

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 368 of 718
<p>interlocking between the switchgear unit at powerhouse and common system switchgears located outside powerhouse shall also be hardwired.</p> <p>5.14.9 Engineer shall be able to carryout engineering & diagnostics functions from DCS engineering station.</p> <p>5.14.10 Status/Monitoring for the power distribution network will be typically as follows:</p> <p>(a) Incomers on 11 kV, 3.3 kV & 415V Switchgear</p> <p>(i) Circuit Breaker (CB) Open/Close.</p> <p>(ii) CB in Local/Remote, Test/Service, Spring charge.</p> <p>(iii) CB Tripped on Fault.</p> <p>(iv) Protection operated.</p> <p>(v) DC supply failed.</p> <p>(vi) CB tripped due to Under voltage.</p> <p>(vii) Trip circuit unhealthy.</p> <p>(viii) Differential protection operated.</p> <p>(ix) Restricted earth fault operated.</p> <p>(x) Load current each phase.</p> <p>(xi) KWh (pulse o/p type).</p> <p>(xii) Voltage 3Ph.</p> <p>(b) Incomers on 415 V Motor Control Centre.</p> <p>(i) Circuit Breaker (CB) Open/Close.</p>		


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 369 of 718
<p>(ii) CB in Local/Remote, Test/Service, Spring charge.</p> <p>(iii) CB Tripped on Fault.</p> <p>(iv) CB DC supply failed.</p> <p>(v) CB tripped due to Under voltage.</p> <p>(vi) Trip circuit unhealthy.</p> <p>(vii) Load current each phase.</p> <p>(viii) KWh (pulse o/p type).</p> <p>(c) Bus tie on 11 kV, 3.3 kV and 415V switchgear.</p> <p>(i) Circuit Breaker (CB) Open/Close.</p> <p>(ii) CB in Local/Remote, Test/Service, Spring charge.</p> <p>(iii) CB Tripped on Fault.</p> <p>(iv) Protection operated.</p> <p>(v) CB DC supply failed.</p> <p>(vi) CB Auto/Manual switch in Manual mode.</p> <p>(vii) CB auto transfer failed.</p> <p>(viii) CB Auto transfer inhibited.</p> <p>(ix) CB tripped on Under voltage.</p> <p>(x) Trip circuit unhealthy.</p> <p>(xi) Bus bar under voltage.</p>		


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 370 of 718
<p>(d) Bus VT Panels on 11 kV & 3.3 kV switchgear</p> <ul style="list-style-type: none"> (i) Bus VT fuse failure. (ii) DC power supply failed. <p>(e) Feeders on 11 kV & 3.3 kV</p> <ul style="list-style-type: none"> (i) Circuit Breaker (CB) Open/Close. (ii) CB in Local/Remote, Test/Service, Spring charge. (iii) CB Tripped on Fault. (iv) Protection operated. (v) CB DC supply failed. (vi) CB tripped on Under voltage. (vii) Load current on each phase. (viii) KWh (Pulse O/P type). <p>(f) Non Motor Feeders on 415V</p> <ul style="list-style-type: none"> (i) Circuit Breaker (CB) Open/Close. (ii) CB in Local/Remote, Test/Service, Spring charge. (iii) CB Tripped on Fault. (iv) CB DC supply failed. (v) Load current (each phase). (vi) KWh (Pulse O/P type). <p>5.14.11 Interposing relay shall be provided in the respective switchgear unit.</p>		


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 371 of 718
<p>5.15 <u>ELECTRICAL POWER DISTRIBUTION SYSTEM FOR OFF-SITE PLANT SYSTEM</u></p> <p>5.15.1 Remote control, monitoring, metering and annunciation of the 11 kV Incomer, Bus Couplers & Transformer Feeders, 3.3 kV Incomer & Bus Coupler and 415V Incomers & Bus-couplers shall be provided. It shall also be possible to control & monitor the complete electrical power distribution system from the remote operators console (HMI Stations) located at respective Local Control rooms of off-site systems like Main CHP Sub-station Building cum Control Room, Ash Handling Plant, DM plant etc. Entire control system shall be implemented through the PLC of the respective plant. All interlocking and protection logics shall be hardwired in their respective panels.</p> <p>5.15.2 Synchronization of incomer & bus coupler for 11 kV & 3.3 kV Switchgear & each of 415V PMCC pertaining to off-site systems e.g., CHP Sub-station Building cum Control Room, Ash Handling Plant, DM plant etc shall be implemented through respective PLC systems. Synchronizing check relay, guard relay and auxiliary relay shall be provided in each Switchgear. Synchroscope, double voltmeter, double frequency meter, synchronizing cut off switch common for all above switchgear/ PMCC and Synchronizing switch & trip selector switch for each set of the Switchgear/ PMCC shall be provided in the PLC.</p> <p>5.15.3 Operator stations of respective off-site plant systems shall display the followings as a minimum :</p> <ul style="list-style-type: none"> (a) Animated single line diagram of the electrical network with dynamic status. (b) Alarm Summary. (c) Display of analog & digital parameters including protective relaying. (d) Display of switchgear status local/remote, service/ test and spring charged. (e) On/Off, CB Trip. 		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 372 of 718
<p>(f) Real time and historical trend of all analog parameters.</p> <p>(g) Disturbance recording.</p> <p>(h) The maximum time required from issuing a Switchgear close/open command at HMI Keyboard/ Mouse to observing a change of status on the HMI screen should not be more than 1sec.</p> <p>(i) In order to implement the electrical power distribution system through respective plant PLC, all switch contact and analog inputs shall be hardwired to the PLC input cards. All output from the PLC panel connecting to different switchgear/PMCC units shall be hardwired.</p> <p>(j) Basic Interlocks & protection for the switchgear units shall be resident to its respective cubicle. Any interlocking between different switchgear/PMCC units shall be hardwired between them.</p> <p>(k) The PLC based control system for the electrical distribution system shall be designed in such a way that failure of the PLC should not lead to the failure of electrical network.</p> <p>(l) In case of failure of the PLC system, operator shall be able to carry out the control functions (ON/OFF) from the respective switchgear unit by taking the system in local mode.</p> <p>(m) Redundancy in output modules for remote open & close of switchgear shall be provided for 11 kV Incoming & Bus Coupler Breakers, 3.3 kV Incoming & Bus Coupler Breakers & 415 V Incomer & Bus Coupler Breakers.</p> <p>(n) Bidder shall provide all the required transducers for remote monitoring of electrical parameters at the operator's console.</p> <p>(o) Redundancy in output modules shall be provided for all HT & LT drives.</p> <p>(p) Annunciation to be provided as follows :</p>		


CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 373 of 718
<p>(i) Individual incomer and bus section breaker tripped for 11 kV SWGR, 3.3 kV SWGR & 415 V Power-Cum-MCC.</p> <p>(ii) 11 kV, 3.3 kV & 415 V Incomer under voltage (individual).</p> <p>(iii) 11 kV, 3.3 kV & 415 V Bus under voltage (individual).</p> <p>(iv) D. C. Supply failure for 11 kV SWGR, 3.3 kV SWGR & 415 V PMCC (for each PMCC).</p> <p>(v) Transformer Winding Temperature High/Very High, Oil Temp. High/Very High, Buchholz High/Very High, magnetic oil level gauge High/Very High for 11 kV / 3.45 kV oil filled transformer (individual alarm & trip).</p> <p>(vi) Trip circuit unhealthy (Group – to be provided for 11 kV SWGR, 3.3 kV SWGR and each 415V PMCC separately).</p> <p>(vii) Momentary paralleling of supplies (11 kV Switchgear, 3.3 kV Switchgear and each 415 V PMCC).</p> <p>(viii) 11 kV, 3.3 kV & 415 V Line P.T. fuse failure (Individual).</p> <p>(ix) 11 kV, 3.3 kV & 415 V Bus P.T. fuse failure (Individual).</p> <p>(x) 11 kV, 3.3 kV breakers not available (Group)</p> <p>5.16 <u>PLC GATEWAY</u></p> <p>5.16.1 Functional Description</p> <p>Interface between “Offsite PLC” networks and DCS system for remote information and monitoring of offsite plants data, shall be carried out by a dual hot redundant PLC gateway. Proposed Gateway shall operate as a node pair, one in operating and the other shall be in hot standby, serving as its redundant partner, with an exact up-to-date copy of the database and ready to take over full operation should the operating member of the pair fails or be taken out-of-service. The gateway shall provide the data conversion,</p>		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 374 of 718
<p>buffering, and sequencing to provide an efficient interchange of information between the DCS network and the programmable controllers.</p> <p>5.16.2 Communication link in between the DCS and the Programmable logic controllers shall be dual and optical fiber based.</p> <p>5.16.3 Data communication shall be in MODBUS or OPC as per requirement.</p> <p>5.16.4 20 % tag handling capacity over the configured tags shall be kept as spare for future expansion.</p> <p>5.16.5 Nodes shall be time synchronized with GPS master clock.</p> <p>5.17 <u>PROCESS PLANT SIMULATOR</u></p> <p>5.17.1 The plant simulator offered shall be suitable for training plant operators to hands- on operation of the actual plant under simulated environment. The system shall be from the latest proven range from reputed manufacturer with established expertise in power plant simulation business.</p> <p>5.17.2 System shall be microprocessor based using latest but standard software platform.</p> <p>5.17.3 In appearance, the simulator operator's console shall be exactly identical to plant control room, excluding the LVS and operator's printers.</p> <p>5.17.4 The entire plant operating parameters and dynamics shall be programmed in the form of mathematical models and shall be stored in the Simulator Server.</p> <p>5.17.5 The process logic, sequence etc shall be stored in another Plant Management System Server.</p> <p>5.17.6 The instructor functions like simulated process setup routines shall be stored in the Instructor Server.</p> <p>5.17.7 All the servers shall be redundant. One being main and the other being back-up unit, so that no data is lost in case of a server crash.</p> <p>5.17.8 The servers shall be seamlessly networked in a Local Area Network.</p>		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	
REV: R0	CONTROL & INSTRUMENTATION	Page 375 of 718
<p>5.17.9 Simulator shall permit the session to start from any plant condition based on Initial Condition set up. At least 200 such preset initial conditions shall be offered.</p> <p>5.17.10 All simulated function dynamics shall match real plant conditions as if the events are happening in “real-time”. The Instructor, however, shall have the discretion to deviate from real time if he finds it beneficial for training and saving in training time. In Fast Time mode, certain plant processes like turbine metal heating, vacuum pulling shall occur at ten times faster than normal speed.</p> <p>In slow time mode, the entire plant operation and response shall get slowed down to a rate ten times slower than normal. This facility shall allow study and analysis of transient conditions etc.</p> <p>In step time mode, the entire plant operation and response shall get stepped down to a rate thirty two times than normal. This facility is particularly useful in the study and analysis of sudden fluctuations in parameters, unit trip sequence etc.</p> <p>5.17.11 As the trainees carry out operations on the simulator, the computer shall constantly record the same. At any moment of time, a record of the past four hours operation at the interval of two minutes shall be available to the computer. The instructor shall, with the Backtrack facility, be able to take the simulator back in time to any past condition up to the last four-hour to analyze trainee’s performance.</p> <p>5.17.12 In the event, the trainee desires that some functions are performed locally, the same shall be simulated from the trainer’s console.</p> <p>5.17.13 Instructor shall be able to freeze the process at any point he desires to stop and explain certain situations to the trainee.</p> <p>5.17.14 The instructor shall inject process malfunctions from his terminal. The action of the operator viz. how fast he suspects some abnormality, how quickly he succeeds in tracing the root cause, what remedial measures he takes and how much effect it has on the plant, can be noted and assessed. At least 300 malfunction conditions shall be available. A malfunction shall be introduced</p>		

CONSULTANT : PROCON ENGINEERS


 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	Section – 5	
REV: R0	CONTROL & INSTRUMENTATION	Page 376 of 718
<p>with percentage of severity and delay & ramp time for delay in operation of malfunction.</p> <p>5.17.15 Malfunctions shall be inserted either from Sim Diagram or from Malfunction Index. Malfunction Summary shall display how many Malfunctions have been inserted.</p> <p>5.17.16 Replay function, similar to the Backtrack function, shall permits the operator to review simulator behaviour with a specific backtrack condition. By this function, the instructor shall demonstrate the trainee's action during any emergency situation to assess the trainee's performance during transient conditions, sudden fluctuations in parameters etc.</p> <p>5.17.17 A total of at least 32 Event triggers shall trigger a pre-defined, automatic response, or set of responses, on the occurrence of a simulation event. An inserted malfunctions or override, which is assigned a trigger, will become active automatically when the plant condition described by the event trigger exists. The Event Trigger summary shall show how many Event Trigger functions are done.</p> <p>5.17.18 Through a set of Automated Plant Procedure the instructor shall crate standard exercises, to test the ability and reflexes of the trainee during operation of the plant. The Automated Plant Procedure summary shall dynamically display the current execution status of every command in the APP. The current command shall be highlighted in blue, and all previous commands shall be highlighted in green and command, which has been skipped, highlighted in yellow.</p> <p>5.17.19 Monitored Parameter shall allow the monitoring and plotting of constants and variables in the database.</p> <p>5.17.20 The Trainee Performance Review function shall effectively produce a printed report that logs, organizes, and interprets the actions that have taken place during a specific section of a scenario so that an instructor can review trainee performance easily. This shall include monitoring the values of selected parameters relative to selected value ranges and all operator and instructor actions.</p>		

CONSULTANT : PROCON ENGINEERS


 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	Section – 5	
REV: R0	CONTROL & INSTRUMENTATION	Page 377 of 718

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


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 378 of 718
<p>In addition to this, 10% or minimum of one off, extra assigned complete spare modules mounted on rails in racks for each type of I/O modules shall also to be provided. The spare channel and cards shall be fully wired and terminated.</p> <p>6.8 Memory unit of the CPU shall be field expandable at least by 25%. Operating system/application program/sequence logic etc. shall be stored in nonvolatile memory for automatic re-booting. Dynamic memories shall be provided with battery back up at least for 360 hours.</p> <p>6.9 Number of input/output points per card shall not exceed 16 (sixteen) for digital and 8 (eight) for analog/thermocouple/RTD signals. Individual input and Output channels shall have galvanic/optical isolation. Merely fusing of individual or a group of channels is not acceptable.</p> <p>6.10 Data communication system of the PLC shall not be limited to the following:</p> <ul style="list-style-type: none"> (a) Internal bus and external data network loading shall in no case be more than 60% of its capacity. (b) Disrupted message shall be automatically retransmitted when the system is restored. (c) Failure or physical removal of any module connected on the system bus shall not lead to any loss of communication. (d) Diagnostics message shall be issued on fault detection. (e) Bus change over from active bus to stand by bus, during failure of active bus, shall be performed automatically and bumpless. Such event shall be suitably logged or alarmed. (f) Noise immunized and reliable high speed dual fault tolerant optic fiber cable communication with standard communication protocol shall be provided between PLCs and remote or extended I/O modules. 		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 379 of 718
<p>(g) Main data network shall comply with the International Standard IEEE-802.3 (Ethernet) for data exchange and communication.</p> <p>6.11 Operator workstation shall be complete with latest user friendly operating system, 24" colour TFT monitor, membrane or positive depression KB, mouse, colour laser printer and dot matrix printer. In addition, 3 no (three) laptop unit loaded with all PLC system software shall be furnished.</p> <p>6.12 For PLC systems without OEWS (Operator cum Engineering work station), above mentioned Laptop shall be used.</p> <p>6.13 Only licenced copy of programming software suitable for multi-user's use shall be provided.</p> <p>6.14 PLC systems without OEWS (Operator cum Engineering work station) shall have panel mounted pushbuttons, lamps, hardware annunciation system and MIMIC for operation and control of the system from desk/panel.</p> <p>6.15 The functions performed from the HMIs shall not be limited to the following:</p> <p style="margin-left: 40px;">(a) Selection of Auto/Manual, Open/Close, Sequence Auto, Start/ Stop operation.</p> <p style="margin-left: 40px;">(b) Dynamic Mimic display depicting the process.</p> <p style="margin-left: 40px;">(c) Alarm monitoring, report & log generation, printing of trends etc.</p> <p style="margin-left: 40px;">(d) On line/historical trending, historical storage and retrieval of data.</p> <p>6.16 Software</p> <p style="margin-left: 40px;">(a) Necessary software for implementation of the control logics, operational displays & logs, data storage, retrieval and other functional requirements, shall be provided.</p> <p style="margin-left: 40px;">(b) Licensed version of required software including operating system, configuration and HMI software suitable for multi-user's use shall be provided.</p>		


CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 380 of 718
<p>(c) Detail documentation on the programming softwares as part of the O&M manual.</p> <p>6.17 <u>POWER SUPPLY</u></p> <p>6.17.1 Power supply to the each PLC system shall be provided from separate redundant solid-state 240V AC \pm 1% packaged UPS (Uninterruptible Power Supply) units to be placed local to the control systems. UPS system shall be complete with Plante type battery & battery chargers. UPS shall have adequate capacity to cater 100% load without overloading. UPS system shall be adequate to provide back up power for not less than 60 minutes. (General guide lines as per section-10). UPS for PLC of CHP shall be provided with redundant battery. But for other PLC (AHP, WTP etc.) one battery for UPS is sufficient. 24V DC interrogation supply for off-site plant should be derived from the dual redundant ac-dc converters.</p> <p>6.17.2 UPS shall be complete with AC Distribution board. Two feeders shall be extended from ACDB to PLC.</p> <p>6.17.3 Bulk power supply units for interrogation, relay and solenoid voltage shall be separate from system power supply units and shall be redundant.</p> <p>6.17.4 System shall have MTBF better than 99.7% and shall be hot maintainable. System hardware shall be designed to be 'fault avoidant' by selecting high-grade components of proven quality and properly thermally de-rated design. The network shall have extensive fault monitoring, self-surveillance & on-line self-diagnostic capability so that failure is immediately detected.</p> <p>6.17.5 System shall automatically check and correct gain & drift for ADCs on-line.</p> <p>6.17.6 Data exchange in a bus shall be fully monitored and checked for validity.</p> <p>6.17.7 Response time consisting of IO scan time, data communication time, processing time etc. shall be equal to or less than the following :</p> <p>(a) OLCS & sequence control inputs : 100 ms.</p> <p>(b) CLCS inputs : 250 ms.</p>		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 381 of 718
<p>(c) Monitoring analog parameters : 500 ms.</p> <p>(d) Monitoring digital parameters : 100 ms.</p> <p>6.17.8 Following operations will be performed on I/Os, as required:</p> <p>(a) Square root extraction</p> <p>(b) Pressure & temperature compensation</p> <p>(c) Reasonability check of all inputs, validation and quality tagging like good, bad, suspect etc.</p> <p>(d) Channel wise engineering unit conversion</p> <p>(e) Contact bounce filtering with adjustable time constant.</p> <p>6.17.9 The PLC controllers shall be time synchronized to GPS master clock via IRIG-B or Ethernet port. Software capability shall be provided to implement closed loop control functions as follows:</p> <p>(a) PID control and their variations.</p> <p>(b) On-off control</p> <p>(c) Cascade control</p> <p>(d) Ratio and bias control</p> <p>6.17.10 Features for Open Loop Control shall not be limited to following:</p> <p>(a) Logic functions like AND/ OR/ NOT gates, timers (on-delay, off-delay), shift registers, counters, latches, flip-flops, mono-shots etc.</p> <p>(b) Automatic sequence control for start up and shutdown of auxiliaries /auxiliaries/equipment in functional groups initiated by command from operator's console. A sequence shall be made of steps executed in predetermined order according to logic criteria. For each</p>		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 382 of 718

step there shall be a provision for ‘waiting time’ and ‘monitoring time’. System shall have the capability to bypass a step, if desired, from the operator’s station. Such action however shall be registered as an exception.

(c) Inputs for protection system shall be of high priority. In the event of either loss of control power or control signal input to the drive, the drive shall remain in its last position unless specifically required otherwise. The system shall be designed such that no upset occurs either to process or to the drive when the power is restored.

6.17.11 Interface of the system with M.C.C/Switch gears shall be in the form of potential free contacts via interposing relay modules mounted in the respective switchgear or MCC unit. Other interfacing relays shall be mounted in a cabinet separate from the system cabinet. 10% wired additional interposing relay modules shall be provided as installed spare. Freewheeling diodes shall be provided across the coil of DC solenoid and contactors/relays. For AC solenoids and contactors directly driven from output cards, arc suppressors shall be provided across the coil.


Each IO rack shall have 10% spare rack space for future upgradation.

6.17.12 Single programming instruction/command shall be sufficient to delete a program rung from memory. Similarly, any rung can be inserted into the existing program. The active and the stand-by CPU programs shall equalize automatically, once the new program is permitted to “RUN”.


6.17.13 Updating time and reaction time shall be as follows:

(a)	Calling up a mimic	:	2 sec or better
(b)	Updating status signal in mimic	:	1 sec or better
(c)	Updating variables in a mimic	:	1 sec. or better
(d)	Issuance of command to output (without considering process lag)	:	1 sec. or better


CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 383 of 718
<p>6.17.14 Displays shall be classified into overview display, group display, point display and trend display.</p> <p>6.17.15 Printing of logs shall be initiated automatically at prescribed time intervals, or initiated on demand by the occurrence of predefined events.</p> <p>6.17.16 System shall permit the operator to specify minimum of 5 summary logs each with minimum of 25 points to be printed on demand.</p> <p>6.17.17 Salient features of the PLC system for I/O handling shall be as follows.</p> <ul style="list-style-type: none"> (a) Input filters to attenuate noise. (b) Isolation of 1500V AC for the input & output module. (c) Common mode noise rejection for analog inputs of 120 db at 50 Hz. (d) Normal mode noise rejection for analog inputs of 60 db at 50 Hz. (e) LED indicators on each card to show status of input. (f) All the outputs shall be with individual fuse. (g) J/ K type thermocouple mV input where applicable. (h) Pt-100 three/four wire resistance thermometer input where applicable. (i) 24 V DC power supply to field mounted two wires transmitters. <p>6.17.18 Salient hardware/software features of the CPUs shall be as follows:</p> <ul style="list-style-type: none"> (a) Watch dog timer : Periodical reset. Alarm and interruption, if not reset within stipulated time. (b) Max. scan time for inputs : 1 second max. 		


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 384 of 718
<p>(c) Maximum Scan Rate : 1 ms (Per K Word) or better</p> <p>(d) Memory capacity : 25% spare capacity after full utilization. Expandable in multiples of 16 K.</p> <p>(e) Comm. processor : Separate</p> <p>(f) Battery back up for : 360 hrs continuous operations. RAM</p> <p>(g) Diagnostic feature : Periodic, automatic self- diagnostic.</p> <p>6.17.19 Salient features of the Input/Output modules are as follows.</p> <p>(a) All modules</p> <p>(i) Surge withstand : IEC-255.4 capability</p> <p>(b) Digital General</p> <p>(i) No. of channels/ : 16 module</p> <p>(ii) Interrogation : 24V DC or 48 V DC voltage</p> <p>(iii) Status indicator : LED type.</p> <p>(iv) Isolation : Optical</p> <p>(c) Digital Input Module</p> <p>(i) Contact bounce : Adjustable time constant of 15 filtering millisecond.</p> <p>(ii) Diagnostic : Module fault</p>		


CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 385 of 718
<p>(d) Digital Output Module</p> <p>(i) Output protection : Short circuit Proof & Individual fuse</p> <p>(ii) Diagnostic : Module fault</p> <p>(e) Analog General</p> <p>(i) No. of channels / module : 8</p> <p>(ii) Isolation : Galvanic/ Optical</p> <p>(f) Hi-level Analog Input Module</p> <p>(i) Type of input : 4-20 mA DC / 1-5V DC</p> <p>(ii) A/D Converter : 11 bits + Sign (or better)</p> <p>(iii) Accuracy : 0.1% or better</p> <p>(iv) Diagnostic : Module fault</p> <p>(v) Powering of transmitter : 24 V DC 2 W type</p> <p>(g) Low Level Analog Input Module</p> <p>(i) Type of input : PT-100; T/C (As required)</p> <p>(ii) C-J-C : On Module</p> <p>(iii) Accuracy : 0.1% or better</p> <p>(iv) A/D converter : 15 bits + Sign (or better)</p> <p>(v) Diagnostic : Module fault</p>		


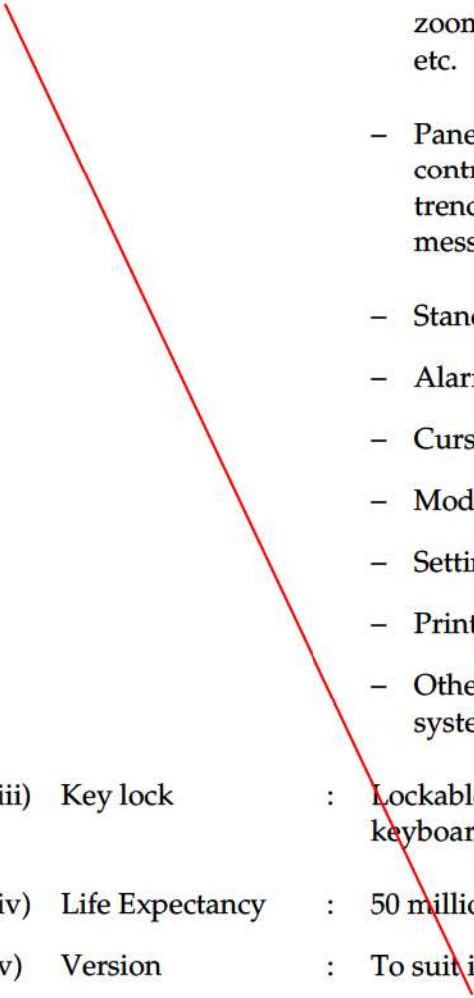
CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 386 of 718
<div style="text-align: center;"> <p>(h) Analog Output Module</p> <p>(i) Type of output : 4-20 mA DC</p> <p>(ii) Accuracy : $\pm 0.1\%$ or better</p> <p>(iii) A/D Converter : 11 bits + Sign (or better)</p> <p>(iv) Load : 600 Ohms</p> <p>(v) Diagnostic : Module fault</p> </div> <div style="border: 1px dashed red; padding: 5px; margin: 10px 0;"> 6.17.20 Bidder shall provide control/work station as below </div> <div style="text-align: center;"> <p>(a) Operator's Station / Engineering Station (PC Based)</p> <p>(i) Processor : 2nd generation core i5 or better</p> <p>(ii) Mother Board : Intel Original</p> <p>(iii) Configuration : Tower/Flat</p> <p>(iv) Internal clock : 2.0 GHz or better</p> <p>(v) Architecture : 32 bit</p> <p>(vi) Video Card : On Board</p> <p>(vii) System Memory : 4 GB or better.</p> <p>(viii) Hard drive : 500 GB or higher</p> <p>(ix) Cache : 6 Mb or better</p> <p>(x) Floppy drive : 3½"</p> <p>(xi) DVD Drive : DVD Read & Write with Dual Layer for both EWS & OWS</p> <p>(xii) Audio controller : 16-bit</p> </div>		


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 387 of 718
<div style="display: flex; justify-content: space-between;"> <div style="width: 20%;"> <p>(b) Monitor</p> <p>(c) Key Board</p> </div> <div style="width: 80%;"> <p>(xiii) Operating system : Window NT or Better</p> <p>(xiv) Graphic accelerator : 2 GB or better</p> <p>(xv) Communication ports : 04 nos. (min.) with serial port & 04 nos. (min.) with parallel port (USB)</p> <p>(i) Type : TFT colour monitor</p> <p>(ii) Screen diagonal : 24" flat</p> <p>(iii) Display : XGA or better</p> <p>(iv) Resolution : 1024 X 768 or better</p> <p>(v) Degree of protection : IP-30</p> <p>(vi) External Controls : Brightness, contrast, Horizontal / Vertical amplification & shift</p> <p>(vii) Power supply : 240 V, 50 Hz, 1 phase</p> <p>(viii) Ambient temperature : 0-50 °C</p> <p>(ix) Humidity : 95% non-condensing.</p> <p>(x) Version : To suit industrial application.</p> <p>(i) Type : Flat spill proof membrane type or Positive depression type.</p> <p>(ii) Different keys : – Soft and user defined function keys for software/programming including text correction, scan rate alteration,</p> </div> </div>		


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 388 of 718
		
6.18 <u>OPTICAL FIBER CABLE</u>		
6.18.1	This specification defines the minimum general requirements for the Design, manufacture, supply, inspection, installation, testing & commissioning of optical fiber cables and accessories, such as fiber distribution (patch) panels, adapters, connectors, joint boxes, pigtails and other components, as required to complete the system. Bidder shall consider all related activities, such as cable stripping, cable entry in boxes and panels, cable fiber splicing/fusion, cable performance testing and other services, to achieve a properly documented and operational cable network.	


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 389 of 718
<p>6.18.2 Fiber Optic Cables shall be installed on cable tray, duct bank, cable trench, as necessary. For outdoor applications the cable shall be armoured with Poly Ethylene sheathing. Cable shall be routed through suitable grade permanently lubricated HDPE protection pipe as per IS 4984, IS 12235 & TEC.G/CDS-08/01of suitable size @ 53% fill factor.</p> <p>6.18.3 The Optical Fiber core shall be of ultra pure fused silica glass coated with UV-cured acrylate suitable to withstand temperature of about 80°C (continuous).</p> <p>6.18.4 Fiber optic cable shall be of loose tube design. Typically, fibers shall be housed in-groups of 6 (minimum) within gel-filled buffer tubes to protect against ingress of moisture and vibration. The tubes shall be manufactured with industry standard material like Poly-Butelene Terathylate (PBT). They shall be colour for easy identification. Buffer tubes shall be approachable with industry standard tools and practices. The buffer tubes shall be stranded around the Central Strength Member utilizing Reverse Oscillating Lay (ROL). Blank fillers shall be used as necessary to maintain circular cable structure. Cable shall withstand water penetration when tested with a one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for one hour. No water shall leak through the open cable end.</p> <p>6.18.5 The central strength member of the cable shall be Fiberglass Reinforced Plastic (FRP) or other material with equivalent mechanical strength to provide both tensile and anti buckling strength to the cable.</p> <p>6.18.6 In addition to central strength member, additional strengthening substance like aramid yarns shall be helically applied over the cable core to provide additional tensile strength to the cable.</p> <p>6.18.7 The cable shall be of dual jacket & armoured. Inner sheath consists of a medium density polyethylene (MDPE) jacket extruded over the cable core. Two highly visible ripcords are placed under the jacket to aid in sheath removal. A co-polymer coated steel tape is corrugated and wrapped around the inner jacket to provide additional cable compression strength and rodent protection. The armour is covered with an outer black FRLS MDPE</p>		


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 390 of 718
<p>jacket. A ripcord is also placed underneath the armour for easy outer jacket removal.</p>		
6.18.8	Minimum bending radius shall be equal or more to 15 D. A continuous strength member shall be provided for the entire length of the cables. Every tube and fiber shall be colour coded to provide easy identification. The outer sheath shall be marked to show fiber type and cable classification at suitable intervals.	
6.18.9	Entire length of the cable shall be marked with the following at regular intervals:	
	(a) Manufacturer’s Name	
	(b) Month and year of manufacturer	
	(c) Coded description of the cable based on Telcordia’s (Bellcore) SR-2014 Suggested Optical Cable Code (SOCC).	
	(d) Sheath Identification Number	
	(e) Sequential Length Marking in meter	
	(f) A Telephone Handset symbol to distinguish communication from power cable as per NESC section –35 G.	
6.18.10	Fiber optic cable shall provide a long life expectancy of minimum 25 years and shall meet the industrial standard of continuous operation at temperature of 55 °C and humidity to 100% without degradation to optical or mechanical performance.	
6.19	<u>OPTICAL FIBER USED IN THE PLANT SHALL GENERALLY CONFORM TO THE FOLLOWING SPECIFICATION.</u>	
	SPECIFICATION FOR G.652 MONOMODE FIBER	
	ATTRIBUTES	VALUE
	(a) Cladding Diameter	125 m 1.0 m


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	Section – 5	
REV: R0	CONTROL & INSTRUMENTATION	Page 391 of 718
<p>(b) Cladding non-circularity $\leq 1.0\%$</p> <p>(c) Attenuation Coefficient at</p> <p>(i) 1290 nm to 1340 nm $< 0.36 \text{ dB/km}$</p> <p>(ii) 1525 nm to 1575 nm $< 0.25 \text{ dB/km}$</p> <p>(d) Chromatic Dispersion Coefficient at</p> <p>(i) 1310 nm $< 3.5 \text{ ps/nm.km}$</p> <p>(ii) 1550 nm $< 18 \text{ ps/nm}$</p> <p>(e) Polarization Mode Dispersion (PMD) $< 0.5 \text{ ps/ km}$</p> <p>(f) Mode Field Diameter at</p> <p>(i) 1310 nm 9.2 0.4 m</p> <p>(ii) 1550 nm 10.50 1.0 m</p> <p>(g) Mode Field Concentricity Error $\leq 0.5 \text{ m}$</p> <p>(h) Proof Test $\geq 1\%$</p> <p>(i) Fiber Curl (ROC) $\geq 4.0 \text{ m}$</p> <p>(j) Macro-bend Test on Fiber at 1550 nm $\leq 0.1 \text{ dB}$</p>		
6.20	<u>CABLE ASSEMBLY</u>	
6.20.1	Optical Fiber Environmental Splice Enclosure <p>Optical fiber environmental splice joint enclosures shall be re-enterable and rack/wall mountable. The interior splice case shall be equipped to mechanically accommodate single-mode optical fibers connected by the fusion method. Splice case shall be equipped to organize the splice trays and the required service loops of buffered incoming optical fibers and outgoing 'pigtailed' in such a way that allows each completed splice and associated optical fiber to be maintained in an unstrained configuration. Splice enclosure shall be dust and weather proof.</p>	


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 392 of 718
6.20.2	<p>Fiber Optic Distribution Patch Panel</p> <p>Fiber optic distribution panels shall be provided as required. Fiber optic distribution panels shall be of a standard wall mounted sheet metal enclosure type. Fiber optic distribution panels shall be equipped to secure optical fiber patch cables and pigtails to prevent damage during all operation and maintenance functions. In general splice enclosure are envisaged. However, if no optical fiber splice enclosures are implemented, than the fiber optic distribution panels shall be equipped with splice trays for storage and protection of fusion splice connections of single-mode fiber optic cable and pigtails. Each fiber optic distribution panel shall be fully equipped with 'S' type bulkhead connector sleeves or equivalent. Unused sleeve ports shall be equipped with reusable caps to prevent the intrusion of dust.</p>	
6.20.3	<p>Pigtail and Patch Cord</p> <p>All pigtails shall be factory SC-connectorized, and satisfy specified performance for optical links. All unused pigtails (including spares) shall be terminated with the connector to a bulkhead connector sleeve, protected by a reusable cap on the opposite sleeve port, to prevent the intrusion of foreign material or dust. All necessary connector pigtails shall be provided in the lengths required.</p>	
6.21	<p><u>FIBER OPTIC TOOL KIT</u></p>	
6.21.1	<p>Optical Time Domain Reflectometer</p>	
	<p>(a) A recording optical time domain reflecto meter (OTDR) will be utilized to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall be equipped with data storage, printer, help feature, compare trace features and OTDR software. The data storage unit must include a built-in floppy disk drive capable of storing a minimum of 100 test traces.</p>	
	<p>(b) Data traces saved to disk shall include the following labels:</p>	
	<p>(i) Fiber Identification (ID) with a minimum of 10 characters</p>	


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 393 of 718
<p>(ii) Cable ID with a minimum of 10 characters</p> <p>(iii) OTDR location with a minimum of 20 characters</p> <p>(iv) Far End location with a minimum of 20 characters</p> <p>(v) Test Operator initials with a minimum of 3 characters</p> <p>(c) The printer shall preferably be internal. The printer shall be able to print data traces within 30 seconds or less. The machine settings used to repeat tests at a later time shall include: index, range, wavelength, average time, pulse width and scale settings. The test results (on printout) shall provide information including: loss, distance, reflectance, date and time.</p> <p>(d) The requirements for the compare trace feature include the ability to recall two historical traces from a diskette and display them simultaneously for analysis and printing. The compare trace must compute and display a single graph representing any differences between two traces. The compare trace must be able to recall historical traces from a diskette and perform the same tests on connected live fibers. The compare trace shall perform a two point loss measurement test for any two particular fibers in a comparison analysis. The losses between the two points on each fiber shall be displayed, and the differences between the two readings clearly shown.</p> <p>(e) The OTDR must be equipped with software to support all of the required functions. The software shall provide for printing of whole set of traces (batch print) with minimal commands eliminating the time spent for printing traces individually.</p> <p>(f) Contractor shall provide all mounting accessories, cables and connectors required to establish data communication.</p> <p>6.21.2 Fiber Optic Splicer, Terminator And Tool Kit Box</p> <p>Bidder shall provide new unused tools comprise of Splicer and Fusion Joiner and tool kit comprise of cutter, stripper, polishing tool, handheld</p>		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 394 of 718
<p>microscope, heat shrinkable sleeve, scissor, knife etc. as required for maintenance and commissioning.</p> <p>6.22 <u>TESTS</u></p> <p>Following minimum test as per any approved standards shall be carried out on the cables:</p> <ul style="list-style-type: none"> (a) Attenuation And Dispersion Characteristics Tests (b) Proof Tests (c) Macro-Bend Resistance Test (d) Mechanical Tests (e) Low And High Temperature Cable Bend Test (f) Impact Resistance Test (g) Compressive Strength Test (h) Tensile Strength Test (i) Cable Twist Test (j) Cable Cyclic Flexing Test (k) Environmental Characteristics Test (l) Temperature Cycling Test (m) Colour Permanence Test (n) Cable Aging Test (o) Water Penetration Test (p) Lightning Test 		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 395 of 718
<p>(q) Routine Test/Sample Test</p> <p>(r) Site Test (Like Continuity & Attenuation)</p>		
7.0	<u>DCS HARDWARE & SOFTWARE SPECIFICATION</u>	
7.1	This section generally describes the hardware and the software features of the DCS System. Modules shall be environmentally ruggedized and tropicalised	
7.2	<p>Bidder shall furnish information of the system not be limited to the following:</p> <p>(a) System architecture and BOM to establish completeness of supply.</p> <p>(b) Write up and catalogues.</p> <p>(c) Expected duty cycle of each controller with the proposed assignments.</p> <p>(d) Capacity (baud rate) of each level of highway and expected data traffic at each level under normal and worst-case situations.</p> <p>(e) Failure analysis of the complete system detailing the MTBF and MTTR. The analysis shall be projected to system availability computation.</p> <p>(f) Spare capacity in respect of controller, IO modules, network, operator station.</p> <p>(g) Number of displays and logs offered.</p> <p>(h) Response time from initiation to execution of a command.</p> <p>(i) System auto start up and initialization time.</p> <p>(j) Operating limit of temperature, humidity, voltage, frequency of the system/modules, susceptibility to contaminants in the ambient etc.</p>	

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 396 of 718
<p>(k) Hot repairing of modules.</p> <p>7.3 <u>HARDWARE SPECIFICATION</u></p> <p>7.3.1 System Cabinet</p> <p>General specification for panel and cabinets described elsewhere in this volume shall apply.</p> <p>(a) The electronic modules located within Operator's terminal shall be completely enclosed type for protection from dust and/or mechanical damage.</p> <p>(b) Electronic cards and modules located in cubicles shall be neatly arranged in sub-racks. Each racks shall have power supply modules catering to the cards mounted in the sub racks.</p> <p>(c) The modules shall be arranged logically and sequentially in the sub-racks. Modules associated with a closed loop/open loop controller viz. input cards, output cards etc. shall be housed together with the corresponding controller in the same cabinet.</p> <p>(d) If, after housing a controller with associated cards in a sub rack 25 % or less card slots are left vacant, the same shall not be used to accommodate any card related to any other system. Adjacent slots to dissipative cards shall be left vacant for proper cooling air circulation within the panels. For future modification 10% spare module slots shall be provided to accommodate 10% spare modules specified elsewhere in this volume.</p> <p>(e) If cards related to a particular controller spill over beyond one sub rack at least 4 cards slots shall be kept vacant before cards related to other systems can be placed in the sub rack. Vacant slots shall be covered with blank plates.</p> <p>(f) Cards, in a sub rack, shall be uniformly grouped, type-wise and functionality wise.</p>		


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 397 of 718


7.3.2 Termination & Relay Cabinet

- (a) Incoming cables originating from beyond the control room and control equipment room area shall be routed through the termination cabinets (TC) located in control equipment room except for the cases like special cables, network /highway cables, thermocouple cables where standard termination concepts are not applicable.
- (b) Termination cabinets shall be free standing, closed type, bottom entry, front and rear accessible cabinets with terminal blocks arranged in vertical rows on side walls and partition walls. Panels shall be provided with internal illumination operated through door switch. Adequate area shall be provided for glanding field cables.
- (c) In no case the number of terminal blocks accommodated in each section shall exceed 1000. Terminal blocks shall preferably be arranged in four vertical rows in two sidewalls with two sets of cable troughs (one for incoming and one for outgoing) arranged on two sides of the terminal block. At least 20% terminal blocks shall be left as spare. This shall be in addition to the terminal blocks for 20% wired channel.
- (d) Troughs shall be slotted PVC type. The gland plate shall be removable and shall be in sections. Signals of different voltage levels shall be clearly segregated by providing separate rows to each type of signal and by using terminal blocks of different color for each type of signal and by providing barrier strips between them.
- (e) Terminal assignment in the termination cabinet will be such that cables originating from a field junction box shall be terminated in one termination cabinet only. This will facilitate use of multi-core cable for field wiring. For each incoming cable an additional terminal block shall be provided adjacent to signal wire termination point for termination and continuation of cable screen.
- (f) Relay used for interfacing with other system shall be modular, plug in type and provided with snap on transparent cover. Rating shall be of 24V DC and shall have at least 2 changeover contacts. All contacts


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 398 of 718
<p>of the relay shall be terminated in terminal blocks. Each relay shall be provided with “Coil on” indication LED and coil protection diode. At least 10% of installed capacity shall be kept as spares.</p> <p>Panel specification is described elsewhere in this volume.</p> <p>7.3.3 Printed Circuit Cards</p> <ul style="list-style-type: none"> (a) Printed Circuit cards shall be suitable for operation at 50 °C (maximum) and 95% RH (non-condensing) ambient condition. (b) Card failure status shall be indicated in the module front panel. (c) Cards/module shall be polarized to eliminate possibility of wrong insertion. (d) Similar and interchangeable cards may be marked similarly. (e) Modules shall be replaceable from front and hot replaceable. (f) On-card volatile memory shall be battery backed for at least 90 days. (g) All Printed Circuit card connectors shall be gold plated. <p>7.3.4 General - Input/Output Interface For DCS</p> <p>All cards shall be in standard 19" sub rack format with the following features.</p> <ul style="list-style-type: none"> (a) Modules shall be available to accept all required signal levels and all module should reject the common mode voltages that might appear between sensor ground and A-D converter ground. (b) Manual adjustment or calibrations should be minimized by automatic calibration, automatic zeroing and automatic ranging. (c) Modules shall be designed in a manner, to prevent damage or maloperation if installed in wrong cage slot. 		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 399 of 718
<p>(d) Fuses shall be accessible for inspection and replacement from front without removing the module from service.</p> <p>(e) Isolation of 1500 V AC in between inputs and outputs.</p> <p>7.3.5 Process Interface Modules of DCS (Analog/Binary Modules)</p> <p>(a) The process interface section of DCS shall comprise of various signal interface modules. I/O processing shall be totally independent of control processing so that IO scan rates are independent of controller loading. Interface modules shall be intelligent and shall form common IO bus connected to the controller/s they are catering to. Generally the following types of modules shall be included:</p> <p>(i) High level analog input modules.</p> <p>(ii) Low level analog input modules.</p> <p>(iii) Binary input modules (Fast & Slow scan).</p> <p>(iv) Pulse input modules.</p> <p>(v) SMART transmitter interface modules.</p> <p>(vi) Modbus & other serial modules.</p> <p>(vii) Analog output modules.</p> <p>(viii) Binary output modules.</p> <p>(b) Function performed by the input & output modules shall not be limited to the following:</p> <p>(i) Digital outputs shall be short circuit proof and overcurrent protected.</p> <p>(ii) Analog modules shall scan and acquire data with time stamping.</p>		


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 400 of 718
<p>(iii) Data validation check and quality tagging.</p> <p>(iv) Generation of interrupts and error code.</p> <p>(v) Data processing like linearization, A/D conversion, multiplexing, noise filtration, Engineering Unit conversion, limit value detection etc.</p> <p>(vi) Extensive self check & diagnostics with reporting at MMI. Diagnostic, communication and status lamps at module front.</p> <p>(vii) Automatic start up.</p> <p>(viii) Automatic calibration of analog input modules during start up and periodic to compensate temperature effect.</p> <p>(ix) Calibration of analog output modules during start up.</p> <p>(x) Contact interrogation and transmitter power supply shall generally be 24V DC unless the system design calls for other voltage level like 48V DC.</p> <p>(c) Spare requirement</p> <p>Bidder shall provide at least 20% or minimum two numbers, whichever is higher, spare channels as hot on rail spares in each configured IO modules. In addition to this 10% or minimum one number, whichever is higher, extra assigned complete spare IO modules mounted on rails in sub racks as hot on rail spare for each category of installed IO modules shall also be provided. Spare modules shall be distributed over each controller group. Spare channel and modules shall be fully wired upto termination cabinets.</p> <p>7.3.6 Controller</p> <p>(a) Type : Microprocessor based, multi-loop and multi-function.</p>		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 401 of 718
<p>(b) Number of loops/ Controller : 40</p> <p>(c) Word length : 32 bits</p> <p>(d) Register add cycle time : 1 microsecond</p> <p>(e) Instruction cycle time : 75 microseconds (maximum)</p> <p>(f) I/O address capability : 256 points (minimum)</p> <p>(g) Memory : RAM 256 MB (Battery backup) or better.</p> <p>(h) Redundancy Supported : Yes</p> <p>(i) Switch over time : 5 milli sec.</p> <p>(j) Power supply : 24 V D.C /5V DC as required.</p> <p>(k) Mounting : Sub-rack</p> <p>(l) Configuration : From hand-held station through front plug and from Engineering Terminal.</p> <p>(m) Diagnostics : Invalid command checking, (Automatic periodic illegal address detection, routine check and memory parity check, watch dog report to engineering terminal) time - out checking, processor status display LED, processor fault.</p> <p>(n) Indication : Processor status and fault display.</p> <p>(o) Features : (i) Power fail hold.</p> <p style="padding-left: 150px;">(ii) Automatic restoration on power.</p>		

CONSULTANT : PROCON ENGINEERS


 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 402 of 718

7.3.7 Operator's & Engineering Station


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

CONSULTANT : PROCON ENGINEERS


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	Section – 5	
REV: R0	CONTROL & INSTRUMENTATION	Page 404 of 718
<p>keys.</p> <p>g. Setting change keys.</p> <p>h. Print-out command keys.</p> <p>i. Other keys as required to operate the system.</p> <p>(iii) Key lock Lockable type push button mounted on keyboard.</p> <p>(iv) Life Expectancy : 50 million cycles per key.</p> <p>(v) Version : To suit industrial application.</p> <p>(d) Laser Printer</p> <p>(i) Type Electro-photographic laser, tabletop.</p> <p>(ii) Printer Memory 256 MB (min.)</p> <p>(iii) Speed Monochrome 24 ppm - A4 Color 6 ppm - A4.</p> <p>(iv) Resolution 1200 x 1200 DPI in color.</p> <p>(v) No. of color (Basic) 4 (four) minimum.</p> <p>(vi) Duty cycle Monochrome 75000 pages / month.</p> <p>(vii) Power supply 240 V, 50 Hz, 1 phase.</p> <p>(viii) Ambient temperature 0-50 °C</p> <p>(ix) Humidity 95% non-condensing.</p> <p>(x) Size of paper Letter, A4, Legal, Ledger, A3</p> <p>(xi) Print media Plain paper, transparencies, thick stock, glossy stock, envelopes.</p>		


CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 405 of 718
<p>(xii) Accessories</p> <ul style="list-style-type: none"> a. Adapters b. Connector Cable c. Multiplexer switch (4 point) 		
<p>7.3.8 Stackable Managed Switch</p> <p>DCS data highway shall be of high speed Ethernet and full duplex configuration. Network shall be built on the Stackable Managed Ethernet switches for better control of data traffic & performance and future expansion. Switch configuration shall be redundant with seamless changeover without any upset in the process or equipment. Failure reporting shall be available at HMI. MTBF of the switch shall be more than 20 Years. Configuration shall be automatic.</p>		
<p>7.3.9 Furniture</p> <p>Bidder shall include a complete set of furniture for the Control Room, auxiliary plant control room and computer Room of ergonomic design from reputed manufacturer especially designed for computer peripherals. The set of furniture shall include but not be limited to control desk, chair, printer table, computer tables etc, all necessary furniture for Computer Room peripherals, cabinets for storage of manuals/booklets/recorder charts, storage racks for special tools/diskettes and Shift Charge Engineer's desk/chair/side rack etc.</p>		
<p>7.4 <u>SOFTWARE SPECIFICATION</u></p>		
<p>7.4.1 General</p> <p>The system shall utilize a readily upgradeable, public domain software platform proven for real-time operation environment at the control and monitoring level overlaid with a relational database program. The desirable features are enumerated below.</p> <p>The operating system shall be suitable for real-time operation both at process as well as HMI end.</p>		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	Section – 5	
REV: R0	CONTROL & INSTRUMENTATION	Page 406 of 718
<p>(a) The software system shall be fully modular.</p> <p>(b) The software shall meet the following general requirements.</p> <p>(i) Simple, easy-to-learn language for editing and on-line operation.</p> <p>(ii) Wide range of peripheral support.</p> <p>(iii) Effective task scheduling and support of multiple priority structure including event based interrupt etc.</p> <p>(iv) Effective debugging.</p> <p>(v) Provision for on-line editing and program development without interrupting on-line functions.</p> <p>(vi) Self-diagnostic routines.</p> <p>(vii) Efficient memory management and effective utilization of system time.</p> <p>(viii) Quick start-up and loading.</p> <p>(ix) Support of multiprogramming and multi-user operation.</p> <p>7.4.2 Memory Management/Operating System</p> <p>(a) The main memory capacity shall be adequate to minimize swapping.</p> <p>(b) Individual task shall reside in partitions, which can be split into sub-partition for parallel task handling.</p> <p>(c) The operating system shall automatically perform housekeeping functions including file management.</p> <p>(d) Task swapping shall be dynamic.</p>		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 407 of 718
<p>(e) Programs called frequently or requiring rapid access shall remain as resident in main memory.</p> <p>(f) Individual program partitions shall be suitably linked.</p> <p>7.4.3 Device Support</p> <p>The operating system shall support the following devices.</p> <p>(a) Floppy/CD R/RW /DVD R/RW/Pen drives.</p> <p>(b) Magnetic tape (if necessary).</p> <p>(c) Monitors.</p> <p>(d) Printer, key board ,mouse/trackball.</p> <p>(e) Random Access Memories.</p> <p>(f) Communication interface (10/100 Base-T Ethernet , TCP/IP etc.)</p> <p>(g) Controller and other 32 bit systems</p> <p>(h) DVD Writer etc.</p> <p>7.4.4 I/O Management</p> <p>The I/O Management system shall have the following features.</p> <p>(a) Device independent address processing.</p> <p>(b) Peripheral diagnostic.</p> <p>(c) Retransmission on request.</p> <p>(d) Exclusive, shared and priority mode of device assignment.</p> <p>(e) Flagging of device failure, etc.</p>		

CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 408 of 718
<p>7.4.5 Program Development and System Generation</p> <p>The operator shall have the flexibility to customize or develop program to suit the system requirement.</p> <ul style="list-style-type: none"> (a) The system generation shall be on-line without interruption to the program under processing. (b) It shall be possible to introduce new programs dynamically. (c) The program development system may include its own assembler, editor, loader etc. (d) The program development process shall be conversational and shall reject faulty or erroneous entry with proper flagging. (e) New programs shall be automatically integrated into the system by interfacing with existing programs. <p>7.4.6 Power Failure Restart</p> <ul style="list-style-type: none"> (a) I/O transfer stoppage shall not be abrupt. (b) Provision shall be there for manual restart and auto-restart on resumption of power supply. (c) In case of power failure interrupt the boxing-up sub-routine shall be automatically initiated. (d) In case of power failure, all data including register content, volatile memory content etc. shall be transferred to the bulk memory. (e) The program status shall be latched. (f) On resumption of supply. registers shall be loaded and programs shall start from the status where they were latched earlier. 		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 409 of 718

7.4.7 Check Routines & System Failure

On-line diagnostic routine shall be run continuously or periodically, as applicable. Detected failures shall be displayed in monitor & printer. The following checks shall be performed.

- (a) Peripheral failure.
- (b) Memory Failure/Error.
- (c) Parity Error, Interrupt Error.
- (d) Program Hang-up.
- (e) Power Supply Failure.
- (f) Module Failure.
- (g) Interface Failure.
- (h) SC/OC failure.
- (i) Controller Failure.
- (j) Highway failure and communication failure etc.
- (k) Failure shall lead to graceful degradation of the system.


7.4.8 Database and Database Management

Data shall be keyboard addressable. It shall be safe-guarded against unwanted and unauthorized manipulation of data.


The database management system shall have the following salient features.

- (a) Open to integrate third party software program, Modular expandability, dynamic partitioning.
- (b) Sequential and random access to data and files.


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 410 of 718
<div data-bbox="402 352 1382 604"> <p>(c) It shall be possible to update, display, dump (selectively), create, search data by simple keyboard entries.</p> <p>(d) The editing language shall be simple and easy-to-learn type, requiring no detailed programming.</p> <p>(e) Easy to install through windows procedure.</p> </div> <div data-bbox="261 642 613 678"> <p>7.4.9 Utility Programs</p> </div> <div data-bbox="402 716 1382 894"> <p>The utility program shall constitute a modular system. The priority status of lengthy routines shall be as low as to be interrupted from operator's terminal. Individual functions in the routine shall be amendable. Provision shall be there to initiate utility program from user programs. Broadly, the system shall perform the following functions by utility requests.</p> </div> <div data-bbox="402 932 1097 1549"> <p>(a) Selective dumping.</p> <p>(b) Dump memory (file to file or file to peripheral).</p> <p>(c) Execute a program selectively.</p> <p>(d) Tracing and break-pointing errors.</p> <p>(e) List debug commands and error messages.</p> <p>(f) Change debug input devices.</p> <p>(g) Operation on octal or hexadecimal numbers.</p> <p>(h) Memory search by interactive editor.</p> <p>(i) Reschedule job priorities, etc.</p> </div> <div data-bbox="261 1587 714 1623"> <p>7.4.10 Programming Language</p> </div> <div data-bbox="402 1661 1382 1761"> <p>The programming languages shall support Relational Data Base Management in a global and truly distributed Client-Server environment and shall have the following minimum features.</p> </div>		


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 411 of 718
<div style="margin-left: 40px;"> <p>(a) Modern high-level block structures type.</p> <p>(b) Powerful, compact syntax.</p> <p>(c) Logical organization that facilitates documentation, modification and maintenance of programs.</p> <p>(d) Early detection of errors at compile and run time.</p> <p>(e) Fast debugging.</p> <p>(f) Improved program reliability.</p> <p>(g) Clearly defined data structure complemented by flexible user-declared data types.</p> <p>(h) Fast execution.</p> </div> <p>7.4.11 Editing Functions</p> <div style="margin-left: 40px;"> <p>(a) The following editing functions shall be performed on the variable via on-line database editor. The editing of an access to the database shall be by simple English like easy-to-learn language.</p> <p>(b) For analogue inputs the variables shall have different scan rate, linearization options, software filtering option etc. and can be assigned externally via the keyboard.</p> <div style="margin-left: 40px;"> <p>(i) Assigning scan frequencies.</p> <p>(ii) Continuous scan and store in working/main memory and display or print-out on demand. Changing the scanning rate for trend display.</p> <p>(iii) Continuous scan, store and printout of values at a specified interval as routine.</p> <p>(iv) Execute immediate scan for a specified interval with or without display and/or print-out.</p> </div> </div>		


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 412 of 718
<p>(v) Assign abbreviated engineering unit in display and print-out along with absolute value.</p> <p>(vi) Assign Hi and Lo alarm limits.</p> <p>(vii) Assign Hi and Lo transducer range limits.</p> <p>(viii) Points to be deleted from and restored to scan status.</p> <p>(ix) Check whether the variable is within a specified limit and at a slow scan rate and immediate restoration of storage status at a higher scan rate in case of anomaly.</p> <p>(x) Specify individual coded sub-routines, which shall be executed when any alarm or return-to-normal message occurs.</p> <p>(xi) Define time averaging of analog inputs.</p> <p>(xii) Assign significant change/increment alarm limits.</p> <p>(xiii) Assign alarm dead bands.</p> <p>(xiv) Assign rate of change alarm limits and dead-bands.</p> <p>(xv) Provision to specify software filtering constant individually.</p> <p>(xvi) Linearization routines by polynomial approximation with specified or adaptive coefficients up to 5th order.</p> <p>(xvii) Assign an alphanumeric point value to each analog input and each calculated point.</p> <p>(xviii) Rounding-off facility when fed to MONITOR, graphic or digital display units.</p> <p>(xix) Serial tabulations on demand in time sequence with HH :MM :SS tag.</p>		


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 413 of 718
<p>(xx) Storage of maximum and minimum value amongst specified values or within a specified interval of time.</p> <p>8.0 <u>ROTATING MACHINE CONDITION MONITORING SYSTEM (RMCMS)</u></p> <p>8.1 RMCMS shall acquire data related to the mechanical health of rotating equipment, perform analysis in a proven software platform and display vibration and other machine data for Turbine, Generator & exciter, BFP drive turbine & pump and all HT motor & their driven equipment like Motor driven Boiler Feed pump & motor, Condensate Extraction Pumps & motors, Circulating cooling water pumps for condenser cooling & motors, Auxiliary cooling water Pumps & motors, ID fans & motors, FD fans & motors, PA fans & motors, Coal Mills motors, Boiler circulation water pumps & motors etc. during all regimes of operation. System shall be proven and from latest product range of the manufacturer.</p> <p>8.2 There shall be hardwired data exchange from RMCMS to DCS for display, trending, alarming and interlocking/protection. Similarly there shall also exchange of process data from DCS to RMCMS for analysis.</p> <p>8.3 The system shall have the following sub systems :</p> <ul style="list-style-type: none"> (a) Field Transducers. (b) Data acquisition, condition management and display. (c) On line Machinery Protection and Monitoring. (d) Automated machine diagnostic with decision support system. (e) Data Interface with DCS. <p>8.4 The system shall be complete with sensors, proximeters, monitors, relay modules, networking hardware, machinery condition management server, dual redundant power supplies, special cables etc.</p> <p>8.5 In all cases vibration shall be measured in both X-Y direction alongwith key phasor for phase reference.</p>		


CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 414 of 718
8.6	The system shall have feature to bypass a relay contact in the event of sensors/proximeters failure.	
8.7	In all cases power supply modules and incoming power feeders shall be dual.	
8.8	Critical measurement shall be in 2 of 3, 2 of 2 or 1 of 2 as per the requirement.	
8.9	Similarly, critical alarm & trip relay output shall be configured in 2 of 3, 2 of 2 or 1 of 2 voting logic as required for the machine criticality.	
8.10	Contact of alarm & trip relays shall be hardwired to the respective control system.	
8.11	Each trip channel shall be configured in separate modules to avoid single failure.	
8.12	Analog output to DCS shall be in the form of isolated 4-20 mA DC and contact output shall be potential free.	
8.13	Following type of transducers shall in generally be used	
	(a) For Steam turbine	:
	(i) Shaft Vibration	: Non contact proximity transducers with mounting position reference to the bearing.
	(ii) Bearing pedestal Vibration	: Seismic vibration transducers with mounting position close to shaft vibration transducers.
	(iii) Key phasor	: Non-contact type proximity transducers for phase reference.
	(iv) Axial Thrust position	: Non-contact type proximity transducers for observing the axial position of rotor.


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 415 of 718
<p>(v) Differential expansion : Non-contact type proximity transducers to observe the differential expansion of HP / IP / LP turbine.</p> <p>(vi) Eccentricity : Non-contact type proximity transducers to observe rotor bow.</p> <p>(vii) Speed & overspeed : Non-contact type proximity transducers to observe the speed of the turbine.</p> <p>(viii) Case Expansion : LVDT type transducers.</p> <p>(b) For Generator & Exciter :</p> <p>(i) Shaft Vibration : Non contact proximity transducers with mounting position referenced to the bearing.</p> <p>(ii) Bearing pedestal Vibration : Seismic vibration transducers with mounting position as close as shaft vibration transducers.</p> <p>Bidder shall refer to section-3B of this volume for measurement detail of Turbine & Generator and BFP steam turbine.</p> <p>(c) For other machines with Journal & Thrust bearing:-</p> <p>(i) Bearing pedestal Vibration : Seismic vibration transducers.</p> <p>(ii) Key phasor Speed : Non-contact type proximity transducers for once per revolution phase reference measurement.</p> <p>(iii) Axial Thrust position : Non-contact type proximity transducers for observing the axial position of rotor with respect to thrust bearing.</p> <p>(iv) Gearbox vibration : Seismic vibration transducers.</p>		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 416 of 718
<p>8.14 Transducer data Interface and the machine monitoring & protection subsystem shall be a complete programmable on-line real time system. It shall be capable of collecting data from machine transducers and from other external devices such as DCS and shall provide it to Condition Monitoring System to assess machine condition.</p> <ul style="list-style-type: none"> (a) The system shall comprise of standard instrument rack mounted in panel, dual power supply modules, monitoring modules, relay modules, interface modules, communication modules and required software. (b) Communication module shall be connected to external machine condition monitoring server for configuration of monitor modules, relay modules and to monitor static & dynamic data. Data shall be transferred with high integrity and without any loss of data. (c) Hard key shall be provided to prevent unauthorized access to the system configuration. (d) Sequence of event and machine data shall be archived in the system for long term storage. (e) Communication processor shall be capable of collecting data better than once per second. (f) System shall be time synchronized with the GPS clock. (g) Removal & replacement of module shall be possible to carry out in system power on condition. (h) It shall be possible to test all the monitors in the rack. The trip and alarm relay shall be automatically bypassed during testing to prevent alarm and trip. (i) 24" TFT colour monitor & colour laser printer for system configuration, graphic, local display of data, local alarm, system & machine diagnostic shall provided. 		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	Section – 5	
REV: R0	CONTROL & INSTRUMENTATION	Page 417 of 718
<p>(j) All racks shall be connected in a network and some of the racks shall be located in remote location such as at CW pump house area. Networking shall be made through optic fiber cable & ethernet data highway cable.</p> <p>(k) Input supply to the system shall only be taken from the UPS system in the nearby area.</p> <p>(l) System shall be capable of operating from 0 to 50 °C and at 95% non-condensing moisture.</p> <p>(m) Panels in off site area shall be fitted with local air conditioner if the area is not air conditioned.</p> <p>(n) Sensors shall be dust proof & weather proof rated to IP-65 and suitable for work in harsh environment.</p> <p>(o) Sensors, proximitors and monitors shall be fully compliant to API.</p> <p>8.15 <u>MONITOR RACKS/CABINET</u></p> <p>8.15.1 System mounting racks shall be furnished to house monitor modules, indicating/display units, power supplies, test and calibration equipment. Grouping of modules in racks shall be equipment wise. The mounting racks shall be fully factory wired</p> <p>8.15.2 The front of each mounting rack shall house a monitor test-switch, test condition indicating lamp and power on indication lamp.</p> <p>8.15.3 Each vibration monitor and mounting rack shall have nameplate engraved to indicate the main equipment to which the module is catering and the bearing details.</p> <p>8.16 <u>LOW NOISE CABLE AND CABLE CONDUIT</u></p> <p>8.16.1 Each transducer shall be furnished with flexible conduit and low noise cable. conduit fittings shall be furnished for connection to transducer. The other end of the flexible conduit will be connected to a suitable junction box.</p>		


CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 418 of 718
8.16.2	Junction box shall be corrosion, dust & weather proof rated to IP 65.	
8.17	<u>MACHINE CONDITION MONITORING STATION:</u>	
8.17.1	System shall be knowledge based and guide the maintenance engineer & operator to detect the fault and to take corrective action. System shall have the software for Configuration, Data Acquisition, Open Database like SQL and display builder etc.	
8.17.2	Machine Condition Monitoring server shall be capable of running several software on single platform and interfacing with multiple machinery protection racks using Ethernet communication link. Configuration and downloading of programs for different modules shall be executable from this server with at least two levels password protection.	
8.17.3	The system shall generate easy to use custom rules. The system shall be developed with automated advisory capability of the system. Rule generator shall reject any rule, which is not syntactically correct.	
8.17.4	Bidder shall supply licensed version of all the applicable softwares in run & edit mode for the system and for integration of his system with third party device.	
8.17.5	Features provided in the system shall not be limited to the following:	
	(a) Bar graph and point display indicating the setpoints.	
	(b) Graphical plant and machine area presentation with location of sensors and their current value.	
	(c) Diagnostic of the system and machine data.	
	(d) Current and history trend.	
	(e) Spectral band and waveform plotting.	
	(f) Multiple trends display including process value for data correlation.	
	(g) Orbit and time base plotting.	


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	Section – 5	
REV: R0	CONTROL & INSTRUMENTATION	Page 419 of 718
<p>(h) Shaft centerline plot indicating position of a machine rotor.</p> <p>(i) Bode and polar plot.</p> <p>(j) Automatic auditing of the equipment health upon alarm/periodical /on request. The audit shall guide the operator regarding location of fault, type of fault, severity of the fault, time of occurrence and recommended actions. As a minimum, malfunctions like Shaft bow, high vibration, rotor rubbing, high runout, loose rotating parts etc shall be provided. The system shall have the facility to take a backup of the malfunction for future use.</p> <p>(k) Date & Time stamped alarm list.</p> <p>(l) Log & Report generation.</p> <p>(m) Provision for beeping icon in case of appearance of alarm.</p> <p>(n) Duplex redundant communication link with the DCS shall be provided.</p> <p>(o) Electronic documentation.</p>		
<div style="border: 1px dashed red; padding: 5px;"> <p>8.18 <u>SPECIAL TOOLS & TACKLE</u></p> </div>		
<p>8.18.1 A Portable data collector shall be provided for taking periodic collection of non critical machine data. Machine condition monitoring system shall be capable to analyze the data. Instrument shall be microprocessor based and ready for use in harsh environment. Integral LCD display shall provide the necessary display of readings & spectral data. Minimum 02 channels along with additional input for phase reference measurement shall be available with the instrument</p>		
<p>8.18.2 A Portable data collector shall be provided for taking periodic collection of non critical machine data. Machine condition monitoring system shall be capable to analyze the data. Instrument shall be microprocessor based and ready for use in harsh environment. Integral LCD display shall provide the necessary display of readings & spectral data. Minimum 02 channels along</p>		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 420 of 718
<p>with additional input for phase reference measurement shall be available with the instrument.</p>		
8.18.3	Instrument shall include necessary accelerometers and other devices with accessories for collection of machine parameters. A long life Plante battery pack shall be used. Replacement of battery shall not lead to loss of stored data.	
8.18.4	Shaker table shall be provided for testing & calibration.	
9.0	<u>PLANT-WIDE NETWORK</u>	
9.1	A plant wide Fiber-optic 100 Mbps/ 1 GBPS high-speed backbone has been envisaged. Said network shall be used by different users of the plant for over viewing selective Plant Graphics & data, historical data & trends and MIS reports such as Plant Generation, Unit Heat rate, Auxiliary Power consumption, DM make up water consumption, Coal/Oil stock & consumption etc. and other day to day online maintenance, Inventory & purchase related functions.	
9.2	Web based & HTML compatible servers shall be provided for Management Information System. These shall provide necessary resources to different workgroups/users in the plant. Work group shall also have the access to e-mail & Internet.	
9.3	A Router with firewall shall be provided on the network for remote access of data from Corporate office/remote location and for e-mail & Internet connectivity. A leased line shall be provided by Owner for the same.	
9.4	Bidder shall consider a Fiber-optic network spread over the entire plant covering the Unit control rooms, GM office (Located outside the plant), GS office & Technical Building (Located close to power house), CHP control room, CHP maintenance Building, Stores, DM plant, AHP control room and Switchyard Control room etc. for accessing MIS functions.	
9.5	Bidder shall provide required PCs with colour ink jet printers, router, switches, OFC cable, optical patch cord, transceiver, connectors, couplers, network switch enclosure, UPS, network server, UTP cabling, computer furniture etc. as required for completeness of the system.	


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 421 of 718
9.6	Bidder shall provide one PC and printer at owner's head quarter and shall be hooked up with plant local area network via dial-up connection.	
9.7	Bidder shall consider licensed version of required software for complete functioning of the network and PCs.	
9.8	Required computer furniture for servers, PC & printers as required shall be furnished.	
9.9	Specification of PC	
	(a) CPU	: 2 nd generation core i5 or better
	(b) Type	: Tower
	(c) Main Memory	: 4 GB or better
	(d) Drives	: 3½" Floppy drive and CD ROM.
	(e) Hard Disk	: 500 GB or higher
	(f) Monitor	: 24" colour TFT.
	(g) Communication port	: 2 serial plus one parallel, 2 USB.
	(h) Expansion slot	: 5
	(i) Connectivity	: Ethernet LAN
	(j) Operating system	: Windows XP or higher.
	(k) Softwares	: Latest version of MS office, Client's Software and other softwares as required.
	(l) Features	: 101 keys keyboard and mouse.
	(m) Accessories	: Furniture, Mouse pad.


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 422 of 718
10.0	<u>CONTROL & INSTRUMENTATION CABLE</u>	
10.1	Cables shall be flame retardant low smoke (FRLS) type. In hazardous areas cables of suitable R/L ratio shall be provided for intrinsic safety.	
10.2	Durable marking shall be provided on the surface of the cable at intervals not exceeding 5 mtrs. Marking shall include Manufacturer's name, Year of manufacture, Voltage grade, Type of cables (Conductor size & no. of pairs/triads/type of compensating /extension cable), Insulation material, FRLS etc. Sequential length marking shall also be provided at every meter interval on outer sheath of cable.	
10.3	Standard seasoned wooden drum containing minimum 500 /1000 M \pm 5% length. Drum shall be anti rodent, anti termite and smooth finish. Both end of cable shall be capped by means of non hygroscopic sealing material.	
10.4	<u>THERMOCOUPLE EXTENSION & COMPENSATING CABLE</u>	
	(a) Conductor	: Solid conductor.
	(b) Conductor size	: 16 AWG (1.31 Sq. mm)
	(c) Type	: KX (Extension) (Chromel Alumel) RX (Compensating) (Copper-Copper alloy) JX (Extension) (Iron Constantan).
	(d) Conductor Insulation	: HR PVC Type-C (IS-5831,1984) 0.6 mm thick.
	(e) Operating Voltage	: 300V /500V RMS (Core to earth / core to core).
	(f) Twisting	: Pair twisted with lay of 60 mm (max)
	(g) Twisting Direction	: All pairs in the same direction. Lapped to form bunch with mylar tape.


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 423 of 718
<p>(h) Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28 μm (min.) for individual pair screen and 60 μm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire.</p> <p>(i) Drain wire : Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands/size:- 7/0.3mm)</p> <p>(j) Inner Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 Thickness as per IS-1554Part-I 1976.</p> <p>(k) Rip Cord : Non metallic under sheath.</p> <p>(l) Armouring : GI wire/strip as per IS 3975.</p> <p>(m) Outer Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 Thickness as per IS-1554Part-I 1976.</p> <p>(n) Filler : Non hygroscopic with FRLS property.</p> <p>(o) Temperature Range : Up to 85 °C.</p> <p>(p) Insulation at 20⁰ C : 100 MOhms/Km [Min].</p> <p>(q) Capacitance at 800 Hz : 120 nf/km.</p>		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 424 of 718
<p>(r) Cross talk : 60 dB.</p> <p>(s) Attenuation : 1.2 dB/Km</p> <p>(t) Codes & Standards : IEC 332-1. ANSI MC 96.1. IS-8784-1987.</p> <p>(u) Tests</p> <p>(i) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)</p> <p>(ii) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I</p> <p>(iii) Temp Index : Min 250 DEG C at 21 Oxy. Ind. (ASTM-D-2863)</p> <p>(iv) Smoke Density Rating : Max.60% (ASTM-D-2843).</p> <p>(v) Flammability Test : as per IEC 332 Part-I/IEEE-383 Swedish Chimney Test - SS-424-1475 F3.</p> <p>(vi) High voltage test Core to core- 1.5 kV for 1 min. Core to screen-1.0 kV for 1 min.</p> <p>(vii) Insulation Resistance 100 M Ohm/Km Min.</p> <p>(viii) Rodent & Termite repulsion test (Presence of lead shall be confirmed)</p>		

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 425 of 718

- (v) Conductor material & sheath color for thermocouple cable as per ANSI MC 96.1.


CABLE TYPE	OVERALL SHEATH COLOR	WIRE	SHEATH COLOR	CONDUCTOR MATERIAL
KX	Yellow	Positive	Yellow	Nickel / Chromium
		Negative	Red	Nickel / Aluminum
JX	Black	Positive	White	Iron
		Negative	Red	Constantan
RX	Green	Positive	Black	Copper
		Negative	Red	Copper Nickel Alloy

- (w) Durable printed or embossed numbering at regular interval of 50mm shall be provided for identification of pairs.


10.5 INSTRUMENTATION MULTI PAIRED SIGNAL CABLE

- (a) Conductor type : Stranded (7) annealed tinned copper.
- (b) Conductor size : 0.5/1.0/1.5 Sq.mm. (as required)
- (c) Conductor resistance : 39 Ω /Km/18 Ω /Km/12 Ω /Km.
- (d) Conductor Insulation : HR PVC Type-C (IS-5831,1984) 0.6 mm thick.
- (e) Operating Voltage : 300/500V RMS. (Core to earth/core to core)
- (f) Twisting : Twin twisted with lay of 60 mm.


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	Section – 5	
REV: R0	CONTROL & INSTRUMENTATION	Page 426 of 718
<p>(g) Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape.</p> <p>(h) Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28 μm (min.) for individual pair screen and 60 μm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire.</p> <p>(i) Analog signals- Individual pair & overall shield to be considered.</p> <p>(ii) Binary signals- overall shield to be considered.</p> <p>(i) Drain wire : Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm)</p> <p>(j) Inner Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)</p> <p>HR PVC Type ST2 of IS-5831,1984</p> <p>Thickness as per IS-1554, Part-I 1976</p> <p>(k) Rip Cord : Non metallic under sheath.</p> <p>(l) Armouring : GI wire/strip as per IS 3975</p> <p>(m) Outer Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties).</p>		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 427 of 718
<p>HR PVC Type ST2 of IS-5831,1984.</p> <p>Thickness as per IS-1554, Part-I 1976.</p> <p>(n) Filler : Non hygroscopic with FRLS property.</p> <p>(o) Temperature Range : 85 °C.</p> <p>(p) Insulation at 20 : 100 MOhms/Km [Min] Deg.C</p> <p>(q) Capacitance at 800 : 120 nf/km Hz</p> <p>(r) Cross talk : 60 dB.</p> <p>(s) Attenuation : 1.2 dB/Km.</p> <p>(t) Codes & Standards : (i) IPCEA-S-61-402. (ii) BS 5308. (iii) IEC 332-1. (iv) ASTM-B-33. (v) IS-8130-1984. (vi) IS 1554 Part-1. (vii) IS 10810.</p> <p>(u) Sheath color : Inner- Black and Outer- Gray.</p> <p>(v) Tests (i) Oxygen Index: Min.29 at room temp. (ASTM-D-2863). (ii) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I. (iii) Temp Index: Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863).</p>		

CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	Section – 5	
REV: R0	CONTROL & INSTRUMENTATION	Page 428 of 718

(iv) Smoke Density Rating: Max.60% (ASTM-D-2843).

(v) Flammability Test : as per IEC 332 Part-I.

(vi) Swedish Chimney Test-SS-424-1475 F3.

(vii) Insulation Resistance 100 M Ohm / Km Min.

(viii) High voltage test

Core to core- 1.5 kV for 1 min.


Core to screen- 1.0 kV for 1 min.

(ix) Rodent & Termite repulsion test (Presence of lead shall be confirmed).


(w) Colour of core for Instrumentation Cable (As per IS-9938)

PAIR	CORE	COLOR
1 st	1 st	Blue
1 st	2 nd	Red
2 nd	1 st	Gray
2 nd	2 nd	Yellow
3 rd	1 st	Green
3 rd	2 nd	Brown
4 th	1 st	White
4 th	2 nd	Black


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 429 of 718
<p>Above 4 Pairs, 4 Pairs making a unit shall have indelible printed colour coded bands like Pink for 1st unit, Orange for 2nd unit and Violet for 3rd unit and so on. In addition band marking, for example single band for 1st. unit, double band for 2nd. unit and so on, shall be provided on each conductor for identification of unit. Band marking on individual core shall be provided at regular intervals not exceeding 50 mm.</p> <p>10.6 Cables near high temperature zone shall be capable of withstanding high temperature and terminated in junction box / panel in normal temperature zone. Teflon insulated and sheathed thermocouple extension cables and copper conductor cables shall be used in high temperature zone. Conductor and sheath shall be extruded FEP (Teflon) as per VDE 0207 Part 6 and ASTM D 2116. These cables shall be pair, multipair, triad, multitriad and twisted & shielded.</p> <p>10.7 <u>CONTROL & POWER CABLE</u></p> <p>Bidder shall refer to Volume IVB of the electrical specification for detail.</p> <p>11.0 <u>ERECTION HARDWARE</u></p> <p>This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument.</p> <p>11.1 <u>ELECTRICAL ACCESSORIES</u></p> <p>Electrical conduit and associated materials shall conform to the requirements of the articles which follow:</p> <p>(a) Rigid Steel Conduit</p> <p>(i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.</p> <p>(ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.</p>		


CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 430 of 718
<p>(iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.</p> <p>(iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.</p> <p>(b) Flexible Conduit</p> <p>(i) Flexible conduit shall be of three-layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.</p> <p>(ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/ Sq. cm and temperature up to 200 °C.</p> <p>(c) Special Fittings</p> <p>(i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.</p> <p>(ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.</p>		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 431 of 718
11.1.1 Electrical Junction Box		
(a) Type of Enclosure : Dust tight & weatherproof conforming to IP 65.		
(b) Material : 3 mm sheet steel		
(c) Type of Cover : Solid unhinged with retention chain.		
(d) Paint : External - RAL 7032, Internal – Brilliant White.		
(e) Mounting : Surface		
(f) Cable Entry : 3 mm (min) Gland plate		
(g) Gasket : Neoprene		
(h) Grounding : Brass earth lug with green screw head External-2 nos , Internal-1no.M6.		
(i) Number of Drain Holes : Two at bottom capped.		
(j) Identification : Label for JB and Tags for cable.		
(k) Accessories : (i) Rail mounted cage clamp type screwless terminals with markers.		
: (ii) Cable gland		
: (iii) Ferrules		
: (iv) Canopy at top		
11.1.2 Cable Gland		
(a) Type : Double compression		
(b) Entry Thread : NPT		


CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 432 of 718
<p>(c) Material : Brass</p> <p>(d) Finish : Cadmium Plated</p> <p>(e) Protection : IP 54 or better</p> <p>(f) Accessories : Neoprene gasket, locknuts, reducers etc.</p>		
<p>11.1.3 Cable Tray</p> <p>(a) Material : Mild steel, slotted</p> <p>(b) Thickness : not less than 2.0 mm</p> <p>(c) Finish : Hot dip galvanized</p> <p>(d) Perforation : As per MFR standard</p> <p>(e) Cover : Suitable for tray</p>		
<p>11.2 <u>PROCESS HOOK UP ACCESSORIES & SPECIFICATION</u></p> <p>Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for owner's approval.</p>		
<p>11.2.1 Seamless Stainless Steel Pipe</p> <p>(a) Reference : ASTM A-312 TP 316</p> <p>(b) Material Grade : TP 316</p> <p>(c) Type : Seamless /Plain end</p> <p>(d) Size : ½" NB</p> <p>(e) Schedule : 40</p> <p>(f) Standard Length : 5 meter</p>		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 433 of 718
11.2.2 Stainless Steel Pipe Fittings		
(a) Reference	:	ASTM A-182 F 316 / ANSI B16.11
(b) Type	:	Forged
(c) Rating	:	3000 lbs / 6000 lbs / 9000 lbs
(d) Size	:	½" NB
(e) End connection	:	Generally socket weld
(f) Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.
11.2.3 Seamless Stainless Steel Tube		
(a) Reference	:	ASTM A-213 TP 316
(b) Material Grade	:	TP 316
(c) Size	:	½" OD X 2.1 MM Thick
(d) Type	:	Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
(e) Properties	:	The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
(f) Test Pressure	:	400 Kg/Sq. cm (minimum)
(g) Tolerance	:	± 0.13 mm for outside diameter


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 434 of 718
<p style="text-align: right;">± 15 % for wall thickness.</p> <p>(h) Standard Length : 5 meter</p> <p>(i) Test : Flare, Hardness, Ball and Bubble Test.</p> <p>11.2.4 Stainless Steel Tube Fittings</p> <p>(a) Reference : ASTM-A-182</p> <p>(b) Type : Double ferrule double compression.</p> <p>(c) Material : 316 Stainless steel forged.</p> <p>(d) Ferrule : 316 Stainless Steel.</p> <p>(e) Type of Fittings : Male/female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.</p> <p>(f) Size : To suit SS tubing and NPT end connection.</p> <p>11.2.5 C.S. Pipe</p> <p>(a) C.S. Pipe : ASTM-A 106 Gr. C</p> <p>(b) Material : Cold drawn seamless black C.S</p> <p>(c) Type : Seamless/Plain ends.</p> <p>(d) Size : ½" NB</p> <p>(e) Schedule : 80, 160, XXS as required.</p> <p>(f) Standard Length : 6 meter</p>		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 435 of 718
11.2.6 C.S. Pipe Fittings		
(a) Reference	:	ASTM-A 105/ANSI B16.11
(b) Type	:	Forged
(c) Rating	:	3000 lbs/6000 lbs/9000 lbs
(d) Size	:	½" NB
(e) End connection	:	Generally socket weld.
(f) Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.
11.2.7 A.S. Pipe		
(a) Reference	:	ASTM-A 335 P22 AS PER ANSI B 36.10
(b) Material	:	Cold drawn seamless A.S
(c) Type	:	Seamless / Plain ends
(d) Size	:	½" NB
(e) Schedule	:	XXS
(f) Standard Length	:	5 meter
11.2.8 A.S. Pipe Fittings		
(a) Reference	:	ASTM-A 182 F22 AS PER ANSI B 16.11
(b) Type	:	Forged
(c) Rating	:	9000 lbs
(d) Size	:	½" NB


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 436 of 718
<p>(e) End connection : Generally socket weld</p> <p>(f) Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.</p> <p>11.2.9 Carbon Steel Globe Valve</p> <p>(a) Reference : ASTM A-105</p> <p>(b) Type : Globe</p> <p>(c) Construction : Forged Body Cadmium Plated.</p> <p>(d) End Connection : ½" Socket Weld</p> <p>(e) Rating : CL. 800 / CL. 2500</p> <p>(f) Material : Body - Carbon steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited</p> <p>(g) Packing : Teflon / Grafoil as required</p> <p>(h) Yoke : ASTM A105</p> <p>(i) Handwheel : Carbon steel</p> <p>(j) Design standard : As per ANSI B 16.34</p> <p>11.2.10 Stainless Steel Globe Valve</p> <p>(a) Reference : ASTM A-182 F316</p> <p>(b) Type : Globe</p> <p>(c) Construction : Forged Body</p> <p>(d) End Connection : Socket Weld</p> <p>(e) Proof Pressure : 400 Kg/Cm2</p> <p>(f) Material : Body - Stainless steel</p>		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 437 of 718
<p>Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited</p> <p>(g) Packing : Teflon as required</p> <p>(h) Yoke : ASTM A182 F316</p> <p>(i) Handwheel : Carbon steel</p> <p>(j) Design standard : As per ANSI B 16.34</p> <p>11.2.11 Alloy Steel Globe Valve</p> <p>(a) Reference : ASTM A-182 F22</p> <p>(b) Type : Globe</p> <p>(c) Construction : Forged Body</p> <p>(d) End Connection : ½" Socket Weld</p> <p>(e) Rating : CL. 2500</p> <p>(f) Material : Body - Alloy steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited</p> <p>(g) Packing : Grafoil as required</p> <p>(h) Yoke : ASTM A182 F22</p> <p>(i) Handwheel : Carbon steel</p> <p>(j) Design standard : As per ANSI B 16.34</p> <p>11.2.12 Condensate Pot</p> <p>(a) Reference : ASTM A182 F22 / ASTM A105</p> <p>(b) Material : Alloy steel/carbon steel as per applicatio</p>		


CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 438 of 718
<p>(c) Construction : Drilled from bar stock</p> <p>(d) End connection : 3 nos. ½" socket weld end</p> <p>(e) Accessories : Vent valves</p> <p>11.2.13 Instrument Valve Manifold</p> <p>(f) Type : (i) Two valve manifold : (ii) Five valve manifold</p> <p>(g) Mounting : Remote 2" Pipe Mounting</p> <p>(h) Construction : Single block (bar stock)</p> <p>(i) Material : Forged body and bonnet AISI 316 stainless steel.</p> <p>(j) Ports : 1/2 " NPT (F)</p> <p>(k) Rating : 420 Kg/Sq. cm at ambient</p> <p>(l) Operating Temperature : (-) 30 to (+) 170 Deg C</p> <p>(m) Packing : PTFE Wafer</p> <p>(n) Seat & Stem : AISI 316 SS</p> <p>(o) Plug : AISI 316 SS free to turn on stem/17-4 PH.</p> <p>(p) Handle Bar : AISI 316 SS</p> <p>(q) Connection : Straight</p> <p>(r) Accessories : (i) Plugs for all ports. : (ii) Mounting Bracket , bolts , nuts.</p>		

CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V	
	Section – 5	
REV: R0	CONTROL & INSTRUMENTATION	Page 439 of 718
11.3 <u>PNEUMATIC HOOK UP ACCESSORIES</u>		
11.3.1 Air Header :		
(a) Technical Particulars	:	For Panel For Field
(b) Material of Construction	:	Stainless steel Stainless steel
(c) Inlet Connection	:	2" NPT (M) 1" NPT (M)
(d) Header Take-off	:	Stainless steel Stainless steel
(e) Take off connection	:	1 / 2" NPT (M) 1 / 2" NPT (M)
(f) Tube Take-off	:	Tube adapter on valve Tube adapter on valve
(g) Drain	:	SS drain valve at lowest point SS drain valves at lowest point
11.3.2 Seamless Stainless Steel Tube		
(a) Reference	ASTM A-269 TP 316	
(b) Material Grade	TP 316	
(c) Size	¼" OD X 0.049" wall thickness.	
(d) Type	Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.	
(e) Properties	The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.	
(f) Test Pressure	400 Kg/Sq. cm	

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 5
REV: R0	CONTROL & INSTRUMENTATION	Page 440 of 718
<p>(g) Tolerance ± 0.13 mm for outside diameter ± 15 % for wall thickness</p> <p>(h) Standard Length 5 meter</p> <p>(i) Test Flare, Hardness, Ball and Bubble Test</p>		
12.0	<u>SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT FOR DCS/PLC AND OTHER SYSTEMS</u>	
12.1	Bidder shall supply a complete set of new, unused and reliable type of special tools and tackle and test equipment which are necessary or convenient for erection, commissioning, maintenance and overhaul of the plant and equipment provided under this specification.	
12.2	The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.	
12.3	Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid.	

CONSULTANT : PROCON ENGINEERS

PRICE FORMAT

SL. NO	MATERIAL CODE	MATERIAL DESCRIPTION	QTY	UOM	RATIO	UNIT PRICE (RS)	TOTAL PRICE (RS)
I	ELBSWLDCS01SU	REDUNDANT DATA CONCENTRATOR SYSTEM FOR BHUSAWAL-SUPPLY	1	LOT	75%		
1	ELBSWLDCS01TG	DATA CONCENTRATOR SYSTEM - MAIN	2	SET			
2	ELBSWLDCS02TG	DATA CONCENTRATOR SYSTEM - STANDBY	2	SET			
3	ELBSWLDCS03TG	DATA CONCENTRATOR PANEL	2	SET			
4	ELBSWLDCS04TG	ETHERNET SWITCH	4	EA			
5	ELBSWLDCS05TG	FOLDABLE MONITOR	2	EA			
6	ELBSWLDCS06TG	KVM SWITCH	2	EA			
7	ELBSWLDCS07TG	EWS	2	EA			
8	ELBSWLDCS08TG	OWS	2	EA			
9	ELBSWLDCS09TG	LAPTOP	1	EA			
10	ELBSWLDCS10TG	PRINTER	2	EA			
11	ELBSWLDCS11TG	GPS CLOCK	1	EA			
12	ELBSWLDCS12TG	MODBUS TO ETHERNET CONVERTER	42	EA			
13	ELBSWLDCS13TG	LIU	40	EA			
14	ELBSWLDCS14TG	FURNITURE FOR EWS	2	EA			
15	ELBSWLDCS15TG	FURNITURE FOR OWS	2	EA			
16	ELBSWLDCS16TG	FURNITURE FOR PRINTER	2	EA			
17	ELBSWLDCS17TG	CHAIRS	4	EA			
18	ELBSWLDCS18TG	CABLE LAYING & TERMINATION	2	LOT			
II	ELBSWLDCS01SE	DATA CONCENTRATOR COMMISSIONING	2	LOT	25%		
1LOT=50% OF ITEMS SUPPLIED ABOVE SHOULD BE COMMISSIONED							
TOTAL PACKAGE COST EXCLUDING FREIGHT AND TAXES					100.00%		

NOTE:

PACKING & FREIGHT EXTRA

TAXES & DUTIES EXTRA

ADD/DEL FOR PR 12303597

SL. NO	DESCRIPTION	QTY	UOM	UNIT PRICE	REMARKS
1	ETHERNET SWITCH	1	EA		
2	FOLDABLE MONITOR	1	EA		
3	KVM SWITCH	1	EA		
4	EWS	1	EA		
5	OWS	1	EA		
6	LAPTOP	1	EA		
7	PRINTER	1	EA		
8	GPS CLOCK	1	EA		
9	MODBUS TO ETHERNET CONVERTER	1	EA		
10	LIU	1	EA		
11	FURNITURE FOR EWS	1	EA		
12	FURNITURE FOR OWS	1	EA		
13	FURNITURE FOR PRINTER	1	EA		
14	CHAIRS	1	EA		
15	CABLE LUGS FOR FO CABLE	1	EA		
16	CABLE LUGS FOR RJ45 CABLE/ ETHERNET CABLE	1	EA		
17	DATA CONCENTRATOR SERVER	1	EA		
18	EWS SERVER	1	EA		
19	EWS MONITOR	1	EA		
20	OWS SERVER	1	EA		
21	OWS MONITOR	1	EA		
22	POWER SUPPLY UNIT FOR DATA CONCENTRATOR PANEL	1	EA		
23	CABLE GLANDS	1	EA		
24	MCB	1	EA		
25	EARTH BUSBAR	1	EA		
26	240V AC TO 220V DC CONVERTER	1	EA		
27	240V AC TO 24V DC CONVERTER	1	EA		
28	SFP FOR ETHERNET SWITCHES	1	EA		
29	ANY OTHER MATERIAL CHARGES, IF VENDOR ANTICIPATES FOR COMPLETION OF PROJECT	1	EA		
30	PER MAN-DAY SERVICE ENGINEER CHARGE	1	DAY		
31	PER VISIT SERVICE ENGINEER CHARGE	1	VISIT		
32	PER MAN-DAY SKILLED TECHNICIAN CHARGE	1	DAY		
33	PER VISIT SKILLED TECHNICIAN CHARGE	1	VISIT		

NOTE:

- 1 PER VISIT SKILLED TECHNICIAN CHARGE = LUMP SUM ALL INCLUSIVE CHARGES PER VISIT FOR SKILLED TECHNICIAN (EXCEPT DAILY CHARGES)
- 2 PER MAN-DAY SKILLED TECHNICIAN CHARGE = LUMP SUM ALL INCLUSIVE DAILY CHARGES FOR SKILLED TECHNICIAN
- 3 PER MAN-DAY SERVICE ENGINEER CHARGE = LUMP SUM ALL INCLUSIVE DAILY CHARGES FOR SERVICE ENGINEER
- 4 PER VISIT SERVICE ENGINEER CHARGE = LUMP SUM ALL INCLUSIVE CHARGES PER VISIT FOR SERVICE ENGINEER (EXCEPT DAILY CHARGES)
- 5 AMOUNT PAYABLE FOR SKILLED TECHNICIAN FOR A VISIT TO SITE WHICH LASTS FOR "N" DAYS = VISIT CHARGES AS PER SL. NO. 33 ABOVE + (DAILY CHARGES AS PER SL. NO. 34 ABOVE X NO. OF DAYS AT SITE "N") (TO BE CERTIFIED BY BHEL SITE)
- 6 AMOUNT PAYABLE FOR SERVICE ENGINEER FOR A VISIT TO SITE WHICH LASTS FOR "N" DAYS = VISIT CHARGES AS PER SL. NO. 31 ABOVE + (DAILY CHARGES AS PER SL. NO. 30 ABOVE X NO. OF DAYS AT SITE "N") (TO BE CERTIFIED BY BHEL SITE)