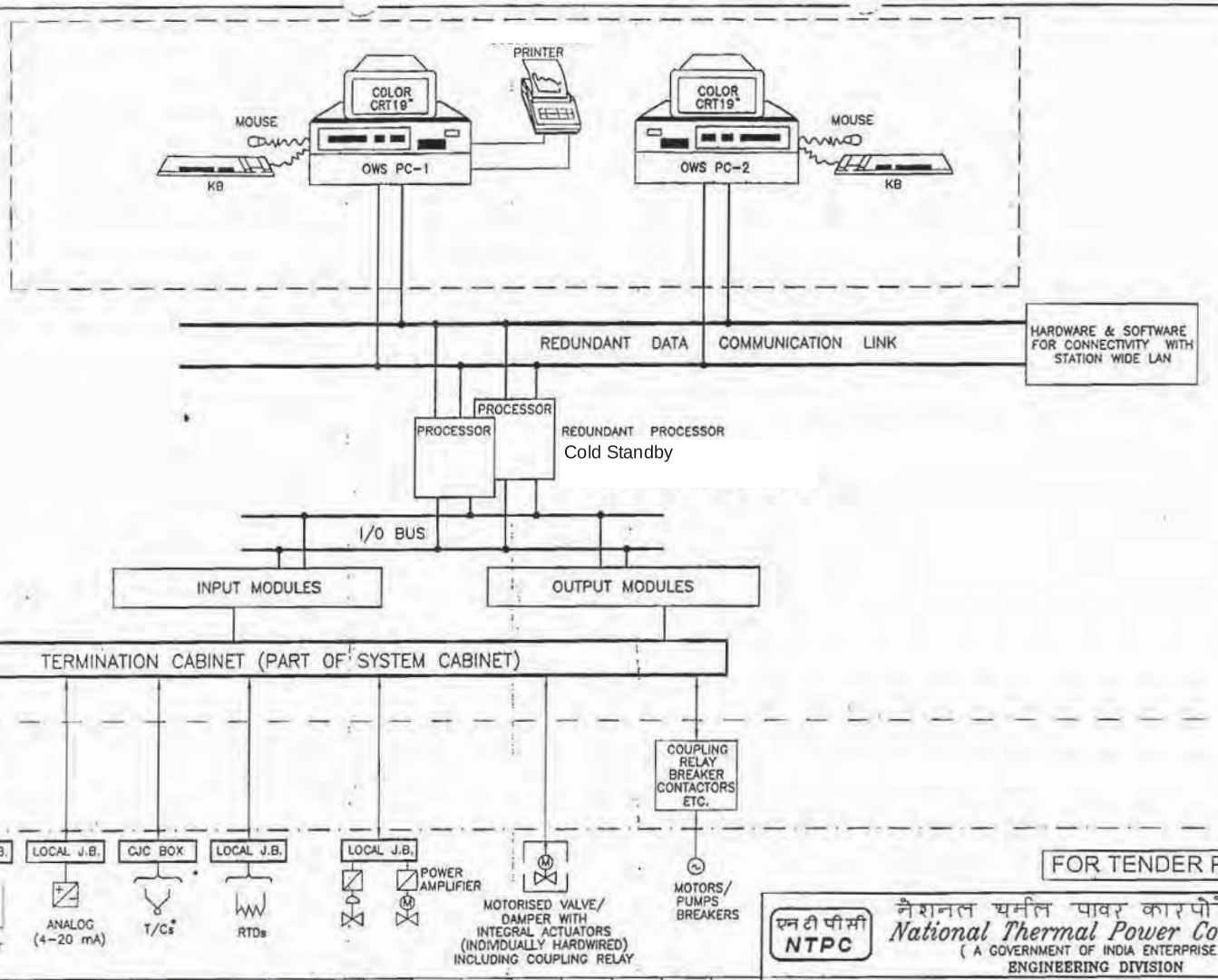
CLAUSE NO.	BIDDER'S NAME	
	4. Applicable standard	.....
	5. Catalogue and indicative sketch attached as annexure no.	.....
7.05.02	**Conduit Pipes & Accessories**	
	1. Maker s name and country of manufacturer	.....
	2. Material	.....
	3. Catalogue attached as annexure no.	.....
	4. Applicable standard	
7.05.03	**Junction Boxes**	
	1. Maker s name and country of manufacturer	.....
	2. Material	.....
	3. Applicable standard	.....
7.05.04	**Cable Glands**	
	1. Maker s name and country of manufacturer	.....
	2. Type of cable gland	.....
	3. Applicable standard	.....
7.05.05	**Cable Jointing / Termination Kits**	
	1. Maker s name and country of manufacturer	.....
	2. Type of system	
	a) Termination	.....
	b) Joints	.....
	3. Catalogue attached as annexure no.	.....

CLAUSE NO.	BIDDER'S NAME	
	4. Type test reports enclosed as annexure no.	.....
	5. Applicable standard	.....
7.05.06	**Cable Lugs & Terminals**	
	1. Maker s name and country of manufacturer	.....
	2. Applicable standard	.....
7.06.00	Type test procedure as per VDE 0472 IS:10810, VDE 0815 & other relevant standards enclosed	Yes/No .....

SECTION – D3

DESIGN REQUIREMENTS
CONTROL AND INSTRUMENTATION

NOTE: - Some of the design requirement specified in section D3 may not be applicable to the bidder design. These requirements shall be accepted as per manufacturer standard practice.



FOR TENDER PURPOSE ONLY

एन टी पी सी NTPC
नैशनल थर्मल पावर कारपोरेशन लिमिटेड
National Thermal Power Corporation Ltd.
(A GOVERNMENT OF INDIA ENTERPRISE)
ENGINEERING DIVISION

PROJECT: TYPICAL THERMAL POWER PROJECT

TITLE: CONFIGURATION DIAGRAM FOR PLC BASED OFFSITE CONTROL SYSTEMS

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	APPD	DATE
C	GENERALLY REVISED		KS.	PS	PS	02.09.03
B	GENERALLY REVISED		AR	PS	MPS	16.05.02
A	FIRST ISSUE		AR	PS	AKB	18.08.02

CLEARED BY: M | E | C | C&I | ARCH.

SIZE	SCALE	DRG. NO.	REV. NO.
A3	N.T.S.	0000-999-POI-A-013	C

CAD FILE NAME: C:\PC_MS\MS\OFFSITE\0000-999-POI-A-013RC.DWG

CLAUSE NO.	TECHNICAL REQUIREMENTS
	CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY SYSTEMS
1.00.00	**CONTROL AND INSTRUMENTATION FOR PLANT AUXILIARY PACKAGES**
1.01.00	Contractor shall provide complete Control and Instrumentation system with all accessories, auxiliaries and associated equipments and cables for the safe, efficient and reliable operation of the plant auxiliary systems as indicated under scope part at IIC, Part-A, Section VI.
1.02.00	The quantity of instruments for each plant auxiliary system shall be as per tender P&ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all instruments and devices, which are needed for the completeness of the plant auxiliary system/equipment, supplied by the Contractor, even if the same is not specifically appearing in the P&ID. Also refer item MEASURING INSTRUMENTS, Subsection CONTROL & INST, Part A Section VI.
1.03.00	All instruments and control equipments like primary and secondary instruments etc. shall meet the requirements specified in Sub-section: MEAS INST Part-B, Section VI. In addition, all electrical instrument devices like switches/transmitters/controllers/ analysers/solenoid valves which are located in the field/hazardous locations like hydrogen generation plant shall be provided with explosion proof enclosure suitable for hazardous areas described in National Electric Code (USA), Article 500, Class-I, Division-I. All field wiring should be through conduits. All fittings, cable glands etc. shall be strictly as per NEC recommendation article, 500 to 503.
1.04.00	Contractor shall provide independent control systems for safe, efficient and reliable operation of the plant auxiliary systems. The type of control system shall be as indicated under scope part at IIC, Part-A, Section VI.
1.05.00	ON/OFF control, indication, annunciation of incomers and bus-coupler are also to be performed from Contractor's Control System for each of the above system as applicable.
1.06.00	It shall be possible to remove/replace online various modules (like any I/O module, interface module, etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. System design shall ensure that while doing so, undefined signaling and releases do not occur and controller operation in any way is not affected (including controller trip to manual, etc) except that information related to removed module is not available to controller. Further, it shall also be possible to remove/replace any of the redundant controller modules without switching off the power to the corresponding rack and this will not result in system disturbance or loss of any controller functions for the other controller. The on-line removal/insertion of controller, I/O modules shall in no way jeopardise safety of plant and personnel.
1.07.00	The Control system shall include on-line self-surveillance, monitoring and diagnostic facility giving the details of the fault on the Human Machine Interface System (HMIS). The faults to be reported shall include fault in main & standby power supplies, sensor fault, Input/ Output card failure, Memory Status, Controller fault,

CLAUSE NO.	TECHNICAL REQUIREMENTS
	failure of Communication/ Network links to PLCs, LAN etc. These faults shall be reported as colour change on system status display and as messages on HMIS as well as through local indication on the faulty module and on respective rack/ cubicle. The diagnostic system shall ensure that the faults are detected before any significant change in any controller output has taken place.
1.08.00	The Control system shall operate in non-air conditioned area and shall meet the minimum requirements as specified below. The Contractor shall, however, provide a Package AC for his control system his Control system. The Control system shall meet the minimum requirements as specified below.
1.09.00	Also refer configuration diagram for PLC based off-site control system, drawing no. 0000-999-POI-A-013.
2.00.00	**PROGRAMMABLE LOGIC BASED CONTROL SYSTEM**
2.01.00	PLC PROCESSOR The processor unit shall be capable of executing the following functions:- a Receiving binary and analog signals from the field and providing command output to MCC/SWGR/Drive etc. through Input / Output modules and operator initiated commands from HMIS / control panel. b Implementing all logic functions for control, protection and annunciation of the equipment and systems. c Implementing modulating control function for certain application as specified elsewhere in the specification. d Providing supervisory information for alarm, various types of displays, status information, trending, historical storage of data etc. e Performing self-monitoring and diagnostic functions.
2.02.00	For a Dual processor based PLC system, each PLC unit shall be provided with two processors (Main processing unit and memories) one for normal operation and one cold standby In case of failure of working processor, there shall be an appropriate alarm and simultaneously the standby processor shall take over the complete plant operation. ~~In case of hot standby configuration, this transfer shall be automatic. The transfer from main processor to standby processor shall be totally bump less and shall not cause any plant disturbance whatsoever.~~ In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processors as master and other as standby. The standby processor shall be updated in line with the changes made in working processor. Wherever multiple functional groups have been specified/ required, the above requirements are applicable for each functional group.
2.03.00	The memory shall be field expandable. The memory capacity shall be sufficient for the complete system operation and have a capability for at least 20% expansion in

CLAUSE NO.	TECHNICAL REQUIREMENTS
	future. Programmed operating sequences and criteria shall be stored in non volatile semi conductor memories like EPROM. All dynamic memories shall be provided with buffer battery back up which shall be for at least 360 hours. The batteries shall be lithium or Ni-Cd type.
2.04.00	Priority of different commands shall be as follows:
2.04.01	Manual intervention shall be possible at any stage of operation. Protection commands shall have priority over manual commands and manual commands shall prevail over auto commands.
2.04.02	A forcing facility shall be provided for changing the states of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements. It shall be possible to display the signal flow during operation of the program.
2.05.00	HUMAN MACHINE INTERFACE SYSTEM (HMIS) PC based OWS (Operator Work Station) shall perform control, monitoring and operation of all auxiliaries/ drives interacting with PLC based control system. It shall be possible to use the same as programming station of the PLC and the Human Machine Interface System. It shall basically perform the following functions. In case the PC based OWS/GIU can not be used as programming station of the PLC and the Human Machine Interface System, then separate PC based programming station shall be provided. Refer Subsection II C, Part A, and Section VI for exact number of Operator Workstations to be provided for each of the control systems. Specification of PC is provided below.
2.05.01	All OWS of the HMIS shall be fully interchangeable i.e. all operator functions including control, monitoring and operation of any plant area on drive shall be possible from any of the OWS at any point of time without the necessity of any action like downloading of additional files. Operator shall be able to access all control/information related data under all operating conditions including a single processor/computer failure in the HMIS.
2.05.02	All frequently called important functions including major displays shall be assigned to dedicated function keys on a soft keyboard for the convenience of the operator for quick access to displays & other operator functions.
2.05.03	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 finalised during detailed engineering.
2.05.04	The display selection process shall be optimised so that the desired display can be selected with the minimum no. of operations. Navigation from one display to any other should be possible efficiently through paging soft keys as well as through

targets defined on the displays. There should be no limitation on number of such targets.

2.05.05 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 unauthorised 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 as finalised 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).

When any drive or sequence is being controlled from one OWS, the system shall inhibit control access of the same drive or sequence from other OWS or Local Control Panel.

2.06.00 PROGRAMMING FUNCTIONALITIES

Programming of the PLC Processor / controller as well as programming of HMIS shall be user friendly with graphical user interface and shall not require knowledge of any specialised language. For example, the programming of PLC shall use either of the following:-

Flow-chart or block logic representing the instructions graphically.

Ladder diagrams.

The programming of HMIS (like development and modification of data base, mimics, logs / reports, HSR functionalities etc.) shall also be possible through user-friendly menus etc.

All programming functionalities shall be password protected to avoid unauthorised modification.

2.07.00 SOFTWARE REQUIREMENT

All necessary software required for implementation of control logic, operator station displays / logs, storage & retrieval and other functional requirement shall be provided. The programs shall include high level languages as far as possible. The contractor shall provide sufficient documentation and program listing so that it is possible for the Employer to carry out modification at a later date.

The Contractor shall provide all software required by the system for meeting the intent and functional/parametric requirements of the specification.

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. The system shall have user friendly programming language & graphic user interface.

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	All system related software including Real Time Operating System, File management software, screen editor, database management software. On line diagnostics/debug software, peripheral drivers software and latest versions of standard PC-based software and latest WINDOWS based packages etc. and any other standard language offered shall be furnished as a minimum. All application software for PLC system functioning like input scanning, acquisition, conditioning processing, control and communication and software for operator interface of monitors, displays, trends, curves, bar charts etc. Historical storage and retrieval utility, and alarm functions shall be provided. The Contractor shall provide software locks and passwords to Employer's engineers at site for all operating & application software so that Employer's engineers can take backup of these software and are able to do modifications at site.
3.00.00	**INPUT/OUTPUT MODULES**
3.01.00	The PLC system should be designed according to the location of the input/output cabinets as specified.
3.02.00	Input Output modules, as required in the Control System for all type of field input signals (4-20 mA, RTD, Thermocouple, non change over/change over type of contact inputs etc.) and outputs from the control system (non change over/change over type of contact, 24/48 VDC output signals for energising interface relays,4-20 mA output etc.) are to be provided by the Contractor. Contractor to refer drawing nos. 0000-999-POI-A-065 for interface/termination requirements of Field Instruments/ Drives.
3.03.00	Electrical isolation of 1.5KV with optical couplers between the plant input/output and controller shall be provided on the I/O cards. The isolation shall ensure that any inadvertent voltage or voltage spikes (as may be encountered in a plant of this nature) shall not damage or mal-operate the internal processing equipment.
3.04.00	The Input/output system shall facilitate modular expansion in fixed stages. The individual input/output cards shall incorporate indications on the module front panels for displaying individual signal status.
3.05.00	Individually fused output circuits with the blower fuse indicator shall be provided. All input/output points shall be provided with status indicator. Input circuits shall be provided with fuses preferably for each input, alternatively suitable combination of inputs shall be done and provided with fuses such that for any fault, fuse failure shall affect the particular drive system only without affecting other systems.
3.06.00	All input/output cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching of power supply.
3.07.00	The Contractor shall provide the following monitoring features: a Power supply monitoring.

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	b Contact bounce filtering. c Optical isolation between input and output signals with the internal circuits d In case of power supply failure or hardware fault, the critical outputs shall be automatically switched to the fail-safe mode. The fail-safe mode shall be intimated to the successful Contractor during detailed engineering.
3.08.00	Binary Output modules shall be rated to switch ON/OFF coupling relays of approx. 3 VA at 24 VDC. Analog ouput modules shall be able to drive an load impedance of 500 Ohms minimum.
3.09.00	Output module shall be capable of switching ON/OFF inductive loads like solenoid valves, auxiliary relays etc. without any extra hardware.
3.10.00	Only one changeover contact shall be provided in MCC for control and interlock requirement. Further multiplication, if required ,shall be done by the contractor in PLC system.
3.11.00	All input field interrogation voltage shall be 24V DC or 48 V DC.
3.12.00	In case of loss of I/O communication link with the main processing unit, the I/O shall be able to go to predetermined fail safe mode (to be decided during detailed engineering) with proper alarm/message.
3.13.00	Wiring Scheme for inputs to control system shall be as follows:
3.13.01	Each of the triple redundant binary & analog inputs shall be wired to separate input modules. Similarly each of the dual redundant binary & analog inputs shall be wired to separate input modules. These redundant modules shall be placed in different racks, which will have separately fused power supply distribution. Implementation of multiple measurement schemes of these inputs will be performed in the redundant hardware. Loss of one input module shall not affect the signal to other modules. Other channels of these modules can be used by other inputs of the same functional group.
3.13.02	The single (i.e. non-redundant) binary & analog signal required for control purposes shall be wired as follows:
3.13.03	All single analog & binary inputs including the limit switches of valves/dampers MCC/SWGR check-backs of all drives & information related signals shall be wired to single (i.e. non-redundant) input modules.
3.13.04	The on-off status of HT drives etc, however, be wired to two input modules in parallel.
3.14.00	Binary & analog outputs shall be non-redundant only. Failure of any single module shall not affect operation of more than one single drive.

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3.15.00	The signal conditioning functions like multiple measurement schemes, square root extraction for flow signals, pressure and temperature compensation, limit value computation can be performed either in the controllers or in signal conditioning and processing hardware outside controllers.
3.16.00	The maximum number of inputs/outputs to be connected to each type of module shall be as follows: 1 : Analog input module 16 2 : Analog output module 16 3 : Binary input module 32 4 : Binary output module 32 5 : Analog input & output (combined) 16 6 : Binary input and output (combined) 32 Note: For binary inputs, one changeover contact is counted as 2 inputs.
3.16.01	Any single sensor/transducer/transmitter failure alarm shall be provided on programmer station CRTs for all sensors/transducers/transmitters. Similarly sensor break alarm for thermocouples etc. shall also be displayed on the CRTs.
3.17.00	Contractor shall provide remote Input/Output modules Housed in free-standing cabinets/racks (with suitable redundant data link to the central PLC system) as specified. These Input/Output modules shall meet the technical requirements as mentioned in the above clauses. Further these Input/Output modules shall be designed to continuously work under the environment expected to be encountered in assigned areas without any air-conditioning support. Wherever the cable route distance of these I/O cabinets/racks exceeds a distance of 600 meters from the Central PLC, fiber optic data link has to be provided.
4.00.00	**SYSTEM SPARE CAPACITY**
4.01.01	Over and above the equipment and accessories required to meet the fully implemented system as per specification requirements, Control System shall have spare capacity and necessary hardware/ equipment/ accessories to meet following requirement for future expansion at site:
4.01.02	10% spare channels in input/output modules fully wired up to cabinets TB.
4.01.03	Wired-in "usable" space for 20% modules 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. Terminal assemblies (if any in the offered system), corresponding to the I/O modules shall be provided for above mentioned 20 % blank space.

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4.01.04	Each processor / controller shall have 30% spare functional capacity to implement additional function blocks, over and above implemented logic/ loops. Further, each processor / controller shall have spare capacity to handle minimum 30% additional inputs/ outputs of each type including above specified spare requirements, over and above implemented capacity. Each of the corresponding communication controllers shall also have same spare capacity as that of processor/controller.
4.01.05	The Data communication system shall have the capacity to handle the additions mentioned above.
4.01.06	Twenty (20) percent spare relays of each type and rating mounted and wired in cabinets TB. All contacts of relays shall be terminated in terminal blocks of cabinets.
4.01.07	The spare capacity as specified above shall be uniformly distributed throughout all cubicles. The system design shall ensure that above mentioned additions shall not require any additional controller/processor/ peripheral drivers in the system delivered at site. Further, these additions shall not deteriorate the system response time / duty cycle, etc. from those stipulated under this specification.
5.00.00	**DATA COMMUNICATION SYSTEM (DCS)**
5.01.00	The Data Communication System shall include a redundant Main System Bus 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. The DCS shall have the following minimum features : a Redundant communication controllers shall be provided to handle the communication between I/O Modules (including remote I/O) and PLCs and between PLCs and operator work station. b The design shall be such as to minimise interruption of signals. It shall ensure that a single failure anywhere in the media shall cause no more than a single message to be disrupted and that message shall automatically be retransmitted. Any failure or physical removal of any station/module connected to the system bus shall not result in loss of any communication function to and from any other station/module. c If the system bus requires a master bus controller philosophy, it shall employ redundant master bus controller with automatic switchover facility. d Built-in diagnostics shall be provided for easy fault detection. Communication error detection and correction facility (ECC) shall be provided at all levels of communication. Failure of one bus and changeover to the standby system bus shall be automatic and completely bump less and the same shall be suitably alarmed/logged. e The design and installation of the system bus shall take care of the environmental conditions as applicable.

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	f Data transmitting speed shall be sufficient to meet the responses of the system in terms of displays, control etc. plus 25% spare capacity shall be available for future expansion. g Passive coaxial cables or fiber optic cables shall be employed. The Contractor shall furnish details regarding the communication system like communication protocol, bus utilisation calculations etc.
5.02.00	The PLC system shall be provided with necessary interface hardware and software for dual fiber optic connectivity & interconnection with station wide LAN (In Employer's Scope)for two - way transfer of signals for the purpose of information sharing. The plant information shall be made available through an Ethernet link following TCP/IP standard. The system shall be OPC compliant. The exact data structure shall be as decided during detailed engg. All required plant data shall be transferred to/from through this ensuring complete security. The exact number of points to be transferred through the above communication link and the format of the data shall be finalised during detailed engineering. The Contractor shall provide all assistance to the BOP C&I System (In Employer's Scope) Supplier including co-ordination and flow of required information etc. for display of all input points under alarm, connected to PLC or generated by PLC, on various operating stations on BOP C&I System and various client PCs on station LAN.
6.00.00	**SYSTEM REACTION TIME**
6.01.00	The reaction time of the programmable control system from input signals at the input cards to output of the associated signals or commands of the output card inclusive of programmed logic processing, comprising a mixture of logic gates, arithmetic operations and other internal operations shall be less than 100 milli seconds under the most arduous control system operating conditions.
7.00.00	**OPERATOR INTERFACE DISPLAYS/LOGS/REPORTS** Suitable Operator Interface Displays/Logs/Reports for control operation & monitoring shall be provided. The details shall be finalised during detailed Engg. Stage.
7.01.01	Historical storage and retrieval system (HSRS)
7.01.02	The HSRS shall collect store and process system data from MMIPIS data base. The data shall be saved online on hard disk and automatically transferred to erasable long term storage media once in every 24 hours periodically for long term storage. Provision shall be made to notify the operator when hard disk is certain percentage full. The disk capacity shall be sufficient to store at least seven days data.
7.01.03	The data to be stored in the above system shall include alarm and event list, periodic plant data, selected logs/reports. The data/information to be stored & frequency of storage and retrieval shall be as finalised during detailed engineering. The system shall provide user-friendly operator functions to retrieve the data from historical storage. It shall be possible to retrieve the selected data on OWS or printer in form of trend/report by specifying date, time & period. Further, suitable index

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	files/directories shall also be provided to facilitate the same. The logs/reports for at least last seven (7) days shall be available on the disk.
7.01.04	In addition to above, the system shall also have facility to store & retrieve important plant data for a very long duration (plant life) on portable long term storage media). These data will include any data from the database as well as processed/computed data based an various calculations/transformation. The retrieved data from long term storage media should be possible to be presented in form of X-T display, X-Y display, logs, reports, etc. The system shall have provision of generation. Of reports and logs. General only two types of logs shall be.
7.01.05	Reports and Logs:- The system shall have provision of generation of reports and logs. Generally two types of logs shall be provided. i) Time dependant - Periodically generated (shift log, daily log etc.). ii) Event dependant - Provision of thirty logs/reports of each type shall be provided.
8.00.00	**CONTROL & POWER SUPPLY SCHEME**
8.01.00	For Control system, redundant power supply shall be provided by the contractor. Necessary redundant transformers and redundant chargers with battery back-up shall be provided by the Contractor to derive power supply from 415 V, 3-phase 3-wire incomers to be arranged by the Contractor at the input terminals of Power supply cabinets. The Contractor shall, however, furnish all required hardware/ equipment/ cubicles for conversion and/or stabilisation of the power source provided by the Owner to all other levels which may be necessary for meeting the individual requirements of equipments/ systems furnished by him within the Contractor's quoted lump sum price. Power supply module shall be of ample capacity to supply all modules. In addition 20% spare capacity for future shall be provided. All the drives shall be switched ON/OFF through 24V DC coupling relays to be provided in HT/LT SWGR panels. Power supply distribution from Contractor's power supply cabinets shall be in the scope of Contractor. The exact power supply scheme shall be as approved by Employer during detailed Engineering stage.
8.02.00	The battery shall be sealed maintenance free Ni-Cd type batteries with long life and shall be able to provide a back-up for one hour at full load requirement of the complete control system.
8.03.00	The equipment of power supply unit can be mounted as an integral part of the enclosure and the same shall provide all voltages necessary to power the processor and I/O modules. All required redundant power packs etc. with inbuilt chargers, with minimum thirty minutes battery back-up shall be provided .Power supply module shall be of ample capacity to supply all modules. In addition 20% spare capacity for

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	future shall be provided. However, the exact power supply scheme shall be as approved by Employer during detailed Engineering stage.
9.00.00	**CONTROL CABINETS / PANELS / DESKS**
9.01.00	The cabinets shall be IP-22 protection class. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Employer during the factory testing of the system. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition as specified in Sub-section-basic Design criteria (Part-B, Section-VI) and specification requirements for remote I/O cabinets. Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If blowers are required for satisfactory system operation, dual blowers with blower failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished with proposal. Suitable louvers with wire mesh shall be provided on the cabinet.
9.01.01	The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom entry of the cables.
9.01.02	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.
9.01.03	Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.
9.01.04	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 colour 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. The finish colors for exterior and interior surfaces shall conform to following shades: (a.) Exterior:- As per RAL 9002 (End panel sides RAL 5012), to be finalised during detailed engineering. (b.) Interior:- Same as above. Paint films which show sags, checks or other imperfections shall not be acceptable.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	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. The Bidder shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory painted surfaces of each item of equipment. The touch-up paint shall be of the same type and color as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.
9.01.05	Refer Subsection Basic Design Criteria, Part B, Section VI for grounding requirements.
9.02.00	The technical specification covering panel fabrication details, wiring and termination details etc. shall be as described under Sub-Section INST CABLE of this specification.
9.03.00	**Control Desk**
9.03.01	PC based OWS (operator Work Station) of PLC shall be mounted on table type control desk to house PC/ keyboards/ mouse etc. Control desk shall be free standing table top type with doors at the back and shall be constructed of 3 mm thick CRCA steel plates. A 34 mm thick wooden top shall be provided on the desk with proper finish of acrylic PVC/polyutherane paint. All operators work stations shall be mounted on this Control Desk. Employer supplied PA system hand sets, telephone sets and CCTV monitors shall also be mounted. The Keyboard shall be capable of being pulled out through a tray. The desk shall be arranged in an continuous arc shape. The exact profile of the desk, dimension and the radius of curvature shall be finalised during detailed engineering stage.
9.03.02	To achieve durable & water resistant finish, a coat of "Polyuthesive crystal clear" on the surface of unit control desks shall be provided. Final paint finish with proper smoothening is to be ensured. Final finish of Control Desk should be in line with relevant International standards.
9.03.03	Two nos industrial grade chairs will be provided with control desk.
10.00.00	**ANNUNCIATION SYSTEM**
10.01.00	Only OWS based alarm system shall be provided with audio alarm facility (beep/tone generator). No facia annunciation is envisaged in the control room. Hooters are to be provided.
10.02.00	The system shall display history of alarms in chronological order on any of the OWS. The HMIS shall have the capability to store a minimum of 500 alarms each with paging features allowing the operator to view any page. The system shall have all alarm functions and related function keys like alarm acknowledge, reset, paging, summaries etc. Other design features like set point/dead band adjustments, provision of alarm priority, manual inhibition & automatic inhibition based on predefined logic etc., shall be provided and shall be as finalised during detailed engineering. The alarm display/report format shall be as approved by the Employer.

CLAUSE NO.	TECHNICAL REQUIREMENTS
10.03.00	Facility of audio annunciation shall be provided in OWS upon the occurrence OWS alarms irrespective of whether alarms are displayed or not. Facility to disable the audio annunciation per OWS shall be provided.
10.04.00	At least three levels of alarm priority shall be available which will be displayed in different colour. It shall be possible to display & print alarms of any of the three levels only on a per OWS basis.
10.05.00	Alarm boxes shall be provided in each display to alert the operator about an alarm when he is viewing some other picture. No of alarm boxes shall be for each process area & each priority therein.
10.06.00	The annunciator sequence shall conform to ISA sequence ISA-2A.
10.07.00	Annunciation facia windows are to be provided in local control panels where ever specified.The number of annunciation facia windows and the provision for original input will be on as required basis.
10.08.00	SOFTWARE DOCUMENTATION AND SOFTWARE LISTINGS
10.08.01	All technical manuals, reference manuals, user's guide etc., in English required for modification/editing/addition/deletion of features in the software of the PLC System shall be furnished. The Contractor shall furnish a comprehensive list of all system/application software documentation after system finalisation for Employer's review and approval.
10.08.02	All The software listings including Source code for application software, All special-to-project data files etc. shall be submitted by the Contractor:
10.09.00	SOFTWARE LICENCES The Contractor shall provide software license for all software being used in Contractor's System. The software licenses shall be provided for the project (e.g. organisation or site license) and shall not be hardware/machine-specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Employer to seek a new license/renew license due to upgradation/change of hardware/machine in Contractor's System at site. All licenses shall be valid for the continuous service life of the plant.
10.10.00	Software Upgrades 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 so that if required, same can be procured & implemented at site.
11.00.00	**SPECIFICATIONS OF OPERATOR WORK STATION** The minimum requirement for PC based OWS shall be as below: CPU Latest generation CPU

CLAUSE NO.	TECHNICAL REQUIREMENTS

	Main memory	1 GB expandable to 4 GB
	Drives	3 1/2" floppy drive, 48 x CD ROM drive
	Hard disk	40 GB
	Removable bulk storage drive (MOD / DVD / DAT)	6 GB (minimum)
	Removable Bulk Storage Media for above	10 nos
	Monitor	19" Full Flat TFT Resolution 1280 x 1024, refresh rate min 85 Hz.
	Graphic Memory	16 MB
	Communication port	2 serial plus, one parallel, 8 USB port, Dual 100 Mbps Ethernet.
	Expansion slots	3
	Other Features	101 Keys Keyboard and Optical Mouse
	UPS	1 no. on-line Intelligent UPS with 30 mins. battery backup on machine load (for PC & its printer) and remote monitoring are to be provided for each PC and PC based OWS.
	Software	a General MS Windows latest version, MS-Office, Microsoft Visual Studio, Adobe Acrobat, anti-virus McAfee or equivalent, etc. b Application software - to suit project specific requirement

12.00.00 PRINTER

One number A4 size color laser printer per PLC shall be provided as a part of the HMIS system, specifications of which shall be as 'DDCMIS' system.

13.00.00 TRAINING

Contractor shall provide training on PLC systems for Employee personnel. The exact duration of the training shall be as per Part-C, Section-VI.

Sl no	Area	Item description	Qty
1.	Hydrogen Generation Plant	a. Chair	3
		b. Key pad	1
		c. Locker set	1

10.00.00 For the items like Measuring Inst ruments, Process Conn ection and piping, Control Valves and Actuators, Other TG C&I systems, and Instrumentation and Power supply cables, contract quantities shall be governed by corresponding Sub-sections in Part-B.

CLAUSE NO.	TECHNICAL REQUIREMENTS

a) Local Instru ment Enclosures (LIEs) complete with all fittin gs, mountings & accessories etc for each unit on as required basis.

b) Local Instr ument Rac ks (LIRs) complete with all fit tings, mountings & accessories etc. for each unit on as required basis.

9.00.00 The following contract quantities of equipments for local operation shall be furnished for the following systems.

Sl no	Item Description	Qty per unit	Application and location
1.	Operator Work stations	2 nos.	At Hydrogen Generation Plant Control room
2.	Graphical Interface unit of 10”	1 no/unit	Local ope ration of Main Turbine lube oil system.
3.	Graphical Interface unit of 10”	1 no	Local ope ration of Central Tu rbine lube oil system

Minimum specifications of Graphical Interface unit shall be as follows:-

Sl no.	Description	
1.	Power supply	24 V DC
2.	Display Type	Color, TFT screens
3.	Humidity	5-95%
4.	Protection class	IP-65 for extremel y dust prone area, otherwise IP-55. Enclosure shall be provided to prevent ingress of dust.
5.	Keys	Function keys and numeric keys
6.	Interfacing requirements	Interface with TG C&I systems
7.	Functional requirements	Ability to operate drives locally using function keys Ability to do programming Graphics display includ ing alarms and operator guidance messages

One set of related furniture, as defined below :

CLAUSE NO.	TECHNICAL REQUIREMENTS
	MEASURING INSTRUMENTS
1.00.00	**MEASURING INSTRUMENTS**
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. They shall comply with the acceptable international standards and shall be subject to Employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications, ranges, makes/numbers as approved by the Employer during detailed engineering.
1.02.00	Every panel-mounted instrument requiring power supply shall be provided with a pair of 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 local gauges as well as transmitters, sensors, and switches 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 under the scope of specification shall be provided on as required basis within the quoted lump sum price. For bidding purpose, tentative minimum instruments have been indicated on the P&IDs. However, contractor shall supply any additional local gauges/switches/transmitters/sensors for reasons mentioned above without any additional cost to the Employer.
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	For all instruments envisaged for sea water applications they 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:
1.06.00	All instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.

CLAUSE NO.	TECHNICAL REQUIREMENTS

2.00.00 SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, D.P., FLOW AND LEVEL

ELECTRONIC TRANSMITTERS

Sl.No.	Features	Essential/Minimum Requirements
1.	Type of Transmitter	Microprocessor based 2 wire type, Hart protocol compatible.
2.	Accuracy	± 0.1% of calibrated span (minimum)
3.	Output signal range	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)
4.	Turn down ratio	10:1 for vacuum/very low pressure applications. 30:1 for other applications.
5.	Stability	± 0.1% of calibrated span for six months for Ranges up to and including70 Kg/cm². ± 0.25% of calibrated span for six months for Ranges more than 70 Kg/cm² (g).
6.	Zero and span drift	+/- 0.015% per deg.C at max span. +/-0.11% per deg.C at min. Span.
7.	Load impedance	500 ohm (min.)
8.	Housing	Weather proof as per IP-55 with durable corrosion resistant epoxy coating.
9.	Over Pressure	150% of max. Operating pressure
10.	Connection (Electrical)	Plug and socket type
11.	Process connection	1/2 inch NPT (F)
12.	Span and Zero	Continuous, tamper proof, Remote as well as adjustability manual from instrument with zero suppression and elevation facility.
13.	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition.

			-2 valve manifold for absolute pressure transmitters (3-valve manifold for gauge/ vacuum pressure transmitters) and 5 valve manifold for DP/level/flow transmitters. -For hazardous area, explosions proof enclosure as described in NEC article 500.
	14.	Diagnostics	Self Indicating feature
	15.	Power supply	24V DC ± 10%.
	16.	Adjustment/calibration/maintenance	Centralised PC based system (In Employer's Scope). In addition total two (2) no. of hand- held type universal calibrators per unit, compatible with HART protocol, shall be provided.

Notes

In case it becomes necessary to use a DP transmitter for pressure measurement then a 3-valve manifold should be used in place of 2-valve manifold.

LVDT type is not acceptable.

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.

2.01.00 Ultrasonic Type level Transmitter

Sl. no	Features	Essential/Minimum requirements
1.	Type of Transmitter	Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic transmitter.
2.	Output signal	Galvanic ally isolated 4-20mA DC (Analog) along with superimposed digital signal (based on HART protocol).
3.	Sensor Accuracy	+/- 0.5% of calibrated span.
4.	Sensor Repeatability	3 mm or better.
5.	Power supply	24 V DC +/- 10%
6.	Temperature compensation	To be provided within transducer.

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	7.	Configuration	Sensor unit and Electronic units are to be separate. It shall be possible to mount the Electronic unit at a remote accessible location from the transducer. All cables and weather proof fittings to interconnect transducer to electronic unit shall be provided by Bidder.
	8.	Housing	Weather proof as per IP-55 with durable corrosion resistant epoxy coating.
	9.	Calibration	Through HART Communicator.
	10.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It shall be possible to calibrate the instrument without any level in the tank/sump etc
	11.	Sensor Material	Corrosion resistant material to suit individual application requirement.
	12.	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
	13.	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
	14.	Display	Minimum 4 character display with integral keypad, access protected by user code.
	15.	Diagnostics	Loss of echo alarm etc
	16.	Load Impedance	500 ohms minimum
	17.	Electrical Connection	Plug and socket
	18.	Accessories	• All weather canopy for protection from direct sunlight and direct rain. • All mounting hardware and accessories required for erection and commissioning mounting fittings material shall be SS 316. • For hazardous areas, explosion proof enclosure as described in NEC article 500.

CLAUSE NO.	TECHNICAL REQUIREMENTS

3.00.00 TEMPERATURE ELEMENTS

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 type).
2	No. of element	:	Duplex
3	Housing/Head	:	IP-55/Diecast Aluminium. Plug in connectors are to be provided for external signal cable connection.
4	Sheathing of Thermocouple	:	Swaged type magnesium oxide insulation.
5	Calibration and accuracy	:	As per IEC-751/ANSI-C-96.1(special class)for T/C.
6	Characteristic	:	Linear with respect to temp, within ±1/2 percent of top range value.
7	Accessories	:	Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.
8	Standard	:	ANSI C 96.1 for Thermocouple and ASME PTC-19.3 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-55/Diecast Aluminium. Plug in connectors are to be provided for external signal cable connection.
4	Sheathing of RTD	:	Metal sheathed, ceramic packed
5	Calibration and accuracy	:	As per DIN-43760 Class-A for RTD

CLAUSE NO.	TECHNICAL REQUIREMENTS

6	Characteristic	:	Linear with respect to temp, within ±1/2 percent of top range value.
7	Accessories	:	Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.
8	Standard	:	DIN-43760 for RTD and ASME PTC-19.3 for Thermo-well.

3.03.00 Metal Temperature Thermocouples

Measuring Medium	Metal Temperature
Material of Thermocouple.	Chromel Alumel Type K
Type of Thermocouple	Duplex with separate hot junctions, ungrounded
Insulation	Mineral Insulation Magnesium Oxide.
Thermocouple wire gauge	16 AWG
Protective sheath	SS 321
Protective sheath dia	8 mm O.D
Characteristics of Thermocouple	Special limits of error as in ANSI thermocouple MC 96.01.1975
Mounting accessories	1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310.
Cold end sealing	SS pot weal with colour coded PTFE headed sleeve Insulated flexible tails. Sealing compound-Epoxy resin.
Minimum bending radius	30 mm
Length of T/C	30 Mtr. (minimum)

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.04.00	**Thermo well (for all process temp. elements)** (a) Shall be one piece solid bored type of 315 SS of step-less tapered design. (As per ASME PTC 19.3 1974) (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 require based on the specify boiler design parameters). (d) For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.
4.00.00	**TEMPERATURE TRANSMITTER** Following types of 2-wire temperature transmitter (directly powered from 4-20mA input cards of DDCMIS) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself. a. Single Input Head mounted Temperature Transmitter These shall be suitable for mounting in the head of temperature element itself. The protection class of head of thermo well along with its plug-in connector shall be min. IP65. b. Single Input DIN-rail mounted Temperature Transmitter These shall be 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. c. Dual-input Temperature Transmitter With Indicator: These shall be suitable for mounting on pipes/ support. These shall be provided for temperature measurement which are used for tripping /protection of auxiliaries e.g. for bearing temperature on which trip is envisaged. Indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails .This change-over is to be alarmed. Protection class shall be IP65 minimum.

CLAUSE NO.	TECHNICAL REQUIREMENTS

d. Common requirements for each of the above type of temperature transmitters

Output	:	2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal.
Input	:	Same transmitter shall be capable to handle Pt-100 RTD , Thermocouples –K&R types (input type to be selectable at site through HART terminal)
Isolation	:	min. 500 V AC
EMC compatibility	:	as per EN 61326
Operating ambient temperature	:	0 to 85 deg C (without indicator) 0 to 70 deg C (with indicator)
Power supply		compatible with input module of Control System
Accessories		Mounting arrangements including clamps etc.
Composite Accuracy (Refer note 2)	(a)	For head mounted and DIN-rail mounted types: RTD =<0.4% of 0-250 deg C span T/C-K type =<0.4% of 0-600 deg C span T/C-R type =<0.4% of 0-1000 deg C span CJC accuracy (for thermocouples) shall be =< 1 deg C
	(b)	For dual-input type: RTD =<0.25% of 0-250 deg C span T/C-K type =<0.2% of 0-600 deg C span CJC accuracy (for thermocouples) shall be =< 1 deg C

Notes:-

1. In case of failure (open or burn-out) of RTD/thermocouple, temp. transmitter shall provide low temperature output.

2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A 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. All such accuracy/ temp effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures.

e. Field bus compatible temperature Transmitters (For Generator Temperature measurement applications)

Minimum requirements shall be as follows:-

Temperature signals shall be acquired using modular system consisting of I/O modules, power supply modules, field terminals and Bus Interface modules. The signals from the field shall be terminated in Terminal blocks using Cage clamp type connection. Input modules (as described below) shall acquire these process signals which shall be converted to field bus compatible signals using Bus interface modules to transfer data to DDCMIS system. Bus interface modules shall be able to support field bus protocols like PROFIBUS, Foundation Field bus etc. All the above modules shall be mounted in a Junction box. Degree of protection for this JB shall be IP 67. However, process signals shall be terminated separately using terminal blocks before entering the modular system.

Sl no	Features	Minimum requirement
1	Input	K-type T/c, Pt 100 RTD
2	CJC Compensation	Integral
3	Accuracy	Minimum 0.4% at 23 deg C or better
4.	Operating temperature	0-55 deg c
5	Diagnostics	Wire break monitoring, Power supply healthiness etc
6	Mounting	DIN rail mounted
7	Accessories	All required accessories shall be provided.
8	Power supply	24 VDC
9	EMC	EN 50081/EN50082 or equivalent

CLAUSE NO.	TECHNICAL REQUIREMENTS
5.00.00	**ANALYSER INSTRUMENTS:**

Common Requirements

1	Output signals Analog	4-20 mA DC
	Binary	2 NO + 2 NC for high alarm
2.	Zero & span Adjustment	Available
3.	Ambient temp.	50°C
4.	Indication	Digital
5.	Enclosure Type/Material	Weather & Dust proof (IP 55) Die cast Aluminium/SS
6.	Type of Electronics	Microprocessor based
7.	Digital Signal transmission	RS 232 Link & to suit connections protocol to DDCMIS
8.	Calibration	Auto & Manual (from Remote)
9.	Error Diagnostic	To be provided
10.	Others	If analyser provides superimposed HART signal on 4-20 mA DC output, It shall also be connected to PC based station (In Employer's Scope).

5.01.00 Hydrogen Analyser

1.	Output signals:	Analog 4-20 mA DC
2.	Zero & span Adjustment	Available
3.	Ambient temp.	50°C
4.	Indication	Digital
5.	Enclosure Type/Material	Weather & Dust proof (IP 55) Die cast Aluminum/SS
6.	Type of Electronics	Microprocessor based with self diagnostic facility
7.	Digital Signal transmission protocol	RS 232 Link & to suit connections to Control System
8.	Calibration	Auto & Manual (from Remote)

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	9. Error Diagnostic	To be provided
	10 Repeatability	± 1% of calibrated span
	11 Linearity	± 2% of calibrated span
5.02.00	PH Analyser	
	1. TYPE	CELL - FLOW THROUGH
	2. ACCURACY	< ± 1% OF SPAN
	3. RANGE	0 - 14 PH, PROGRAMMABLE
	4. NO. OF STEAMS	SINGLE
	5. STABILITY	< 0.001 PH / WEEK
	6. TEMP. COEFFICIENT / TEMP. ERROR	0.001 PH / DEG. C
	7. TYPE OF ELECTRONICS	MICROPROCESSOR BASED WITH SELF-DIAGNOSTIC FACILITY.
	8. INDICATION	DIGITAL
	9. ENCLOSURE	WEATHER DUST PROOF (IP55) DIE CAST ALUMINUM.
6.00.00	**SPECIFICATION FOR FLOW ELEMENTS**	
6.01.00	**Orifice Plate**	
	Features	Essential/Minimum Requirements
	Type	Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042
	Material	316 SS
	Thickness	3 mm for main pipe diameter up to 300 mm and6 mm for main pipe dia above300 mm.
	Material of branch pipe	Same as main pipe
	Root valve type	Globe
	Root valve material	316 SS
	Root valve size	1 inch

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	Impulse pipe of same material up to root valve	Required
	Tappings	Flanged weld neck. 3 pairs. of tapping.
	Beta Ratio	0.34 to 0.7
	Beta Ratio calculation to be submitted	Yes
	Assembly drg. and flow Vs DP Curves	Yes
	Accessories	Root valves, flanges, Vent/drain hole(As required)
	Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval. One Flow element of each type shall be calibrated in the test laboratory for validation of commutated flow calculations.	
6.02.00	**Flow Nozzle**	
	Features	Essential/Minimum Requirements
	Type	Long radius, welded type as per ASME PTC-19.5 (Part-III) or BS-1042
	Material	316 SS
	Thickness	Suitable for intended application.
	Material of branch pipe	Same as main pipe
	Root valve type	Globe
	Root valve material	316 SS
	Root valve size	1 inch
	Impulse pipe of same material up to root valve	Required
	Tapping	D and D/2 (3 sets of tapings points)
	Beta Ratio	Around 0.7
	Beta Ratio calculation to be submitted	Yes

CLAUSE NO.	TECHNICAL REQUIREMENTS

Assembly drg. and flow Vs DP Curves Yes

Accessories Root valves, vent and drain hole.

Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval. One Flow element of each type shall be calibrated in the test laboratory for validation of computed flow calculations.

7.00.00 SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.

Sl. No	FEATURES	ESSENTIAL/MINIMUM REQUIREMENTS		
		Pr. Gauge/ DP Gauge/ Draught gauges	Temperature Gauge	Level Gauge
1	Sensing Element and material	Bourdon for high pressure, Diaphragm/Bellow for low pr. Of 316 SS	Mercury in steel for below 450°C and inert gas actuated for above 450°C of SS bulb and capillary.	Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon steel/304 SS
3	Dial size	150mm	150 mm	Tubular covering entire range
4	End connection	1/2 inch NPT (M)	3/4" NPT (M)	Process connection as per ASME PTC and drain/vent 15 NB
5	Accuracy	±1% of span	± 1% of span	± 2%
6	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
7	Range selection	Cover 125% of max. of scale	Cover 125% of max. of scale	Cover 125% of max. of scale
8	Over range test	Test pr. for the assembly shall be1.5 to the max. Design pr. at 38°C.		

CLAUSE NO.	TECHNICAL REQUIREMENTS

9	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof
10	Zero/span adjustment	Provided	Provided	--
11	Identification	Engraved with service legend or laminated phenolic name plate		
12	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel/SS as per CS/Alloy process Requirement.
13	Material of Bourdon/ movement	316 SS / 304 SS	316 SS / 304 SS	

Notes:-

*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.

Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.

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.

8.00.00 ROTAMETERS

SR. NO.	FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS
1.	TYPE	VARIABLE AREA METAL TUBE
2.	FLUID MEDIA	WATER/OIL
3.	TUBE BODY	SS316