

CORRIGENDUM – I

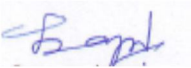
RFQ No. – BSV0000055 dt. 11.02.2020

Item: EPABX System

Projects: Yadadri 5X800MW

Corrigendum is issued for below changes/clarifications –

1. Due date of tender is extended upto **13.00Hrs on 02.03.2020**
2. Technical specification PS4702159 Rev 00 is revised to **PS4702159 Rev 01**. Applicable technical specification for the tender will be **PS4702159 Rev 01** and bidders to submit their offer as per technical specification **PS4702159 Rev 01**. Same is attached.

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COPY RIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited. It must not be used directly or indirectly in anyway detrimental to the interest of the company.		PURCHASE SPECIFICATION OF EPABX SYSTEM FOR 5 x 800 MW NALGONDA-YADRADRI THERMAL POWER STATION			
				REVISION: 01	Approved: Alok Mandal 
			Prepared  Patrali Sanyal	Issued CE-Engg-SCADA	Date 19.02.2020



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REVISION HISTORY SHEET

Rev No	Date	Nature of change	Reason	Prepared By	Approved By
00	24.01.2020	First issue	-	PS	AM
01	19.02.2020	Second issue	CI No. 3.2 (b), 7.5, 15 BOM Table-5 : Item no 1.1.iv, 1.6, 2, 5, 7 revised. Note 2 (1) revised and Note 3 added. (Highlighted in document)	PS	AM



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EPABX SYSTEM FOR NALGONDA-YADADRI THERMAL POWER STATION (5X800 MW)
CUSTOMER: M/s. TELENGANA POWER GENERATION CORPORATION LIMITED (TSGENCO)

1.0 GENERAL

This document covers specifications of EPABX System of Nalgonda-Yadadri Thermal Power Station (5x800 MW for plant wide communication. The detailed specifications of the EPABX system are given in the following sections. The vendor shall be totally responsible for the desired performances of the offered EPABX system including survey, design, engineering, manufacturing, testing, supply, installation and commissioning **(Total Turnkey Project)**.

2.0 DESIGN CRITERIA

A telephone system based on distributed architecture over IP backbone, with Survivable Media gateways located in various buildings over the plant, to form nodes, linked by Optical Fiber Cables shall be supplied. The system shall be of converged IP PBX with both pure IP and TDM capabilities and shall support a combination of IP and TDM client devices as well as any combination of SIP and H.323 or traditional analog or digital trunking.

The proposed IP-PBX shall be fully equipped for E1/PRI or SIP connectivity with PA system etc. and E1/PRI junctions connectivity with BSNL/Telecom Service Provider apart from the connections for proposed shop unit gateways.

The EPABX system shall be placed in the service building. Plant communications shall be extended to the buildings within power plant premises of Nalgonda-Yadadri Thermal Power Station (5x800 MW).

3.0 TECHNICAL SPECIFICATIONS**3.1 General Requirements**

- a. The system shall be based on the IP based telephony (IPT) and shall have capabilities implemented with automatic procedures for re-establishing communications and connectivity in case of major failures.
- b. The system shall have a modular design capable of further expansion. Modularity of the system architecture shall permit block-by-block addition of nodes and clients consistent with the progress of the project to assume the full functional form at the completion of the works.
- c. The system shall be capable of supporting analog telephones. The system shall support Fax-over-IP transmission and legacy fax services.
- d. The system software shall be protected against data loss/corruption in the event of power failure, unauthorized command or other faulty conditions.
- e. The system shall be designed to provide voice and video services.
- f. Selected users shall be connected to GSM/CDMA gateway at the exchange so that the subscribers can be contacted when they are out of their office, by automatic call diverting.
- g. The system shall support Video Call
- h. Voice conferences which are generally "meet me" conferences at prearranged times. The size of a conference group may be three (3) participants up to thirty (30). A conference participants may be 'listen only' or 'talk and listen' based on preassigned status. Integrated voice recording and logging facilities shall be provided. Feature shall be included to automatically initiate voice conferencing amongst pre-selected groups on emergency events and / or on 'time of the day' basis.
- i. Date, time announcement service or log.
- j. The System shall provide Alerting Services through suitable interface with process control systems, by raising an alerting call at specific handsets, for instance at the Central Control Room and/or Security office to notify of emergency events. Emergency Alerting shall give, via pre-recorded messages, alert and information on serious situations or disasters to specified callers including emergency handling and disaster management groups. Management Alert is used to



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notify participants at pre-defined telephone numbers of serious situations and provide a conference and / or recorded message capability.

- k. The System shall feature one-to-one or one-to-multiple hotline voice communications with facility for immediate calling from a location to another location(s) without dialing.
- l. Interactive voice response capability and directory service shall be supported.

3.2 System Architecture

- a. The system architecture shall be based on ITU-T H.323/3.0 and IETF SIP/2.0/MVCP standards and shall be capable of migration to IPv6.
- b. The system shall be equipped with total **1038 no subscriber line including 638** no analog subscriber lines and 400 no IP lines, expandable up to 1200 lines by addition of suitable hardware and software in future.
- c. The main EPABX and the local survivable media gateway shall be interconnected through a FO cable backbone network.
- d. The TDM telephone sets shall be connected to nodal media gateway equipment through copper cable network and IP phone sets shall be connected to the Ethernet port of the same media gateway or other Ethernet switch.
- e. The nodes shall be connected by 1 GBPS Fiber optic Ethernet LAN. At each of the nodes, field Ethernet switch with fiber and electrical Ethernet interface shall be deployed. The Ethernet port of the field Ethernet switches shall be connected to the OFC backbone and shall comprise the OFC backbone network. The distributed media gateways connected to the Ethernet ports of the field Ethernet switched shall connect the TDM phones. At VoIP server end L3 switch in 1+1 clustering with high availability mode shall be connected to VoIP server. At nodes the Ethernet switches shall be L2 type with fiber and copper.
- f. IP telephone sets shall be connected to Ethernet switch directly over Cat-6 cables. TDM telephones shall be connected via copper cable lines.

3.3 Design Objectives and Performance criteria

- a. The telephone system shall be configured to ensure that the system availability is equal to or greater than 99.99%, with no complete loss of telephone service under any circumstance.
- b. Quality-of-Service supported by the network shall be compliant with the ITU-T Y.1541 recommendation.
- c. System shall guarantee voice and video applications to satisfy the mean delay and jitter values stated for Class-0 QoS :
 - i) Latency below 150 m sec;
 - ii) Jitter below 50 m sec.
- d. The System shall support the following signaling protocols, as a minimum:
 - i) QSIG
 - ii) Q.931
 - iii) SIP/2.0
 - iv) MVCP
- e. The system shall comprise of standard call processing platform of call servers/ gatekeeper servers/ media servers based on industry standard hardware and software. The system shall be based on open standards multimedia communication protocols i.e. SIP. The system shall be configured to support Unix / Linux / Solaris, which is incorporated on open standards. No proprietary operating system shall be used.
- f. Processors and switches in the main exchange shall be configured in dual hot redundant mode (N : N) to avoid any single point of failure. The standby processor shall remain synchronized with the active server and shall be able to take over the database and telephony functions seamlessly in case of failure of active server without disruption of active calls.
- g. In case of catastrophic failure of the exchange, media gateways shall work independently as islanded units to provide telephony services to the extensions (Analog & IP) of their respective plant areas without manual intervention. Media gateways shall work in standalone mode.



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- h. Fault in the network including link failure, switch failure etc. shall be flagged with visual indication to the operator with printing of the same.
- i. The system shall offer BHCC of minimum 3,00,000 to ensure superior traffic handling capacities.
- j. The offered system shall be modular in design. The architecture of IP PBX shall be capable of seamless migration to its maximum capacity by simply adding gateways and peripheral cards on the set of control server without compromising on any functions / features of this system or any degradation of service.
- k. The system shall have universal slot architecture for maintaining flexibility in assigning any peripheral cards to any slots.
- l. At the time of failure of the main exchange, media gateways at different locations shall function amongst the IP and TDM telephone sets. Switch back from survivable media gateways to main exchange shall be automatic on recovery, without manual intervention.
- m. Once main call server fails, entire system (users of Media Gateway) shall not be affected & there shall not any feature limitation i.e. they shall get all the features which are permissible over IP backbone.
- n. The system shall be configured to support interfacing with audio conferencing system at Plant central exchange on SIP trunks in case of external appliance based server.
- o. The equipment shall be capable of supporting standard telephone instruments from any manufacturers. Not only basic voice-communication shall be supported, but also evolved services like multi-party, video, instant-messaging, as a minimum, shall be operational when a selection of COTS IP telephone sets are used.
- p. The System shall be designed with the focus on security issues. Security shall be guaranteed with a solution based on, as a minimum, IPsec Policy, SSL, TSL and firewall. All necessary means to preserve confidentiality, authentication and integrity shall be evaluated. Procedures for user's authentication, authorization, and accounting shall be deployed for this purpose.
- q. The System shall be provided with installed capacity to accommodate a 20% expansion.
- r. Configuration of the system shall be achieved by software for maximum flexibility. A "user friendly" setting up and checking routine shall be provided which enables an operator using a PC to implement speed commissioning and fault finding functions. The use of these methods shall allow adjustments to be easily made when the system is installed without resulting in modifications to the system wiring. The system shall be provided with standard serial interface (preferably a USB connection) to be connected with a laptop for local and remote access for maintenance and operations activities. One Notebook PC shall be provided for these functions.
- s. All software utilized shall be the latest and upgraded version.
- t. The server shall be designed to comply with EMI and RFI Regulations particularly the requirements of IEC 61000 series.
- u. The system shall be specifically designed for life safety application and shall be of proven design. The equipment shall comply with latest electromagnetic compatibility directives 89/336 EEC and shall also comply with the low voltage directive. The equipment shall be manufactured by a BSI accredited ISO 9001 certified company.
- v. Serial Communications
Since communication to the system microprocessor is via an RS 232 serial data port (by USB is preferred), it shall be able to be used to give remote control and/or remote display. Accommodation of additional serial interfaces is to be achieved by use of additional serial interface modules.
- w. Software
The software shall be "User Friendly", for easy re-configuration, maintenance and future expansions. The software shall be able to work with the latest windows version.
- x. Multiple Sources of Speech
Announcements shall be able to be made from a variety of sources such as the engineers test panel, operator access panels, telephones via PABX units, radio units or digitally recorded messages.
- y. Interface with PA System etc.



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The VOIP Server shall have the provision of an interface to the telephone system to enable users to broadcast routine speech announcements from telephones assigned the correct class-of-service. Facilities shall be included to prevent acoustic feedback that may be generated from telephones situated close to loud-speakers. The IP PBX shall have the facility to be interfaced with GPS clock for Time Synchronization (preferably IP based GPS interface i.e. SNTP etc)

3.4 EPABX Communication server

- a. The Communication Server as would be deployed in a resilient (both hardware and software resiliency) manner over the distributed IP Infrastructure (LAN / WAN), shall form part of the IP PBX infrastructure.
- b. The communication server shall be based on either a 32 bit or 64 bit computing platform wherein the operating platform shall be based on open standards (LINUX, UNIX, SOLARIS).
- c. The server shall constitute of at least 2 GB RAM expandable up to 6 GB as would be necessary for concurrent system CPU processes during operation of the system for the scope of maximum capacity.
- d. The server shall have dual CPU and duplicated memory resources.
- e. The server shall be equipped with duplicated SMPS power supply units.
- f. The server shall have 230/240V AC supply for power supply requirements.
- g. The server shall mandatorily be of a 19" form factor capable of fitting into a standard 19" network enclosure.
- h. The server shall have Dual HDD (min 256 GB) with RAID 1 architecture.
- i. The server shall have four USB ports for modem, flash drive & other connections, two nos GB Ethernet ports.
- j. The communication server shall have IDE CD/DVD-ROM drive or USB drive or Ethernet ports.
- k. The communication server shall have min Two nos GB Ethernet ports.
- l. The equipment shall be of latest configuration at the time of supply.
- m. The communication server shall have an indicator display panel as regards to different operating parameters and status of the server.

3.5 Media Gateway

- a. The Media gateway shall be interoperable with other standard soft switch. The media gateway shall be registered in the soft switch as end equipment which shall cater the VOIP application. The Gateway shall be in distributed architecture for deployment. The Gateways shall communicate with each other through Central call server.
- b. The Media gateway shall be individually survivable within the gateway whereas can be registered to a local call server.
- c. **The media gateway shall be modular in design. Min 2 no additional wired free slots shall be available in each gateway for future expansion.**
- d. **Analog line cards with same port sizing are to be considered for all media gateways.**
- e. In case of failure of central server, the N:N backup redundant server shall take over the Media Gateway seamlessly .
- f. The Media gateway shall support the bellow VOIP functionality :
 - a) SIP Proxy
 - b) SIP 2.0
 - c) G.721 a law and L law 64 Kbps
 - d) G.729 8Kbps
 - e) G.168 LEC 8-32 Millisecond
 - f) T.38 Fax Relay
 - g) Automatic Fax/Modem
 - h) VAD (Voice Activity Detection)
 - i) Comfort Noise Generation (CNG)
 - j) Caller ID
 - k) Call Forward (Unconditional , on Busy, on No answer)



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- l) Call waiting
- m) Call Hold
- n) Message Waiting
- o) 3-Way Call
- p) QOS (Quality of Service)
- q) TCP/UDP/RFC 1144
- r) SNMP V1, V2,V3
- s) TOS
- t) 802.1p priority tagging
- u) WEP,TKIP,WPA,IEEE802.1x and AES
- v) IDS (Intrusion detection system)
- w) L2 and L3 Functionality
- x) VLAN IEEE 1p/Q
- y) RTP/RTCP
- z) TELNET
- aa) IPV4 RFC 791
- bb) ITU G.992.5
- g. The Media gateway shall be in distributed architecture for deployment and installed on each floor preferably. The media gateways shall communicate with each other through Central call server.
- h. In case of failure of central server, the redundant server shall take over the media gateway seamlessly.
- i. The Media gateway shall have redundant power supply.
- j. The Media gateway shall be placed in any geographical locations.
- k. The Media gateway shall handle the call processing locally whereas call process monitored by central server.
- l. The Media gateway shall be on the standard platform to communicate with other vendor make Media gateway seamlessly.
- m. The Media gateway shall be managed centrally or from any location through IP.
- n. The Media gateway shall be operational with any Open standard SIP call server.
- o. The Media gateway shall have minimum 02 Nos. Ethernet port.
- p. The Media gateway shall be security enabled as firewall /NAT.
- q. The Media gateway shall be operational on pure IP backbone to communicate with any other IP media gateway.
- r. The media gateway shall have at least 01 No. WAN port.
- s. The Media gateway shall have different uplink technology, LAN configuration and environmental conditions.
- t. In case of complete cut off from all servers the local media gate way shall act independently for handling internal calls of the area where it is located and shall be further supported by analog CO for junction calls from/to main exchange if it shall become applicable in future.
- u. The media gateways units shall be able to provide hybrid end points i.e. both IP and TDM (analog/digital).
- v. The media gateways shall support DMZ, Access Control List.
- w. The media gateways shall support remote management and configuration.
- x. The media gateways shall support Intrusion Detection System: DoS, Port Scanning and Web Spoofing protection.
- y. The media gateways shall be RoHS compliant.
- z. The media gateways shall have the option to take directly fiber/ copper. (Fiber connection with Fiber module. Fiber module shall be from the Same OEM).
- aa. The media gateways shall have minimum 30 MB of RAM.
- bb. The media gateways shall have minimum 8 MB of Flash- ROM.
- cc. The media gateways shall have the minimum LED indications for Power/System with WAN and LAN link/activity detection.



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- dd. The media gateways shall have the VOIP indication for – ringing / use / activity.
- ee. The media gateways shall support the security features.
- ff. In case of complete cut off from the main & redundant server the local media gate way shall act independently/standalone mode for handling internal calls of the telephone sets which shall be connected to it at the remote location where it is located.
- gg. These units shall be able to provide hybrid end points i.e. both IP and TDM (analog/digital).
- hh. There shall not be any distance limitation on positioning the media gateway. If there is any limitation on distance, Bidder shall mention the same.

3.6 User Feature Requirement Specifications

All the users connected over IP backbone shall avail of the following features along with the detailed sub features as mentioned thereof with no exception.

- a. Call Generation
- b. Call Hold
- c. Call Completion
- d. Ring Generation
- e. 3 way Conference
- f. Universal Numbering plan.
- g. Audio Level
- h. Call Forwarding unconditional
- i. Call Forward on No answer
- j. Call Forward on Busy
- k. T.38 Fax Relay
- l. VAD (Voice Activity Detection)
- m. CNG (Comfort Noise Generation)
- n. Caller ID
- o. Call Waiting
- p. Message waiting
- q. Camp on Busy 18. Camp on Idle
- r. Call Pickup
- s. DID (Direct Inward Dialing)
- t. Hold Retrieve
- u. Speed Dial
- v. Toll restriction
- w. Day Night Scheduling
- x. Call Consultation
- y. Group Pickup
- z. Register
- aa. Speaker ON/OFF
- bb. Specific Trunk Group Seize
- cc. User Location (Country , Time Zone)

4.0 EPABX KEY FEATURES

The server shall provide following features as a part of its telephony functions.

- a. Station Call: User can dial any extension anywhere in plant by dialing simple extension number under unified dialing scheme.
- b. Call Coverage: Min 5 independent coverage paths for various incoming call.
- c. Authorization Codes: 5 digit authorization code to make outgoing calls for ensuring no misuse of the system with enabling / disabling facility to be used by system administrator.
- d. Automatic Call Back: User can register ACB feature to any extension across all locations between main location, back up location, or any other remote gateway of this IP-PBX.
- e. Call Pick-Up: It shall be possible for an extension user to pick-up incoming calls of 6 to talk to each other at the same time on a conference circuit. One of the extension user or by the attendant may set



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up the conference call. This facility would be available throughout the network if more than one EPABX are interconnected in a private network.

- f. Alternate Routing: Automatically re-route calls which encounter a busy trunks on the initial route. Automatic digital translation is carried out by the system. Provides the possibility of reaching external destinations via different routes.
- g. Voice Guided Assistance Announcement System: The system shall be able to provide contextual voice guided assistance with codes in English, Hindi and local languages to all users irrespective of type of phone for all telephone feature like busy extension / trunk, Call Forwarding, Wakeup Alarm/ Registration / Cancellation DID messages, Appointment, Reminder Alarm / Registration / Cancellation, Wrong Dialing of Extensions etc. The system shall support at least 50 such simultaneous callers with recorded voice announcements. The announcements shall be digitized and stored in electronic memory devices. The system shall be able to store minimum of 5 such voice announcements.
- h. Real time Call Detail Recording: The system shall provide detailed call information on all incoming and outgoing calls on specified trunk groups and stations, including those administered for intra switch recordings, and send this information to any serial printer or other CDR security device and PC through the LAN. Call billing application software shall also be loaded which shall provide various types of reports as and when required. Necessary hardware and software if required to be quoted separately. In case the call billing application is offline due to PC failure or any other network related issues the call server shall buffer the CDR's for all incoming and outgoing calls for a minimum duration of last 30 days.
- i. Malicious Call Tracing / Record: Records detailed call information on all incoming calls (trunks & stations) on any station at any point of time. This information can be stored in any file and can be sent to any printer or other CDR security device.
- j. Class of Restriction: Defines different call origination and termination privileges. There shall be support for minimum up to 50 CORs in the system.
- k. Class of Service: Defines whether or not voice terminal users may access the following features and functions: Automatic Callback, Call Forwarding, Call Forward Busy / Don't Answer, Data Privacy, Extended Forwarding, Extended Call Forward Busy / Don't Answer, Priority Calling, Restrict Call Forwarding Off-Net, Personal Station Access, Trunk to Trunk Transfer Restriction Override, Off-Hook Alert & Console Permission.
- l. Direct Inward / outward Dialing: The proposed system must support direct inward/outward dialing to/from external parties with metering facility in Main & other locations.
- m. Direct Inward / Outward Station Access: This feature must be optionally available, allowing an outside caller to access switch features by dialing a special telephone no. Without attendant assistance, it shall permit remote access to the server and long-distance facilities from off premise stations. For security, there shall be the option of turning off this feature.
- n. Auto Attendant: The system shall provide 16 port (apart from the voice mail and DISA ports) multi-level tree based auto attendant to help the callers to reach the desired extensions. The callers shall be given a choice of English, Hindi and & local language. Auto attendant feature shall be provided the system itself and not by any external hardware/server.
- o. Day / Night Trunk Control: To reduce cost and improve system security it shall be possible to restrict the access to certain trunks depending on time of day.
- p. Distinctive Ringing: The system shall provide audibly different ringing patterns between internal, external and special feature calls.
- q. Flexible numbering plan: Support up-to 6 Digit for an extension number & Allow phone number assigned to a station to be changed through software.
- r. Music on Hold: The system must provide music and/or a recorded announcement to callers on hold.
- s. Least Cost Routing: It must be possible to use private networks and alternate public networks from different Service Providers to optimize your communications traffic in terms of both access and cost.
- t. System Traffic Reports: Traffic statistics shall be provided on incoming and outgoing trunk groups, attendant consoles, station hunt groups, and individual stations. The information reported must include the number of calls and call duration. The Bidder must describe the proposed system's traffic reporting capabilities.



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- u. System Abbreviated Dialing: The system shall have the ability to store a list of frequently called numbers that shall be available on a system-wide basis to all users. Bidders must state the capacity limitations of the system including maximum digits per entry.
- v. Uniform Numbering Plan: The system shall permit a uniform numbering plan (Closed Numbering Plan) system, to be used to simplify access to all extensions of different exchanges of the network. The system must be able to implement a uniform numbering plan up to 6 digit extension numbers for all sites. However connectivity to BSNL & other service provider trunk shall be through access code for incoming & outgoing calls.
- w. 6-Party Conferencing: The system must have in-built ability to have conference circuits between minimum 10 nos. of 6 parties and unlimited no. of 3 party conferencing with the conferencing parties being a mix of both internal and external. (This facility is different from multi party audio conference systems).
- x. Automatic Call Distribution: System shall offer In-Built/External Help-Desk software to support Automatic Call Distribution feature for complaint logging/emergency reporting etc.
- y. Multi-Tenant: System shall allow multiple tenants whereby each tenant can be assigned an attendant group for service with each group having its own queue. System shall allow multiple tenants whereby each attendant group can serve more than one tenant. System shall allow multiple tenants whereby each tenant can have a designated night service station and when an attendant group is put into night service, the facilities of each tenant shall go to their night service station. System shall allow multiple tenants whereby each tenant can be assigned a unique source for music that is most appropriate to the business of the tenant, including type of music, special advertisements, and so on to be heard when a call is on hold.
- z. Message Announcement System: This facility shall be available in the system. The system shall announce recorded message / greeting to maximum number of subscriber without any need of switching off exchange. The Bidder shall provide details for it in their offer.
- aa. Automatic Line Testing: The system shall be configured to support testing of line parameters.
- bb. Voice Mail System: The system shall be configured Software based voice mail system. It shall be fully embedded & integrated with the call server without the need of any additional hardware, PC or software. Shall be manageable from the same interface as of IP PBX. It shall be configured for 24 port & 200 Mail Box & expandable up to 500 Voice Mail for all users by addition of suitable hardware and software in future.
- cc. Wake up Call facility / Appointment Reminder: The system shall be configured to support wakeup call/appointment reminder facility (voice prompt) for all users.
- dd. Hotline Facility: Hotline facility between all subscribers shall be possible via system programming.
- ee. Integrated Voice Guidance: The system shall guide users during the various steps needed to activate specific features by means of voice guides that indicate the services available at each stage of a call.
- ff. Fixed-Mobile Interface: The system shall be configured to provide fixed-mobile interface natively on any GSM or CDMA mobile to at least 50 people. The users shall be able to receive and make calls from the mobile phone.
- gg. Programming and Interface: The system functions may be programmed from a variety of external and/or internal sources such as via the connection to a Notebook PC.
Long range remote access which may be used for setting up, fault finding, system parameter changes etc., using the PTT network via V 32 dial up modem is an advantage.
- hh. PABX Interface: This unit is required in order to gain direct access to the PA system via telephones for high priority announcements by such people as supervisors, etc. However, this interface shall need to be reviewed during the incorporation of this facility in future.
- ii. Diagnostics: The system shall have many built in diagnostic features to ensure the integrity of the system on a regular basis. Checks shall include monitoring of audio paths from source to speaker loop, correct functioning of software and status of the duplicate system.



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5.0 SYSTEM POWER SUPPLY

The EPABX system and maintenance & diagnostic station shall be powered from a central UPS system at 240V AC, 50 Hz. A power supply unit shall provide the required low voltage levels to feed the equipment and their stand-by unit.

The distribution board, 3 core- 2.5 sq mm power supply cables and protection device such as MCB etc shall be provided.

6.0 MEAN TIME TO REPAIR (MTTR)

The design and construction of the EPABX system shall ensure high reliability and availability.

The EPABX system shall employ modular constructional techniques in its design.

Allowing a first line maintenance philosophy of module replacement shall be implemented. The average module replacement time for the system is less than 1 hour.

7.0 TECHNICAL DATA OF EPABX AND OTHER ASSOCIATED EQUIPMENT**7.1 EPABX**

- a) EPABX architecture : Distributed type
- b) Code & standard : ITU-T H.323/3.0 and IETF SIP/2.0/MVCP standards and capable of migration to IPv6
- c) Zone Station : Safe Area
- d) Number of Nodes : Six
- e) Node connectivity : 1 GBPS Fiber Optic based LAN
- f) Communication : Intra-site and inter-site voice and video
- g) Interface :
 - Mobile Services through PSTN (external connectivity)
 - Radio System
 - Videoconferencing Terminals
 - Public Address & General Alarm System / Partly-line.
 - The system interface to the telephone system shall be via a 2-wire/4-wire E & M tie-line or SIP channel
- h) Operating Voltage : 240 Volts 50 Hz AC (UPS)
- i) Supporting Signaling protocols :
 - QSIG
 - Q.931
 - SIP
- j) Inter-operability: Capable of full support of telephone instruments from different manufacturers.
- k) Security: IPsec Policy, SSL, TSL and firewall.
- l) Expansion / Support capability : In terms of users, bandwidth and equipment
- m) Serial interface : Preferably a USB connection
- n) Quality-of-service : ITU-T Y.1541 recommendation
- o) Time Synchronization : Required, with Master GPS clock(NTP,SNTP)
- p) Make : Ericsson-Aastra / Alcatel / Unify-Siemens / Tadiran / Avaya / Karel / Matrix /any other make approved by DOT/TEC

7.2 SIP based IP Telephone

- a) 8 line appearance/feature key buttons – with dual LED's (Red, Green)
- b) Backlit display – 3.5" diagonal, 3 rows by 20 characters
- c) Full – duplex speaker phone & Message waiting indication
- d) Four-way navigation cluster button
- e) Volume button- (separate volume levels in the handset , headset, speaker and ringer)
- f) Fixed Button like contacts button, Call Log button, Redial Button, Speaker button, Mute Button, Headset Button, Hold Button, Conference Button, Transfer Button etc.



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- g) Ethernet (10/100) line interface with a secondary 10/100 port for collocated laptop or PC
- h) **PoE** 802.3 of class 2 device, also supports a local power supply
- i) Contacts application – supports up to 100 entries
- j) Call Log – contains last 100 calls
- k) Standards - based codec support : G.711, G.726, G.729 A/B

7.3 TDM Telephone with CLI (Desktop & Wall-mounted)

- a) Last number redial
- b) Manual pause
- c) Dual-tone ringer, volume adjustable in 2 steps (high, low)
- d) Mute
- e) Pulse or tone dialing, temporary Switch-over possible with CLI display.
- f) Memory storage

7.4 Maintenance & Diagnostic station

PC and printer with following specifications shall be provided for Operator console, NMS software, Call billing maintenance, & Diagnostics of EPABX.

Printer: One No dot matrix printer, 24 pin 136 columns, with USB port interface (Epson).

PC: Two nos of computer with minimum Intel i7 processor, 2.4 GHz minimum with latest Intel Chipset (IBM-Lenovo / HP)

- a) Shall operate in non-AC environment of 0-50 Deg C
- b) 230 V /240 V AC single Phase
- c) L2 cache, minimum 512K at full processor speed
- d) RAM 6GB minimum
- e) Min. 1 TB Hard disk drive, USB drive, 52x RW DVD Drive
- f) 21" Color TFT monitor with power saving features
- g) 10/100 BASE-T Ethernet network card.
- h) Minimum Two USB ports
- i) PS2 minimum 104 Keys keyboard
- j) Three button mouse (optical)
- k) 56 KBPS internal modem
- l) Pre-loaded Windows 10 or latest OS release with media, latest antivirus software and other required software/driver
- m) Computer Table & Printer Table [Make: Godrej (Reflex Series), Featherlite (Freedom/Fusion Series), Pyrotech]
- n) Operator chair [Make: Godrej, Featherlite, Pyrotech]

7.5 Industrial grade redundant UPS with redundant battery :

2x5 kVA, Single-phase 0.8 p.f lagging 240V AC, 50 Hz parallel redundant industrial grade UPS guaranteed at 50 deg. C with 5 feeders in each ACDB-1 & ACDB-2.

1 set of online redundant UPS system comprises of minimum of the following:

- i) 100% Capacity Static Inverters (2 nos)
- ii) 100% Capacity Static Switches (2 sets)
- iii) Manual Bypass Switch (1 set)
- iv) Input & Output Isolation Transformers (2 nos)
- v) 100% Capacity float cum boost chargers (2 nos)
- vi) UPS Battery (Lead Acid Plante Battery with accessories with back up time of 1 hour (2 sets)
- vii) Step down transformer 415V, 3 Ph. to 240V, 1 Ph (1 no)
- viii) Servo Controlled Voltage Stabilizer (1 no)
- ix) AC power Distribution boards (5 feeders each) (2nos)
- x) Battery isolation box(housed in UPS panel) (1 set)



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- xi) Battery Health Monitoring System (1 set)
- xii) Special Tools & Tackles (1 set)
- xiii) Tie Isolator between Battery banks (1 set)
- xiv) Accessories of UPS system including suitable interconnection ac/dc power cables, cable glands, lugs, Base Frame, Anti-Vibration Pad, etc (1 set)
- xv) Battery accessories (1 set)

Make : Vertiv Energy, Ambernath / Hitachi-Hirel, Gandhinagar / Keltron, Trivandrum

The panels shall be finished in Opaline Green to Shade 275 of IS:5 (Semi-Glossy) Exterior & Brilliant White (Glossy) Interior with two coats of synthetic enamel paint. The panels shall have a matt finish to prevent any glare from surface due to illumination.

Feeder list

Each ACDB shall comprise of 5 feeders each consisting of Double pole MCB with 2 No fuses (phase & Neutral) and feeder On LED.

Feeder Name	MCB Rating	Fuse Rating	Quantity
Feeder 1 - 3	4A	6A	3
Feeder 4 - 5	6A	10A	2

UPS Battery sizing calculation is to be provided by vendor. The procedure for battery sizing calculation shall be generally as per relevant IEEE, considering design margin as 15% and aging factor as 1.25. The rated ampere hour capacity of the cell/battery shall be at reference temperature of 27°C, constant current discharge at 10 hours rate (C10) for Plante type Battery to meet end cell voltage of the Cell.

7.6 Notebook PC

Notebook PC shall be having Intel i7 processor, 8 GB RAM, 1 TB HDD, DVD R/W, USB ports, min 14 inch display, preloaded with Windows 10, antivirus software & drivers.

7.7 Power Cable

3 core, 2.5 sqmm Power supply cable of any reputed make is to be supplied. Interconnecting power cables shall be heavy duty 1100 volts grade multicore stranded copper conductor, PVC insulated, FRLS, extruded PVC inner sheathed, galvanized round steel wire/ strip armored and extruded PVC overall sheathed conforming to IS:1554 as revised and amended up to date.

7.8 CAT 6 Cable

- a) No of Pairs : 4 Pair
- b) Conductor : Solid tinned copper
- c) Construction Parameters : Values
- d) Nominal DC Resistance : 67 ohms/1km
- e) Nominal Impedance : 100 ohms+/-15 Ohms
- f) Nominal Capacitance : 46 pf/m
- g) Nominal Velocity of Propagation : 68%
- h) Nominal Attention : 100 MHz:- 19.9 dB/100m
155 MHz:- 25.3 dB/100m
200 MHz:- 29.2 dB/100m
- i) Insulation Materials : Poly Vinyl Chloride
- j) Cable Outer Diameter : 0.38 mm+/-0.15 mm
- k) Nominal Outer Diameter : 6.35 mm



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- l) Bend Radius : 0.90" For 6.35 mm
 m) Make : Legrand (LCS2)/Ortronics/ Luscent/ Amp/Avaya/Belden/Digilink/D-link/any other Reputed make)

Cat6 cable shall be Unshielded Twisted Pair (UTP- CAT6 Cable) category 6 LAN (local area network) four pair cable per box (305 mtrs). Blue Colour 23 AWG, which is UL listed, 3P certified and tested, conforming to the following standards in Cat 6 UTP cable like 250 MHz speed, IEC 11 801 edition 2.0, Nominal Velocity Propagation (NVP) 72%, as per EIA/TIA standards and cable laying shall be through the existing MS/PVC conduit or floor raceways including connections etc. as required complete in all respect.

7.9 PoE Based L3 Core Switch : Network Switch

- The vendor shall select the port architecture of switches considering no of fiber optic and CAT-6 terminations from camera ends as well as from PCs and other equipment in line with the system configuration diagram to be submitted along with the offer.
- The Central control switch shall be manageable type with minimum Layer-3 functionality. The switch shall have required nos. of fiber optic (FO)/SFP and RJ-45 port including 20% spare for each type of port. No media converter shall be used for connecting OFC cable to switches. All the switches shall be fed from UPS. The switches shall be **PoE** based.
- All the switches shall operate with wire speed switching on the same Network Management Software and shall have required intelligence and synchronization to control, monitor and maintain the IP network of the EPABX system. It shall be possible to administer all the switches from a pre define PC in the network.
- The switches shall support both ring and star architecture.
- The minimum technical requirement of Central Control switch is given below :

1. Switch type

Layer-3 Switch. 19" Rack Mountable. Min. 24 Nos. 10/100/1000 BaseT (Auto Sensing) ports And Min.12 Nos. free mini SFP/GBIC slot to accommodate 1000 BaseSx / 1000BaseLx Ports upgradeable. Modular support for adding two 10G ports if required in future. All ports shall be switched ports.

2. High Availability

Shall have the Active – Active Clustering technology capability of VSS / equivalent high availability technology to connect the switches with Min bandwidth for connecting 2 or more switches in a single cluster shall be of min 30Gbps or more with no single point of failure , all the required modules / other related cards shall be proposed from day 1 and The VSS or Equivalent technology shall work in Active - Active mode for IP Multicasting traffic as well as Layer-3 Traffic as well In case of VSS or equivalent module failure, the switch shall have the necessary technology to ensure nonet work loop is formed to avoid both chassis forwarding the network traffic

3. Fiber Optic Interface

1 Gbps for Switch to Switch and 100 Mbps for camera direct single mode fiber



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- | | | |
|-----|--|---|
| 4. | Routing | termination.
Support Up to 256K IPv4 routes, 16K MAC, 4K layer 3 interfaces , Up to 1K layer 3 IPv4 multicast groups and IPv6 routing option. Also Support IP routing and RIPv1 and RIPv2, OSPF, ICMP, TCP, ARP, RIP-2 MD5 Authentication, RIPng for IPv6, RIPng Protocol Applicability Statement etc. |
| 5. | Switch fabric | 160 Gbps |
| 6. | Forwarding rate | 100 Mbps |
| 7. | Failover protection through ring redundancy | Supported |
| 8. | Port-based, MAC-based and protocol-based VLANs | Supported |
| 9. | Dynamic VLAN assignment, NAC, BPDU protection, Guest VLAN support, Web-based authentication | Supported |
| 10. | Policy based QoS features, 8 QoS queues per port, IEEE 802.1p Priority Tagging and Highly configurable traffic classification Mixed scheduling, to support complex traffic queuing requirements | Supported |
| 11. | Bootstrap Router for PIMSM, IGMP Proxy, IGMP Snooping, MLD Snooping (v1 and v2), RFC 1112 Host extensions for IP multicasting, RFC 3376 IGMPv3, Internet Group Management Protocol v2 (IGMPv2), Interoperability Rules for Multicast Routing Protocols etc | Supported |
| 12. | SNMPV3, Web based, Telnet, RMON (4 groups) and command Line Interface, Support RFC 2741 Agent Extensibility (AgentX) Protocol and Shall have Gigabit management Port and Back-up SD/NVRAM Port allowing switch firmware, configurations to be stored for backup and distribution to other switches | Supported |
| 13. | Private VLAN to provide security and isolation between switch ports, helping ensure that users cannot snoop on other users' traffic | Supported |
| 14. | The switch shall support Port Mirroring based on port basis / VLAN basis to support intrusion prevention system deployment in | Supported |



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- different VLANs
15. TACACS+ and RADIUS authentication to enable centralized control of the switch and restrict unauthorized users from altering the configuration Supported
 16. MAC address notification to allow administrators to be notified of users added to or removed from the network Supported
 17. Certification UL, cUL, TUV
 18. Power supply 240 VAC 50 Hz UPS supply
 19. Approved make **Hirschmann**

7.10 PoE Based L2 Field Managed Switch (Type-1)

a) The minimum technical requirement of Field switch is given below :

1. Functionality : Minimum Layer-2 manageable type and minimum 8 port 10/100 Mbps port with 2 Nos. SFP FO Port. The switches shall be **PoE** based.
2. Fiber Optic interfaces : 1 Gbps for Switch to Switch direct single mode fiber termination. The fiber ports shall be compatible to the L3/L2 switch
3. Performance : Switching capacity 5Gbps, Mac Address 8K or better, Flash and RAM as per switch. Shall Support Redundant Power option. MTBF Greater than 272,000 hours or better and Power Consumption nominal 8W or better.
4. Minimum Protocol Support : VLAN IEEE 802.1Q, GVRP, Port-based VLAN Redundancy using X-Ring, Dual Homing and Couple Ring, STP, RSTP, IP Access security, port security, DHCP Server, IP Binding per Port, IEEE 802.1x, IGMP Snooping / Query for multicast, Port trunking, Static IEEE 802.1p QoS /CoS /ToS / DSCP priority queuing, 802.3x flow control ,Port Mirroring, LLDP , Real-time trace and Support IEEE 802.3af and switch work on X-Ring Function Etc.
5. Physical : Enclosure IP30, Metal with aluminum shell and this Switch Shall be placed in IP65 encloser.
6. Management : TFTP firmware update, system configure, restore and backup , SNMP v3, Web, Telnet, CLI, Statistic, MAC Address Table, SNTTP, Syslog, E-mail Alert, SNMP Trap, RMON Etc.
7. Environment : Operating Temperature -10 ~ 60oC, Storage Temperature -40 ~ 80°C and Humidity 5 ~ 95% (non-condensing) and Single Mode FO module operating Temperature -5 to 70°C



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8. Safety Standard : UL. FCC, CE , Environment Compliance RoHS compliant and WEEE
 9. Support Shock : IEC60068-2-27, Freefall IEC60068-2-32, Vibration IEC60068-2-6 EN61000-4-2 (ESD), EN61000-4-3 (Radiated RFI), EN6100-4-4 (Burst), EN61000-4-5 (Surge), EN61000-4-6 (Induced RFI) ,EN61000-4-8 (Magnetic Field)
 10. Power Supply : Redundant
 11. Make : **Hirschmann**
- b) All switches shall be provided with surge protective device to withstand surge for each external signal cable, required connectors, trans-receivers, connecting cables etc. as required.
- c) All the switches shall be loaded with the same network management software which shall be administered from a pre-defined PC in the network.
- d) All switches shall be PoE based and shall support both ring and star architecture.

7.11 PoE Based L2 Field Managed Switch (Type-2)

- a) The minimum technical requirement of Field switch is given below :

1. Functionality : Minimum Layer-2 Stackable manage type and minimum 24 port 10/100 Mbps port with 2 Nos. SFP FO Port and 2 Dedicated stacking ports as well come with Stacking cable. The switches shall be **PoE** based.
2. Fiber Optic interfaces : 1 Gbps for Switch to Switch direct single mode fiber termination. The fiber ports shall be compatible to the L2 switch.
3. Performance : Switching capacity 18Gbps, Mac Address 16K or better, Flash and RAM as per switch. Shall have internal Redundant Power option. MTBF Greater than equal to 430,000 hours or better and Power Consumption nominal. 19.5W or better and 10Gbps stacking bandwidth as well Single IP management support.
5. QoS Support : 8 Hardware queues per port, endless rate limiting, DSCP for IP-based QoS, IEEE 802.1p Class of Service with strict and weighted round robin scheduling.
4. Minimum Protocol Support : IEEE 802.3ad LACP - 8 groups, LLDP & LLDP-MED, RSTP, MSTP, DHCP snooping, DHCP option 82, DNS, ICMP. BootP, BPDU guard, Loop guard and Root guard, Broadcast storm control and Port mirroring, EAP, EAP-TLS, LEAP, PEAP, TTLS, NAC, RADIUS Client and RADIUS accounting, IGMPv1 and V2 snooping and IGMPv2 snooping querier, ICMPv6, Static IPv4 routing, RIP V1/V2, Dual-stack IPv4/IPv6 management, Port-based , MAC-Based, Private VLANs.
6. Management : Industry Standard CLI, Web GUI, SNMP V3,



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- encrypted WEB and CLI management with SSH v2 and SSL, RMON 4 Group, Syslog and Event Log, supports Flow or equivalent.
7. Environment : Operating Temperature 0°C to 40°C, Storage temperature: -25°C to 70°C, Operating Humidity 5 ~ 90% (noncondensing) and Single Mode FO module operating Temperature -5 to 70°C
8. Safety Standard : UL. FCC, EN , Environment Compliance RoHS compliant and WEEE compliant and WEEE
9. Support Shock : IEC60068-2-27, Freefall IEC60068-2-32, Vibration IEC60068-2-6 EN61000-4-2 (ESD), EN61000-4-3 (Radiated RFI), EN6100-4-4 (Burst), EN61000-4-5 (Surge), EN61000-4-6 (Induced RFI) , EN61000-4-8 (Magnetic Field)
10. Power Supply input : Redundant
11. Make : **Hirschmann**
- b) All switches shall be provided with surge protective device to withstand surge for each external signal cable, required connectors, trans-receivers, connecting cables etc as required.
- c) All the switches shall be loaded with the same network management software which shall be administered from a pre-defined PC in the network.
- d) All the switches shall be **PoE** based and shall support both ring and star architecture.

7.12 Network Management Software (NMS)

- Automatic topology discovery and creation of network maps for Layer 2 & Layer 3 network
- It shall have high level network inventory polling capability for IP network nodes, all available L2 switch, camera, modules, ports, physical links, VLAN interfaces and all the other SNMP capable devices in the network
- Powerful administration control
- Detailed performance monitoring and management
- Extensive fault management capabilities with real time event and alarm notifications, system logs
- Scheduled device configuration back-up and restore functionality
- Automatic detection of configuration changes for easy troubleshooting
- It shall support 3rd party devices and end points
- It shall have the functionality of group provisioning/scheduled configuration roll out management
- It shall have the ability to perform scheduled or unscheduled network wide software or firmware upgrades
- It shall have ability to customize the NMS dash boards as per the requirements.
- It shall have the ability to perform/create group of devices for applying same task.
- It shall have extensive centralized trouble shooting tools in built.
- It shall provide the flexibility to the network administrator to assign task to an individual network engineer and assign ownership/track the status of the issue resolution
- The NMS solution shall be preferably from the same active switching vendor, in case vendors proposing for 3rd party NMS solution shall provide all the reports certified by both the NMS vendor and active switching vendor on seamless interoperability.

7.13 Main Distribution Frame (MDF), Sub Distribution Frame (SDF) / Junction Boxes (JB) fitted with Krone modules



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- a) The MDFs, SDF/junction boxes shall be sheet steel or die-cast alluminium enclosed, corrosion resistant, dust and weather proof complete in all respects with inspection covers, terminal strips etc. The covers shall be gasketed.
- b) The MDFs shall be installed indoor. The MDFs shall be complete with requisite number of test jack assemblies. All incoming & outgoing telephone cables to/from MDF in the telephone Exchange room for the subject EPABX type exchange shall be terminated on the MDF in Telephone Exchange Room for which suitable connecting facilities shall be provided on the MDF in Telephone Exchange Room.
- c) The Junction boxes shall be of galvanized steel or die-cast aluminium alloy construction. It shall be complete with double compression type cable glands suitable for in & out field cables and earthing stud. It shall be suitable for wall/ column/ structure mounting. The quantity of indoor and outdoor JB's shall be as per requirement.

7.14 Conduits

- a) Conduits shall of PVC, minimum size of conduits shall be limited to 20 mm.
- b) These shall be supplied in standard length with min. wall thickness.
- c) Rigid steel conduits shall be used to draw jelly filled cables that are laid in road-cutting trench, where heavy load movement is envisaged.

7.15 Accessories

- a) **Information Outlet (I/O) of CAT-6 UTP**
Information outlet shall be RJ45 Toolless Information Outlet of CAT-6 UTP with white colour RJ-45 transparent shuttered socket outlets (modular) with all accessories including label holder, both side colour marking as per EIA/TIA standards. conformity of standards like ISO/IEC ed. 2, EN 50173 and EIA/TIA 568 for fast connection socket and it takes fast tool-less connectors with contact marking by double colour code 568A and B and numbers connectors with insulation displacement contact (IDC). It has the possibility of min. 5 times re-wiring in the event of error, multidirectional cable entry. (Make : Legrand (LCS2)/Ortronics/ Luscent/any other reputed make).
- b) **Face Plate (Plastic Modular Face Plate white in Colour 1 Module)**
Face Plate shall be white modular plate type front plate with accessories for 1/2 nos RJ 45 data outlet, but excluding RJ45 data outlet complete in all respect with grid plate, screws, MS box etc with connections as required. (Make : Legrand (LCS2)/Ortronics/ Luscent//any other reputed make).)
- c) **Rack End Patch Cord-1 mtr. Blue in Colour**
The Patch Cord shall be of CAT6 UTP PATCH CORD - 1 MTR (3 feet) Blue Colour factory moulded as per EIA/TIA standards.
(Make : Legrand(LCS2)/Ortronics/ Luscent/any other reputed make).
- d) **End User Site Patch Cord-2 mtr Blue in Colour**
End User Site Patch Cord shall be of CAT6 UTP LSC2 PATCH CORD – 2 MTR (7 feet) Blue Colour factory moulded as per EIA/TIA standards. (Make : Legrand (LCS2)/Ortronics/ Luscent/any other reputed make).
- e) **19" rack mountable 24 Port CAT6 UTP Patch Panel Loaded**
This item shall be 24 port PATCH PANEL RJ-45 Loaded CAT-6 UTP 19" rack mountable patch panel preferably with front loaded 6 in a blocks as per EIA/TIA standards, modular in mechanism. (Make : Legrand (LCS2)/Ortronics/ Luscent/any other reputed make).
- f) **Wall Mounting Rack/cabinet**



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Cabinet shall be of Width (mm)-600 (max), Depth (mm) – 500 (max), height as required. CRCA 'D' Grade thickness (mm) - 1.2, Powder Colour for Cabinet - RAL9002, Glass - 4mm Toughened Tinted Glass Door, Accessories:, Cooling Fan (230V A/C 90 CFM, PDU 230VAC with MCB, Cable Manager Metal, Mounting Hardware, Wall Screws - 1 set, Door Lock, Front Metal Band. In the rack there must be maintained 1U = 1.75 inches space. (All Stand alone rack and server shall have 6A, 220V socket link with UPS line) (Make : Legrand (LCS2) / Ortronics / Rittal /any other reputed make).

g) **Stand alone Rack /Cabinet**

Cabinet shall be of Width (mm) 800 (max), Depth (mm) 800 (max), and height max 42U. CRCA 'D' Grade thickness (mm) 1.2, Powder Colour for Cabinet RAL 9002, Glass: 4mm Toughened Tinted Glass Door, Accessories: Cooling Fan (230V A/C 90 CFM), Cable Manager Metal, PDU 230VAC with MCB, Cable Channel 100mm wide, Heavy Duty Stationary Shelf - 1 No., Mounting Hardware, Earthing Strips, Door Lock, Castor Wheels (with Brake), Castor Wheels (without Brake, Front Metal Band. In the rack there must be maintained 1U = 1.75 inches space. (All Stand alone rack and server shall have 6A, 220V socket link with UPS line) (Make : Legrand (LCS2) / Ortronics / Rittal/any other reputed make)

h) **19" LCS2 Modular LIU-Fiber Optic Drawer-24 Port**

The item shall be Modular fiber optic drawer modular 19"(LIU) 24 port - FIBER OPTIC DRAWER fully loaded with SM SC Pigtail - 9/125 µm for 6 Cr. OFC armoured LCS2 and adapter for 6 OFC SM LCS2 without Blanking plate. All 24 ports of LIUs shall be loaded with 24 pigtails. (Make : Legrand (LCS2) / Ortronics/ Luscent/any other reputed make).

i) **Screened Twisted Pair (STP) Cables**

All the STP cables shall be of Cat.6 variety conforming to ANSI/TIA/EIA 568-B.2-1, 4 pair UL/NEC rated and shall have maximum attenuation of 54.8 dB/100m at 600 MHz. Each pair shall be separately shielded with polyester Aluminium foil.

j) **HDPE pipe**

The HDPE pipe shall be used for laying STP cables in outdoor environment. HDPE pipe shall be permanently lubricated type with ISI marked. The internal diameter of the HDPE pipe shall be suitably selected so that 50% free space is maintained during cable drawing. The pipe shall conform to DOT standard GR/CDS-08/02 Nov. 2004 with latest amendments.

k) **Nameplate**

Nameplates shall be furnished for identification of devices and circuits. All junction boxes, switches, controls and indications shall be permanently and legibly marked in English as to their functions.

l) **Consumables and Hardware**

- a) The contractor shall furnish all consumables, hardware and erection material as required for the complete installation.
- b) These material shall include but not limited to
Consumables: welding rods & gas, oil & grease, cleaning fluids, paints, cotton waste, electrical tape, soldering material etc.
Hardware: bolts, nuts, washers, screws, brackets, supports, hangers, saddles, cleats, clamps etc.
Materials: conduits and accessories, junction boxes, terminal blocks, connections, lugs, ferrules, brass glands, ground wires etc.



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Weather proof telephone is for wall mounting and suitable for outdoor installation. Telephone enclosure shall be made of aluminium alloy casting which has suitable entries for wiring through weather proof cable glands. Gaskets are to be provided for weather proof protection.

Make : Baliga / any other reputed make

8.0 SCOPE OF SUPPLY

Scope of supply shall be as per **BOM Table 5**.

9.0 SPARES

- a) Power supply module - 10% of supplied quantity or one whichever is more
- b) Controller module - 10% of supplied quantity or one whichever is more
- c) Line cards - 10% of supplied quantity or one whichever is more
- d) IP phone - 10% of supplied quantity
- e) Analog desktop phone - 10% of supplied quantity or one whichever is more
- f) Fuses – 120% of supplied quantity

10.0 GROUNDING / EARTHING

All metal enclosures, conduits, junction/pull boxes shall be grounded in compliance with I.E. rules. Separate ground earthing shall be provided for the EPABX system.

11.0 METHODS, MATERIAL AND WORKMANSHIP

All work shall be done in a first class, neat and workmanlike manner by mechanics / electricians skilled in the trade involved.

12.0 ERECTION TOOLS AND TACKLES

The supplier shall arrange all tools, tackle, implements, scaffoldings, ladders etc, which are required for handling and erection of the equipment and materials.

13.0 CLEANING UP OF WORK SITE

- i) The Contractor shall, from time to time, remove all rubbish resulting from execution of his work. No materials shall be stored or placed on passage driveways.
- ii) Upon completion of work, the Contractor shall remove all rubbish, to scaffoldings, temporary structures and surplus materials etc. to leave premises clean and fit for use.

14.0 INSTALLATION AND COMMISSIONING

Erection and commissioning of the Telecommunication equipment (VOIP EPABX Servers, media gateways, Network panels, UPS, MDF, JB's, IP and TDM Telephone instruments etc.) is in the scope of supplier. Supplier has to quote for erection and commissioning of the EPABX system (EPABX Servers, media gateways, Network panels, UPS, Operator Console, Telephones, grounding/ Earthing, MDF, JB's, RB's etc.). Vendor has to supply of all required associated accessories as per Table 3.

The vendor shall perform survey of site for cable routing and estimation after the site is ready. After cable routing and estimation, vendor shall prepare layout and erection drawings showing location of all system equipment & components, cable routing, detailed cable scheduling in cable trays/ racks/ trenches/ buried underground, conduits routing along with distribution schemes of the system. Vendor shall submit the above mentioned drawings to BHEL for approval. Vendor has to do cable terminations of all the telephones to SDF junction boxes. Vendor shall provide identification tags for all junction boxes, MDF, SDF. The vendor shall design the IP networking in an intelligent and efficient way. IP networking architecture drawings are to be submitted to BHEL for approval. Vendor has to configure Servers, gateways network Ethernet switches with all necessary networking features required to establish trouble free voice and data connectivity.



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Laying of telecom cables and FO cable is NOT in vendor's scope. Vendor has to supervise, coordinate and monitor all the cable laying (FOC, telecom cable) activities with BHEL site office.

After completion of telephone cable laying activities, vendor has to do MDF/SDF/JB fixing and terminations.

Vendor has to perform Final Integrated testing for SAT (Site Acceptance Test). After SAT (Site Acceptance Test) at site, the vendor shall furnish to BHEL "AS BUILT" layout and erection drawings along with distribution schemes properly incorporating changes / alterations/field modifications, if any, as carried out at field.

15.0 DOCUMENTATION & TOOLS

In the event of order, the supplier shall provide each 6 sets of following documents to BHEL Immediately after award of order for main equipment. **The document shall be complete in all respect failing which vendor shall be liable for penalty.**

- Bill of material
- Layout drawing indicating dimensions of all equipment, power supply requirements
- OGA drawings and Technical Data Sheets with **OEM** Catalogues of all items
- System architecture drawing
- Technical detail of network panel, wiring diagram of panel
- Manufacturing Quality Plan document shall be prepared by vendor in consultation with BHEL and shall be submitted to M/s. TSGENCO for final approval.

After manufacturing clearance from BHEL

- Test Certificates and reports for all the items as per agreed manufacturing quality plan (MQP) document.

After site survey and before installation and commissioning

- Telephone cable schedule and routing drawings covering all the plant buildings interconnections.

After SAT at site, the vendor shall furnish to BHEL "AS BUILT" layout and erection drawings along with distribution schemes, cable schedule properly incorporating changes/ alterations/ field modifications, if any, as carried out at field.

The supplier shall provide each one sets of following documents to BHEL and 4 sets shall be sent along with the system to site after technical datasheets customer approval / dispatch clearance of the main equipment.

- O&M manuals
- Technical Catalogues of the equipment.
- Programming manual
- Installation and commissioning instruction
- General maintenance documents

16.0 SPECIAL NOTES

- POINT WISE CONFORMATION FOR THE ENTIRE SPECIFICATION SHALL BE FURNISHED AT THE TECHNICAL OFFER STAGE AFTER FILLING IN THE TABLE 1, 2, 3 , 4 AND 5. DEVIATION IF ANY SHALL BE LISTED OUT CLEARLY.
- Any other hardware & software required but not mentioned in the specifications but important to make complete system functional, shall be in the scope of supplier.
- Supplier shall submit catalogues of all offered products, EPABX configuration drawing with BoM along with technical bid.
- Supplier shall submit dimensions of the equipment being supplied.
- Boarding and lodging charges at site shall be borne by the supplier.



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- f) Supplier shall mention in his offer the nearest authorized service center for reporting any malfunctioning of EPABX system.

17.0 TRAINING

Supplier shall offer training for the staff of M/s. TSGENCO for operation and maintenance of the telecommunication system.

18.0 WARRANTY

Supplier shall offer standard warranty for 3 years .

19.0 AFTER SALES SERVICE AND SPARES

Supplier shall confirm availability of spares and after sales service support for the offered system for minimum 5 years.

20.0 BILL OF MATERIAL

Supplier shall submit bill of material as per table 5 and PVC casing, CAT 6 cable, JB etc BoM as per Table 3.

Table 1: Technical Compliance

S. No.	DESCRIPTION	Supplier's Confirmation	Deviations
1.	Clause 1.0 : General		
2.	Clause 2.0 : Design Criteria		
3.	Clause 3.0 : Technical Specifications 3.1 General Requirements 3.2 System Architecture 3.3 Design Objectives and Performance criteria 3.4 EPABX Communication server 3.5 Media Gateway(self-survivable) 3.6 User Feature Requirement Specifications		
4.	Clause 4.0 : EPABX Key Features		
5.	Clause 5.0 : System Power Supply		
6.	Clause 6.0 : Mean Time To Repair (MTTR)		
7.	Clause 7.0 (Technical Data of EPABX and Other Associated Equipment) 7.1 EPABX 7.2 SIP based IP Telephone 7.3 TDM Telephone 7.4 Maintenance & Diagnostic Station 7.5 Industrial grade redundant UPS with redundant battery 7.6 Notebook PC 7.7 Power Cable 7.8 CAT 6 Cable 7.9 PoE Based L3 Core Switch – Network Switch 7.10 PoE Based L2 Field Switch (Type-1)		



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- 7.11 PoE Based L2 Field Switch (Type-2)
 7.12 Network Management Software (NMS)
 7.13 Main Distribution Frame (MDF), Sub Distribution Frame (SDF) / Junction Boxes (JB) fitted with Krone modules
 7.14 Conduits
 7.15 Accessories
- Information Outlet (I/O) of CAT-6 UTP
 - Face Plate (Plastic Modular Face Plate white in Colour 1 Module)
 - Rack End Patch Cord-1 mtr Blue in Colour
 - End User Site Patch Cord-2 mtr Blue in Colour
 - 19" rack mountable 24 Port CAT6 UTP Patch Panel Loaded
 - Wall Mounting Rack/cabinet
 - Stand alone Rack/cabinet
 - 19" LCS2 Modular Liu-Fiber Optic Drawer-24 Port
 - Screened Twisted Pair (STP) Cables
 - HDPE pipe
 - Nameplate
 - Consumables and Hardware

- | | | | |
|-----|--|--|--|
| 8. | Clause 8.0 Scope of Supply | | |
| 9. | Clause 9.0 Spares | | |
| 10. | Clause 10.0 Grounding/Earthing | | |
| 11. | Clause 11.0 Method, Material and workmanship | | |
| 12. | Clause 12.0 Erection Tools and Tackles | | |
| 13. | Clause 13.0 Cleaning up of work site | | |
| 14. | Clause 14.0 Installation and Commissioning | | |
| 15. | Clause 15.0 Documentation & Tools | | |
| 16. | Clause 16.0 Special Notes | | |
| 17. | Clause 17.0 Training | | |
| 18. | Clause 18.0 Warranty | | |
| 19. | Clause 19.0 After Sales Services & Spares | | |
| 20. | Clause 20.0 Bill of Material | | |

Table 2: Compliance (Installation, commissioning, prices etc)

S. No.	Description	Vendor's Confirmation	Deviation, if any
1.	All the junction boxes and EPABX accessories shall be of reputed make.		
2.	The vendor shall perform survey of site for cable estimation after the site is ready.		



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	After cable estimation, vendor shall prepare layout and erection drawings showing location of all system equipment & components, cable routing in cable trays/ racks/ trenches/ buried underground, conduits routing along with distribution schemes of the system. Vendor shall submit the above mentioned drawings to BHEL for approval. After SAT at site, the vendor shall furnish to BHEL "AS BUILT" layout and erection drawings along with distribution schemes, cable schedule properly incorporating changes/ alterations/ field modifications, if any, as carried out at field.		
3.	In case of any additional requirement of telephone instruments, cables, accessories and labour charges at the time of commissioning of telephones, unit price offered in this enquiry shall be valid.		
4.	Prices offered as per this BoM shall be valid for one year from the date of placement of PO.		
5.	All laying & fixing charges, Labour charges shall be considered as per actual Work completed at site.		

Table 3: BoM for JBs, Conduit, Power cables, Cat6 cables, misc. loose items

S. No.	Description	UoM	Tentative Qty	Prices / UoM (To be filled in price bid only)
	A. PVC casing, conduits etc			
1.	½" box type PVC casing	Meter	10000	
2.	¾" box type PVC casing	Do	10000	
3.	1" PVC conduit with bents & coupler	Do	2000	
4.	2" PVC conduit with bents & coupler	Do	1000	
5.	Flexible tubes 1½"	Do	750	
6.	Other items not listed above but necessary for fixing PVC casing (Pl list down here such items)	Set	1	
	B. Junction Boxes (with double compression type cable glands & earthing stud) with SDF			
7.	10 pair Krone SDF JB	No.	300	
8.	20 pair Krone SDF JB	No.	60	
9.	50 pair Krone SDF JB	No.	12	
10.	100 pair Krone SDF JB	No.	7	
	C. CAT 6 UTP Cable & Accessories			
10.	CAT 6 UTP cable	Mtr	26000	
11.	RJ-45 connectors	No.	1000	
12.	Crimping tool for 8 pin RJ-45 UTP connector with integrated cable cutter	No.	5	



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13.	Portable LAN cable tester	No.	3	
	D. Power Cable			
14.	3 core, 2.5 sq mm Power cable Armoured	Mtr	3000	
	E. Misc Loose Items			
15.	Miscellaneous items i. Earthing materials ii. Loose items as per actual requirements for E&C and cable laying like Ferrules, terminations, route markers, consumables hardware, nameplates, sleeves, conduits, JB glands (for in & out field cables), clamps, Cable identification tags ,ground wires, all tools for cable terminations, etc iii. AC & DC Distribution box (1ph, 3 ph) with MCBs (in EPABX room) iv. All EPABX components and accessories mentioned in specification as per actual requirement at site	Lot	1	

Table 4: Laying and Fixing charges for JBs

	Description	UOM	Tentative Qty	Prices / UoM (To be filled in price bid only)
	Junction Boxes Fitting and Termination charges			
1.	10,20,50 pair JB with Krone SDF and fixing Termination charges	No.	372	
2.	100 pair and above JB with Krone SDF and fixing Termination charges	No.	7	

Table 5: Format for BoM (Complete System) :

Vendors shall necessarily fill Bill of Material in this format only. Vendor shall provide make/model, details of all items and attach catalogues of all items.

Sl.NO	ITEM DESCRIPTION	Make / Model / Rating Details (to be filled for technical bid)	Catalogue attached (Yes / No / NA)	QTY	Unit Price (To be filled in price bid only)	Total Price (To be filled in price bid only)
1.	EPABX System as per details of			1 Set	Please	



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	purchase specification. Note: Mention no of ports & total quantity considered against each card in Details column. Server license to be provided and considered for all types of analog, IP, interface cards & functions listed below for EPABX system. Add any other module if required to make system complete but not listed here.				<u>mention individual unit price of each item under sl no 1 in this column</u>	
1.1	Gateway Panel (with Ethernet switch & media gateway) at EPABX room in Service Building, Stage - I shall be consisting of following :			1 Set	Individual prices for all item under 1.1 is to be mentioned in this column	Total price for all item under 1.1 is to be mentioned here
	i) Primary server -1 no					
	ii) Secondary server -1 no					
	iii) Server SIP IP Voice Extensions license – 400 nos					
	iv) Server analog extension ports license –638 nos					
	v) PA system interface card (SIP connectivity) and license in server for 4 channels					
	vi) POE based L3 core switch (managed network switch) - 2 nos					
	vii) POE based L2 field managed switch (24 cu port & 2 FO SM port) - 1 no					
	viii) 24 Port, 200 User Voice Mail (server based)					
	ix) Self survivable distributed media gateway to cater min 400 Analog ports with 20% spare wired slots					
	x) Analog line Cards for gateway for min 400 ports.					
	xi) Analog trunk card for gateway -8 ports and Server license.					
	xii) GSM gateway (8 port)					
	xiii) Suitable redundant Power conversion units for gateway , server, PoE switch etc, power distribution boxes, MCBs [230V					



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	AC input power supply shall be considered for Network panels]					
	xiv) Panel All type of connectors, TBs, UTP to Krone patch panel rack, network cables, Single Mode FO patch cables, 2 No LIUs with Single Mode pigtails for all ports to achieve network connectivity. Assembled and wired.					
	xv) 30 Port Meet Me Conference Audio Conference Bridge including required Hardware & Software					
	xvi) Network Management Software (NMS) (Original software CD to be provided)					
1.2	Gateway Panel (with Ethernet switch & media gateway) at Admin bldg shall be consisting of			1 Set	Individual price for all item under 1.2 is to be mentioned in this column	Total price for all item under 1.2 is to be mentioned here
	i) POE based L2 field switch (24 cu port & 2 FO port) - 1 no					
	ii) Self survivable distributed media gateway to cater min 50 Analog ports					
	iii) Analog line Cards for gateway for min 50 ports.					
	iv) Suitable redundant Power conversion units for gateway, switch etc. power distribution boxes, MCBs [230V AC input power supply shall be considered for Network panels]					
	v) Panel with all type of connectors, TBs, UTP to Krone patch panel rack, network cables, Single Mode FO patch cables, LIU with Single Mode pigtails for all ports to achieve network connectivity. Assembled and wired.					
1.3	Gateway Panel (with Ethernet switch & media gateway) at Service Building, Stage - II shall be consisting of			1 Set	Individual price for all item under 1.3 is to be mentioned in this column	Total price for all items under 1.3 is to be mentioned here



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	i) POE based L2 field switch (24 cu port & 2 FO port) - 1 no					
	ii) Self survivable distributed media gateway to cater min 100 Analog ports					
	iii) Analog line Cards for gateway for min 100 ports.					
	iv) Suitable redundant Power conversion units for gateway , PoE switch etc. power distribution boxes, MCBs [230V AC input power supply shall be considered for Network panels]					
	v) Panel with all type of connectors, TBs, UTP to Krone patch panel rack, network cables, Single Mode FO patch cables, LIU with Single Mode pigtails for all ports to achieve network connectivity. Assembled and wired.					
1.4	Gateway Panel (with Ethernet switch & media gateway) shall be consisting of			1 Set	Individual price for all item under 1.4 is to be mentioned in this column	Total price for all items under 1.4 is to be mentioned here
	i) POE based L2 field managed switch (8 cu port & 2 FO port) - 1 no					
	ii) Self survivable distributed media gateway to cater min 50 Analog ports					
	iii) Analog line Cards for gateway for min 50 ports.					
	iv) Suitable redundant Power conversion units for gateway , PoE switch etc. power distribution boxes, MCBs [230V AC input power supply shall be considered for Network panels]					
	v) Panel with all type of connectors, TBs, UTP to Krone patch panel rack, network cables, Single Mode FO patch cables, LIU with Single Mode pigtails for all ports to achieve network connectivity. Assembled and wired.					
1.5	Network Panels (with Ethernet switch) shall be consisting of			16 sets	Individual price for all item under	Total price for all items under 1.5 is



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					1.5 is to be mentioned in this column	to be mentioned here
		i) POE based L2 field managed Ethernet switch (24 Cu port & 2 FO port) - 1 no				
		ii) Suitable redundant Power conversion units for PoE switch, power distribution boxes, MCBs [230V AC input supply shall be considered for Network panels]				
		iii) Panel with all type of connectors, TBs, UTP to Krone patch panel rack, network cables, Single Mode FO patch cables, LIU with Single Mode pigtails for all ports to achieve network connectivity. Assembled and wired.				
1.6	Network Panels (with Ethernet switch) shall be consisting of			62 sets	Individual price for all item under 1.6 is to be mentioned in this column	Total price for all items under 1.6 is to be mentioned here
	i) POE based L2 field managed Ethernet switch (8 Cu port & 2 FO port) - 1 no					
	ii) Suitable redundant Power conversion units for switch, power distribution boxes, MCBs [230V AC input supply shall be considered for Network panels]					
	iii) Panel with all type of connectors, TBs, UTP to Krone patch panel rack, network cables, Single Mode FO patch cables, LIU with Single Mode pigtails for all ports to achieve network connectivity. Assembled and wired.					
1.7	Gateway Panel (with Ethernet switch & media gateway) at Gate complex shall be consisting of			1 set	Individual price for all item under 1.7 is to be mentioned in this column	Total price for all items under 1.7 is to be mentioned here
	i) POE based L2 field switch (8 cu port & 2 FO SM port) - 1 no					
	ii) Self survivable distributed media gateway to cater min 50					



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	Analog ports					
	iii) Analog line Cards for gateway for min 50 ports.					
	iv) Analog trunk line : 8 No					
	v) 1 no E1/PRI connectivity for BSNL/Telecom service provider connectivity and Server license.					
	vi) Interface card for 8 Tie lines and Server license					
	vii) Suitable Power conversion units for gateway , switch etc. power distribution boxes, MCBs [230V AC input supply shall be considered for Network panels]					
	viii) All type of connectors, TBs, UTP to Krone patch panel rack, network cables, Single Mode FO patch cables, LIU with Single Mode pigtails for all ports to achieve network connectivity. Assembled and wired.					
	ix) Integrated OEM make 16 port auto attendant with required extensions					
1.8	Any other hardware or software licenses not included in the list but necessary to make system complete and functional as per specification. Please mention all the items			1 set		
2.	Analog Desktop Telephone Instruments with CLI with RJ-11 telephone cord (min 5 mtr length)			453 Nos		
3.	Analog Wall mounted Telephone Instruments with CLI with RJ-11 telephone cord (min 5 mtr length)			50 Nos		
4.	SIP IP Voice Phones			400 Nos		
5.	Outdoor weather proof telephone with canopy with RJ-11 telephone cord (min 5 mtr length)			135 Nos		
6.	Flush mounted RJ-45 Rosette box			425 Nos		
7.	Flush mounted RJ-11 Rosette box			650 Nos		
9.	Desktop Workstation PC			2 Sets		



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	(Hardware & License) for 1) PC Based Operator Console 2) Maintenance & Diagnostic Station (Spec as per CI 7.4)					
10.	Workstation accessories: i) Dot Matrix Printer-1no ii) Computer table -2nos iii) Printer table- 1no iv) Chair for Operator-2nos			1 set		
11.	Industrial grade redundant UPS (min 5 KVA) with redundant battery for 1 hour backup for PCs, printer, server, gateway, switches at EPABX room (Spec as per CI no 7.5)			1 set		
12.	Notebook PC for Local & Remote maintenance with latest hardware & software configuration (Spec as per CI 7.6)			1 No		
13.	Krone Tool			4 Nos		
14.	Dial Tester			2 Nos		
15.	Lineman Hand held telephone set			2 Nos		
16.	JBs with double compression type cable glands and earthing studs, PVC pipes, Conduits, CAT 6 UTP cable & accessories, power cable and misc. loose items as per Table 3			1 Set		
17.	Original Software CD's with license certificate shall be provided for all types of software offered in this system. a. Call billing software b. Voice Mail Application c. PC – Operating system d. PC – drivers e. Maintenance software f. Anti-Virus Software g. Any other software which is to be supplied			1 Set		
18.	MDF, Connector Blocks and			1 Set		

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	accessories for 1200 extensions with all necessary protection arrangements					
19.	MDF, Connector Blocks and accessories for 80 extensions with all necessary protection arrangements			1 Set		
20.	Any other item not included in the list but necessary to make system complete and functional. Mention details of other items			1 Set		
21.	Spares			1 Set	Individual price for all item under 21 is to be mentioned in this column	Total price for all items under 21 is to be mentioned here
	i) Power supply module - 10% of supplied quantity or one whichever is more					
	ii) Controller module - 10% of supplied quantity or one whichever is more					
	iii) Line cards - 10% of supplied quantity or one whichever is more					
	iv) IP phone - 10% of supplied quantity or one whichever is more					
	v) Analog desktop phone - 10% of supplied quantity or one whichever is more					
	vi) Fuses – 120% of supplied quantity					
22.	Erection and Commissioning Charges of EPABX Servers, Ethernet switches, Media gateway, UPS with battery bank, Operator console, maintenance PC, MDF, Earthing with terminations etc., Supervision of cable laying activities and software programming of all the telephone sets of EPABX system in EPABX Room at site.			1 Set		
23.	Charges for site survey for Cable estimation and submission of cable routing drawings by vendor at site.			1 Set		



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24.	JB fixing and termination charges as per Table 4.			1 Set		
25.	Charges for (SAT) final system integration, testing and hand over of EPABX system at site and submission of "AS BUILT" layout and erection drawings.			1 Set		
26.	DOT Liaison and other charges for BSNL trunk lines as mentioned in the specification			1 Set		
27.	Documents			1 Set		
28.	Training			1 Set		
29.	Warranty			3 year		
30.	Tools & Tackles a) Long Nose Plier 6" – 1 No b) Diagonal Cutter 6" – 1 No c) Box Spanner – 1 Set d) Hammer Steel – 1 No e) Adjustable Spanner 12" – 1 No f) Screw Driver 8" and 10" – 1 No each g) Mains Tester – 1 No			1 set		

Note 1 :

Gateway panel at Gate complex (Table 5, Item no 1.7) shall be supplied and commissioned during initial stage of power plant commissioning. This should work as standalone. Later the panel will be shifted to Gate complex.

Note 2:

- For Technical bid, Table 1 & 2 shall be duly filled. **Compliance in tabular form shall be submitted with respect to specification.** Deviations if any, shall be mentioned with proper justification.

OEM Technical datasheet/catalog of Server, media gateway, different types of EPABX modules/cards, IP phone, desktop & wall mounted analog phone, outdoor weatherproof telephone , workstation PC, printer, furniture, Notebook PC, cable etc are to submitted along with technical offer. UPS panels and battery layout drawing, technical datasheets, battery sizing calculation are to be submitted along with technical offer.

Failing to submit any of above documents, offer is liable to be rejected.

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COPY RIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited. It must not be used directly or indirectly in anyway detrimental to the interest of the company. 2. For Price bid, Table 3, 4 & 5 shall be duly filled. Unit prices of all individual items are STRICTLY to be mentioned, failing which offer is liable to be rejected. 3. The system shall be complete in all respect and shall not be limited to the above. All necessary hardware and software shall be supplied as a package to meet the specification and trouble free operation. Please note that all the items required for commissioning for EPABX system up to Telephone instruments is in the scope of vendor. Therefore list down all such material in BoMs without fail. Note 3: Chinese make finished products are not acceptable by TSGENCO. Wherever Chinese make RAW MATERIAL is used by approved vendors, specific approval for usage of chinese make raw material has to be obtained from TSGENCO before start of manufacture to avoid rejection of material at later stage.					