STANDARD SPECIFICATION
PROGRAMMABLE LOGIC CONTROL (PLC) FOR BOILER PACKAGE

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<tr>
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<td>SPM</td>
<td>BSP</td>
</tr>
</tbody>
</table>
TABLE OF CONTENTS

1.0 GENERAL
1.1 SCOPE
1.2 BIDS
1.3 DRAWINGS AND DATA

2.0 DESIGN AND CONSTRUCTION

3.0 TESTING AND ACCEPTANCE
3.1 GENERAL
3.2 FACTORY ACCEPTANCE TEST (FAT)
3.3 INSTALLATION, TESTING AND COMMISSIONING
3.4 FIELD INSPECTION
3.5 LOOP CHECKING
3.6 SITE ACCEPTANCE TEST (SAT)
3.7 PERFORMANCE TEST

4.0 GENERAL REQUIREMENTS

5.0 SHIPPING

6.0 REJECTION
1.0 GENERAL

1.1 SCOPE

1.1.1 This specification defines the minimum requirements of system design including hardware & software, configuration, manufacture, engineering, programming, inspection and testing, documentation, installation, commissioning and shipping of Programmable Logic Controller (PLC) for boiler package. This standard specification shall be referred in line with job specification and system configuration diagram. Vendor’s scope shall include following as a minimum:

- manufacture, procure, supply, testing, installation, handling and commissioning of all equipment and accessories.
- For Design, engineering, FAT, site execution & SAT of PLCs, exclusive team of respective PLC vendor to be involved in each stage in co-ordination with DCS vendor.
- PLC and DCS integrated communication test.
- Building of all Operator interface, screen displays, database and reports.
- Building of a PC based Diagnostic / Maintenance Workstation including printer and interconnecting cables.
- System Hardware & Software configuration.
- FAT of all hardware / software and system integration testing under simulated conditions at vendor’s works.
- Supply, install, test and commission marshalling racks, system cabinets and workstation / printers. Including cables, terminals, IS barriers, power supplies and cubicle internal mountings.
- Demonstration of PLC system functionality as per requirements during FAT/SAT.
- Training of Owner’s personnel at factory and at site on functional, operational and maintenance aspects of the system.
- Supply of all system as well as control room furniture as per ergonomic and Owner requirements.
- Supply of complete technical and as built documentation in electronic form as well as hardcopy.
- Supply of all software on CDs along with required software licenses.
- Supply of spare parts and special tools.
- Project management.
- Warranty.

1.1.2 The related standards referred to here in and mentioned below shall be of the latest editions at the time of purchaser’s enquiry.


DIN V 19250 (1/89, 5/94) - Measurement and control. Fundamental safety aspects to be considered for measurement and control equipment.

DIN V 0801 (1/90) and Amendment A (10/94) - Principles for computers in safety-related systems. Microprocessor-based safety systems

UL 1998 (1st edition) - Safety-related software

S84.01 – Application of SIS’s for the process industries

VDE 0116 (10/89) - Electrical equipment of furnaces.
DIN EN 54-2 (01/90) – Components of automatic fire detection systems; control and indicating equipment

UL 508 - Industrial control equipment, 16th edition Underwriters Laboratories

EN 61131-2-1994 - Programmable controllers. Part 2: Equipment requirements and tests

CSA C22.2 - Process control equipment. Industrial products. Canadian Standards Association No. 142 (R1993)


EN 50082-2-1993 - Electromagnetic compatibility – Generic immunity standard, Part 2: Industrial environment

ISA-S 71.04 Environmental Conditions for Process Measurement and Control System. Airborne Contaminants

1.1.3 The detailed scope of work, specific job requirements, exclusions, deviations, additions etc shall be indicated in the material requisition and job specification.

1.1.4 Where any conflict exists between this specification and other job specification, the purchaser shall be consulted. Vendor shall not deviate from this specification without prior approval from the purchaser.

1.2 BIDS

1.2.1 Vendor’s quotation shall enumerate and include the detailed specifications of each subsystem and each module of programmable logic controller, detailed system configuration, hardware and software capabilities, programming aids, display facilities and other relevant information. Offer shall also indicate the amount of memory occupied by the actual program and spare capacity available for later program modifications or additions

1.2.2 Vendor shall furnish a detailed list of deviations / confirmations clause-wise described in this specification. Vendor must provide enough supportive reasons for the deviations listed.

1.2.3 Vendor’s quotation shall include catalogues, drawings, technical specification sheets, operating and maintenance manuals, performance evaluation certificates etc. All documents shall be in English language only.

1.2.4 Vendor shall also supply the following items.

- Mandatory spares as indicated elsewhere. Mandatory spares should also include spare cooling fans, filters etc for cabinets and workstation.
- Spare parts for start-up, commissioning and two (2) years trouble free operation
- Consumables for one year such as printer cartridges, Re-Writable CDs, Floppies, Fanfold papers / A4 Size papers for Printers etc.
- Special tools and test equipment’s.
- 5 Years Post warranty maintenance contract.
1.3 DRAWINGS AND DATA

1.3.1 After placement of purchase order, vendor shall submit certified drawings and specification sheet for each instrument and its accessories which shall include the following, as a minimum:
- Configuration diagram
- Detailed dimensional drawings of internal components
- Power consumption in voltamperes
- GA (General Arrangement) drawings
- Rack layout including physical I/O module locations.
- Logic diagrams
- Input / Output (I/O) assignments.
- I/O mapping with DCS / other PLCs including MODBUS address.
- Power supply distribution drawings.
- Heat Dissipation figures for all components
- Functional Design Specification (Hardware and Software)
- FAT / SAT procedures
- Wiring drawings for system cabinet & marshalling racks.
- All manuals
- PLC vendor to submit bill of quantity of components of all major components including relays for Owner/PMC approval before commencing the manufacturing.

1.3.2 The required number of reproducible soft copies and prints should be dispatched to the address mentioned adhering to the time limits indicated.
The software documents shall be supplied based on the OWNER’s documents and requirement.

2.0 DESIGN AND CONSTRUCTION

2.1 Programmable Logic Controller (PLC) shall be microprocessor based system which shall be used for implementation of plant safety shutdown/interlocks, and plant operation wherever specified in job specification. The PLC shall be Dual Processor. The PLC shall incorporate open system architecture, redundant processing systems and mass storage devices. The system shall be designed for maximum reliability, safety and integrity while maintaining an availability of 99.99% or better.

2.2 The basic engineering includes configuration diagram, network design, sizing and scan time calculations.
- The engineers involved in the basic and detailed engineering of safety PLC shall be certified as Functional safety Engineers for implementing as per IEC 61508 safety lifecycle.

2.3 The PLC system shall be designed as fault tolerant and fail-safe. The system shall be designed by high grade components of proven quality and proper design of system electronics. A “1” logic signal is considered to be normal state, and a “0” logic signal is the trip state. Logic output signals are to fail to a “0” state on power failure, or on component failure. The system shall have Dual Modular Redundancy (DMR) system architecture as described in the IEC 61508 standard.

2.4 The system shall be able to operate satisfactorily from 15°C to 40°C and 0 ~ 95% non-condensing humidity range unless otherwise specified. Wherever required, the components shall be tropicalised to suit Indian conditions.
2.5 The system shall be modular in construction and expandable in future by adding additional modules which shall be easily accessible for maintenance and repair. The modules shall preferably be suitable for inserting in 19" rack(DIN standard). The types of modules shall be kept to minimum possible in order to have interchangeability and low spares inventory.

2.6 On-line replacement of any module shall be possible in such a way that the removal and addition of the module shall be possible without de-energising the system. Further there shall not be any interruption in the system while replacing a faulty module. System degradation of any kind is not acceptable.

2.7 Based on application like critical and non critical, input/output tags to be defined accordingly during design/ engineering.

2.8 The system shall be highly reliable and shall have well proven record of operating satisfactorily in a hydrocarbon processing plant for a minimum of one year for a similar application. Prototype system or instruments of experimental nature shall not be offered.

2.9 The PLC shall have a very high noise immunity in order to ensure safe and reliable operation when subjected to electrical radio frequency interference and electro-magnetic disturbances expected in a plant. The surge withstand capacity for input / output modules shall be as per IEEE Standard 472 / IEEE C37-80.1.

2.10 The system shall be programmed in principle as per the logic diagrams. However vendor shall prepare their own FLD / logic diagrams depending upon the capability of the programmable logic controller offered by them. Purchaser reserves the right to revise or review the logic diagram even after acceptance of the offer.

2.11 The system shall have extensive set of self diagnostics hardware and software for easy and fast maintenance of PLC. Routine checks should run automatically at frequent intervals for identifying any fault in software or hardware. Diagnostics shall be required at local as well as workstation level. Diagnostics shall be available upto the channel.

2.12 Pop up menu to be configured in DCS operator workstation to capture any degradation of PLC.

2.13 Rack – to – rack connectivity shall be separate for separate legs of the DMR PLC.

2.14 All I/Os shall be duplicated as per DMR philosophy by duplicated signal conditioning circuits per I/O point. The use of relays or signal multipliers shall not be implemented for duplication of I/Os, same is to be implemented by use of duplicated signal conditioning circuit boards.

2.15 Redundant power supply distribution shall be such that redundancy is maintained at all modules and even up to the channels for field termination unit.

2.16 Operation of the PLC shall be completely unaffected by the momentary power loss of the order of 20 milliseconds, unless otherwise specified. This feature shall be demonstrated during FAT. Bulk power supply shall be designed for functionalities to ensure power failure bridging time of less than 20 milliseconds under full load.

2.17 The scan time of programmable controller shall be 250 milliseconds or better including spare I/O channels. Scan time of PLC is defined as the cycle time taken by the system to read input, process input executing logic and update control output for all the logic’s configured within the system. Other activities like diagnostics routines, output / dump of data to peripherals, or any other activity which consume processor time shall also be accounted while computing scan time.
In case any plant unit requires faster scan time, the same may be adopted for that application.

2.18 Spares philosophy

2.18.1 Installed engineering spare modules of 20% shall be provided in input/output subsystem for each type of module with a minimum of one module of each type to enhance the system functional requirements. All installed spare shall be fully wired up to field termination level.

2.18.2 In addition the system shall have the following minimum spare capability:
- I/O racks of PLC shall have 10% usable spare slots for installing I/O modules of each type in future. These racks shall be part of the offer.
- The processor system shall have the capability to execute logic’s for additional I/O’s. In addition it shall be possible to extend memory by additional 20% at a later stage.
- Power supply modules shall be capable to take load of the spares as outlined above.
- The PLC workstation shall have capacity to meet all requirements for the additional input / outputs as outlined above.
- Whenever relays are used to interface process input / outputs with PLC, 20% additional relays shall be provided. In addition, 20% spare space shall be provided in cabinets to install 20% additional relays in future.

Vendor shall design all systems / racks based on the above. Additional terminals shall be provided to enable termination of above spare I/O’s and also to terminate spare cores of existing multipair cables. This shall be adhered to under all circumstances.

2.18.3 Wherever possible, all equipment shall be standardised to ensure commonality of spares, minimal training and greater economies as far as maintenance and additional procurement is concerned

2.19 Paper, cartridge, printer heads required for printer, copier, or any other consumable item shall be supplied with the system required for minimum of one year duration after SAT. Any consumables required for system development, testing and commissioning shall be provided by vendor and not included in the 6 month consumable supply.

2.20 Safety barriers shall be provided by the vendor for intrinsically safe input/output circuits wherever specified. In such cases, the system shall be designed intrinsically safe based on entity concept. The barriers shall be certified by a statutory authority like BASEEFA, CENELEC, FM, PTB, CMRI etc for the use in the area classification as specified elsewhere in the job specification. The proper selection of the safety barriers shall be the vendor’s total responsibility. The safety barriers shall be 3 port isolation type. The safety barriers shall not be zener type barriers. IS barriers shall be active type, back plane mounted with surge protection.

2.21 Required software for configuration of all barriers shall be provided.

2.22 PLC engineering stations shall be provided with CD writer(CD/DVD RW) for back up.

2.23 Unless otherwise specified all electronic modules shall meet the requirements of Environmental classification class “G3” as per ISA-S 71.04
2.24 System configuration

Basic system configuration shall be as per the job specifications. However, the system shall consist of the following major subsystems:

2.24.1 Engineering station

2.24.2 All pump/compressor stop/selector switches to be configured in PLC LCD through soft switches. All emergency push buttons for critical pumps and compressors are to be mounted on HWC horizontal plane. No start switches for pump/compressor to be provided in HWC or PLC except the selector switches for auto start.

2.24.3 Input/Output Subsystem

2.24.3.1 All I/O fail-safe cards shall have built-in self-testing and diagnostic features.

2.24.3.2 I/O redundancy shall not be on the same card to reduce common cause failure. The redundant card shall be permanently installed next to the I/O card for automatic & bumpless transfer & replacement.

2.24.3.3 I/O devices interface with PLC shall be at I/O racks only. The I/O modules shall be mounted in the I/O racks.

2.24.3.4 The maximum number of input/outputs per module shall be limited as follows:

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<th>No. of I/Os</th>
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<td>DI</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>DO</td>
<td>8</td>
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<td>3</td>
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2.25.3.5 Each I/O shall be protected against reversal of polarity of the signal.

2.25.3.6 Each module shall have LED for each I/O channel to indicate the status of each input/output.

2.25.3.7 All I/O circuits shall be provided with galvanic isolation or optical isolation using isolation barriers.

2.25.3.8 Card layout shall be approved by purchaser before hardware installation start.

2.25.3.9 All I/O modules shall be redundant. For the system hot replacement of I/O modules shall be provided. No output shall be affected while replacing these modules in either case. For all modules, channel to channel isolation shall be provided. On-line replacement of faulty modules shall be possible on-line without shutdown of any part of the system.

2.25.3.10 All I/Os shall have facility for sequential time stamping at CPU level.

2.25.3.11 All not used/spare card slots shall be fitted with cover plates.
2.25.3.12 The system shall be supplied with earth fault detector which, generates alarms on any input/output circuit earth fault. The ELD shall also provide a mean of localising the earth fault without disconnecting any cable or shutting down part of the plant.

2.25.3.13 Each input shall be provided with filters to filter out any noise in the input line or noise because of input contact bouncing.

2.25.3.14 Generally the input contacts shall be closed under normal operating conditions.

2.25.3.15 Short-circuiting of one input shall not affect other inputs.

2.25.3.16 PLC inputs shall be provided with potential free/dry contacts unless otherwise specified.

2.25.3.17 The interrogation voltage to the input / output contact shall be powered from separate and redundant power supply and shall not be a part of PLC unless otherwise specified. This power supply shall be supplied at one point and shall be distributed by the vendor. PDB shall be provided by the vendor.

2.25.3.18 Output contacts from the PLC shall be potential free/dry contacts. Wet contacts / powered contacts / TTL outputs etc. shall not be acceptable. Vendor must provide arc suppression device for each output contact.

2.25.3.19 Output cards shall have output contact rating of 24 VDC 2Amp inductive to drive MCC controls though interposing relays and contact rating of 5Amps for 110 V AC solenoid valves. Each output shall be short-circuit proof and protected by fuse. Visual indication of fuse down must be provided for each output.

2.25.3.20 PLC I/O cards shall have facility to detect wire open condition whenever normally open inputs (close on alarms) are considered.

2.25.3.21 In addition to digital input / output, PLC shall be able to cater for following types of I/Os:
- Analog inputs: - 4-20 mA, 1-5 VDC, 2-wire signals (24 VDC) & 4 wire, free from earth.
- Analog outputs: - 4-20 mA, 1-5 VDC, 2-wire signals (24 VDC) & 4 wire, free from earth.
- Active (system powered) or passive (field powered) analogs which can be configured on a point basis.

2.25.3.22 Analog inputs and analog outputs shall have ‘open, short and out of range circuit’ detection. It shall be configurable per input channel.

2.25.3.23 The power for all field mounted 4-20 mA signals connected to the PLC shall be provided by the PLC. Each analog input power supply and analog output power supply shall be short circuit proof.

2.25.3.24 All Digital input and output cards shall provide visual indication of the status of the input, relative to the trip point and the status of the outputs.

2.25.3.25 Fail-safe DO cards shall have built-in SMOD (secondary means of De-energization), this enables the watchdog and/or processor to de-energize the outputs in case of internal fault.
2.26 Process System

2.26.1 The processor shall have capability to implement all the control functions required to implement the logic schemes.

2.26.2 The size of the memory shall be sufficient for storage of the program instruction required by the logic schemes. A minimum of 50% spare memory space shall be provided at the time of handover of the system to Client.

2.26.3 Memory shall be non-volatile. However, in case volatile memory is provided, battery backup shall be provided for a minimum of 50 hrs to keep the stored program intact. A battery drain indication shall be provided at least one week before the battery gets drained. A potential free contact shall be provided for hardwired annunciation in the control room.

2.26.4 Watchdog timer shall be a software device. The healthiness of processors shall be continuously monitored by watchdog timer. Any hardware or software problem in the processor subsystem including CPU, memory, power supply, communication interface etc shall cause the watchdog timer to report processor failure.

2.26.5 If one of the two CPUs fails, the system will continue to operate on the other CPU. Replacement of the faulty CPU shall be possible without process interruptions. In case of failure of complete processor system i.e. both processors in case of dual configuration and two or more in case triple redundant system outputs shall take fail safe state automatically unless otherwise specified in the job specification.

2.26.6 Switchover of PLC from dual to single modular shall be automatic & bumpless and shall be displayed in DCS operator workstation through DCS/PLC communication for alarm purpose.

2.26.7 The processors must be able to communicate with each other over the interconnecting data link. Vendor shall ensure that system performance shall not degrade when such system is offered.

2.26.8 It shall be possible to generate the first out alarm by PLC in case where a group of parameters are likely to trip the system.

2.27 PLC WORKSTATION

2.27.1 PLC workstation shall be used for program storage, fault diagnostics and alarm monitoring. For programming, a desktop PC shall be provided. It shall also be possible to have the programming functionality in the PC and all functionality of the PC shall be by using suitable passwords. The programming terminal shall not be online under normal operating conditions (either powered off or have multiple password protection). Printer provided with programming terminal shall be able to print alarms (system and process), SOEs and documentation.

2.27.2 The PC consist of a 21” colour LCD unless otherwise specified, one programming keyboard, and operating keyboard whenever specified. The programming workstation shall have latest hardware, operating system and windows based graphics user interface (GUI). It shall include Ethernet connectivity, DVD compatible CD-RW drive, USB port, SCSI port, 32 bit CPU with 600 MHz system clock, 512 MB RAM as a minimum.

2.27.3 PLC workstation when used for plant operation shall be supplied with dedicated operator keyboard with a set of user configurable / assignable function keys. Even when touch-
screen is specified, the workstation in addition shall be supplied with operator keyboard which shall have the same capability as the touch-screen as a minimum.

2.27.4 The keyboard shall preferably be touch sensitive sealed type easy to operate with each key clearly identified. It shall be provided with a lock and key to prevent any unintentional program modification. Key sequences shall be as short as practicable and the keyboard layout shall be arranged so that the general flow of keying sequences shall be from left to right. Where practicable, major functions shall be accessed using a single key stroke.

2.27.5 In addition to keyboard, pointer device viz. trackball should also be provided.

2.27.6 All illegal entries shall be rejected by workstation and shall be identified by warning signal on LCD monitor.

2.27.7 Manual operation / forcing of any element connected to PLC shall be possible from keyboard. Any forcing event should be registered/recorded in SOE. All forced input/output should come as a separate group with distinct color in alarm management system for better identification of all forced input/output.

2.27.8 It shall be possible to modify, add or delete the application program on-line with password protected access. System should have capability of logging the engineering changes made along with detail of activities, user name and time stamp.

2.27.9 PLC workstation, LCD shall display logic and / or ladder diagram indicating power flow and shall show description and real time status of each contact. It shall also be possible to display process alarms and diagnostic message as and when they appear. Further it shall also be able to display I/O map in a user defined format.

2.27.10 Whenever PLC workstation is used for the operation of the plant, it shall be able to display process, dynamic graphics, overview and group displays, real time and historical trends of up to one month. It shall be able to operate the plant i.e. start and stop rotating machinery, opening and closing of valves etc from dynamic graphics and group displays. All such displays shall be user configurable.

2.27.11 All soft switches to be configured in PLC monitor(operator workstation) should use standard library for PB,SS etc.

2.27.12 It shall be possible to print the ladder / logic diagram on the PLC printer. In addition, printer shall also be able to print the following:
- Diagnostic messages as and when they appear
- Diagnostic reports on demand
- Processor alarms related to PLC as and when they appear and alarm report whenever initiated
- Shutdown report as and when initiated
- I/O map showing status of all inputs and corresponding outputs in a user defined format
- Screen print

2.27.13 The printer softwares for all printers shall be loaded so that any printer may be selected at any given time by any workstation. Screen displays shall be sent to any of the laser printers. The laser printers shall be capable of printing 15 pages a minute and shall support paper sizes up to A3. Sufficient memory shall be provided to support full page graphics printing.
2.27.14 In addition to self-diagnostic alarms, PLC workstation shall be provided with a common fault alarm with potential free contact which shall be connected to the hardwired annunciator. PLC self diagnostic alarms shall be mapped to DCS for alarming.

2.27.15 In addition a service unit or hand-held programming unit for trouble shooting and initial check-ups from local level shall be quoted separately.

2.27.16 Where multiple process units are connected to the same PLC, a common workstation shall be provided. These workstations shall display unit database for all units.

2.27.17 Isolation shall be provided between Work stations and related sub systems if there is any possibility of high voltage from work station display unit being transmitted to other subsystems.

2.28 Communication subsystem

2.28.1 The communication subsystem shall consist of communication processor with communication ports / adaptors and cables for communication with processor and I/O sub-systems.

2.28.2 Communication system shall be redundant. On the failure of the device, the redundant device shall take-over automatically without interrupting the system operation. Information about the failed device shall be displayed locally as well as on the PLC workstation. It shall be possible to manually switch-over the communication from main bus/device to redundant bus/device without interrupting the PLC functions.

2.28.3 Point-to-point and multi-drop network shall be supported.

2.28.4 The PLC shall be connected directly to the DCS network via Fault Detecting Ethernet based communication. High speed communication of 100Mbps is preferred. PLC system shall not be connected via modbus or OPC based communication to DCS.

2.28.5 Loss of communication link to DCS shall not cause nuisance or process trips.

2.28.6 PLC shall support the extensive alarming features of DCS, as process alarms are detected, they are brought to the operator attention at the operator console.

2.28.7 Integration between DCS & PLC shall be seamless which shall provide automatic time synchronization. DCS shall broadcast the time over its network, to PLC for used in synchronization & alarm time stamping.

2.28.8 There shall be a write protection or firewall between DCS & PLC. To maintain the safe & reliable operation of the PLC system, direct write access from DCS to all hardwired PLC points is not recommended.

2.28.9 The mechanism used by the system for error check and control shall be transparent to the application / information / programme. Error checking shall be done on all data transfers by suitable codes.

2.28.10 The total load on any of the communication buses at any point of time shall not exceed 60%.
2.29 System power supplies

2.29.1 Programmable logic controller shall operate on uninterrupted power supply with following specifications:
- Voltage: 110 V ± 10%
- Frequency: 50 Hz ± 3%

2.29.2 Power supplies in the system shall be provided as follows:
- In normal operation, the redundant power supply shall share the load. In case of failure of one module, the other power supply shall take the full load. Power supply shall be sized taking into account the spare I/O's into account. Failure of power supply module shall be alarmed to DCS through mapping from PLC.
- For further details for power distribution refer job specification.
- Redundant power supply distribution shall be such that redundancy is maintained at all modules and even up to the channels for field termination unit.

2.29.3 All power feeders shall be with individual circuit breakers / Isolator and power on indicator. All power supply bus bars and terminals shall have suitable removable insulating covers. All power supply feeders shall be protected by robust transient suppression devices within each cubicle or enclosure. Where the same PLC is used for multiple units, vendor shall offer a facility wherein sequential unit wise power on can be carried out and overload tripping circuits are arranged in such a manner to offer unit wise shutdown of the plant in case of main power failure.

2.30 System loading

2.30.1 The contractor shall submit calculations and basis to determine the ability of equipment and architecture of the system to meet all the requirements in this specification and at the same time observe the maximum loadings defined in this para. Loading here refers to the use of memory, CPU time and communication capacity. The loading shall consider the "worst case" of high system activity. Maximum loadings on various sub-systems shall be as indicated in engineering design basis.

2.31 Self diagnostics

2.31.1 The system shall have an extensive set of self-diagnostic routines which shall be able to identify and provide information on the system failures up to channel level including redundant components and power supplies through detailed display pages and report print outs.

2.31.2 At the local level, an individual LED shall identify failure of a module in any subsystem.

2.31.3 Self-diagnostics shall be provided to detect faults (which make the contacts permanently close or open) in the input and output modules or input and output signal conditioning modules whenever specified in the job specifications. This may be achieved by automatically running the testing software at cyclic intervals. The testing software cycle may be field adjustable by engineer. However, the system performance shall not be degraded whenever testing feature is specified.

2.31.4 Testing software's shall be capable of detecting faults in case of normally closed system as well as in normally open system.
2.31.5 No internal self diagnostics shall be capable of preventing or delaying normal system operation and system availability. The self diagnostics shall be carried out with the main purpose of reliability and integrity as paramount aims.

2.31.6 The minimum requirements for system diagnostics shall be as follows:
- Analog input diagnostics – Sensor out of range, open or shorted loop, analog-to-digital converter check.
- Analog output diagnostics – Open or shorted loop.
- Configuration diagnostics – Checking the compatibility and availability of selected I/O hardware and software.
- Memory diagnostics – Checksum, parity check etc.
- End-to-End CPU / memory diagnostics
- Processor executes a test control or arithmetic algorithm, then compares results with pre-stored answer.
- Power system diagnostics – Monitor the availability of supply voltage.
- For all 2 out 3 voting logics, in addition to individual and voted alarm, contractor shall provide a maintenance alarm indicating discrepancy shown by any of inputs.
- The PLC system shall be able to generate a common alarm (High Priority) for PLC diagnostics, power supply failure, fan failure, battery life over etc.

2.32 System software

2.32.1 The system software shall include all programs for the PLC and PLC workstation which are required to perform all the PLC functions including communication, self diagnostics and shall include separate SOE software. Any software supplied shall be of the latest version with long term support from software vendor. It shall be responsibility of vendor to ensure software protocol compatibility for third party systems and transfer of data between the same. The PLC workstation operating system shall be Windows NT, Windows 2000 or latest version available. The system software should allow all database points be imported/exported to a database format like dBase or Microsoft Excel.

2.32.2 When fully tested, the configuration software shall be stored in a central point non volatile memory. Logic program shall be recorded on the floppy disk or cassettes, tape, two copies of which shall be delivered with the system. All databases shall be field configurable and expandable without software redesign.

2.32.3 The system software shall have the application compilation & verification option to confirm that no translation or transfer faults have occurred to the control program. The verification option compares the translated program in the PLC system with the database & FLD that are stored on the user station. This allows the user to verify that the defined program has been loaded correctly. In addition, it compares the different versions of the control program in the PLC system & in the user station and list all the differences or modifications between the different versions, and verify if all modifications have been implemented correctly. This verification process is part of the safety life cycle as laid down in IEC 61508 and ISA S84.

2.32.4 The vendor shall supply an integrated sequence of events (SOE) recording function which allows the system to detect and record alarms and events that indicate or may cause deviations from the normal process operation.

2.32.5 Integrated SOE shall be such that the PLC events shall be viewed in DCS operator station without any additional engineering in PLC or DCS systems.

2.32.6 Integrated SOE in DCS operator station shall be with capabilities like filtering, sorting and searching for the all the PLC related events.
2.32.7 All SOE events shall be time stamped by the PLC and the events shall be available based on the resolution of the PLC according to its application cycle time. However, resolution between two separate SOE events shall be equivalent to or better than scan time of PLC and shall be displayed on the SOE summary page as HH:MM:SS:xyz, where xyz is the time in millisecond.

2.32.8 Each SOE event shall be a unique tag number and service description which shall consist of at least 16 alphanumeric characters. The sequence of alphabetic and numeric characters shall be at the discretion of the Purchaser and shall be not be restricted by system design.

2.32.9 The PLC programming language for implementation of logic operation shall be based on

- Ladder diagrams i.e. series parallel connection of relay contacts (LD)
- Functional block diagrams (FB).

If a single PLC is used for multiple process units, then each logic sub system shall be suitably grouped for I/O's, logic, diagnostic with proper identification. Vendor shall note that changes in the functional logic diagrams will occur throughout the project phase.

2.32.10 I/o assignment should be grouped based on equipments. For 2oo3 logic implementation, 3 input to be assigned in three different input card.

2.32.11 Details of the diagnostic package and its related equipment and software shall be supplied by the vendor with the offer. A list of additional diagnostic packages available including their description and capabilities shall be provided as a separate quote.

2.32.12 Development software for the generation of various displays including dynamic graphics shall be provided. Where the PLC workstation is the sole window to the Process, it shall have the functionality as indicated in clause number 2.26 above.

2.32.13 System software for the report generation for reports like hourly on demand per shift daily and weekly report shall be provided, whenever specified in the user defined format.

2.32.14 All system software including operating system software, network software and any other proprietary software supplied shall be with suitable number of Licenses valid for the next 15 years. All updates / upgrades, software patches to fix bugs shall be provided free of cost for above period.

2.32.15 Database backup:

i) The system shall have an automatic and on demand data protection scheme for the preservation of all data during a planned / unplanned outage. The entire control software shall be backed up including vendor software control database, user-built programs, source code and data files.

ii) Back-up copies produced on bulk devices shall be removable for remote storage. On line backup shall not degrade system performance.

iii) To correct from an outage, any component of the system must be able to be reloaded from bulk. The contractor shall quote the maximum time required to reload the entire system for backup bulk storage.
2.33 Power supply distribution

2.33.1 All power supply units shall be redundant. Each redundant power supply system shall be rated to handle individually, a minimum 150% of its relevant loads.

2.33.2 Diagnostics, signaling and adequate power disconnect (mains and secondary) facilities shall be provided to service and replace a faulty redundant PSU without system interruptions.

2.33.3 Two feeders of 110 VAC, 240 VAC power supply shall be made available at one point. Further distribution of power supply shall be in vendor's scope. Also, any other voltage level required for operation of PLC shall be derived by vendor using power supply units.

2.33.4 The distribution network for interrogation voltage shall be designed such that a single fault in any branch shall not cause trip of the logic other than where the fault has occurred.

2.33.5 Power distribution network must use bus bars of adequate capacity with DPDT (Double Pole Double Throw) switches and HRC (high rupture capacity) fuses in each branch network. Vendor may select circuit breaker if short circuit characteristics do not match the HRC fuse. Bus bars to be covered with transparent acrylic sheet for safety.

2.33.6 All cubicles lighting shall be on 240 V 50 Hz AC normal power supply.

2.33.7 All power supply units shall have inbuilt surge protection system.

2.34 PLC system cabinets

2.34.1 All cabinets shall be RITTAL make. Each cabinet shall be maximum 2100 mm high (excluding 100 mm channel base), 800 mm wide and 800 mm deep with front and rear access door in general. Doors shall be equipped with lockable handles and concealed hinges with pull pins for easy door removal. Construction shall be modular preferably to accommodate 19" standard electric racks. All cabinets shall be of same height. Maximum swing out for pivoted card racks, doors and drawers shall be limited to 800 mm.

2.34.2 All PLC system cabinets shall be completely wired with all modules in place. Inside cabinet wiring shall preferably be done using pre-fabricated cables.

2.34.3 All the cabinets shall be free standing, enclosed type and shall be designed for bottom entry of cables. Cabinet structure shall be sound and rigid and shall be provided with removable lifting lugs to permit lifting of the cabinets. Spare holes for cable entry should be plugged with removable type cap so that additional cable can be routed online.

2.34.4 Cabinet shall be fabricated from cold rolled steel sheets of minimum 2 mm thickness suitably reinforced to prevent warping and buckling. Doors shall be fabricated from cold rolled steel sheet of minimum 1.6 mm thickness. Cabinets shall be throughly deburred and all sharp edges shall be grounded smooth after fabrication.

2.34.5 Cabinet finish shall include sand blasting, grinding, chemical cleaning, surface finishing by suitable filter and two coats of high grade lacquer with wet sanding between two coats. Three coats of paint in the cabinet colour shall be given for non-glossy high satin finish. Colour of the cabinets shall be as per specified.

2.34.6 In order to remove dissipated heat effectively from cabinets, vent louvres backed by wire mesh screen shall be provided in cabinet doors. Each cabinet shall be with internal temperature device and dual cooling fans. An alarm viz. fan failure and cabinet
temperature shall be logged on the operator workstation in case of excess temperature or cooling fan failure in any of the cabinets. The alarm shall be displayed in DCS system. In addition to alarm, cabinet temperature indication to be provided in DCS.

2.34.7 Illumination shall be provided for all cabinet by incandescent lamps, which shall be operated by door switch. Termination point for door switch should not be bare.

2.34.8 Equipment within the cabinet shall be laid out in an accessible and logically segregated manner. Cable glands shall be provided for incoming and outgoing cables to prevent excessive stress on the individual terminals. All metal parts of the cabinet shall be electrically continuous and shall be provided with a common grounding lug.

2.34.9 Each I/O module shall be provided with separate terminals for individual inputs and outputs. All inter cubicle and internal signal wiring shall be done using minimum 1.5 mm² stranded copper conductor, and power wiring shall be done using minimum 2.5 mm² stranded copper conductor. All terminals shall be suitable for minimum 2.5 mm² cables. All terminals upto 2.5 mm shall be case clamp screwless type / connector of Wago / Phoenix make.

2.34.10 All cabling inside each panel shall follow a common colour coding for cables. The same shall be based on the type of signals as listed below.

Digital Input
Digital Output
Analog Input
Analog Output
110V AC power supply
240V AC power supply
24V DC power supply
Earthing (Frame)
Earthing (IS Barrier)

2.34.11 All panels shall be segregated based on type of signals. Also, IS and Non IS signals shall be suitably segregated.

2.34.12 All cabinets shall be uniquely identified on the basis of unit, type of I/O and serial number. Legend plates shall be made from SS 316 plate engraved black coloured characters, 15mm high.

2.35 System software and database back-up

2.35.1 The system shall have an automatic and on demand data protection scheme for the preservation of all data during a planned / unplanned outage. The entire control software shall be backed up including vendor software control database, user-built programs, source code and data files.

2.35.2 Back-up copies produced on bulk devices shall be removable for remote storage. On line backup shall not degrade system performance.

2.35.3 To correct from an outage, any component of the system must be able to be reloaded from bulk. The contractor shall quote the maximum time required to reload the entire system for backup bulk storage.

2.36 Earthing
2.36.1 Each cabinet, workstation and other equipment supplied as a part of PLC system shall be provided with an earthing lug. All these earthing lugs shall be properly secured to the AC mains earthing bus.

2.36.2 All circuit grounds, shields and drain wires of control cables shall be connected to the system ground bus, which shall be electrically isolated from AC mains earthing bus. This bus shall be typically of 25 mm wide and 6 mm thick of copper. Grounding philosophy for PLC should be as per PLC vendor recommendation.

2.36.3 All barriers, if used shall be securely grounded. Safety barrier ground wire shall be capable of carrying a maximum fault level current of 0.5 A at 250 V r.m.s per barrier.

3.0 TESTING AND ACCEPTANCE

3.1 GENERAL

3.1.1 On the basis of guidelines specified in this specification, vendor shall submit their own testing, installation, commissioning and acceptance procedure. For hardware, the procedure shall include purpose of test, test definition of input, procedure, results, expected and acceptance criteria. For software, it shall include details of the method, list of test sequence of execution, results expected and acceptance criteria.

3.1.2 The testing and acceptance of the system shall be carried out on the mutually agreed procedure and criteria based on these guidelines and vendor standard procedures.

3.1.3 The engineers involved in the basic and detailed engineering of safety PLC shall be certified as Functional safety Engineers for implementing as per IEC 61508 safety lifecycle.

3.2 FACTORY ACCEPTANCE TEST (FAT)

3.2.1 Vendor shall demonstrate functional integrity of the system hardware and software. No material or equipment shall be transported until all required tests have been successfully completed and the material / equipment have been certified “Ready for Shipment” by purchaser.

3.2.2 Purchaser reserves the right to involve and satisfy himself at each and every stage of testing. They shall be free to request specific tests on equipment considered necessary by them, although not listed in this specification, but agreed as a part of factory acceptance test procedure. The cost of performing all tests shall be borne by the vendor.

3.2.3 Vendor to note that acceptance of any equipment or the exemption of inspection / testing shall in no way absolve the vendor of the responsibility for delivering the equipment meeting all the specified requirements.

3.2.4 It shall be vendor’s responsibility to modify and/or replace any hardware or software if the specified functions are not completely achieved satisfactorily during FAT.

3.2.5 Schedule of FAT shall be included in the Vendor’s proposal. The FAT procedure shall be submitted to PMC and Owner at least 30 days in advance for approval.

3.2.6 Vendor shall not replace any component / module / subsystem unless it has failed and a log of such failures shall be maintained during FAT. If a malfunction of module / component in a subsystem repeats, the test shall be terminated and vendor shall replace the faulty component – module. Thereafter test shall start all over again. If a subsystem fails during FAT and is not repaired and made successfully operational within 4 hours of active repair time after the failure, the tests shall be suspended and restarted.
all over again only after vendor has replaced the device into acceptable operational condition.

3.2.7 Testing and FAT shall be carried out in two phases. The minimum requirements for testing during these two phases shall be as follows:-

3.2.7.1 Under the first phase, vendor shall perform tests at his works to ensure that all components function in accordance with the specification for each type of test. A test report shall be submitted for purchaser review within two weeks of completion of this test. All subsystem shall undergo a minimum of 30 days burn in period. Following tests shall be performed by the vendor and reports shall be forwarded to purchaser.

Quality control test which shall be carried out to assure quality of all components and modules. System pre-test which shall be of physical check of all modules, racks, cabinets etc. System power-up test which shall test functionally all hardware and software.

3.2.7.2 The second phase of testing shall systematically, fully and functionally test all hardware and software in the presence of purchaser representatives. All subsystems shall be interconnected to simulate, as close as possible the total integrated system. Following minimum tests shall be carried out.

- Visual and mechanical testing
- High voltage and insulation testing

3.2.8 Functional testing

This shall include the simulation of each input and output to verify proper system response. The testing as a minimum shall include:-
- Complete system configuration loading
- Demonstration of all PLC system builder functions including additions / deletions of an input/output, addition / deletion of a rung or an element in a rung generation of dynamic graphics and other views, report generation etc.
- 100% checking of logic’s configured in the PLC by connecting switch/ lamp at input / output.
- Checking of scan time.
- Checking of all PLC workstation displays, keyboard and touch-screen operation, printer/hard copier function etc.
- System redundancy check including correct change over of the backup unit in case of failure of main unit.
- System diagnostic checking for all subsystems on local level as well as on workstation, including checking of the testing software for I/O modules signal conditioning modules, when specified.
- Checking of output status on processor failure.
- Checking of first-out alarm generation.
  - Simulation of power failure and system restart auto boot-up of system configuration and program after power restoration.

3.2.9 Vendor shall notify the purchaser at least three (3) weeks prior to factory acceptance test. In the event that representative arrive and the system is not ready for testing, vendor shall be liable for back charges for any extra time and expense incurred.

3.3 INSTALLATION, TESTING AND COMMISSIONING
3.3.1 Vendor shall offer the services of an installation team which would install the equipment in the control room, lay the interconnecting cables inside control room, check-out, test and commission the system. For Design, engineering, FAT, site execution & SAT of PLCs, exclusive team of respective PLC vendor to be involved in each stage in co-ordination with DCS vendor.

3.3.2 Vendor’s responsibility at site shall include all activities necessary to be performed to complete the job including:
- Receipt of hardware/software and checking completeness of supplies.
- Installation of the system including free supply equipment’s if any.
- Inter-cabinet cabling and termination.
- Check out equipment installation.
- Checking of interconnections, hardware and software configuration, overall system functioning etc.
- Loop checking
- Commissioning and on-line debugging of the system
- Involvement during plant commissioning and performance of final acceptance test.

3.4 FIELD INSPECTION

3.4.1 All equipment’s shall be inspected throughly by vendor after its receipt at site for completeness and proper functioning. Vendor must initiate the remedial action, in case unsatisfactory operation of any item is observed, with an intimation to Engineer-in-charge.

3.4.2 Vendor must document all observations including details of any malfunction observed. Items / equipment’s requiring total replacement must document the reasons for the same.

3.5 LOOP CHECKING

3.5.1 Loop checking shall be carried out by vendor including checking the interconnections, configuration and overall system functioning.

3.5.2 Vendor shall coordinate with the field contractor for smooth and proper loop checking. Any discrepancy found during checking shall be brought to the notice of the Engineer-in-charge. Complete loop checking shall be performed in his/her authorised representative’s presence.

3.6 SITE ACCEPTANCE TEST (SAT)

3.6.1 The purchaser shall provisionally take over the system from vendor after system acceptance test. System acceptance test shall be started only after the satisfactory performance of loop checking, commissioning of plant and verification of records by Engineer-in-charge.

3.6.2 The system acceptance test shall be carried out in the presence of purchaser’s representative and Engineer-in-charge or his authorised representative.

3.6.3 Vendor shall carry out the following functional tests, as a part of system acceptance test as a minimum:
- Hardware verification as per final bill of material.
- Visual and mechanical check-up for proper workmanship, identification, ferruling, nameplates etc.
- System configuration as per approved configuration diagram.
3.7 PERFORMANCE TEST

The owner shall take over the system after satisfactory full functional performance test for a period of 3 weeks.

During above period, any malfunctioning of the system components shall be replaced / repaired as required free of cost. Once the system failure is detected, the acceptance test shall start all over again from the beginning. The warranty period commences from the day owner takes over the system.

4.0 GENERAL REQUIREMENTS

4.1 Vendor shall comply fully with the general requirements of PLC system including logistic support services, documentation, warranty, maintenance contract and shipping instructions.

4.2 Proven Track Record (PTR) requirements

The PLC vendor shall have presence in India for a period of minimum 5 years as PLC supplier with expert manpower for support and shall have supplied minimum of two PLC systems of similar size to refinery, petrochemical plants for a continuous critical and hazardous application. The offered system shall have proven track record of successful operation for minimum 1 year after completion of Site Acceptance Test and vendor shall provide supporting documentation for the same from the end user.

4.3 Availability of System

Vendor shall confirm that support for supplied system hardware and software shall be available for a period of 10 years from the date of commissioning.

4.4 TRAINING

4.4.1 Vendor shall include for training of the engineering /operation/maintenance staff. The training shall include but will not be limited to the following in general.

- Training for all components supplied along with system
- The hardware/software operation and maintenance engineers shall be trained for different module level and optionally component level diagnostics of the system. Vendor is required to quote separately for these training facilities. Duration of training and minimum no of persons required to be trained to be specified.
- The details of diagnostics software package for isolating the fault at module level for all the subsystem shall also be specified.
- Vendor shall conduct a course in hardware(module level and optional component level), software operation and maintenance and diagnostics of the system for owner at vendor's facility. The course shall be conducted prior to the factory system performance tests so that trained personnel can participate effectively in the final testing.
- The hardware and software operation and maintenance training course shall cover every equipment item supplied as part of PLC. This course shall include:
  - Actual operation, detection and correction of faults in equipments.
- Familiarisation with operation and maintenance procedures for the system offered.
- Maintenance training on the individual instrument being supplied.
- Fundamentals of the system and its operation.

Training on the operation of the entire systems as per functional requirement

- Details of training plan for all categories will be divided mutually at a later date.

4.5 WARRANTY CONTRACT AND SERVICES

4.5.1 HARDWARE AND SOFTWARE WARRANTY SERVICE REQUIREMENT

All components, parts and assemblies supplied and installed by vendor under the offer shall be warranted against defects in design, material quality, workmanship and operation for a period of at least 24 months commencing from the date of handover to Owner upon successful completion of SAT or 36 months from the date of complete supply of materials whichever is earlier. Vendor shall be fully responsible for the manufacturer/sub-bidder/ sub-contractors/suppliers in this respect. Warranty services shall be provided by qualified & competent Engineer. During warranty period Vendor shall carry out following activities/services/requirements without any cost implication.

- Checking the proper functioning of Hardware and Software periodically. Attending and rectification of Hardware/Software failures/ problems immediately, by repair or replacement of the failed components/faulty components/ faulty electronic cards. Providing all type of maintenance services for continuous operation of the systems/sub-systems during the warranty period shall be totally vendor’s responsibility and shall be done without any cost implication.

- It shall be obligatory on the part of the vendor to carry out all type of modifications/ upgradations of any hardware and software (both system software and application software) if the same are required for proper maintenance/running of the systems and the same is inevitable. In case any malfunction is revealed even during on-line operation after taking over of the systems by Owner the same shall be rectified by the vendor. These services shall be provided by the vendor during warranty period without any cost implication.

- In case of failure on part of vendor (i) to attend and rectify the problems logged/complained by Owner (ii) to replace any component/equipment for ensuring desired performance/ continues operation of the systems within the Warranty period. Owner reserves the right to invoke entire amount of performance bank guarantee that are valid at the time of invoking, irrespective of the value of the items which need to be replaced /rectified.

- Service or Maintenance personnel shall be able to receive 24-hour help-desk technical support to be provided by the system manufacturer.
- The service engineer shall be well qualified and competent enough to take on the job of Service engineer in terms of training, experience, qualification and aptitude. He/She should have minimum three year work experience on the system supplied or on the previous versions of the system supplied. (If the system supplied to Owner is available in the market for less than 3 years).

- Vendor shall supply maintenance spares, tools and tackles as required during the contract period.
Vendor shall routinely and systematically carry out recommended preventive maintenance. The Preventive Maintenance involves complete periodic overhaul of the system, inspection of the hardware and software, fault prediction, inspection of power supply quality, environmental operating condition checks, calibration checks, major repairs/replacements and detailed reporting. Vendor shall carry out routine condition monitoring and routine servicing of the system and other associated equipment in the installed by the vendor.

- The service contract shall be compulsory and the Owner shall have the right to accept or reject the bid based on the non compliance in meeting service contract.

- Attending to any breakdown or malfunction of the system within 12 hours of receiving the call from site.

- The vendor should be able to provide a comprehensive software maintenance and enhancement program for on-going warranty support of the system. All updates, new releases of the software during the warranty period shall be provided without cost implication.

4.6 POST WARRANTY COMPREHENSIVE ANNUAL MAINTENANCE CONTRACT (PWCAMC)

- Vendor shall submit proposal to provide extended service/maintenance agreements for up to 5 years after completion of warranty period. The agreement shall be renewable yearly. The Comprehensive Annual Maintenance Contract (PWCAMC) shall include i.e. comprehensive maintenance of the PLC/bought out items etc.

- Periodical checking the proper functioning of Hardware and Software. Attending Hardware/Software failure problems immediately by repair or replacement of the failed component. Provide system maintenance and repair of system or workmanship defects during the year PWCAMC period free of charge (parts and labor).

- It shall be obligatory on the part of vendor to modify and/or replace any hardware and modify/correct/upgrade the operating application and diagnostics software without any additional cost, in case any malfunction is revealed even during on-line operation after taking over by the Owner within the PWCAMC period.

- In case of failure on part of vendor, to attend to the complaints that are raised by the Owner or to replace any component/equipment for ensuring desired performance from the PLC, within the PWCAMC period. Owner reserves the right to cancel the PWCAMC and withhold any payments payable to the party irrespective of the value of the items which need to be replaced/rectified.

- Service or maintenance personnel shall be able to receive 24-hour help-desk technical support provided by the vendor.

- The offer for PWCAMC shall be compulsory and the Owner has the right to accept or reject the bid based on the non compliance to meet PWCAMC requirement.

- The proposal shall include supply of maintenance spares, tools and tackle as required and also travel, boarding & lodging of service engineer. The bid shall be made year wise up to 5 years and the price validity shall be available for the entire period of contract.
- In the event of any malfunction of the system hardware/system software, experienced service engineer shall be made available at site within 12 hours on the receipt of such information from Owner.

- Vendor shall maintain a record of all faults during post warranty period.

The services under Post Warranty Maintenance Agreement, including supply of spare parts and services, shall broadly comprise of:

- Preventive Maintenance.
- Periodic Maintenance.
- Emergency Service.
- Software enhancement & software support including minor changes in graphic etc.
- Anti Virus software

- Preventive Maintenance:

This involves complete periodic overhaul of the system, inspection of the hardware and software, fault prediction, inspection of power supply quality, environmental operating condition checks, calibration checks, major repairs/replacements, replacement of cards and accessories because of expected ageing failure and detailed reporting. This visit is in addition to visit required for periodic maintenance.

- Periodic Maintenance:

This involves site visits, minimum four (4) times in a year (total days 8 in a year), schedule of visits to be discussed and finalised jointly between Owner and vendor after placement of order/delivery. It shall include inspection of general healthiness of the system, study and advice on daily maintenance, inspection of H/W & S/W, if any problem is reported, and running of test programs, on-line servicing and solving reported problems. Checks shall be conducted on running system i.e. (a) On-line systems/sub-systems (b) Power supply checks (c) HMI/ Operating workstation (d) Printer etc. Cleaning of cabinet air filters, minor modification/addition related to system configuration/data base. Vendor shall take backup in 2 copies of last updated software also.

Identification of any hardware/software modification carried out in the PLC from the date of last modification and Updating of as-built documents, records for loop diagrams, I/O assignment, alarm, Logic block, control programs etc, as and when any modification is carried out or identified shall be vendor’s responsibility.

- Software Maintenance/Support:

Vendor shall maintain the existing operating & application software to improve upon performance of the system. Software modification and up gradation, as & when required, shall also be covered under this scope at no extra cost. During the PWCAMC period if vendor feels that the system require software release up gradation and same is necessarily required then same shall be provided with out any additional cost implication.

- Emergency Service :

In the event of any malfunction of the Control System hardware/system software during this period, service Engineer must report at site within 2 hour to max 12 hours of report of failure, with necessary spares. The system must be brought back within maximum 12 hours after reporting at site.
- Software Enhancement & Software Support including minor changes in graphics

The vendor shall provide a comprehensive software maintenance and enhancement program for on-going support of the system under PWCAMC. All updates, new releases of the software for the next 2 years during PWCAMC shall be provided without any additional cost.

- Antivirus software support

The vendor shall provide necessary antivirus software support if the system software gets affected by any kind of viruses under PWCAMC without any additional cost.

- Vendor to note that while carrying out the Post Warranty PWCAMC activities, Owner engineers shall oversee/associate with the Bidder/Contractor’s service engineer. Also on-job, training to HPCL’s engineers if HPCL required shall be covered under this scope.

PWCAMC shall include all items being supplied by vendor, including any bought out items but not limited to the following:

- Labor and materials, at no additional cost, to repair any system devices including, controllers, communication devices, computers, servers and related equipment, network controllers, printers etc
- Labor and materials, at no additional cost, to provide tests, and adjustment to system devices including printers.
- Regular checkups to ensure that a correct procedure is established for data base backup and archiving.

- Provision of Resident Engineers support as option can be quoted separately. Resident engineer shall be available during day shift (General shift, 6 days a week having Sunday as Off day) The price validity shall remain constant for entire period of PWCAMC contract.

- The resident engineer shall be well qualified and competent to take on and handle the job of engineer in terms of qualification, training, well experience, and positive attitude. He should have minimum three year work experience on the system supplied or on the previous versions of the system supplied. (if the system supplied to Owner is available in the market for less then 3 years). Before appointing the resident engineer at site, the vendor shall submit the credential of resident engineer (meeting above mentioned criteria) to Owner and only after approval of Owner the resident engineer shall be posted to the site. Owner decision in this regard shall be final and binding to the vendor.

- Payments for PWCAMC services shall be post services rendered, i.e. payments shall be made monthly on satisfactory rendering of service on production of certified service report and invoice. Vendor shall provide bank guarantee for entire PWCAMC period (5 years) for the amount equal to value offered by the bidder for 5 years PWCAMC. Owner reserves the right to invoke part or full bank Guarantee amount in case of poor performance of system or poor PWCAMC support provided by the vendor at any stage during the PWCAMC period. Owner’s decision in this regard shall be final and shall be binding to the vendor.

Responsibility of Resident Engineer
Responsibilities/duties of Resident Engineer required during the day shift (General Shift), 6 days a week, under PWCAMC are as follows:

1. System management and administration; evolving procedures for operation and maintenance of the system.

2. To ensure smooth running of the day to day working of the system at the refinery with respect to Hardware as well as Software.

3. Maintaining the Software to improve performance of the system. Software modification, as and when required, shall also be covered under this scope.

4. Job Training to Owner’s people.

5. Preventive Maintenance : This involves complete periodic overhaul of the system, inspection of the hardware and software, fault prediction, inspection of power supply quality, environmental operating condition checks, calibration checks, major repairs/replacements and detailed reporting.

6. Condition monitoring and routine servicing of all the system and other associated equipment in the refinery installed by vendor.

7. Attending to any breakdown or malfunction of the system.

8. Resident engineer will follow HPCL work schedule for working hours (48 Hours working) and holidays.

5 SHIPPING

5.1 All the materials used for packing, wrapping, seals, moisture resistant barriers and corrosion prevention shall be of recognised brands and shall conform to the best standards for the articles which are packed.

5.2 Workmanship shall be in accordance with best commercial practices and requirements of applicable specifications. There shall be no defects, imperfections or omissions, which would tend to impair the protection offered by the package as a whole.

5.3 The packing shall be suitable for storing in tropical conditions, as specified in job specifications. Shipment shall be thoroughly checked for completeness before final packing. Vendor shall be responsible for any delay in installation or commissioning schedule because of incomplete supply of equipment.

6 REJECTION

Vendor shall make his offer in detail with respect to every item of the purchase’s specifications. Any offer not conforming to this shall be summarily rejected.