MAHARASHTRA STATE ELECTRICITY TRANSMISSION CO. LTD
(CIN U40109MH2005SGC153646)

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MSETCL/CO/CE (ACI&P)/MTAMC-Ph-2/644 **Date:27.10.2025**

Budgetary Offer
(Through MSETCL Web page)

To Whomsoever It May Concern

Sub: Calling of budgetary offer for substation-level work related to the various systems proposed at EHV substations of MSETCL, for integration into the centralized MTAMC Control Centre under MTAMC Phase-2.

MSETCL has established the Maharashtra Transmission Asset Management Centre (MTAMC) for the remote monitoring, operation and control, data acquisition, protection management, and asset life cycle management of EHV substations within its grid. Phase-1 of the MTAMC project has been successfully implemented.

As part of Phase-1, a centralized Control Centre has been commissioned at Airoli, and nine 400 kV EHV substations have been integrated with sub-systems such as SCADA, Visual Monitoring System (VMS), Relay Remote Access System (RAS), and the Automated Fault Analysis System (AFAS).

MSETCL now intends to expand the MTAMC project to integrate additional existing EHV substations (approx. 43 Nos) where SAS are working or Partial working and providing additional systems at substations to achieve the objective of MTAMC. These substations are proposed to be integrated with the existing centralized infrastructure of MTAMC Control Centre.

In view of this the BOM & BOQ of material required at these substation is prepared by this office. To process this work, budgetary offer of each item is required to this office. Some of items rate are available in MSETCL SOR as mentioned in the column.

Please submit the budgetary offer of the items whose rates are not available in MSETCL SOR as per enclosed Annexure-B.

Total scope of work at substation level considered under MTAMC Ph-2 is enclosed herewith for reference.

If required, the concerned agency could visit the MTAMC Control Centre, Airoli and the Sub-Stations proposed for MTAMC Ph-2 integration to identify any additional materials not listed in the BOQ, ensuring seamless integration with the MTAMC Control Centre in the various systems, before the submission of budgetary offer.

Sub: Calling of budgetary offer for substation-level work related to the various systems proposed at EHV substations of MSETCL, for integration into the centralized MTAMC Control Centre under MTAMC Phase-2.

You are requested to quote the latest and lowest rates for **tentative quantities** as per Annexure-B attached. The terms and conditions are as follows:

1. The Budgetary offer shall reach to this office on or before 10.11.2025 on email ceaci@mahatransco.in/ee2protection@mahatransco.in/ By hand/ By post in sealed envelope.
2. The rate should be quoted o**n firm quotation basis**.
3. The rates should be exclusive of all taxes**. Ex-works should be mentioned separately in the offer. All applicable taxes and other charges, if any to be quoted extra.**
4. **The said budgetary offer is only for estimation purpose and will not be considered for any bidding & no work order will be issued based on this offer**.
5. The offer will be on agencies **letter head** and valid for **minimum period of 06 Months.**

Encl:1. Annexure-A: Scope of work
2. Annexure-B: Bill of quantity for substations (Supply & service)
3. Annexure-C: MSETCL Substations list

Sd/-
(Pramod Bhosale)
Chief Engineer (I/C)
ACI&P, CO, MSETCL.

Annexure-A-Scope of Work

Overview of MTAMC Ph-1 commissioned system

The MTAMC project Ph-1 has achieved following milestones,

1. Local and Remote monitoring and Control through SCADA:

Local SCADA is established at each of the nine numbers 400kV Sub-Stations under the MTAMC Project Ph-1 along with the remote monitoring and Control from MTAMC Control Center, Airoli. The substation SCADA software is WinCC and Control Center SCADA software is Spectrum Power 7.

This system is supplied by M/S. Siemens and is commissioned and operationalized.

2. Visual Monitoring System (VMS):

Visual Monitoring System (VMS) is established at Sub-Station Level and integrated with Control Centre Centralized VMS system. In this system 360˚ PTZ and CCTV Cameras are installed at strategic locations at Sub-Stations along with Perimeter Intrusion Detection System (PIDS) for providing surveillance and security of the entire switchyard. This system also ensures the proper operation and supervision of switchgear within the switchyard. In addition to general yard supervision, the system also facilitates the analysis of physical events occurring in the switchyard during any disturbances or incidents.

The VMS includes a Perimeter Intrusion Detection System (PIDS), which monitors the boundaries of the switchyard to detect any unauthorized entry through the sub-station's perimeter wall. The PIDS uses infrared beam technology to create an invisible fence around the sub-station premises. If this invisible fence is breached, an alarm is triggered to alert security personnel.

The VMS system (Siemens Siveillance) is supplied by M/s Siemens Ltd and is commissioned and operationalized.

3. Relay Remote Access System (RAS):

The Remote Access Server (RAS) performs the following key functions related to the Protection Management System:

i. At Sub-Station Station Data Concentrator (SDC) fetches Disturbance Records (DRs) from relays.
ii. Renames the DRs received from Intelligent Electronic Devices (IEDs) according to the IEEE COMTRADE format.
iii. SDC forwards DR to the Control Centre for repository and analysis to RAS Server.
iv. Establishes secure access between the Control Center and sub-station relays through RAS Server and SDC.
v. Once secure access is established, authorized personnel at the Control Center can access and modify protection settings remotely with access logging.
vi. RAS maintains a repository of DRs, IED details, and associated IED software.
vii. RAS monitors the health and communication status of SDC and IEDs along with time sync status.

The RAS is provided by M/s Synergy Systems and Solutions, through M/s Siemens and is commissioned and operationalized.

4. Automated Fault Analysis System (AFAS):

AFAS system is provided only at MTAMC control centre, Airoli and its web page can be accessed at Sub-Station level for monitoring of EHV Lines and Transformers tripping. AFAS system picks up the DRs from RAS, digitally processes it and generates an automated report in PDF format. This PDF report is emailed with notification through SMS on mobiles to concerned stakeholders of MSETCL.

AFAS system is provided by M/S. PRDC, Bangalore through M/S. Siemens and is commissioned and operationalized.

5. Transformer Monitoring System (TMS):

This system monitors the condition of Transformer assets of MSETCL. In this system a Transformer Monitoring Unit (TMU) is installed in the switchyard near Transformer Assets. This system facilitates monitoring the transformer condition like Loading, Bushing Tan Delta & Capacitance, nine gas Online DGA, Transformer Auxiliaries such as OTI, WTI, TPI, FAN and Pump status etc to assist the operator for efficient operation and maintenance of the transformer.

TMS is established at Sub-Station Level (M/s. MR) and integrated with Control Centre Centralized TMS system (M/s. Sensital) through Siemens where multiple analytics are drawn with the help of software as per methods in IEEE, IEC standards.

The TMS system is commissioned and operationalized

6. Voice over IP Phone (VoIP) System:

VoIP system is provided at Sub-Stations with its servers at MTAMC Control Centre, Airoli to establish direct voice communication through the MSETCL OPGW Network between Control Centre and Sub-Station with voice recording facility.

The VoIP system (M/s. Exato Technology) supplied through M/s. Siemens is commissioned and operationalized.

7. Corporate Data Warehouse System and Asset Health Management System (CDWS-AHMS):

This system envisages overall health monitoring of MSETCL assets by integrating different systems. The integration of different systems together helps in taking decision with regards to life assessment of critical assets of MSETCL.

MSETCL OPGW network is used for communication between Control Centre and Sub-Station.

----------End of Chapter 01----------

Chapter No. 02

Substation SAS/SCADA System:

1. Introduction:

The proposed sub-stations under MTAMC Ph-2 are having SAS/SCADA pre-installed of various OEMs as per **Annexure-1** with status mentioned therein. Substation SCADA system is based on IEC 61850 edition 1 or 2. MTAMC Phase-2 covers Approx. 33 substations with various makes of SAS/SCADA (e.g., Siemens, GE, ABB, Ashida, etc.).

At present station level gateway communicating with the SLDC for visibility point of view over IEC 60870-5-104 protocol. Using the existing network we propose to replace the existing gatew

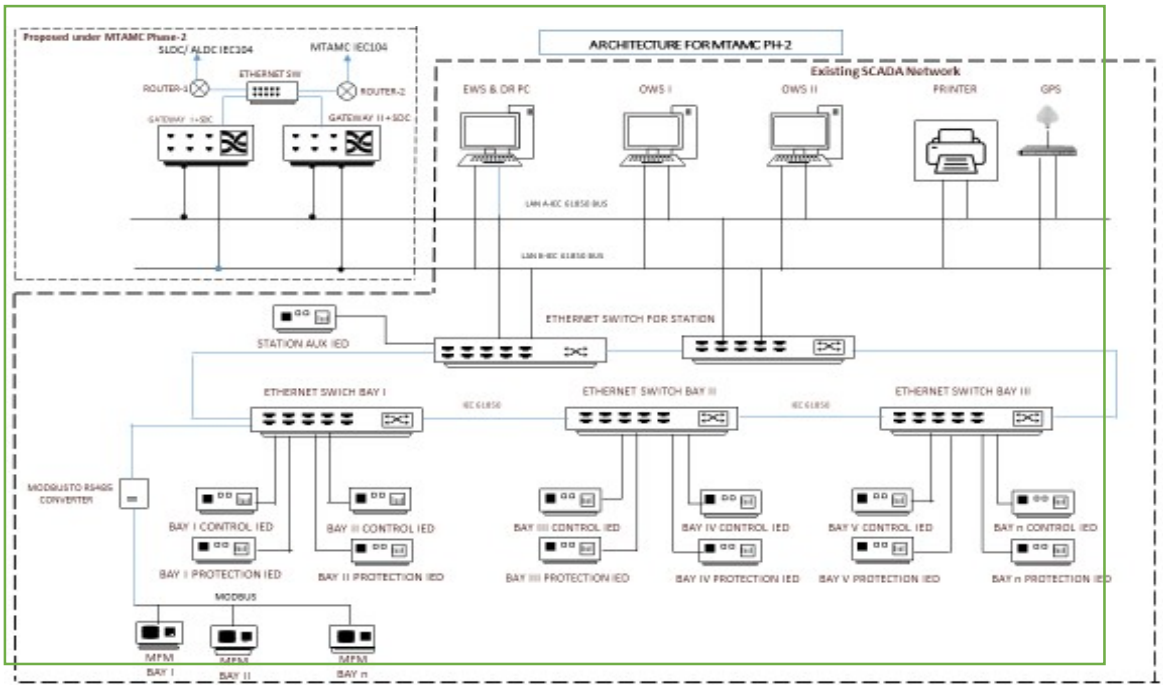
ay with another gateway having combined functionality of communicating data over IEC 60870-5-104 and as an SDC for serving the purpose of relay remote access system. The gateway technical specifications are described in this chapter.

The Gateway shall function as transparent remote access for substation IED's the remote configuration and diagnostic of the IED's. This shall be achieved through a secure authenticated VPN between the gateway and the control center.

The detailed functionality of SDC used in RAS is given in chapter No-3.

The gateway functions towards reporting data to MTAMC Control Centre as well as SLDC and ALDC independently.

Proposed substation SAS/SCADA Architecture for MTAMC ph-2



2. Scope of Work:

Following work is proposed to be carried out for MTAMC ph-2,

a) Replace the existing gateway with another gateway having combined functionality of communicating data over IEC 60870-5-104 and as an SDC for serving the purpose of relay remote access system. Two individual gateways shall be in a hot-standby configuration

b)

c) Configuration & integration of new substations gateway as per the MTAMC signaling requirement at local level and control center. Existing SAS/SCADA backups will be provided by MSETCL.

d) SCADA hardware (e.g., workstations, Ethernet switches, GPS devices, PCs, monitors, LIUs, and communication networks including patch cords and optical fiber cables) shall be supplied and integrated if found in non-working condition or incompatible. Detailed quantity will work out after survey.

e) IED (Relay/BCU etc) shall be supplied by the contractor as per site requirement, if found in non-working condition or incompatible. Detailed quantity will work out after survey.

f) If the existing SCADA system is non-functional, has an obsolete OS, or the backup is unavailable, then the SAS/SCADA software shall be provided as per the latest MSETCL SAS specifications. (Rev.2 Dec-2018)

g) Required antivirus software and third party software to be supplied and installed.

3. Technical Specification of Gateway/SDC, IED, BCU & other equipment.

a) IEDs:

i. Bay control unit, Bay protection unit, Substation Auxiliary IED shall be independent.

ii. The IEDs should be IEC 61850 edition – II or latest standard complaint.

iii. The protection shall be provided by separate protection IEDs-BPU (numerical relays) and other protection devices indicated separately.

iv. All IEDs shall be connected to the communication infrastructure for data sharing and shall meet the real-time communication requirements for automatic functions.

v. The data presentation and the configuration of the various IEDs shall be compatible with the overall system communication and data exchange requirements.

vi. IEDs shall be equipped with a real-time clock, with full calendar support (including leap year). Clock resolution shall be governed by IEC 60870-4,

vii. Clocks shall have an accuracy of ±2ppm and shall not drift more than twenty (20) ms per hour.

viii. If necessary, IEDs shall employ software algorithms to counter inaccuracies and drift resulting from crystal ageing.

ix. All IEDs that need to maintain precise time for time-stamping shall be capable of supporting IEC 61850 time-synchronization.

x. Maintaining acceptably low drift in time between synchronizations, and time-stamping events with an absolute precision of +/-0.5ms relative to the GPS source

xi. IEDs shall support local setting of time and date from the front port or HMI panel. This feature is intended only for use in unusual circumstances, such as the loss of Synchronization or for IED testing. This set of values shall be maintained by the IED until overridden by a successful time synchronization

xii. Except for synchronization, the IED's real-time clock shall be completely independent of outside sources, so that the IED can continue to properly handle time related applications, should the time-synchronization mechanism fail.

xiii. The IEDs to be provided for Line Differential should be compliant with IEC60255/ IEC 61850 – 3 / with latest standard. Further, the Transformer Differential relay to be supplied should be suitable for use with three winding Transformer / ICT

xiv. All the numerical IEDs must be fully IEC 61850 compliant and must have the following features:

1. Peer-to-peer communication using GOOSE messages (IEC 61850) for interlocking.
2. Inter-operability with third party IEC 61850 compliant devices
3. Generate XML file for integration/engineering with vendor independent SCADA systems should be directly connected to the inter-bay bus on IEC 61850 without the use of any gateways/protocol converters.
4. Connections of bay protection IEDs to the IEC 61850 bus through the bay control units is not acceptable.
5. The IEDs shall be capable of reporting to at least six clients.
6. Distance, Differential, REF Relay required if any shall be as per MSETCL specifications enclosed **Annexure-2**.
7. Manual DR trigger facility and required IEC 61850 node shall be provided.

8. IED shall have the provision for monitoring time not synch in SCADA/SAS system.
9. IEC 61850 Signal list required for configuration of IED/BCU is as per **Annexture-3** as enclosed.

b) **Bay Control unit**

i. The Bay control unit shall be industrial grade components flush mounted in the panel based on microprocessor technology, shall use numerical techniques for the calculation and evaluation of externally input analogue signals.

ii. Its mimic displays accessible from the front of the panel.

iii. The Bay control unit mimic shall dynamically represent the current value of the measurements, state of the devices and control of devices.

iv. It shall be possible to remote control the Bay equipment's through the Bay control unit (BCU) from control centers.

v. The Bay control unit shall acquire all the analog measurements, Status of Circuit breakers, Isolators and Earth switches, status of alarms, and provide Control of devices (Circuit breaker/Isolators/Reset of Relays/position selection for Auto reclose etc).

vi. The Bay control unit shall also provide synchronization check facility for the circuit breakers according to the Bus configuration arrangements and requirements.

vii. It shall incorporate select-before-operate control principles as safety measures for operation via the HMI.

viii. It shall perform all bay related functions, such as control commands, bay interlocking, data acquisition, data storage, event recording and shall provide inputs for status indication and outputs for commands.

ix. It shall be directly connected to the switchgear.

x. It shall acquire and process all data for the bay (Equipment status, fault indications, measured values, alarms etc.) and transmit these to the other devices in substation automation system.

xi. It shall receive the operation commands from station HMI.

xii. It shall have the capability to store all the data for at least 24hours.

xiii. All bay level interlocks are to be incorporated in the Bay level unit so as to permit control from the Bay level unit/local bay mimic panel, with all bay interlocks in place, during maintenance and commissioning or in case of contingencies when the station HMI is out of service.

xiv. The Bay level unit shall meet the requirements for withstanding electromagnetic interference according to relevant parts of IEC 61850.

xv. Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.

xvi. The I/O modules shall form a part of the bay level unit and shall provide coupling to the substation equipment.

xvii. The I/O modules shall acquire all switchgear information (i.e. data coming directly from the switchgear or from switchgear interlocking devices) and transmit commands for operation of the switchgear.

xviii. The measured values of voltage and current shall be from the secondary of instrument transformers.

xix. The digital inputs shall be acquired by exception with 1 ms resolution. Contact bouncing in digital inputs shall not be assumed as change of state.

xx. For Protection transfer switch function in Transfer bus schemes, the logic for protection transfer from 'Normal' to 'Transfer' and vice versa, shall be implemented and monitored.

xxi. BCU specifications enclosed in technical specs **Annexure-2.**

xxii. IED shall have the provision for monitoring time not synch in SCADA/SAS system.

xxiii. Manual DR triggered facility and required IEC 61850 node shall be provided.

c) Ethernet Switch:

i. The Bay Control unit and the numerical relays supplied under present scope shall be connected to the LAN Ethernet switch(s) (managed switch).

ii. Not more than 16 nos of IEC 61850 devices shall be connect on one bay level Ethernet switch and at least 6 spare ports (3 Optical +3 copper).

iii. Ethernet switches that fulfill the hardened requirements concerning temperature, EMC, power supply (220/110 V DC from the Station Battery) and complying to IEC61850- 3, RSTP Protocol enable of the specification suitable to be installed in substations

iv. The switches shall support priority tagging and open standards for ring management like fast scanning tree to ensure that e.g. for later system extension utility has not to rely on one switch supplier only.

v. For Detail technical Specification please refer **Annexure-2**

vi.

d) Gateway cum SDC:

i. The Substation Automation System shall have the capability to support simultaneous communications with 6 independent remote master stations. Ports having capability to

handle 4000 tags for 220 kV & 8000 tags for 400 kV substations.

ii. The Gateway shall have adequate memory & processing capability to meet the required response time.

iii. Performance complying with the requirements of IEC 61850-3 or the latest standard.

iv. Use of industrial grade PCs & hardware with moving parts such as fan will not be accepted as gateway.

v. The Gateway shall be responsible for collection of instantaneous measurement data, status data etc. from the numerical relays. These data shall be made available to the HMI as well to the control center.

vi. It shall have web server functionality for Remote access with a web browser for monitoring.

vii. All the functions/routines of the gateway shall start automatically upon power up or restart of the equipment.

viii. The Gateways shall comply with the clauses of IEC 61850-3 for EMI/EMC, Mechanical and Environmental requirements.

ix. The Gateway should be capable to integrate at least 100 numbers of IED's on IEC 61850 IEDs.

x. It shall be possible to integrate the MFM meters as well data transfer to the Meter Management on Modbus (RS485) protocol.

xi. The gateway shall be responsible for collection of instantaneous measurement data, status data etc. from the numerical relays. These data shall be made available to the HMI as well to the control center.

xii. Gateway shall communicate with the remote control center through IEC 60870-5-101 and 104 protocols. This shall be both in monitoring and control directions.

xiii. Gateway shall communicate with the numerical relays and BCUs on IEC 61850 protocol. To this extent the gateway shall support client function, both edition 1 and 2 of IEC 61850.

xiv. Gateway shall communicate with the meters on DLMS/COSEM (IEC62056) protocol over the Ethernet as well as Modbus and transfer the data to the Meter management system or application system over DLMS protocol Ethernet as well as Modbus. To meet this functionality the gateway shall support both Client and server functions of DLMS.

xv. The gateway shall support DLMS client, Modbus Master and edition 1 and 2 of IEC 61850 server and client protocols.

xvi. Gateways shall be able to connect and communicate to the IEDs on PRP, HSR and RSTP redundancy protocol.

xvii. Gateways shall support SNMP V3 protocol for device monitoring.

xviii. Gateway shall be provided with minimum 8 serial ports and 6 Ethernet ports in each gateway.

xix. The gateway shall be deployed in a redundant Hot-Standby configuration. All functions, protocols and capability according to those asked in this specification shall be duplicated in either hardware.

xx. Gateway shall be provided with redundant power supply.

xxi. Gateway shall support simultaneous communication over two communication links with remote station.

xxii. Gateway should have preferably a mimic and LEDs to display alarms/events/hot-standby mode etc. HMI shall also be used for minimum setting changes if required with user authentication.

xxiii. Gateway shall have a redundancy for connecting station network (IEC61850)

xxiv. Gateway shall have provision for Time synchronization on SNTP/NTP/Remote command/IRIG-B, PTP.

xxv. Provision and configuration of 104 Slave in the gateway for remote SCADA shall be compulsory either for Up-gradation OR for New SCADA.

xxvi. The Gateway can function as transparent remote access for substation IED's the remote configuration and diagnostic of the IED's. This is achieved through a secure authenticated VPN between the gateway and the control center.

xxvii. The access can be done to specific IED's only for which the system operator has enabled the remote access.

xxviii. The gateway function operates in parallel to the data acquisition functions to report to RAS & SCADA system of control center independently.

xxix. Gateway shall have integrated function for disturbance records collection from connected numerical relays on protocols such as IEC 61850.

xxx. The disturbance records shall be pushed to one or more central servers over a secure tunnel on standard secure file transfer protocol (SFTP). The Gateway shall have provision to install third party applications to create connectivity and push files to the central server.

xxxi. Gateway shall also enable Remote access to IEDs in the substation from the control center for centralized parametrization and configuration. Transparent tunneling support is required in Gateways for communication with IEDs.

xxxii. The access to specific IED's only for which the system operator has enabled the remote access with logs.

xxxiii. Gateway shall have integrated function for disturbance records collection from connected numerical relays on protocols IEC 61850.

xxxiv. Gateway cum SDC shall function as a transparent remote access of substation IED's for remote configuration and diagnostic of the IED's. This is achieved through a secure authenticated VPN between the gateway and the control center.

xxxv. **Hardware specification for Gateway cum SDC:**

a. **Certification:** IEC 61850-3, IEC 60870-2, IEC 61000-4 (Test/Details specified in Anne III)
b. **Driver Support for OS:** Linux / Windows.
c. **CPU:** Quad Core 1.2 GHz & Above
d. **Memory:** 8 GB RAM or higher
e. **Storage:** 4 GB Flash as standard and option to expand up to 256 GB SSD.
f. **Power Supply:** Dual Redundant Power supply, 100-220V AC/ DC ,50/60 Hz, (Only on AC not accepted)
g. **Mounting:** 1U/2U 19" Rack Mount
h. **IP requirement:** IP 30

xxxvi. **Annexure 4** for Gateway PC/hardware type test.

xxxvii. **Communication Interface for Gateway cum SDC:**

a. **Serial Ports:** Total No of 8 ports as per user requirement (RS-232, RS 485 (Terminal Block) 2,000V isolation
b. **Serial, Ethernet Port Speed:** RS-232: 300 bps -115.2 kbps, RS 485: 300 115.2kbps (Max.). LAN 6 x 10/100/1000 Base-T RJ45 ports with Isolation Protection of 1.5 kV built-in (Supports Teaming Function)
c. **Support PRP Network redundancy**
d. **Time Synchronization:** SNTP V4/NTP V4, IRIG-B and PTP (IEEE 1588) shall be available

e. **Cyber Security:**

All type of access to the Gateway shall be secured and shall be in built in the design of the Gateway. The security requirements are summarized below, and details of security requirements are presented as a table which are relevant clauses from NERC CIP V5 and clause 5 of IEEE 1686.

i. Authorization shall be done using Role Based Access Control (RBAC), and authentication shall be PKI based using X.509 certificates. Any central application needed to achieve this shall be supplied and installed by the vendor.

ii. Root user access shall be available only through the console port of the gateway, which is accessible by physical presence near the gateway.

c. Strong password enforcement according to CIP 007-5 R5 (5.5)Shall be minimum 8 characters long, must insist lower case and upper-case characters, special characters, numbers etc.

d. All communication with the gateway including the configuration utility software shall be encrypted. Login to the gateway shall use SSH. Number of wrong log-in attempts and lockout time after allowed unsuccessful logins shall be configurable according to CIP 007-6 R5.7. Administrator shall have the privilege to reset any locked-out accounts.

e. Gateway shall support a user configurable firewall policy. It shall be possible to configure rules for inbound and outbound connections, open/block ports. By default, all ports except configuration access shall be enabled for single port, all others shall be configured to deny any inbound/outbound packets.

f. There shall be option to monitor the physical port status and control the physical ports.

g. Network Address Translation (NAT) policy configuration shall be possible to reach out the end device from control center.

h. Encryption of remote access shall be over bi-directional by TLS 1.2 tunnel.

i. IEC104 telemetry protocol communication shall be over TLS tunnel according to IEC 62351-3 security standard

j. Gateway shall support SSL based VPN tunnel creation.

k. Device shall accept only digitally signed files for Firmware update, package updates, licenses etc. If the signature doesn't match the downloaded files shall be removed by the gateway.

l. All security incidents shall be logged in syslog.

m. The gateway shall maintain a user access log including unsuccessful login attempts.

n. Gateway logs shall not be modified /deleted by any user except the root use.

o. All type of access to the Gateway /SDC shall be secured and shall be in built in the design of the Gateway.

p. Gateway / SDC shall support a user configurable firewall policy. It shall be possible to configure rules for inbound and outbound connections, open/block ports.

q. Local/Remote selection of device shall be possible.

r. Gateway / SDC log shall not be modified / deleted by any user expect the main user.

Gateway cyber security features	
Requirement	**Description**

Electronic access control	All electronic access to the Gateway, whether locally through a control panel, locally through a communication/diagnostic port with a test set or personal computer, or remotely through communications media, shall be protected by unique user identification (ID) and password combinations.
Password defeat mechanisms	The Gateway shall have no means, undisclosed to the implementing entity, whereby the user-created ID/password control can be defeated or circumvented. This includes, but is not limited to the following mechanisms and techniques: 1. Embedded master password. 2. Chip-embedded diagnostic routines that automatically run in the event of hardware or software failures 3. Hardware bypass of passwords, such as jumpers and switch settings The vendor shall disclose any and all mechanisms whereby the user-created ID/password control can be circumvented. If the vendor represents that no such mechanisms are present in the Gateway, the vendor shall certify in writing to that effect.
Password construction	User-created passwords shall follow a set of rules that shall be adhered to in the creation of each password. At least eight characters shall be used, and the password shall be case sensitive. When encoding passwords in plain text, the password characters shall contain the following: · At least one uppercase and one lower case letter ·At least one numeral character ·At least one non-alphanumeric character (e.g., @, %, &, *) Any attempt to create a password that violates these rules shall be captured at the time of attempted creation, and the user shall be notified and prompted to choose another password that conforms to the rules.

Gateway access control	
Authorization levels by password	The Gateway shall support the ability to assign authorization to utilize one or more Gateway functions and features based on individual user-created ID/password combinations.
Authorization using role-based access control (RBAC)	The Gateway configuration tool/IAM shall have the capability of defining at least four user defined roles (administrator, Engineer, Viewer, Security Admin), other users such as installer, security auditor operator, RBAC management. Each role shall have the capability of having any combination of functions assigned to that role. A role shall be assignable to each user/password combination, thereby conveying the permissions of that role to the user upon log in.

Gateway main security functions	
View data	a) View data refers to the ability to view operational data (voltage, current, power, energy, status, alarms, et al.) of the Gateway that are not intended to be available as general information display.

View configuration settings	b) View configuration settings refer to the ability to view configuration settings of the Gateway, such as scaling, communications addressing, programmable logic routines, and the firmware version Numbers.
Configuration	c) Configuration change refers to the ability to download /upload configuration files to the unit and/or effect changes to the existing configuration, update license, device setting change.
Security settings	Firewall settings, Trust chain update, user management
Firmware change	d) Firmware change refers to the ability to load new firmware that does not require a corresponding hardware change.
ID/password or RBAC management	e) ID/password or RBAC management refers to the ability to create, delete, or modify user IDs, passwords, roles and/or password, and role authorization levels.
Audit trail	f) Audit trail refers to the ability to view and download the audit trail.
Password display	Only user IDs shall be displayed in screens, audit trails, the memory area or files, and other records and configuration files. It shall not be possible to cause Gateway passwords to be displayed through any means, including local display panel, configuration software (local or remote; offline or online), web browser, and terminal access.
Access timeout	The Gateway shall have a timeout feature, that automatically logs out a user who has logged in, after a period of user inactivity. Inactivity shall be defined as the absence of input from local (web screen/faceplate) mechanisms and/or the absence of keystroke activity on a computer connected to the Gateway port.

Audit trail	
Storage capability	The audit trail facility shall store at least 2048 events before the circular buffer begins to overwrite the oldest event with the newest event. It shall not be possible to remove the storage media of the audit trail without permanently damaging the Gateway beyond the capability of field repair.
Storage record	For each audit trail event, the following information shall be recorded:
Event record number	a) Event record number: The automatically-generated sequential number for the event
Time and date	b) Time and date: Time and date of the event including year, month, day, hour, minute, and second

User identification	c) User identification: The user ID logged into the Gateway at the time of the event
Event type	d) Event type: Refer below for a definition of event types
Audit trail event types	The following events shall cause an entry into the Audit Trail record:
Log in	a) Log in: Successful log in (locally or remotely) of a user to the device
Manual log out	b) Manual log out: User-initiated log out
Timed log out	c) Timed log out: Log out of user after a predefined period of inactivity elapses
Configuration access	d) Configuration access: Downloading of a configuration file from the Gateway to an external device or memory location (e.g., computer, memory stick, compact disk)
Configuration change	e) Configuration change: The uploading of a new configuration file to the Gateway or keystroke entry of new configuration parameters that causes a change in Gateway configuration
Firmware change	f) Firmware change: Writing to memory of new Gateway operating firmware
ID/password creation or modification	g) ID/password creation or modification: Creation of new ID/password or modification of ID/password or RBAC levels of authorization
Password deletion	h) ID/Password deletion: Deletion of a user ID/password for additional users.
Audit log access	i) Audit log access: User access of audit log for viewing or audit log download to an external device or memory location (e.g., computer, memory stick, compact disk)
Time/date change	j) Time/date change: User request to change time and date
Alarm incident	k) Alarm incident: The occurrence of an alarm incident
Supervisory monitoring and control	In addition to the audit trail capability, the Gateway shall monitor security-related activity and shall make the information available through a real-time communication protocol for transmission to a supervisory system. The supervisory system shall be either a SCADA system or network management system. If serial communications are used for the configuration of the Gateway and the supervisory communications port, separate serial communications ports shall be provided for configuration and supervisory monitoring. Configuration port activity shall not interfere with nor disable the supervisory monitoring port, except for a configuration or firmware change requiring a reboot of the Gateway. Information to be monitored and transmitted shall fall into two groups: events and alarms.
Events	Events are defined as authorized activities which can be expected to occur in the routine use and maintenance of the Gateway. All events listed in audit trail shall be included in the requirement for events to be monitored and transmitted to the supervisory system. Event points shall have momentary change detect capability so that the

	occurrence of an event will be reported on the next scan of the Gateway by the supervisory system. The Gateway shall report each occurrence as an individual event
Alarms	Alarms are defined as activities which may indicate unauthorized activity. The following shall cause a unique alarm occurrence:
Unsuccessful login attempt	a) Unsuccessful login attempt: Three incorrect password entries in succession during a single log-in attempt. Successive failed log-in attempts after three shall generate a single entry into the audit trail listing the time of the last attempt and total number of log-in attempts that have occurred in succession.
Reboot	b) Reboot: The rebooting or restarting of the Gateway by means of removing power or using a device-resident rebooting mechanism such as a reset button, power-up sequence, or access software feature.
Attempted use of unauthorized configuration software	c) Attempted use of unauthorized configuration software: The detection by the Gateway of an attempted use of configuration software, accessing computer, or a combination thereof that is not registered as legitimately able to be used for configuration of the Gateway.
Invalid configuration or firmware download	d) Invalid configuration or firmware download: The detection by the Gateway of a configuration or firmware downloads to the Gateway that does not contain the proper credentials that identify the configuration or firmware as valid.
Unauthorized configuration or firmware file	e) Unauthorized configuration or firmware file: The detection by the Gateway of a configuration or firmware download to the Gateway that does not contain the proper credentials that identify the configuration or firmware as authorized.
Alarm point change detect	Alarm points shall have momentary change detect capability so that the occurrence of an alarm will be reported on the next scan of the Gateway by the supervisory system. The Gateway shall report each occurrence as an individual alarm.
Event and alarm grouping	A means shall be provided to allow the user to group events and alarms. If a point is assigned to a group, only the group alarm shall be sent to the supervisory system upon the occurrence of that point. Individual points shall be assignable to a group in any combination. Assigning points to a group for supervisory reporting shall not cause the individual point identification in the audit trail to be affected. At least two groups shall be provided. One group shall be for events and the other group shall be for alarms. Group events and alarms shall have momentary change detect capability so that the occurrence of a group event or group alarm will be reported on the next scan of the Gateway by the supervisory system.

Supervisory permissive control	The Gateway shall provide a mechanism that, when enabled, requires independent supervisory permission prior to performing actions or requests in the field and/or remotely.

Gateway cyber security features	
Gateway functionality compromise	The general purpose of this sub clause is to alert the user of any possible compromise of the primary Gateway functions during the usage of either the protocol port(s) or diagnostic port(s). The Gateway vendor shall specifically state what functions, if any, may be affected by usage of any protocol or diagnostic port.
Specific cryptographic features	For Gateways that implement specific communications functions over IP based networks, the following cryptographic techniques and versions shall be implemented in the Gateway
Web server functionality	a) Web server functionality provided by the Gateway shall be over secured channel.
File transfer functionality	b) File transfer functionality provided by the Gateway shall be Secure File-Transfer Protocol (SFTP).
Text-oriented terminal connections	c) Text-oriented communication facilities using a virtual terminal connection over an Ethernet-based network shall be secure shell (SSH).
SNMP network management	d) Single Network Management Protocol (SNMP) implemented in the Gateway shall be SNMPv3.
Network time synchronization	e) Network time synchronization shall be Network Time Protocol (NTP). Network time synchronization functionality implemented by NTP shall be NTP v3/4 or SNTP 3/4.
Secure tunnel functionality	f) Secure tunnel functionality provided by the Gateway shall be a virtual private network (VPN) or TLS 1.2 two-way encrypted tunnel.
Protocol-specific security features	IEC 62351-3 TLS security shall be supported by all TCP based protocols.

Gateway configuration software	
Authentication	The Gateway shall have a means to authenticate that the configuration software being used to access or change the configuration is a copy that has been authorized by the user. Unauthorized copies of the configuration software shall be prevented from accessing any features of the Gateway.

Digital signature	The configuration software shall have the capability to generate a digital signature in the configuration and firmware download files indicating the file has been produced by an authorized configuration software program and by an authorized user. The Gateway shall have the capability to read the digital signature applied to a configuration file or firmware file to verify that the file has been created by an authorized entity and has not been altered or corrupted. The Gateway shall only accept properly signed files
ID/password control	The configuration software shall be ID/password controlled so that the software cannot be accessed without the proper ID/password combination. At least ten individual ID/password combinations shall be provided for each copy of the configuration software program. Under no circumstances shall the configuration software cause the passwords of the software itself or the Gateway to be displayed in readable text.
ID/password-controlled features	Gateway configuration software shall have the ability to assign features to specific users and/or roles. At the least, permission to view/change configuration data shall be assignable on an individual user or role basis
View configuration data	In view configuration data mode, a user can only view configuration data. No changes to the configuration can be made.
Change configuration data	In change configuration data mode, the user can change and save configuration data and/or firmware revision files to be uploaded to the Gateway at a later point in time.
Full access	a) Full access: In full access mode, all functions, including ID/password changes and user assignment levels can be made.
Change tracking	b) Change tracking: The configuration tool shall track changes to the Gateway configuration. Audit-trail log shall be provided for the configuration changes.
Use monitoring	c) Use monitoring: The configuration tool shall log when a user begins and ends using the tool
Download to Gateway	d) Download to Gateway: The configuration tool shall log when a user applies (downloads) a configuration and or firmware revision to a Gateway
Communications port access	All communications ports, whether physical or logical, other than the diagnostic port on the Gateway shall have the capability to be enabled or disabled through configuration of the Gateway. When disabled through configuration, no communications shall be possible through the disabled port. The Gateway shall have all User Datagram Protocol (UDP) and Transmission Control Protocol (TCP) ports that are not being used by an application disabled

f. Monitoring:

Gateway cum SDC should be capable of providing the following features.

i. IED communication status.
ii. Module health.
iii. IEC 60870-5-101 / 104 connection status.
iv. Hot / Standby Mode Status
v. Gateway cum SDC shall have the status of communication and information of system and minor setting change.
vi. Gateway cum SDC must have a potential free contact for power loss/failure of power card. This supports user to provide alarm on failure of power supply to gateway.
vii. Gateway cum SDC shall support DI/DO inputs for user configuration/monitoring.
viii. Utility for system parameter monitoring, configuration, online view of data.
ix. Gateways/SDC shall have LEDs for Health, Communication Error, Alarm, Event, Hot Standby, Power module status, LAN ports link/activity and serial Tx/Rx etc.

i. Geo Positioning System (GPS):

i. Time Synch. Equipment With Antenna & NTP Display, Antenna Cable, Aux. Supply: 90-370V DC, 85-260V AC, 47- 55Hz, (Work on only AC not accepted) Ports: IRIG-B (Modulated), IRIG-B (Un-Modulated), RS232, SNTP, PPS.
ii. The Time synchronization equipment shall receive the co-ordinate Universal Time (UTC) transmitted through Geo Positioning Satellite System (GPS) and synchronize equipment to the Indian Standard Time in substation.
iii. The times synchronization shall be realized using the SNTP protocol to inter system.
iv. Time synchronization equipment shall include antenna, all special cables and processing equipment etc.
v. It shall be compatible for synchronization of Event Loggers, Disturbance recorders and SAS at a substation through individual port or through Ethernet realized through optic fiber bus.
vi. The synchronization equipment shall have 2 micro second accuracy.
vii. Equipment shall give real time corresponding to IST (taking into consideration all factors like voltage, & temperature variations, propagation & processing delays etc). Including communication time for satellite link to achieve real time signal.
viii. Equipment shall meet the requirement of IEC 60255 for storage & operation.
ix. The system shall be able to track the satellites to ensure no interruption of synchronization signal.
x. The output signal from each port shall be programmable at site for either one hour, half hour, minute or second pulse, as per requirement.
xi. The equipment offered shall have six (6) output ports. Various combinations of output ports shall be selected by the customer, during detailed engineering, from the following.
    1. Voltage signal: Normally 0-5V with 50 milli Seconds minimum pulse duration. In case any other voltage signal required, it shall be decided during detailed engineering.
    2. Potential free contact (Minimum pulse duration of 50 milli Seconds.)
    3. IRIG-B
    4. RS232C
    5. SNTP Port
    6. PTP port
xii. The equipment shall have a periodic time correction facility of one second periodicity.
xiii. Time synchronization equipment shall be suitable to operate from 220V/110V DC supply available at the substation with voltage variation of + 10% and 15%

xiv. Equipment shall have real time digital display in hour, minute, second (24 hour mode) & have a separate time display unit to be mounted on the top of control panels having display size of approx. 100 mm height and in hh:mm:ss format.

j. GPS Antenna and Receiver

i. Antenna location : The antenna will be located on the roof of the EHV substation's control building
ii. Antenna housing: The antenna shall be placed in a weather proof plastic housing.
iii. Lightning Protection: Surge protector with response time of ≤1nsec and a discharge current of 10KA, housed in an aluminum case.
iv. Signal strength at the input of the antenna: ~ 1X10 E-16 Watt, i.e. below the general noise level.
v. Temperature Range : -5 Deg to + 55 Deg
vi. Antenna supports: the antenna will be supported by brackets of anodized aluminum and designed to withstand strong winds.
vii. Low-noise ore-amplifier (optional, depending on the supplier's opinion, given the fact that the antenna receiver cable distance is about 100m): Fitted behind the antenna shall be an extremely low-noise preamplifier. The low-noise preamplifier will be located inside the EHV substation's control building.
viii. GPS-receiver location : Inside the EHV substation's control building, rail mounted
ix. GPS-receiver supply voltage : 220V/110V DC
x. GPS-receiver configuration and setup: Via professional "windows" based software which must be included in the supply.
xi. GPS-receiver interfaces : Serial interfaces with RS 422 hardware or RS 232 or RS 485
xii. Cabling: All required cabling for the connection of antenna, preamplifier and receiver and of the GPS system to the HMI center unit, must be included in the supply. Furthermore the cables must be described in great detail in the offer.
xiii. The length of cable between antenna and receiver : ~ 100 m

k. Printer

i. It shall be robust and suitable for operation and shall accept and print all ASCII characters via master control computer unit interface.

ii. The printer shall have in built testing facility.

iii. Failure and dynamic status of the printer shall be monitored in NMS software.

iv. Any protocol convertor required for the same, shall be supplied by the vendor.

v. The printer shall have an off line mode selector switch to enable safe maintenance.

vi. The maintenance should be simple with provisions for ease of change of print head, ribbon changing, paper insertion etc.

vii. Printers mounted in the control room shall be provided with a separate printer enclosure each. The enclosure shall be designed to permit full enclosure of the printers at a convenient level.

viii. Plexiglas windows shall be used to provide visual inspection of the printers and ease of reading. The printer enclosures shall be designed to protect the printers from accident external contact and each should be removable from hinges at the back and shall be provided with lock at the front.

ix. All reports and graphics prints shall be printed on A4 size color laser printer.

x. Printer shall be continuously online.

xi. The printing shall be with a minimum of 132 characters per line. The printing operation shall be quiet with a noise level of less than 45 dB suitable for location in the control room.

xii. A4 Color Laser Printer specification:
Print Resolution: Up to 600x600dpi
Aux. Supply: 110-240V AC,
Port: 1 Hi-Speed USB 2.0, 1 Fast Ethernet 10/100base-TX

l. Hardware Functionality of Auxiliary BCU:

i. Auxiliary BCU shall be compliant to IEC 61850 Ed-1 & 2.

ii. Digital data to Aux BCU shall be taken from potential free contacts.

iii. All the data (analog & digital) pertaining to, Diesel Generator set, ACDC panel, Distribution Transformers, battery charger etc, shall be taken into SAS through Auxiliary BCUs and they all shall be mapped to SLDs (Pictorial View).

iv. The status and control of auxiliaries shall be done through separate one or more IED and all alarm and analogue values shall be monitored and recorded though this IED.

v. Necessary interfacing devices / transducers shall also be included in the substation auxiliary BCU in order to integrate station auxiliaries with SAS.

vi. The exact number and description of digital inputs shall be as per detailed engineering requirement apart from the above mentioned digital inputs; minimum of 64 inputs shall be kept for MAHATRANSCO use in future.

Note: It is requested to note that specification given in this chapter are suggestive and will be finalized mutually after detailed survey and assessment of MSETCL requirement.

----------End of Chapter – 2----------

Chapter 03

Remote Access system

3.1 Introduction

This Technical specification is for the Remote Access system (RAS) for accessing the substation relays/IEDS from Control Center under the MTAMC project.

The following are the functional requirements of this system:

a) Auto downloading of disturbance record files and Event logs from IEDs in the substation at the Remote Control Center.
b) Remote access of the Relays/IEDs in the Substation from Control Center for collecting the configuration information, event lists etc.
c) Remote configuration of the Relays/IEDS in the Substation from the Control Center.
d) Provision of RAS client at substation for accessing all above RAS functionalities.
e) The Remote Access system (RAS) shall provide access to the Relays, Condition monitoring devices and other IEDs which are communicating on TCP/IP, for configuration changes, database downloads and diagnosis.

3.2 System Architecture

The Conceptual system architecture of the Remote Access System (RAS) is described below.

1. **Substation communication architecture**

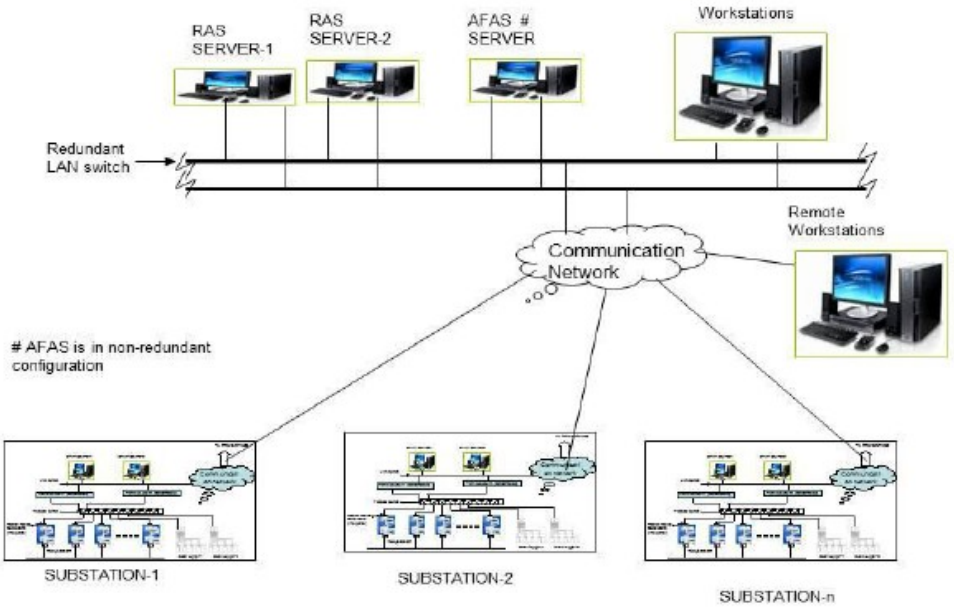
   Proposed Substations under this scheme are having SAS system commissioned. Newly proposed Gateway cum SDC shall communicate with existing IEDs at substation through available network. Gateway cum SDC shall be commissioned to achieve the RAS functionality.

   The existing IEDs will provide disturbance recorder file in COMTRADE format (1999 or above standard).

2. **Control Center architecture**

   The existing Control Center architecture contains redundancy in all aspects such that failure of a single hardware/software does not affect the availability of the system. Proposed Gateway cum SDC redundancy is considered in the Substation architecture.

   The communication link between Gateway cum SDC and the Control Center is based on IEC 104 with necessary security features, and hardware firewall is used to isolate each network to ensure that the core system is effectively protected.



Indicative communication architecture for Control Center

3. System sizing

The Gateway cum SDC shall be sized such that they can accommodate 100% expansion in the number of devices connected to it. The response times for various applications is indicated in Table-A. The Gateway cum SDC shall be sized to store relay data for at least 1 month. The number of files/size of files being generated by each relay per day is indicated in Table-B.

4. Time synchronization

The various time synch signals which are available include RS232, SNTP, IRIG-B etc. The time of the Gateway cum SDC shall also be synchronized by signals from Control Center or from the existing GPS receivers at each of the substation.
All the IEDs at substations shall have redundant Time Synchronization. Primary Time sync shall be from the existing GPS receivers at each of the substation and secondary time sync from Gateway cum SDC.
Time Synchronization monitoring of IEDs and Gateway cum SDC shall be done in supplied RAS client.

5. Remote Access System PC with Monitor - Specification required from IT section

a) Latest version of Remote Access System Software (RAS)
b) OS: Windows10 professional, 64 bit
c) CPU: Intel i7 8th gen & above 3 GHz,
d) Memory: DDR3L 1.35V ECC; 8GB, Storage: RAID1, 1 x 2.5'' SATA HDD 1TB.
e) Anti-glaze LED monitor Size: 30", multimedia keyboard & optical mouse
f) Maximum Resolution: 1920x1080
g) Backlight: LED Aux
h) Aspect Ratio: 4:3
i) Port: HDMI/VGA.

j) USB ports (3.0).
k) Supply: 220-240 VAC, 50 Hz ± 3 Hz

6. Functional requirement of Gateway cum SDC

The data (disturbance records/files/logs/database changes/updates) shall be synchronized between the Gateway cum SDC and control center. As per the new architecture Gateway cum SDC proposed in a Hot-redundant mode. In case if Gateway cum SDC is not available or offline, then this information shall be synchronized as soon as it becomes operational. In no case there shall be a loss of data. All the functions of the Gateway cum SDC shall start automatically upon power up or restart of the Gateway cum SDC. The availability of the Gateway cum SDC shall be monitored by the existing servers at MTAMC CONTROL CENTER. SDC shall be integrated into all the functionalities of existing Remote Access system at MTAMC control center.

a) Data Acquisition: Acquisition of Disturbance data records from various Relays/IEDS

System shall be capable of archiving COMTRADE DR files with standard IEEE naming in server.

The devices (DR/Relays/IEDs) shall be polled periodically at every 60 seconds, so that the DR files are available in the Gateway cum SDC within 60 seconds of occurrence of disturbance. The file shall be available at the MTAMC CONTROL CENTER after required processing within 5 minutes of its occurrence. Any extra delay because of the limitations of the existing relays shall be additional to the specified response time.

The Gateway cum SDC shall support data acquisition both through scheduled polling and device (DR/IEDs) initiated transfer and on demand from the SCADA system.

The Gateway cum SDC shall also monitor the communication status/healthiness and inform the loss of communication with a device to the remote server at MTAMC as an event. All device communication failures shall be logged and stored in the Gateway cum SDC.

The captured data from IED's must be filtered and processed to extract the longest amount of useful information.

b) Acquisition of Disturbance data and event log from other computers

Many relays are connected to computers having vendor specific applications which poll disturbance data from the relays periodically or on demand. These files may be in a proprietary format or in COMTRADE format. These files are to be acquired by the Gateway cum SDC and stored. Any conversion required shall also be done in the Gateway cum SDC. These files then shall be sent to the Control Center.

Similarly, the Disturbance records in substations having Substation Automation Systems are being polled by an engineering workstation PC and can be taken either from this PC or directly from the various relays using IEC 61850. It is preferable to acquire the data from the Relays directly as the Engineering PC is in a non-redundant configuration.

c) Data collection

A basic user interface for interacting with Gateway cum SDC for accessing the stored information chronologically and analyzing its functioning (various logs) shall be provided.

d) **File Management, Archiving and transfer mechanism**

The system should be capable of having adequate storage for storing no. of fault records as specified in the performance tables.

The files shall be given a standard name such that it identifies the Substation, the device, the time, the date of the disturbance records preferably in line with the IEEE file naming convention.

These files shall be transferred to the Control Center periodically and on demand. The periodicity shall be such that the disturbance records are available at the Control Center within the pre-defined response time. The file transfer mechanism shall be robust enough to allow for communication disturbances and reestablish the communication. The users at the control center shall be able to explore the directory in the Gateway cum SDC just like a Windows Explorer. The files which have been transferred to the remote location shall be tagged with the time and date on which these were sent to the remote-Control Center.

e) System and Device monitoring

The availability of each of the devices (DR/Relays etc.) as well as the networking equipment shall be maintained at each of the Control Center. The communication failure to any of the device shall be alarmed. The no. of records received from each device, substation shall be available. Diagrammatic representation of Gateway cum SDC and the various devices connected in each substation shall be readily available for the Operator. Devices not communicating shall be shown in a different color than the devices communicating properly. If the operator is viewing the Substation list, then the same color representation shall be used i.e. if any of the device in a substation is not communicating it shall be shown in red color.

Monitoring shall include:

i. System Information:
   a) The list of components installed with their version
   b) Database version & size at the control center.

ii. System monitoring: It shall include-
   a) Status of components installed in substations (Gateway cum SDC and associated relays/IEDS)
   b) Devices status – Device name & type, S/S where the device
   c) Clients connected at that instant
   d) Server load level (No. of records processed in last 24 hours etc)
   e) Communication Manager Activity status: (polling status, current data transfer.)

iii. Activity logging:
   a) It shall allow user to sort/filter events by time stamps, event type etc.
   b) It shall have the ability to store more detailed level by checking operation log categories. This allows to provide trouble shooting information.

7. Functional capabilities of Existing Remote Access system at MTAMC Control Center

The remote Access system available at control center provides access to the remote devices including protection relays, Controlled switching relays, Condition monitoring device. These remote devices are having Ethernet ports.

The devices with Ethernet/TCP/IP connectivity are accessed directly on the LAN. The application software, which is supplied by the IED/relay vendors, is used to access the devices from remote. The application software, which is device specific (to be provided by the employer) provides access the relays for configuration and settings changes. The configuration files are kept in a centralized location. Similarly, the data from condition monitoring devices are accessed from the Control Center through the device specific applications.

Navigation software is provided for remote Access of the devices in substation. This navigation software organizes the remote devices in a structured tree and link the respective application software along with the configuration settings (port no., protocol, communication parameters) for communication to each of the devices.

A simple click on the device icon in the structure tree launch the device specific application and automatically connect to the device.

The user interface for RAS provides the following requirements in addition to the above requirements.

a. Provide customized display of devices i.e. devices enabled/disabled for access as per the user rights assignment
b. Add, modify and remove access rights to the IEDs from a central location
c. View the status of all devices connected through Gateway cum SDC in the substation/ Gateway.
d. Enable and disable the pass-thru connections at the substation gateway
e. Manage device configuration files, IED software versions, passwords and access history centrally
f. Manage alarms and events
g. Track user access to the devices
h. Produce user activity audit trail
i. Manage device access logs
j. Log all user actions. A centralized architecture is preferred in which a server at each of the Control Center (MTAMC) holds the configuration and connectivity information and the user can access the devices through a client of navigation software installed in his system. A device can be accessed from multiple Control Center and hence the RAS system shall consider this requirement.
k. The data/files received from the various devices are organized in a predefined hierarchical manner.

8. Cyber security

Firewalls are being provided at the substation and in the Control Center as per the technical specifications. The Remote Access system shall be suitable for working with the Firewalls.

Also, the Operating systems of the computers shall be hardened and all unnecessary operating system services shall be disabled. Similarly, all other protocols and services in the networking hardware/interface hardware shall be disabled.

Integration of Protection and Control IEDs in the substation shall be carried out in a secured manner in compliance with relevant NERC CIP Cyber Security standards particularly CIP-0051 (Electronic Security). Remote Access to the IEDs in the substation shall be restricted through a single point by the "Gateway cum SDC" or a "Substation Gateway". The Substation Gateway can be provided as a standalone unit or can be an integral part of the Gateway cum SDC. The Gateway shall act as a single point of access to the substation devices. The Gateway must effectively create an electronic perimeter that protects all the electronic devices e.g. IEDs/ Relay/ DR from unauthorized access.

The Gateway cum SDC should implement the following capabilities:

a. Perform true authentication with user name and password before allowing connection to the IEDs.
b. Set up true authorization by assigning users to groups with well-defined privileges.
c. Provide pass-through connections to and from any IED for maintenance and configuration. These connections can be used locally in the substation, or remotely through the WAN to the intelligent gateway. Pass thru shall be TCP/IP pass through or serial pass through.
d. Grant Pass-thru connection rights to authorized users only.
e. Log all successful or failed pass-thru attempts in a temper-proof log.
f. Encrypt all pass-thru connections that span the WAN connection.
g. If required, encrypt all data communications with SCADA or other Control Center.
h. Provide the SCADA with internal data points to indicate the state of pass-thru connections, globally or to any specific IED
i. Provide the SCADA with internal control points to enable or disable pass-through access, globally or to any specific IED
j. Provide the SCADA with the state of each device link, to detect device failure or tampering

9. APIs, Device drivers and Software deliverables

The Contractor shall supply all the application programming interfaces (API) which shall be used for interfacing the RAS to other systems like SCADA system etc. Specific device drivers developed for interfacing the various devices (IEDs/Relays) shall be delivered to the Employer as part of the system.

The protocol used to exchange the data (disturbance records/event logs) between substation and the control center shall be IEC 60870-5-104 or SFTP. The details of protocol messages used and the data formats shall be provided so that the employer can use it in integration of future substations with the Control center.

10. Performance and Sizing requirements

The performance and sizing requirements for the AFAS system is given below:

Table-A Response times

Sl.no.	Description	Periodicity/Response time	Remarks
1	Data Concentrator Polling of the Devices in S/S	Polled within 60 seconds or on demand	Triggered from SCADA on CB operation/EL
2	Processing at Station Data concentrator	60 seconds	
4	Availability of Fault Summary Analysis Reports at Control centers	5 minutes after occurrence of fault at the Substation	
5	Intimation to Operator regarding availability of Summary reports	10 seconds after generation at Control center	
6	Failover between Servers at Control centre	10 seconds for detection and 30seconds for failover	
7	Event Logger data shall be available at the Control Centre	within 2 minutes of its output from the Event logger	
8	Maximum processing time for each DR at the	10 sec.	

Table-B- Sizing Requirements

Sr.No	Description	Sizing	Remarks
1	No. of Substation	33	
2	No. of devices	3300	App.100 per S/S
3	Server utilization (CPU and Memory)	30%	Consider 5 no. of disturbance files are received per minute during peak condition
4	No. of Operators	33 users	concurrent
5	Online data storage (DR files & Reports) in Servers	Ten years	Considering 1000 DRs every day
6	Online Data storage at Station Data Concentrator	For 30 days assuming daily 1 file from each DR in the station and 1000 lines (132 character) from event logger	
7	Size of DR file and duration –Gateway cum SDC	12 Analog, 128 Digital inputs for 5 seconds	
10	Storage of Configuration Information	50 GB	

Note: Bidder is requested to note that specification given in this chapter are suggestive and will be finalized mutually after detailed survey and assessment of MSETCL requirement.

----------End of Chapter 3----------

Chapter-04
Visual Monitoring System (VMS)

4.1 Introduction

The VMS system deployed at substations serve to monitor and safeguard substation assets through PTZ cameras and PIDS. Data from these systems can be locally viewed, monitored, and controlled at the substation, as well as accessed remotely at any time from the MTAMC Control Centre, Airoli. Each substation has localized storage for system data. The system also features event archiving, allowing important incidents to be securely stored and retrieved at any time through VMS software at local level irrespective of communication link availability and at control centre subject to availability of communication link.

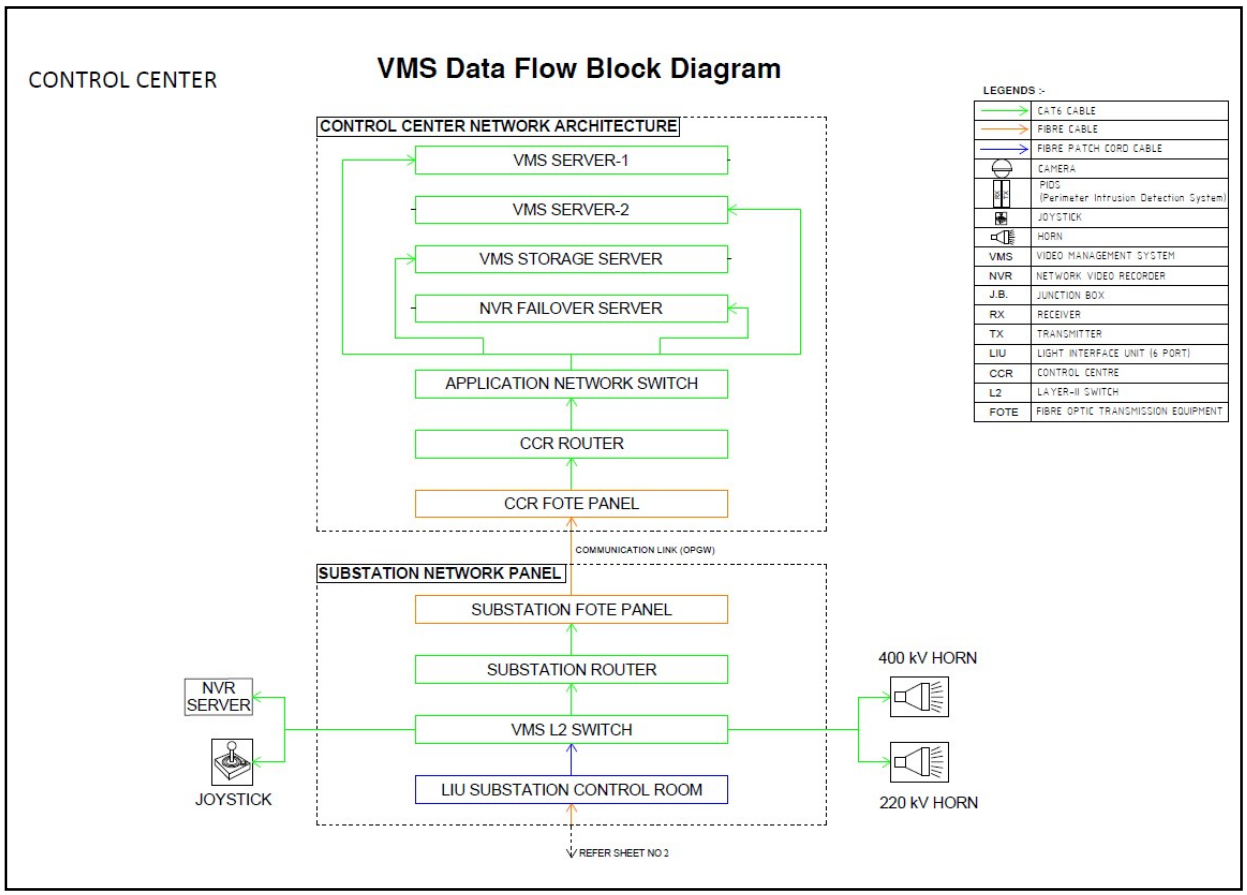
VMS includes a Perimeter Intrusion Detection System (PIDS), which monitors the boundaries of the switchyard to detect any unauthorized entry through the sub-station's perimeter wall. The PIDS uses infrared beam technology to create an invisible fence around the sub-station premises. If this invisible fence is breached, an alarm is triggered to alert security personnel

The existing VMS system deployed at the Control Centre has major components:

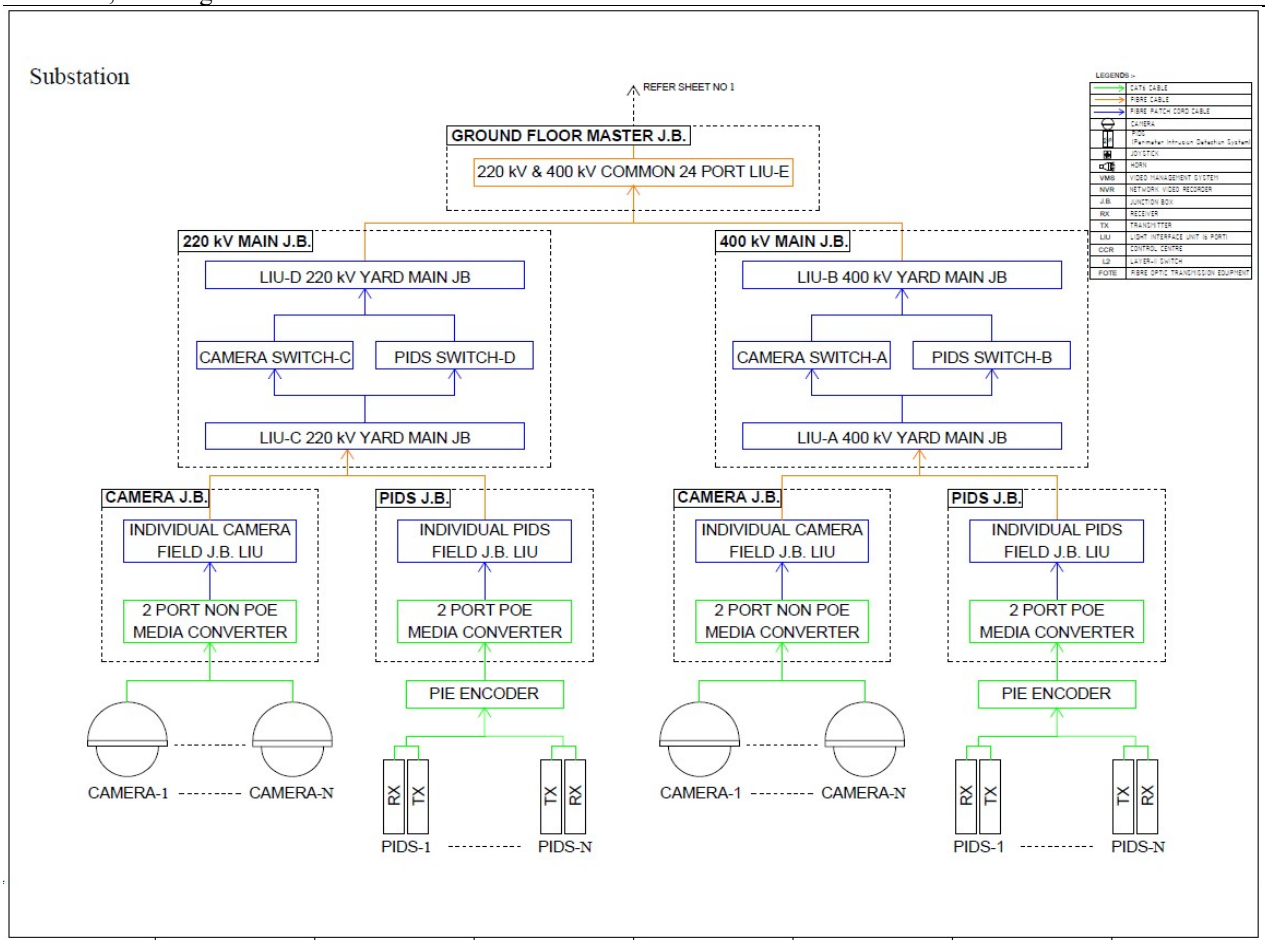
a) **VMS Management server**: main server for entire VMS system which manage all Back-end operations and communication across all VMS network between substation and control centre. There are two management servers working in hot redundancy and has Siveillance Video Management Client software (SVMS). It is capable of configuring Users, Roles, and Devices (Camera, NVR), rules and other hardware pertaining to the substation locations.
b) **VMS Storage Server**: It is common database storage for both the VMS management server.
c) **Fail over Network Video Recorder (NVR)**: a backup NVR which takes over when any of the substation NVR fails.
d) **Other components:** Workstations, network switches, Routers, FOTE panel, joystick etc.

The existing VMS system deployed at Substations, the Network Video Recorder (NVR) serves as the major component, facilitating communication among local devices such as IP-based cameras, PIDS, and horn speakers. The NVR records data as per configuration from cameras and PIDS alarms, using the client version of SVMS. Additional components at substations include junction boxes, switches, LIUs, routers, FOTE panels, and horn speakers.

Block Diagram of existing VMS system deployed at nine EHV substations enclosed:



Sub: Calling of budgetary offer for substation-level work related to the various systems proposed at EHV substations of MSETCL, for integration into the centralized MTAMC Control Centre under MTAMC Phase-2.



1. Scope of work

a) For new Camera and new NVR :

i. The contractor shall design, engineer, supply, erect, test and commission at substations which includes IP based cameras, Network video recorder, mounting arrangement for cameras, cables, and any other items/accessories required for a fully functional system and integrate the above devices in the existing centralized VMS system software at MTAMC Control Centre.

ii. The exact number of Camera/NVR to be installed and their locations at individual substation shall be finalized during detailed engineering.

iii. The number of cameras and their placement shall be decided in such a way that any location in the switchyard area can be monitored. The cameras shall be placed in position to monitor at least:

1) The isolator contacts for each and every isolator pole in the switchyard
2) All the Transformers & Reactors bushings
3) All the major equipment such CB, CT, CVT, ICT/Transformer, Kiosk of station with SAS etc.
4) Main entrance gate.

Also, note that the Switchyard area and the layout of the equipment is different at various substations and the Contractor has to finalize the placement of cameras for each substation after detailed survey.

b) Integration of existing cameras with the Visual monitoring System: CCTV system is already installed at some substations, the Integration of this system shall be in the scope of contractor.

c) For PIDS (Perimeter Intrusion Detection System):

i. The contractor shall design, engineer, supply, erect, test and commission at substations which includes PIDS sensors, intrusion alarm panel, mounting arrangement for perimeter sensor, cables, IP module for VMS integration, enclosures and any other items/accessories required for a fully functional system & integrate the complete Perimeter intrusion detection system in the existing deployed VMS software.

ii. The number of perimeter sensors and their placement shall be decided in such that entire perimeter can be secured.

iii. Switch yard area and the layout of the equipment is different at various substations and the Contractor has to finalize the placement of Perimeter sensor for each substation after detailed survey.

Please note:

The BOQ as estimated by the MSETCL covers only the major equipment of the system. Contractor is advised to assess additional items/ components as required to make the Visual Monitoring System completely operational.

3. Features of existing VMS Software:

a) View live video.
b) Control the PTZ position of a camera.
c) Search through the stored video clips of a camera for recording of an incident
d) Recording of a snapshot of the current viewed video.
e) Addition of new camera to the system.
f) Delete a camera from the system.
g) Changes in the configuration settings for a camera.
h) Configures the following for live video and/or recording:
i) Frame rate, Resolution.
j) Compression mode (H.264, MPEG-4, JPMEG).
k) Search for video clips from different cameras.
l) View and acknowledge alarms.
m) Configuration of the pre-record time and post record time in case of occurrence of an event and able to view the video.
n) Streaming/snapshot automatically at the time of occurrence of the event.
o) Define Pre-sets and/or Create a sequence (camera tour)
p) Conduct a sequence (camera tour)
q) Create a multiple camera view.
r) View a multiple camera view.
s) View live video from a custom schematic
t) Add live video to a custom schematic
u) Configure, schedule and tune Video Analytics.
v) Configure, schedule and tune camera tamper alarms
w) View the audit log.
x) Manage Users.
y) Configuration of administrative rights/priority for users
z) Have the facility of operator messaging which allows operators to communicate with each other. Operators can exchange text, images and video sources.

aa) Video summarization – to view hours of video in minutes both in offline and online mode of operations.
ab) File compression and sharing format.
ac) Video conferencing.
ad) Substation level equipment reporting tool.

Please note: Required VMS software at substation should be compatible with the existing VMS Software at MTAMC Control Centre.

4. Technical Specifications

Please note: Following are the basic minimum specifications. Contractors can offer the latest and suitable specifications.

a) VMS Camera:

Sl. No.	Description	Minimum Specifications
1	Salient Features	a) The cameras shall be pure IP and fully digital without having any External encoder circuit/ web-server associated with it.
		b) The cameras shall have PAN, TILT and ZOOM facilities so that it can be focused to the required location from the remote station through a controller.
		c) The cameras must be of Day and Night type. The cameras must be controllable for use in black & white mode when needed. The cameras shall have provision to operate with enhanced sensitivity in the darkest conditions.
		d) The cameras must be operative in automatic mode for switching from day mode to night mode depending on the ambient natural light intensity without having to manually operate. All cameras shall be operative in colour in day and black & white modes in night.
		f) The Cameras shall be provided with built-in external alarm input/ output ports minimum (2 in, 2 out)
		g) It should also be possible to view the individual IP based cameras through internet browsers by authorized Users without need of any other software. All the features of the Camera like resolution, FPS, PTZ features etc shall be available for control.
		h) The VMS camera shall be suitable for wall mounting, ceiling mounting, pole mounting and switch yard structure mounting. All accessories required for the mounting shall be provided.
		i) It shall be possible to define at least 128 selectable preset locations per camera so that the camera gets automatically focused on selection of the location for viewing a predefined location. It should be possible to name each of the preset position using at least 16 alphanumerical characters.

		j) The camera should be able to detect motion in day & night environments having light intensity of Colour: 0.5 Lux; B&W: 0.02 Lux.
		k) Each Camera shall have an inbuilt battery/flash memory for back-up configuration/ time information.
		l) The cameras features must be quickly and easily accessible by provision of on-screen displays.
		m) The VMS camera shall have tamper proof feature i.e. it shall inform the Operator of any change in its placement, blocking of the view etc
		n) The VMS camera shall have BMC (masking of light sources) and BLC (compensation for lighting effect/shadow) feature.
		o) The VMS camera shall store 'Tour' feature, i.e. perform a pre configured PTZ movement and record the video during this movement. When the operator takes control of the camera, the camera shall move as per the operator's direction and return to the 'Tour' after a pre configured amount of time. Minimum 8 guard tour per camera.
		p) The Camera should be EMI/EMC compatible and shall work without causing interference and be immune to the / Extra High Voltage environment of the Substation.
2	Other features	• Remote firmware updates • Secure backup of all camera settings • Password protection prevents unauthorized users from altering system settings • Built-in surge and lightning protection · Communication : RS232, RS485 · UL certified
3	Housing Enclosure	The cameras shall have IP–66 Protection Class enclosures. Weather resistant Sun shields shall be provided in the Camera housing in all Cameras required to be installed outdoors. Enclosure shall have provision to avoid fogging during high humidity condition & Camera shall be able to perform. Housing shall be robust and not be affected by electromagnetic induction in a switch yard up to 765/400KV class.
4	Junction box	A Junction box (JB) shall be provided to accommodate all the accessories like media converters, power supply converters, LIU etc required at the camera site. The junction box shall be of MS painted sheet of at least 2.0 mm thick (cold rolled) or 2.5mm thick for hot rolled and meet the IP-66 ingress protection class. The JB shall have suitable provision for its mounting on the pole/lattice structure. The doors, removable covers and plates shall be gasketed with suitably profiled EPDM/Neoprene gaskets. All sheet steel shall be degreased, pickled, phosphate in accordance with IS 6005. After application of primer, two coats of finishing synthetic enamel paint shall be applied.

5	Camera Interface	The Cameras should be capable of interfacing with Optical fibre Cable and wireless radio system. Camera shall be preferably interfaced on Optical Fibre Cable and if OFC laying is not possible or due to any other site specific conditions, then camera shall be interfaced on wireless radio system. Accordingly, quantities of wireless system and cables may vary as per site requirement. Specify the details of the proposed wireless radio system in their offer. The Cameras and the access points shall be connected to the CCTV/visual Monitoring System through underground single mode 9/125 micron 6 core armoured direct burial fibre optic cable.

b) Outdoor IP66 PTZ HD Camera Specifications

S.No.	**Feature and Specs**	***Details***
1	Image sensor	¼" Progressive Scan CCD, WDR(128x or Better)
2	Security	Multiple user access with password protection
3	Effective Pixel/Resolution	720x576,704×576, 640×480, 384×288, 320x240
4	Compression	H.264 or MPEG-4 or JPEG
5	S/N (signal to noise) Ratio	> 50 dB
6	Electronic Shutter	1/3 to 1/10,000s
7	Scanning System	Progressive/Interlace
8	Zoom	36x optical, 12x digital
9	Lens	F= 3.4 ~ 119 mm, F 1.6- 4.5
		Horizontal Angle of View : 55.8"-1.7"
10	Electronic Image Stabilization	Electronic compensation for external vibration sources that cause image blurring;
11	Image Enhancement	Electronic improvement of sharpness of objects, lines or text in high contrast areas
12	Low Light Sensitivity (lux) - Colour: 0.5 Lux at 30 IRE , B&W:0.01 Lux at 30 IRE	0.45 lux colour, 30IRE
		0.012 lux B/W, 30IRE
13	Panning Range	Complete 360 degrees endless
14	Pan Speed	preposition speed 250°/sec, (Variable 0.10°/sec ~ 120°/sec)
15	Tilting Range	Minimum 180° Tilt Rotation (+/-90°)
16	Tilt Speed	preposition tilt speed 120/sec
17	Pre-set Accuracy	-+ 0.1° or better
18	Working temperature	-5 DEG C TO +50 DEG C

19	Working Humidity	10 ~ 90%
20	Mounting	Camera mounting/clamp size shall be robust enough to ensure no vibration which can affect the quality of video particularly at highest zoom level.

c) Substation/Local Network Video Recorder (NVR):

Sl. No.	Functionality/ Description	Minimum Specifications
1.	Location	The Network video Recorder shall be located at each of the substations and all the camera recording shall be done locally. It should be possible to store data for at least 15 days locally and can be viewed/playback from remote through client licensee. The NVR application software and hardware shall comprise of a single unit.
2	Type	Dedicated Network Video Recorder with hardware
		suitable to connect up to 32 Cameras.
3	Server Spec.	Intel Hexa Core (or better) 3.0 Ghz (min.) , 8 MB
		Cache ,16 GB memory , with suitable NVIDIA
		graphics card (2GB or more with GPU decoding) ,3 TB HDD , Raid 5 with suitable
		configuration along with Coloured LED 32" High
		resolution monitor
4	Recording and	Real time (25/15/12.5/10 or lower) fps per channel,
	display frame rate	User selectable
5	Recording Resolution	(PAL): 1280X720 , 704(H) x 586(V), 1920x1080 and higher MP
		It should be possible to select lower resolutions
6	Compression Method	H.265/H.264/MPEG-4 or better and latest
7	Alarm/Event Recording Capable	The NVR shall be capable to integrate with digital I/O points either available in cameras or access controller. In case of alarm triggered by any Digital Alarm Input the NVR ~~/ VMS~~ shall be capable to activate custom defined rule already programmed in the system without any manual intervention. Upon recognition of an alarm, the system shall be capable of displaying the video from the NVR~~/VMS~~ that is associated with the alarm point.
8	Network Capable	To be provided by using WAN or LAN router
9	RemoteViewing Capable	Using WAN or LAN router
10	HDDStorage Consumption	to size the memory requirement of the NVR for continuous recording of 10 cameras per location at 4CIF resolution, 25 fps for 15 days. 8 cameras are to be considered as on continuous tour mode operation
11	Operation	Triplex operation (simultaneous recording, playback, network operation)

12.	Optical Drive	16x DVD +/-RW with dual layer write capabilities.
13	Network Card	Dual 10/100/1000 Ethernet (RJ-45 port)
14	Operating System/Security/Virus Protection	Windows 2008 or latest Windows operating system with licensed Anti-virus etc. to specify details.

d) Perimeter Detector:

Sr. No.	Description		Minimum Specification
1	PRINCIPLE		The intrusion detector shall operate on the verified intrusion principle using Infrared Photoelectric (AIR)
2	OUTPUT AND ENCLOSURE	a	The detector shall provide the detection, signal processing, alarm relay, and operating power circuitry in the same enclosure; and shall provide an alarm relay actuation upon the detection of an intruder moving into or through its protection pattern.
		b	The housing cover and chassis shall be highly durable and heat resistant, and shall be capable of mounting to a Wall or Pole mounting either outdoor or indoor without modification. The enclosure shall be weatherproof construction rated to IP65 (International Protection Code 65).
		c	The detector shall feature a single piece electronics logic board whose circuitry is specifically designed for this detector alone, and which has sustained a substantial "Burn-in" test for several days. The case shall include easy wiring knockouts, and 4 pieces of Pole - mounting Bracket.
3	LED OPERATION	a	The detector shall incorporate Red LEDs to indicate the operating conditions on the Transmitter and Receiver. On the Transmitter, a Red LED illuminated shall indicate a transmitting condition, and the same LED not illuminated shall indicate a non-transmitting condition. On the Receiver, an "Alarm Condition" Red LED illuminated shall indicate an alarm condition, and the same LED not illuminated shall indicate a non-alarm condition. "The Alignment Level Indicator" 5 Red LEDs on the Receiver shall indicate a rough condition for a beam alignment. Their illumination shall represent the level of alignment ranging from "Poor" to "Excel". Each LED shall indicate 3 steps of alignment, slow flicker is okay, fast flicker is better, continuously ON is the best, totally providing 15 graduated stages
		b	Another red LED illuminated on the receiver shall indicate Alarm Memory condition that occurs immediately after the detector recognize a disarmed status by A.M. terminal input if there shall be any alarm during armed period, and shall remain until re-armed.
		c	The detector shall also contain a "D.Q. (Environmental Disqualification)" Red LED on the Receiver. It shall illuminate when the beam strength shall be below an acceptable level due to heavy fog, rain, snow or other changes in the installation site, continuing as long as the beam strength is below an acceptable level.

			Workstations on Windows to optimise the total cost of ownership as well as to ensure system openness.
4	MIRRORSAND DETECTION PATTERN	a	The high-grade Reflective Mirrors shall create more sharply defined and precise infrared beams to ordinary mirrors or lenses. The precise area of the detection field shall be specific. Sensor should be available for following detection range : 1. Detection range of 350ft. (100 meters) outdoor and 700ft. (200 meters) indoor, with a Maximum Arrival Distance of 3,500ft. (1,000 meters). 2. Detection range of 200ft. (60 meters) outdoor and 400ft. (120 meters) indoor, with a Maximum Arrival Distance of 2,000ft. (600 meters). 3. Detection range of 650ft. (200 meters) outdoor and 400ft. (120 meters) indoor, with a Maximum Arrival Distance of 2,000ft. (600 meters).
		b	Easy optical beam alignment shall also be incorporated into the detector. The 2X magnification View finder and LED indicator shall provide rough alignment, while voltage meter jacks shall allow fine tuning. The alignment angle may be adjusted easily either horizontally (180 degrees = +/- 90 degrees) or vertically (20 degrees = +/- 10 degrees).
5	RECIEVER FEEDBACK		Receiver unit should be able to communicate back to transmitter. In bad weather conditions when the beam energy being received by receiver from transmitter drops than receiver should give command to transmitter to increase the beam power. Thus operating effectively even in bad weather condition.
6	BEAM POWER CONTROL		Transmitter should have button which helps in controlling the beam power being emitted from it to receiver.
7	SUN SATURATION COMPENSATION		Photo beams should be able to reduce the false alarms caused by sun saturation by adjusting its photo beam strength.
8	CERTIFICATION		UL, CE

e) PTZ Keyboard cum Joystick:

·Fully functional dynamic keyboard/joystick controllers.
· Controls all pan, tilt, zoom, iris, pre-set functions.
· Control up to 255 units from a single keyboard.
· Many pre-set options and advanced tour programming.
· Compatible with all connected cameras.

S.No	Item Description	Features
1.	Key Application	wired keyboard control operation of PTZ functions for weatherproof dome cameras
2.	Pan / Tilt Protocol Supported	Selectable
3.	PTZ Data Transfer Baud Rates Supported	selectable 1200 bps / 2400 bps / 4800 bps / 9600 bps
4.	Additional Features	dynamic joystick for smooth camera movements, preset location option for quick access to frequently monitored areas

f) IP module for VMS integration

Sl. No.	Description		Minimum Specification
1	General	a	The encoder shall have five dry contact closure alarm inputs and Ethernet output.
2	ELECTRICAL SPECIFICATIONS	a	Power Supply : PoE (IEEE 802.3 af/at Compliant)
		b	Alarm Output : ASCII Event Code (UDP/TCP)
		c	Supported Protocols : ARP, UDP, TCP, ICMP
	CERTIFICATION	d	CE

----------End of the Chapter-4--------

Chapter 05

Transformer Monitoring System

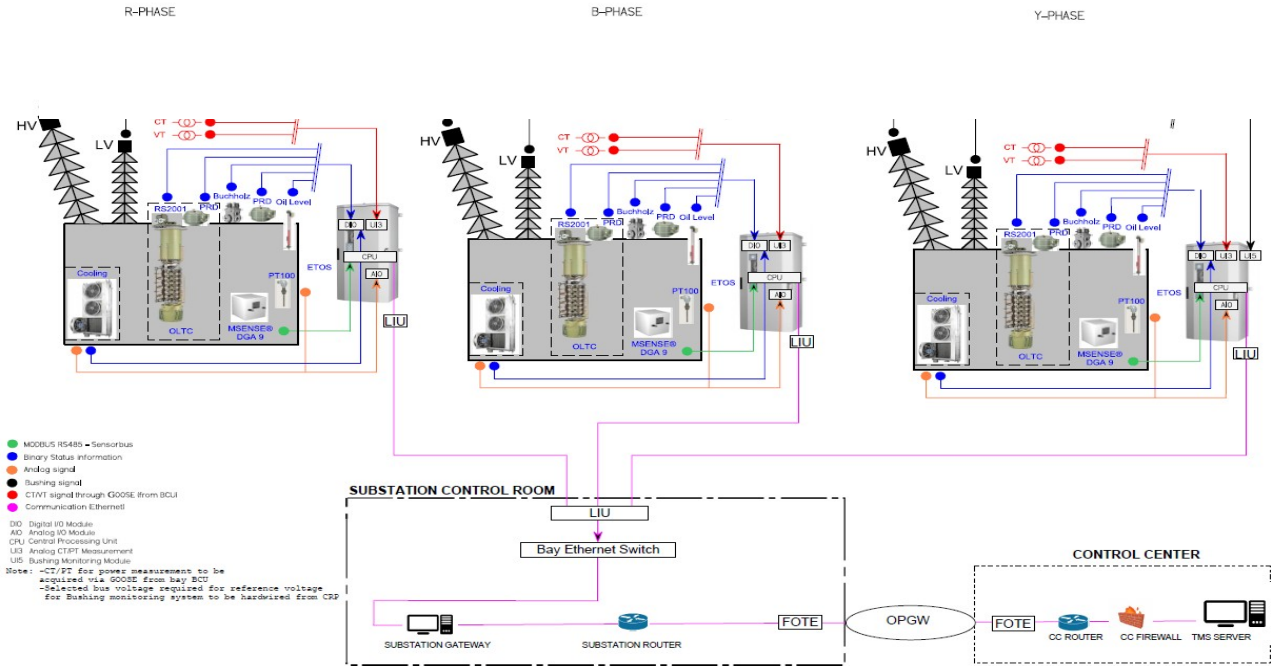
1. Introduction:

The Transformer Monitoring System is installed at nine numbers 400kV Sub-Stations.

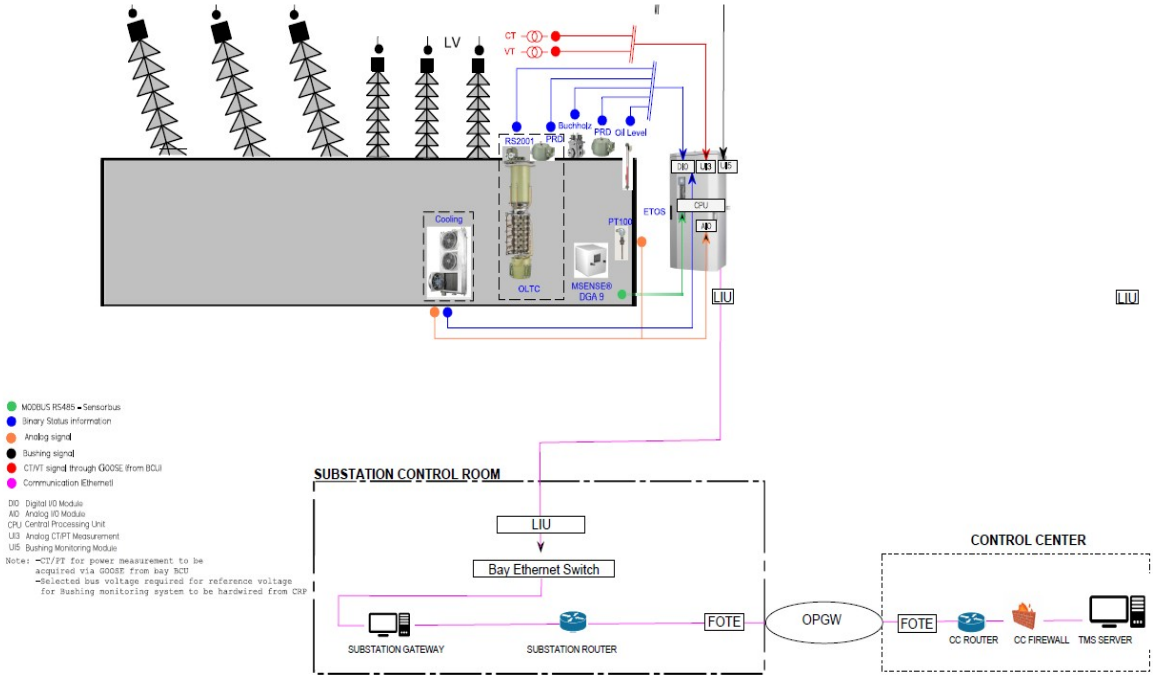
This system monitors the condition of Transformer assets of MSETCL. In this system a Transformer Monitoring Unit (TMU) is installed in the switchyard near Transformer Assets. This system facilitates monitoring the transformer condition like Loading, Bushing Tan Delta & Capacitance, nine gas Online DGA, Transformer Auxiliaries such as OTI, WTI, TPI, FAN and Pump status etc to assist the operator for efficient operation and maintenance of the transformer.

The indicative architecture required for TMS at Sub-Station Level is as given below,

1. Single Phase ICTs



2. Three Phase ICTs or Power Transformer



3. Scope of works:

The TMS shall have two main components as given below,

a) Transformer Monitoring Unit (TMU)

b) Online DGA

c) Bushing Monitoring System (BMS)

a) Transformer Monitoring Unit (TMU)

The TMU supplied should Technical Specification Asset Monitoring system Transformers should be equipped with an on-line condition monitoring. Such a system should support the operation and maintenance of a transformer with regard to at least following aspects:

i. It should provide tools which enable the user to operate a transformer close to its thermal/current/voltage limits, with taking into account thermal aging and avoiding critical hot spot temperature. It should support advanced management of possible overload conditions.

ii. With use of sensors, sophisticated modelling and diagnostic functions it should help to detect incipient faults at an early stage, in order to avoid a catastrophic outage of the transformer. The sensors shall be provided for WTI, OTI, TPI, OLTC Motor Power, OLTC Op Hrs, OLTC Switching Time etc.

iii. It should enable the user to perform condition-based maintenance of the transformer.

The TMS system shall be capable of measuring following,

The following measured variables should be recorded by the TMU,

i. Load current on HV side
ii. Operating voltage on HV side by means of voltage sensors connected to the voltage/tan measuring tap of the condenser bushings.
iii. Oil temperature with Transducer if required
iv. Winding Temperature with Transducer if required
v. Ambient temperature
vi. Fans and pumps status
vii. Relative moisture of oil (water activity) [%]
viii. Tap position of on-load tap changer, if applicable
ix. Power consumption of the tap changer motor drive by means of an active power measuring converter, if applicable
x. Circuit states of Buchholz relay, oil level indicator, over-pressure relief device, etc.
xi. Shall Communicate with third party devices like Online DGA over MODBUS/TCPIP protocol input to record Gas-in-oil content (separate values Hydrogen (H2), Ethane (C2H6), Methane (CH4), Ethylene (C2H4), Acetylene (C2H2), Carbon monoxide (CO), Carbon Di-oxide (CO2), Oxygen, Moisture) and report the values over IEC61850 protocol to Sub-Station Gateway for further integration to Control Center.

Note:

The information required as per points 1 & 2 above can be obtained from protection relays/BCUs integrated in the SCADA.

Along with above requirements TMU should be able to perform the OLTC operations, Cooling System Control operations.

Technical Specifications for TMU:

Sr. No.	Technical Specification	Description
1	Input and Output	Digital Input: 2 x 16 nos.
		DC Analog Inputs 4-20 mA, 0-10 VDC : 2 x 4 Nos.
		Digital Outputs: 2 x 4 Nos. potential free contacts (SPDT relay)
2	Power Supply	230 VAC, SMPS 230 VAC to 24 VDC
3	Communication	RS485, Ethernet 10/100, Fiber Optics
4	Supported Protocols	Modbus TCP/IP, IEC61850
5	Compatibility	Compatible to existing SCADA system, Report Generation, GPS Time synchrinization
6	Cabinet Material	Double walled Aluminium sheet
7	IP rating	IP66
8	Operating Temperature	-25 to 55 Deg Celsius
9	As IEC61850 client how many servers it can connect at a time	Minimum 3 servers
10	As IEC61850 server it shall report to multiple client, specify quantity	
11	Top layer of oil temperature	
12	Bottom Layer of Oil temperature	
13	Ambient Temperature	
14	Iron Core grounding current, precision	
15	Load voltage, current, freq etc. precision	+/- 1%
16	Software for fleet level alarm & Monitoring	
17		

The necessary BI-BO contacts of suitable rating to achieve above functions shall be available in the TMU.

b) Online DGA:

Online DGA Monitor shall have following features,

i. Shall be able to record Gas-in-oil content (separate values Hydrogen (H2), Ethane (C2H6), Methane (CH4), Ethylene (C2H4), Acetylene (C2H2), Carbon monoxide (CO), Carbon Di-oxide (CO2), Oxygen, Moisture).

ii. Shall provide data on MODBUS/TCPIP Protocol to TMS System for analysis.

The minimum required technical specifications of the Online DGA are as given below,

SrNo.	Technical Specification	Parameters
1	**Interpretations**	Shall be as per IEC60599-1999
2	**Gases & Moisture Parameters**	**Detection range**
	Hydrogen	3 - 3,000
	Carbon Dioxide	5 - 30,000
	Carbon Monoxide	5 - 10,000
	Methane	5 - 7,000
	Ethane	5 - 5,000
	Ethylene	3 - 5,000
	Acetylene	1 - 3,000
	Oxygen	30 - 25,000
	Nitrogen	5,000 - 100,000
3	**Sensitivity**	
4	Installation Details	Pole Mount Installation for retrofit applications
5	Indication on front panel	3 LED indicators for Power, Service, Alarm event
6	DGA enclosure	IP66
7	Connections to Transformer	Connected at 2 Valves one to take Oil Sample and other to send back the oil after sampling. Thus ensuring True Oil Sampling.
8	Measurement	Near field Infrared
9	Sampling rate	Oil sampling shall be every 20 minutes
10	Calibration and standard	Onsite calibration facility shall be available
11	**Technical Feature**	**Range**
	Accuracy	+/-5% for all gases and for N2 +/- 10%
	Repeatability	<2% for H2, CO and C2H2 & <1% for other gases
	Oil temperature range	minus 40 to 120°C
	External Temp. Range	minus 50°C to 55°C
	Humidity range	5% to 95% RH, non-condensing

	Operating Voltage	115 VAC+DC or 230 VAC+DC ±15%
	Communications	RS-232 or RS-485, Ethernet Fiber (100Base-FX)

Substation wise information of no of ICT / Transformers is given in Table - I in this chapter, which is indicative for TMU and T/F units where DGA system is to be provided by the bidder. Further, the contractor is requested to note that, for the T/F / ICTs, where provision of DGA is not envisaged in this project, the contractor has to make provision for integration of existing / future DGA monitoring system in TMU.

It must be possible to retrofit additional sensors in the future. Also, already existing Online DGA Monitors should be possible to be integrated in the monitoring system.
Any other material/accessories required to achieve the full functionalities given above shall be supplied by the contractor.

The monitoring modules (Sensors) are to be installed at the transformer. All monitoring modules at the substation are to be connected by field bus technology to a fan-less IED (TMU) which shall be installed near the transformer.
On the base of received on-line measurements, it should calculate/analyse for each transformer individually:

a) Apparent power (MVA)
b) Load factor
c) Number of over-voltages on HV side
d) Last over-voltage on HV side
e) Hot spot temperature in accordance with IEC 60076-7
f) Top oil temperature according to thermal model
g) Cumulative Ageing rate in accordance with IEC 60076-7
h) Capability to integrate third party devices like Online DGA over Open source protocols like MODBUS/TCPIP etc.
i) Moisture of insulation paper from received parameters from Online DGA monitor
j) Bubbling temperature
k) Bubbling safety margin
l) Number of over currents and short circuit currents on HV side
m) Last over current and short circuit current on HV side
n) Overload capacity
o) Emergency overloading time when overloading

p) Running hours of fans and pumps
q) Cooling efficiency (thermal resistance Rth)
r) Switching time of OLTC, if applicable
s) Sum of cumulative switched load current of OLTC, if applicable
t) Switching time (OLTC), if applicable
u) Switched energy (OLTC), if applicable
v) Number of OLTC operations until service & provision of alarm after fixed number of operations, if applicable

Note: The information required as per points 1, 3, 4, 12 & 13 above can be obtained from protection relays/BCUs integrated in the SCADA.

The software of the monitoring system must include and not limiting to the following:

w) Dissolved gas analysis and diagnostic tool according to:
x) Doernenburg
y) Rogers
z) Duval
aa) Key Gas
ab) Evaluation of paper insulation condition acc. IEC 60599.
ac) Simulator tool for load factor,
ad) hot-spot temperature,
ae) aging rate,
af) losses,
ag) moisture of insulation paper
ah) Report generator, which creates periodically or on demand protocols with status information about the transformers and its main components at TMU or Central Data Warehouse System at Control center.
ai) Initially, the on-line data acquired by means of the monitoring modules are to be held in the RAM memory of the IED with a high timely resolution.
aj) The monitoring system should have the capability of resolution and processing of the measured values in millisecond grid.
ak) Periodically the individual data of the different on-line channels are stored as timely mean or maximum values in the historical database (data reduction).

al) Events, e.g. tap changing, energizing of the transformer, or alarms, are to be saved with time stamp and timely resolution.

am) The monitoring system shall provides long term storage of all measured and calculated data (5 years plus) in the memory of the IED.

an) It must be possible to communicate with SCADA by means of standard protocols such as IEC 60870-5-101, IEC 60870-5-104, IEC 61850 (reports) certified by KEMA, Modbus.

ao) In case the values will exceed individually defined limits the system generates an alarm record which is also saved in the database.

ap) The alarm signal can be sent to the control room by either closing of relay contacts or standard protocols.

aq) It should be possible to download the contents of the data memory to a local PC.

a) The communication with the user and the visualization should be possible through:
b) A local PC connected by an TCP/IP or RS 232 interface
c) A remote PC connected by an Ethernet TCP/IP link
d) A Fleet level Software monitoring all the Transformers in that Sub-Station with analytic as required above.
e) The monitoring modules shall be type tested by an accredited and independent laboratory as follows:
f) Safety tests: IEC/EN 61010-1;
g) Electromagnetic disturbance tests:
h) IEC/CISPR 11/EN 55011;IEC/EN 61000-3-2;IEC/EN 61000-3-3;IEC/EN 61000-6-4

Electromagnetic immunity tests:

IEC/EN 61000-4-2; IEC/EN 61000-4-3; IEC/EN 61000-4-4; IEC/EN 61000-4-5; IEC/EN 61000-4-6; IEC/EN 61000-4-11; IEC/EN 61000-6-2;

Temperature and climate resistance:

IEC 60068-2-1; IEC 60068-2-2; IEC 60068-2-30; IEC 60068-2-78.

Chapter-6
Voice over Internet protocol.

1. Introduction

The purpose to deploy the VoIP system at substations and MTAMC Control Centre is used to enhance communication for coordination purposes. It allows operators at MTAMC control center to communicate seamlessly with operators at substations.

2. Existing VoIP system deployed at MTAMC control center has major components:

a) **VoIP Server** :
Open Scape 4000 Eco Server as communication server to support high analog and TDM requirements and for OpenScape 4000 Branch as hybrid side.
It is designed to support Hybrid TDM/IP-PBX for Enterprise Voice with an extensive Enterprise feature set for traditional to next generation communication and Single system scales up to 12,000 users. There are two servers working in hot redundancy.

b) **VoIP (Voice) Recorder**: There are two Voice recorders of make Lenovo Think Centre M720 on which application Tele suite call recording system records all incoming and outgoing telephonic conversations.

3. Scope of work:

The contractor shall design, supply, erect, test and commission at substations which includes IP phones and any other items/accessories required for a fully functional system and integrate the IP phones in the existing centralized VoIP system at MTAMC Control Centre.

4. Specifications for IP Phones:

IP phones shall have the minimum following features. Contractors can offer the latest and suitable specifications.

a) An adjustable ring tone
b) A hearing aid compatible handset
c) Headset compatibility
d) Speaker phone
e) An integrated 2-port Ethernet switch that allows the telephone and a computer to share a single Ethernet port.
f) G.711 and G.729a audio compression
g) IP address assignment DHCP client or Manual
h) Call forward
i) Call hold
j) Call transfer
k) Call Back (By calling into a specific no. the caller can initiate a return call)
l) Call parking (ability to place call on phone, and pick it up at a different extension)
m) 3-way calling
n) Do not disturb
o) Multiple directory numbers
p) Call waiting
q) Direct number dialing

r) Caller ID blocking
s) Voice mail
t) Auto answer mode
u) Redialing
v) Speed dialing
w) Provide call logs for Missed calls, Received calls and dialed calls (100 entries)
x) Have message waiting indication LED
y) Address book (100 entries)
z) It need not have 4 inch monochrome display. The display could be smaller size.

Please note: Required IP phones should be compatible with the VoIP system deployed at MTAMC Control Centre.

---------End of the Chapter-6--------

Annexure-B

Bill of Quantity (Supply Part) for Substations under MTAMC Ph-2

Name of System	Sr. No.	Material Description	Unit	Total Qty	Ex.works (Excl.of(Incl.Pkg.Fwd+Unloading at site+F&I etc.)
		Supply Part (Substation)	**Ref**		
SCADA System	1	SAS HMI (Operation), Engineering and DR work Station with all accessories e.g. Monitor, CPU, Key board, Mouse, Speakers, Cables & KVM extender etc. as per **MSETCL SCADA/SAS specifications Rev.-2 dtd: 13.12.2018.**	EA	**25**	Rates are available in MSETCL SOR
	2	Operating system (**Windows OS**) License copy with life time validity (latest version compatible to existing SCADA)	EA	**25**	
	3	SAS Software license for **400 kV** substation (**8000 Tags**) as per Annexure-1- MSETCL SCADA/SAS specifications Rev.-2 dtd: 13.12.2018.	EA	**4**	Rates are available in MSETCL SOR
	4	SAS Software license for **220 kV** & below substation (**4000 Tags**)	EA	**4**	Rates are available in MSETCL SOR
	5	Modbus to TCP/IP converter	Nos.	**80**	
GPS System	1	GPS Device including all accessories i.e. GPS device, GPS remote display clock, GPS antenna, GPS cable etc	Nos	**4**	
	2	GPS Clock Display suitable for existing GPS device	Nos	***5***	
	3	GPS Antenna suitable for existing GPS device	Nos	***5***	
	4	GPS Server suitable for existing GPS device	Nos	***5***	
	5	GPS Cable (Co-axial) with Connector suitable for existing GPS device	Mtr	***50***	
Station Gateway	1	**Substation Gateway** for Remote Visibility, Control and Monitoring. Compliant **to existing BCU/Relays/IED on IEC61850 protocol** Including multimaster reporting & Master Slave configuration **Gateway Software**	Nos	***10***	Rates are available in MSETCL SOR

	2	**Substation Gateway/Station Data Concentrators (SDC)** for Remote Visibility, Control and Monitoring with functionality for remote access of protection Relay/IED with sending the DR files over a SFTP protocol to achived the functionlity mension in a tender.Compliant to exsiting BCU/Relays/IED on IEC61850 protocol Including multimaster reporting & Master Slave configuration over a IEC 60870-5-101 and 104 protocol **(Note-Existing DR PC will be utilized if DR PC is working)**	Nos	**66**	
Ethernet Switch	1	Bay Level managed Ethernet switch (12 Cu, 12 FO + 4x 1 GBPS FO port) and other detailed specifications	Nos	**32**	Rates are available in MSETCL SOR
	2	Substation level Managed Ethernet Switch (16 Cu+4 FO+4 FO X1Gbps) and other detailed specifications	Nos	**12**	Rates are available in MSETCL SOR
Networking Panel	1	Networking & Communication panels to mount PCs,Gateway,GPS device,GPS display,Switches along with internal wiring / cabling & accessories,etc.	Nos	**8**	Rates are available in MSETCL SOR
Router	1	Router and associated equipments which includes MPLS Customer Edge 4 port Ethernet(1 Gbps) Routers cum Firewall for substations.	Nos	**33**	
LIU	1	12 core (06 Pair) / 24 port LIU with all accessories	Nos	**22**	Rates are available in MSETCL SOR
	2	12 core (06 Pair) / 12 port LIU with all accessories	Nos	**42**	Rates are available in MSETCL SOR
UPS system	1	5 kVA UPS with Maintenance free Batteries (05 hrs backup) (Redundant & parallel) with Stand	Nos	**31**	Rates are available in MSETCL SOR
MFM	1	Multi-function Meter (MFM)	Nos	**23**	Rates are available in MSETCL SOR

Bay Control unit (BCU)		**Line / ICT/GT/STN/Power TF/bus reactor / TBC/BC/TIE Bays etc. for 765kV/400kV/220kV**			
	1	765kV / 400kV line bay	Nos	**6**	Rates are available in MSETCL SOR
	2	220 kV line Bay	Nos	**9**	
	3	132 kV line Bay	Nos	**3**	
	4	765kV / 400kV ICT bay	Nos	**6**	Rates are available in MSETCL SOR
	5	220 kV TRF/ICT Bay	Nos	**9**	
	6	132 kV TRF Bay	Nos	**3**	
	7	Auxiliary BCU	Nos	**31**	
Protection / Relay IEDs		**Protection IED/Relay**			
	1	Distance Protection Relay	Nos	**19**	Rates are available in MSETCL SOR
	2	Differencial Protection Relay	Nos	**19**	Rates are available in MSETCL SOR
	3	REF Protection Relay	Nos	**15**	Rates are available in MSETCL SOR
	4	Backup Relay	Nos	**15**	Rates are available in MSETCL SOR
	5	Electrical reset Master Trip (86) / Bus - Bar trip (96) Relay	Nos	**20**	Rates are available in MSETCL SOR
	6	Trip/Heavy duty CB/ISO Open Close control Relay	Nos	**117**	Rates are available in MSETCL SOR

Switch	1	Local/Remote switch (L-R) 3 Mode	Nos	**319**	Rates are available in MSETCL SOR
Remote Accessibility System	1	**Station Data Concentrators(SDC) -** Hardware & compatiable Software for complete Integration with existing centralised MTAMC RAS and AFAS system. Detailed specifications are mentioned as per **(Note -Not required if gateway cum SCD is installed/PoC sucessfully)**	Nos.	**33**	Rates are available in MSETCL SOR
	2	**RAS/DR PC** with 30" monitor, keyboard, mouse and other detailed specifications IEC61850-3 RAS i7 W10 1TB 30" Desktop, **Latest version of Remote Accessibility System Software (RAS).**	Nos.	**2**	
Substation Auxiliary Monitoring System	1	Transformer Monitoring system (TMS) / Unit **including online bushing monitoring system, 9 Gas Dissolved Gas Analysis (DGA) & Transformer Auxilary system** (Fan, Pump, Oil level, OLTC, Temp etc.) with suitable protocol (IEC-61850) :- (DI-16; DO:4; AI: 4) x 2 cards detalied specification as per Anxx-6. **for 100 MVA and above ICT/TRF**	Nos	**34**	
	2	Transformer Monitoring system (TMS) / Unit **including 9 Gas Dissolved Gas Analysis** (DGA) & Transformer Auxilary system (Fan, Pump, Oil level, OLTC, Temp etc.) with suitable protocol (IEC-61850) :- (DI-16; DO:4; AI: 4) x 2 cards detalied specification as per Anxx-6. for **50 MVA and below ICT/TRF**	Nos	**31**	
	3	Transformer Monitoring system (TMS) / Unit including Transformer Auxilary system (Fan, Pump, Oil level, OLTC, Temp etc.) with suitable protocol (IEC-61850) :- (DI-16; DO:4; AI: 4) x 2 cards detalied specification as per Anxx-6. **for 25 MVA and below ICT/TRF**	Nos	**6**	
	4	Online 9 Gas Dissolved Gas Analysis (DGA) with suitable protocol (IEC-61850) detalied specification as per Anxx-6. As per MSETCl requirement	Nos	**2**	

Transducer	1	Temperature Transducer (Indoor)	Nos.	**33**	Rates are available in MSETCL SOR
	2	Temperature Transducer (Outdoor)	Nos.	**33**	
	3	Humidity sensor (Outdoor)	Nos.	**33**	
	4	WTI & OTI Transducer for TMS integration with Output: 4mA to 20 mA	Nos.	**204**	
	5	Tap Position indication Transducer Output: 4mA to 20 mA	Nos.	**168**	
	6	Add ON block for fan pump Indication for TMS integration (2NO 2 NC)	Nos.	**842**	
	7	Transducer for Battery & charger Voltage & Current Output: 4mA to 20 mA	Nos	**126**	
Visual Monitoring System		0-360 Deg PTZ colour Camera (1080P, 30X IP PTZ Dome Camera) with Junction Box (with media converter, LIU _ 6 port, Surge Protector, POE & etc) with required cables	Nos.	**152**	
	1	Junction Box. detailed specs are mentioned in the Tech Specs	Nos.	**190**	Rates are available in MSETCL SOR
	2	Media converter	Nos.	**152**	Rates are available in MSETCL SOR
	3	LIU _ 6 port	Nos.	**152**	Rates are available in MSETCL SOR
	4	PTZ Camera Surge Protector	Nos.	**152**	

	5	Power Supply Unit 220 / 110 V DC	Nos.	**152**	
	6	Layer - II station level Switch for Camera (8FO + 4 Cu)	Nos.	**38**	
	A	**Perimeter Intrusion Detection System (PIDS) <u>Option-1.</u> Tx Rx equipments with allied items**	Nos.		
	1	Synchronized Quad beam 650ft outdoor all weather: Transmitter & Receiver	Nos.	**264**	
	2	Junction Box	Nos.	**264**	Rates are available in MSETCL SOR
	3	Media Converter (Box type)	Nos.	**264**	Rates are available in MSETCL SOR
	4	PIE (PIE-1)	Nos.	**264**	
	5	LIU - FO Patch Panel - 06 Port	Nos.	**176**	Rates are available in MSETCL SOR
	6	LIU FO Patch Panel - 24 Port	Nos.	**66**	Rates are available in MSETCL SOR
	7	Horn Loud Speaker	Nos.	**44**	
	8	GI Pole for Transmitter/Receiver (50MM Dia x Suitable Height)	Nos.	**154**	
	B	**Perimeter Intrusion Detection System (PIDS) <u>Option-2</u> Bullet camera with allied items**			
	1	Bullet Camera with PIDS features	Nos	**264**	

	2	Required allied item with complete set.	Nos	**264**	
	C	Network Video Recorder hardware & Software (along with client license) with Coloured LED 32" High resolution monitor, mouse, joystick, etc	Nos.	**33**	
	D	Required IP device licenses for Management client in NVR system for integration in a MTAMC VMS system	Nos.	**486**	
VoIP System	1	VoIP (Voice Over Internet Protocol) phone device **(high end)** with all accessories for substation level compatible with MTAMC control center VoIP system.	Nos	**33**	Rates are available in MSETCL SOR
Furniture	1	Furniture industrial type table for accommodating all 3 Nos of monitor, UPS with power supply arrangement & all type of cable entry	Nos	**33**	Rates are available in MSETCL SOR
	2	Furniture Chair (Revolving Type)	Nos	**44**	Rates are available in MSETCL SOR
Communication Cable	1	RS485 cable for MFT (armoured) communication cable	Km	**24**	Rates are available in MSETCL SOR
	2	CAT-6 STP cable	Km	**7**	Rates are available in MSETCL SOR
	3	Multimode Fibre optic cables (6 cores) outdoor Armoured (TMS system)	Km	**154**	Rates are available in MSETCL SOR
	4	Patch Cord- LC-LC MMDX -1M	No	**1248**	
	5	Patch Cord-LC - LC MMDX -3M	No	**110**	
	6	Patch Cord-LC - LC MMDX -5M	No	**161**	Rates are available in MSETCL SOR

	7	Patch Cord-LC - LC MMDX -10M	No	**108**	Rates are available in MSETCL SOR
Power / Control Cable (armoured)	1	3CX6 sqmm Multi-strand Copper conductor Armoured (UPS)	km	**7**	
	2	3CX2.5sqmm Multi-strand Copper conductor Armoured (Power Supply) (VMS system)	km	**50**	Rates are available in MSETCL SOR
	3	14CX2.5Sqmm Multi-strand Copper conductor Armoured (For Additional Signals (IO) and TMS control)	km	**33**	Rates are available in MSETCL SOR
	4	4CX2.5Sqmm Multi-strand Copper conductor Armoured (Power Supply) (TMS system)	km	**37**	Rates are available in MSETCL SOR
	5	7CX1.5Sqmm Multistrand Copper conductor Armoured (PT)	km	**38**	Rates are available in MSETCL SOR
		Total			

Annexure-B

Bill of Quantity (Service Part) for Substations under MTAMC Ph-2

		Material Description	Unit		
	Sr. No.	**Service Part (Substation)**	**Ref**	**Total Qty**	**Ex.works (Excl.of(Incl.Pkg.Fwd+Unloading at site+F&I etc.)**
ETC of Substation level SCADA System	1	Installation, Configuration, Testing & Commissioning of **SAS/SCADA Software & Hardware** which includes SAS HMI, Gateway, switches, GPS,LIU, fiber, CAT cables with Complete Configuration & Integration of all Bays in substation SAS including IED/BCU/Relay, IEC 104 configuration	EA	11	Rates are available in MSETCL SOR
	2	*Complete Integration & configuration of* ***any non integrated bay (IED/BCU/Relay/MFM etc) in existing working SAS/SCADA*** *including IEC 104 configuration for voltage level 400/220/132 kV*	Nos	*10*	Rates are available in MSETCL SOR
	3	*Complete Integration & configuration of* ***any non integrated bay (IED/BCU/Relay/MFM etc) in existing working SAS/SCADA*** *including IEC 104 configuration for voltage level 33/22/11 kV*	Nos	*15*	
	4	Complete Integration & configuration of **IEC104 Gateway (Proposed under Phase-2)**	Nos.	80	Rates are available in MSETCL SOR
	5	Complete Integration & configuration of **GPS devices** or alied equipment in **existing SAS/SCADA system**	EA	4	
	6	Complete Integration & configuration of **bay and station level Ethernet switches** or allied equipment i**n existing SAS/SCADA system**	Nos	56	

	7	Complete integration & configuration of **Router and associated equipments** which includes MPLS Customer Edge 4 port Ethernet (1 Gbps) Routers cum Firewall for substations.	Nos	40	
	8	Complete ETC of **Networking & Communication panels** to mount PCs,Gateway,GPS device,GPS display,Switches along with internal wiring / cabling, Earthing & accessories,etc.	Nos	8	
	9	Complete Installation, Termination (splicing) & configuration of **24 and 12 port LIU** with all accessories	Nos	64	
	10	ETC of 5 kVA **UPS** along with maintenance free batteries with stand at Substation level.	EA	37	
	11	ETC of MFM meter along with its accessories and integration with substation SAS/SCADA system.	Nos	29	
ETC work of BCU	12	Installation, Wiring, Termination, Configuration, Testing & Commissioning of **BCU** for 765kV / 400kV / 220 kV / 132 kV line/ICT/GT/STN/Power TF/bus reactor/TBC/BC/TIE Bays/Auxillaries Integration with SAS/SCADA system along with its allied equipments which not mentioned above or in BOM but required to complete the job and to make the system fully functional	Nos	73	Rates are available in MSETCL SOR
ETC of Protection Relay	13	Installation,Wiring, Termination, Configuration, Testing & Commissioning of **Protection Relay** (Distance/Differencial/backup/REF/TEED etc) Integration with SAS/SCADA system along with its allied equipments which not mentioned above or in BOM but required to complete the job and to make the system fully functional	Nos	80	
	14	Installation,Wiring, Termination, Configuration, Integration, Testing & Commissioning of **Master Trip (86) / Bus - Bar trip (96)** Relay along with its allied equipments which not mentioned above or in BOM but required to complete the job and to make the system fully functional	Nos	20	Rates are available in MSETCL SOR

	15	Installation,Wiring, Termination, Configuration, Integration, Testing & Commissioning of **Trip/Heavy duty CB/ISO open close control relay, CMR, LR switch, etc**. and found in faulty condition along with its allied equipments which not mentioned above or in BOM but required to complete the job and to make the system fully functional	Nos	508	
ETC of RAS System	16	Installation complete Integration & configuration of **Station Data Concentrators(SDC) - Hardware & suitable Software with RAS/DR PC for RAS System** at substation level for complete Integration and configuration of system for seamless integration of the same with the existing centralised existing centralised MTAMC RAS and AFAS system.	EA	39	
ETC of TMS system	17	Installation, Networking, Configuration, Testing & Commissioning of Transformer Monitoring system (TMS) / Unit **including online bushing monitoring system**, 9 Gas Dissolved Gas Analysis (DGA) & Transformer Auxilary system (Fan, Pump, Oil level, OLTC, Temp etc.) with proper Civil work (foundation of stand), cable laying, termination etc. & **Integration in substation SAS/SCADA system**	Nos	34	
	18	Installation, Networking, Configuration, Testing of Transformer Monitoring system (TMS) / Unit including **9 Gas Dissolved Gas Analysis (DGA)** & Transformer Auxilary system (Fan, Pump, Oil level, OLTC, Temp etc.) with proper Civil work (foundation of stand), cable laying, termination etc. & **Integration in substation SAS/SCADA system**	Nos	31	
	19	Installation, Networking, Configuration, Testing of Transformer Monitoring system (TMS) / Unit including Transformer Auxilary system (Fan, Pump, Oil level, OLTC, Temp etc.) & **Integration in substation SAS/SCADA system**	Nos	12	
	20	Installation, Networking, Configuration,Testing of Online 9 Gas Dissolved Gas Analysis (DGA) & Integration in substation SAS/SCADA system	Nos	2	
ETC of Transducer	21	Complete installation & configuration **any type of transducer for integration** along with fiting/wiring / termination with all required accessories etc.	Nos	1631	

ETC of Substation level VMS	22	Installation, Configuration, Integration, Testing & Commissioning at **substation level Visual Monitoring System Camera & PIDS system** along with its allied equipments as mentioned in BOM **and configuration of system for seamless integration of the same with the existing centralised MTAMC VMS system**	EA	26	
	23	Complete Configuration, Integration of PIDS system into the VMS system at substation level in existing centralised MTAMC control centreVMS system	EA	39	
	24	Installation, Configuration, Integration, Testing & Commissioning of **any devices** and their hardwares in the substation **VMS system network** such as **NVR**, cameras, Junction boxes, media converters,etc.	Nos	39	
ETC of VoIP System	25	Complete Integration & configuration of **VoIP system** at substation level and seamless integration of the same with the existing centralised **MTAMC VoIP system.**	EA	39	
ETC of Other Works	26	ETC of Industrial Type Furniture with required supply and fixing arrangement	EA	39	
	27	ETC of all type of **communication Cable** Laying includes ferruling, lugging, glanding, clamping, termination etc.	Km	185	Rates are available in MSETCL SOR
	28	ETC of all type of **control cable Cable** Laying includes ferruling, lugging, glanding, clamping, **termination** etc.			
	29	14 C x 2.5 sqmm	Km	33	
	33	3C*2.5 sqmm	Km	50	
	31	3C*6 sqmm	Km	7	
	32	7 C x 1.5 sqmm	Km	38	
	33	4C*2.5 Sqmm	Km	37	
Training	34	Training Part	Nos.	1	Rates are available in MSETCL SOR
	40	**Total**			

Sub: Calling of budgetary offer for substation-level work related to the various systems proposed at EHV substations of MSETCL, for integration into the centralized MTAMC Control Centre under MTAMC Phase-2.

Annexure-C

Tentative list of MSETCL EHV Substations to be considered for MTAMC Phase-2

Sr No.	Zone	Name of Substation
1	Amravati	400kV Akola
2		220kV Wani
3		220kV Ner
4		220kV Pandherkawada
5		220kV Nandgaon peth
6	CSN	400kV Kumbhargaon
7		400kV Thaptithanda
8		220kV Shendra
9		220kV Nagewadi
10		220kV Partur
11		220kV Jalkot
12	Karad	400kV Alkud
13	Nagpur	400kV Chandrapur-2
14		400kV Chandrapur-2 Switching
15		400kV Koradi
16		400kV Khaperkheda
17		220kV Karanja
18		220kV Uppalwadi
19		220kV Pachgaon
20		220kV Butibori
21	Nashik	400kV Karjat
22		220kV Kekatnimbora
23		220kV OCR Eklahare
24		220kV Shivajinagar

25	**Pune**	400kv Lonikand-2
26		400kV Chakan
27		220kV Khed city
28		220kV Magarpatta
29		220kVPegasus
30		400kv Hinjewadi-II GIS
31		220kV Chakan Phase-2
32	**Vashi**	220 kV Ulve ss
33		220 kV Waghivali ss
34		220 kV Palghar ss
35		220 kV GIS Pawane ss
36		220 kV Timber Market ss
37		220 kV Khandeshwar ss
38		220 kV Bhaveghar ss
39		220 kV Palava ss
40		220 kV Bapgaon ss
41		220 KV AIROLI KNOWLEDGE PARK S/S
42		220 KV VIRAJ S/S
43		220 KV JAMBHUL S/S