MAHATRANSCO
Maharashtra State Electricity Transmission Co. Ltd.

MAHARASHTRA STATE ELECTRICITY TRANSMISSION CO. LTD.

Executive Engineer
MSETCL EHV O&M, Division,
Near Market Yard, Bapat Camp, Kolhapur
Tal: - Karvir, Dist-Kolhapur-416 005
E-mail: - ee3210@mahatransco.in
Mobile: - Off-0231-2651529, Fax-0231-2680171

EE/EHV(O&M)/Dn./1852

Date: 15.10.2024.

Sub: Budgetary offer for work of supply, installation, testing, commissioning of Transformer Auxiliary Monitoring system (TAMS) at 110 kV Jaysingpur S/s under EHV O&M Division, Kolhapur for preparation of estimate.

Ref: - 1) MSETCL/CO/CE(ACI&P)/TAMS/No. 710 Date.25.09.2024.

Dear Sir,

Budgetary offer are invited by the undersigned for supply, installation, testing, commissioning of Transformer Auxiliary Monitoring system (TAMS) at 110 kV Jaysingpur S/s under EHV O&M Division, Kolhapur for preparation of estimate on or before:22.10.2024 up to 10:00 Hrs. The other terms and conditions are as mentioned below.

- The budgetary offer rates shall include all charges for T&P, skilled workmen etc.
- The Quantities mentioned in our schedule are tentative & subject to varied.
- The bidder should be approved vendor of MSETCL for TAMS. The product offered by bidder should be verified at Automation Lab MSETCL Airoli. Necessary approval should be attached.
- The bidder should submit IEC 61850 ed. 1 & 2 certificate, IEC 62351 Certificate, IEC 61000-4-2, IEC 62443-4-2, IEC 61000-4-8, Environmental Certificate as per IEC 600068, IEC 600068-2-6 certificate.
- The GST & other taxes should mention in the budgetary offer.
- Budgetary offers received after the due date will not be accepted.
- Schedule is attached, offer should be submitted strictly in the format.
- For more details ref. Circular under ref No. 1.

Encl: Schedule.

(Aftab Khan)
Executive Engineer
EHV (O&M) Division, Kolhapur.

Schedule for supply, erection and commissioning of transformer auxillary monitoring system at 110kV Jaysingpur S/s under EHV O&M Dn, Kolhapur

r. No.	Particulars	Specification	Units	Qty	Rate per unit excl of the taxes	GST	Rates per unit incl of all the taxes
	Supply Portion						
1	TAMS Software with necessary Customization as per S/s requirement	Compatible with IEC 61850, 104, Modbus shall be able to generate Chart, Graphs, Customized reports in PDF / Excel Format	Each	1			
2	TAMS TAP Changer Controller cum Transformer Monitoring Unit (TF IED)	IEC 61850 edition 1 & 2 complied, 2x ethernet ports, 2x FO Port, 2x RS 485 Port, Supply Voltage 110 or 220 VDC or 0-300 V AC/DC, 16 DI, 8 AI, 4 DO	Each	5			
3	TAMS RTU / PT IED	IEC 61850 edition 1 & 2 complied, 2x ethernet ports, Supply Voltage 110 or 220 VDC or 0-300 V AC/DC, LV PT Input Module	Each	1			
4	TAMS Terminal Board (Yard Cabinet)	IP 65 rated Panel with necessary stand	Each	5			
5	TAMS Industrial Grade PC along with Standard Kiosk in the Control Room	Fanless design, 2x ethernet interfaces, 2.0 GHz, Windows Operating System	Each	1			
6	Armoured Fibre Optic Cable	6 Core Armoured Fiber Optic Cable	RMT	500			
7	12 Core Copper Cable	12 Core Copper Cable	RMT	200			
8	4 Core Copper Cable	4 Core Copper Cable	RMT	400			
9	TAMS FO Joint Box / LIU	Convertor for Armoured to unarmoured vice versa	Each	5			
10	TAMS Managed Ethernet Switch	4x Ethernet Ports, 4x Fiber Ports, managed arch. Based communication switch	Each	1			
	Service Portion						
11	Configuration, Testing, Validation of T/F or ICT in TAMS Software	Cabling, Termination of OLTC DM & FCC with IED & Programming of IED as per site requirement	Each	5			
12	Installation of terminal board near T/F in yard	Grounding of stand & Installation of terminal board on stand	Each	5			
13	Customization of TAMS Software as per Substation	Development of welcome screens & individual T/f screen & settings page of TAMS as per site requirement	Each	1			
14	Laying of FO Cable	Laying of FO Cable from T/f to control room using existing cable trench	RMT	500			
15	Testing & establishment of communication using FO Joint Box & managed Ethernet Switch	Installation of multiple FO Joint Box & managed ethernet switch & establishment of communication from each T/f IED & TAMS	Each	1			

Executive Engineer
EHV O&M Division Kolhapur

MAHATRANSCO

MAHARASHTRA STATE ELECTRICITY TRANSMISSION CO. LTD.

(CIN NO. U40109MH2005SGC153646)

From:
Office of The Chief Engineer (ACI&P),
Old Load Dispatch Centre Building,
Thane Belapur road, Airoli Sector-1,
Navi-Mumbai–400708
E-mail : ceaci@mahatransco.in
Tel. No: 022-27600405
Web: http://www.mahatransco.in.

To,
The Chief Engineer (Tr. O&M)
'Prakashganga', MSETCL,
Plot No C-19, E-Block,
BKC, Bandra (E),
Mumbai – 400 051

MSETCL/CO/CE (ACI&P)//TAMS/No. 0710 **Date:** 25 SEP 2024

SUB: General Technical Specifications for 'Tap changer controller cum Transformer Auxiliary Monitoring System' **(TAMS).**

REF: 1) MSETCL/CO/Tr. (O&M)/SE-I/EE-II/TE/No. 5795 dtd 26.08.24
2) MSETCL/Dir (Op.)/No.1386 dtd 24/09/2024

With reference to your office under ref. no. 1, to finalize the uniform technical specification of Transformer Auxiliary Monitoring System, this office has prepared general technical specification of said system and put up for the approval of competent authority.

Accordingly, Competent authority approved the General Technical Specifications for 'Tap changer controller Cum Transformer Auxiliary Monitoring System' (TAMS) along with 02 types of architecture solutions (ring topology & star topology) and BOQ. The solution is suitable to apply at Non SAS substations in MSETCL.

The selection of locations for installation of 'TAMS' are to be decided by CE Trans O&M Section, CO, MSETCL.

The approved architecture, BOQ & Technical Specifications are enclosed herewith for your reference and further needful.

Encl: 1) Architecture (Ring & Star Topology).
2) BOQ & Technical Specifications.

Chief Engineer (I/C)
ACI&P, CO, MSETCL

Copy s.w.r.to:
The Director (Operations), MSETCL, C.O. Mumbai.

MAHARASHTRA STATE ELECTRICITY TRANSMISSION CO. LTD.
CIN No. U40109MH2005SGC153646
Office of the Chief Engineer (ACI&P)
Contact no.: (O) 022-27600405
Email Id : ceaci@ mahatransco.in
Website : https://www.mahatransco.in
Old Load Despatch centre Building,
Thane Belapur road, Airoli,
Navi Mumbai – 400708

No. MSETCL/CO/CE/ACI&P/No.0666 **Date: 10/09/2024**

DOCKET – SHEET

Subject : General Technical Specifications for 'Tap changer controller Cum Transformer Auxiliary Monitoring System' (TAMS).------ Approval thereof.

TO WHOM CASE IS SUBMITTED	INWARD / OUTWARD DETAILS				REMARKS IF ANY
	INWARD		OUTWARD		
	NO.	DATE	TO WHOM CASE FORWARDED	DATE	
Director (Operations)	MSETCL/Dir (OP) No. 1386 Inward Dt. 11.09.2024 Outward Dt. 24.09.2024				

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N-1

ACI&P Section CO. 00660 3

MSETCL/CO/SE-P/ACI&P

Date: 10 SEP 2024

OFFICE NOTE

SUB: General Technical Specifications for **'Tap changer controller Cum Transformer Auxiliary Monitoring System'** (TAMS). ------- Approval thereof.

REF: 1) Trans O&M Letter No. MSETCL/CO/Tr.(O&M)/SE-I/EE-II/TE/No.5795 dtd 26.08.24

2) Office note MSETCL/Dir(OP)/No. 908 Dtd.05.07.2024.

3) T.O letter no. MSETCL/CO/CE (ACI&P)/KE/TAMS/0414 Dtd.19.06.2024.

I) Preamble:

In reference to the above subject, solution architecture offered by M/s Karishma Electricals, CSN using Phoenix Contact products for **'Tap changer controller Cum Transformer Auxiliary Monitoring System' (TAMS)** was approved vide reference (2) above. In this solution the architecture with star & ring topology was standardized.

Now, in view of the discussion of CE, Trans O&M, CO with Director (Operations), CE, Trans O&M, CO, vide letter under reference (1) has asked to frame and finalize the technical specification of TAMS to have uniformity in technical specification & design of TAMS in MSETCL.

In view of above, General Technical Specifications for Transformer Auxiliary Monitoring System (TAMS) irrespective of any specific vendor have been prepared as below -

II) General Technical Specifications for Transformer Auxiliary Monitoring System (TAMS):

A) General Scope:

1. The transformer auxiliary data collecting device **(IED / RTU / PLC controller)** is to be installed in the switch yard near transformer. The device shall be mounted in the switchyard near transformer in a separate panel (suitable for IP65) and the transformer auxiliary signals are to be hardwired-up from FCC to TAMS panel. The device shall have BO card for o/p command and BI - AI card for connecting transformer auxiliary inputs and 4 – 20 mA inputs from transformer / Transducer. Suitable as per site requirement.

2. From TAMS panel (PLC controller/ IED/RTU) the data shall be routed through optic cable to the monitoring device (PC with TAMS software) in control room. The output data from the device shall be on IEC 61850 / IEC 60870-5-104 and transferred to the control room via armored fiber optic cable.

3. Control room shall have a wall mounted rack for termination of communication cable from yard and for mounting other required devices. Industrial grade furniture to be

provided for workstation PC or a suitable panel can be provided for the same in Control Room.

4. There shall be one device / RTU in control room having following ports – IEC 61850 x 2 ports, IEC 104 x 2 ports, Modbus x 2 ports (at least one serial port). This device is required for configuration of transformer LV side voltage & current (for AVR & temperature curve purpose). Also it shall act as a data exchange unit on protocol such as IEC 61850, 104, Modbus.

5. The data from all transformer connected devices shall be integrated in the transformer local data monitoring system (TAMS PC) where the required software shall be installed.

6. **The MSETCL approved OEMs / vendors for IED / RTU / Controller / SAS shall be acceptable. The vendors offering said solution with approved products are acceptable provided their solution is verified and approved at Automation Lab, ACI&P office.**

B) Technical specifications and Test Certificate of major parts of offered product solution:

1. **IED / RTU / PLC controller with BI, BO & AI card:**
   - MSETCL approved IED / RTU / Controller
   - Protocol - IEC 61850 Edition 1 & 2
   - IEC 60870-5-101/104 server & client
   - IEC 61131-3 (for PLC controller)
   - Modbus/TCP – 2 no's RS485
   - Memory / storage 512 MB
   - Protocols supported- https, FTP, SNTP, SNMP, and SMTP.
   - IEC 61850 Server with GOOSE Publish/Subscribe mechanism.
   - Binary Inputs –16/24/32 – as per site requirement.
   - Binary Outputs –8/16/24- as per site requirement.
   - 8 Channel for Analog Input.
   - Ports ---- 2 x Ethernet Port, 2 x FO port, 2 x RS485.
   - Supply voltage – 110/220 V DC OR Universal 0-300V AC/DC.

     (Suitable converter can be utilized, if required)

Cyber Security compliance: The equipment provided shall be cyber secured

1. IEEE 1686
2. IEC 62351

2. **Test and Standards:**

- **Electromagnetic Compatibility Test (EMC):**
  1. Electrostatic Discharge IEC 61000-4-2.
  2. Immunity Test (power frequency magnetic field) IEC 61000-4-8.
- **Environmental Test** : As per IEC 60068
- **Mechanical Test** : Vibration test (IEC 60068-2-6)

3. **Workstation PC:** (As per MSETCL approved make)

- Windows operating system (latest version).
- Industrial PC. FAN less design (IEC 61850-3 complied).
- 2 x Ethernet interfaces (integrated switch)
- i7, 2.0 GHz, 8GB RAM, 2 x 512 GB SSD, RAID 1.
- Power supply – dual power, 110/220V DC, 230 V AC.

4. **Transformer Auxiliary Monitoring System software (TAMS) software:**

i. MSETCL approved / verified. For new solution provider, Software functionality shall be verified at MSETCL Automation Lab, ACIP office.

ii. Windows based software with suitable anti-virus software to be provided on PC. TAMS Software database should be binary encrypted database and it should be tamper proof.

iii. Software display: Analytics kind of display & view like SCADA with details chart/graphs with SAS supported protocols library.

5. **Ethernet switch:**

Managed Layer 2 switch, ports requirements as per site, with sufficient spare ports.

6. **All other equipment's** shall be MSETCL SAS standard make.

C) Minimum Features required in Transformer Auxiliary Monitoring System (TAMS):

1. The Transformer Auxiliary signals are to be hardwired up in the PLC controller/IED/RTU/ (to be installed in substation switch yard) and its configuration in TAMS software (to be installed in substation control room) is to be done.

   Following functionality and features are min. required in TAMS system

   i. Monitoring of FAN status, HV and LV winding temperature, Oil temperature, TAP position, Number of TAP operation and LV voltage.
   ii. Manual & Auto operation of FAN, TAP.
   iii. BI/ BO/ AI/ Temperature readings.
   iv. **Automatic Voltage Regulation (AVR) function required.**
   v. Auto/ Manual, Master/follower mode selection for AVR / Tap operations.
   vi. Report extraction tool for temperature values, BI/ BO signals values and Tap position.
   vii. Reports, trends / graphs extracted in excel sheet & pdf formats.
   viii. Time based data log record for HV& LV- WTI, OTI, TAP Position, Tap Count & HV, and LV Voltage.
   ix. Real time summary view, individual transformer screen, temperature setting, AVR setting page & Alarm pop up & master follower.
   x. Event & Alarm list in LDMS as per operation.
   xi. Load temperature curve for each T/F (current Vs Temperature graph)

2. Option for 02 types of Architecture are proposed, one with Ring topology & other with Star topology.

3. The PLC controller / IED/RTU output on IEC 61850 / IEC 60870-5-104 communication protocol to be verified.

III) Benefits observed:

Following benefits are observed for this solution implemented at MSETCL substations –

1. The unit shall be useful at substation where frequent tap change operations are required for Voltage regulation. AVR helps in achieving this easily by operating automatically as per requirement.

SUB: *General Technical Specifications for 'Tap changer controller Cum Transformer Auxiliary Monitoring System' (TAMS).* ------- *Approval thereof.*

2. Getting history & records of tap change as well as temperature and cooling system status through report generation.
3. Easy to commission at substations where existing RTCC are out of service. Saving in the cost as control cables for transformer auxiliary signals are not required from yard to control room.

4. Substation wherein there is space problem for accommodating new bay control & relay panel commissioning, at such places RTCC panel can be replaced by retrofitting of TAMS unit thereby creating free space.

IV) Approval of 'General Technical Specifications & solution architecture' for Tap Changer Controller cum Transformer Auxiliary Monitoring System (TAMS):

Substations which are old often face several challenges that can be effectively addressed through the implementation of customized automation solution. By implementing customized automation solutions, MSETCL can modernize its aging infrastructure, thereby improving reliability, efficiency, and safety while reducing operational costs and ensuring compliance with modern standards.

The proposed 'General Technical Specifications & solution architecture' (ring topology & star topology) and BOQ are enclosed herewith. This standard solution is verified and found suitable to apply at Non-SAS substations. If approved, same will be intimated to CE, Trans (O&M), section, CO. The selection of locations for usage of 'TAMS' be decided by CE, Trans (O&M) section, C.O.

10.9.24

Superintending Engineer (Protection)

Chief Engineer (ACI&P)

---- For recommendation.

Director (Operations)

---- For approval.

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General Technical Specifications for 'Tap changer controller Cum Transformer Auxiliary Monitoring System' (TAMS)

A) General Scope:

1. The transformer auxiliary data collecting device **(IED / RTU / PLC controller)** is to be installed in the switch yard near transformer. The device shall be mounted in the switchyard near transformer in a separate panel (suitable for IP65) and the transformer auxiliary signals are to be hardwired-up from FCC to TAMS panel. The device shall have BO card for o/p command and BI - AI card for connecting transformer auxiliary inputs and 4 – 20 mA inputs from transformer / Transducer. Suitable as per site requirement.

2. From TAMS panel (PLC controller/ IED/RTU) the data shall be routed through optic cable to the monitoring device (PC with TAMS software) in control room. The output data from the device shall be on IEC 61850 / IEC 60870-5-104 and transferred to the control room via armored fiber optic cable.

3. Control room shall have a wall mounted rack for termination of communication cable from yard and for mounting other required devices. Industrial grade furniture to be provided for workstation PC or a suitable panel can be provided for the same in Control Room.

4. There shall be one device / RTU in control room having following ports – IEC 61850 x 2 ports, IEC 104 x 2 ports, Modbus x 2 ports (at least 01 serial). This device is required for configuration of transformer LV side voltage & current (for AVR & temperature curve purpose). Also it shall act as a data exchange unit on protocol such as IEC 61850, 104, Modbus.

5. The data from all transformer connected devices shall be integrated in the transformer local data monitoring system (TAMS PC) where the required software shall be installed.

6. **The MSETCL approved OEMs / vendors for IED / RTU / Controller / SAS shall be acceptable. The vendors offering said solution with approved products are acceptable provided their solution is verified and approved at Automation Lab, ACI&P office.**

B) Technical specifications and Test Certificate of major parts of offered product solution:

1. **IED / RTU / PLC controller with BI, BO & AI card:**
   - MSETCL approved IED / RTU / Controller
   - Protocol - IEC 61850 Edition 1 & 2
   - IEC 60870-5-101/104 server & client

- IEC 61131-3 (for PLC controller)
- Modbus/TCP – 2 no's RS485
- Memory / storage 512 MB
- Protocols supported- https, FTP, SNTP, SNMP, and SMTP.
- IEC 61850 Server with GOOSE Publish/Subscribe mechanism.
- Binary Inputs –16/24/32 – as per site requirement.
- Binary Outputs –8/16/24- as per site requirement.
- 8 Channel for Analog Input.
- Ports ---- 2 x Ethernet Port, 2 x FO port, 2 x RS485.
- Supply voltage – 110/220 V DC OR Universal 0-300V AC/DC.

(Suitable converter can be utilized, if required)

Cyber Security compliance:

I. IEEE 1686
II. IEC 62351

2. **Test and Standards:**
   - **Electromagnetic Compatibility Test (EMC):**
     1. Electrostatic Discharge IEC 61000-4-2.
     2. Immunity Test (power frequency magnetic field) IEC 61000-4-8.
   - **Environmental Test** : As per IEC 60068
   - **Mechanical Test** : Vibration test (IEC 60068-2-6)

3. **Workstation PC:** (As per MSETCL approved make)
   - Windows operating system (latest version).
   - Industrial PC. FAN less design (IEC 61850-3 complied).
   - 2 x Ethernet interfaces (integrated switch)
   - i7, 2.0 GHz, 8GB RAM, 2 x 512 GB SSD, RAID 1.
   - Power supply – dual power, 110/220V DC, 230 V AC.

4. **Transformer Auxiliary Monitoring System software (TAMS) software:**

i. MSETCL approved / verified. For new solution provider, Software functionality shall be verified at MSETCL Automation Lab, ACIP office.

ii. Windows based software with suitable anti-virus software to be provided on PC. TAMS Software database should be binary encrypted database and it should be tamper proof.

iii. Software display: Analytics kind of display & view like SCADA with details chart/graphs with SAS supported protocols library.

5. **Ethernet switch:**
Managed Layer 2 switch, ports requirements as per site, with sufficient spare ports.

6. **All other equipment's** shall be MSETCL SAS standard make.

C) Minimum Features required in Transformer Auxiliary Monitoring System (TAMS):

1. The Transformer Auxiliary signals are to be hardwired up in the PLC controller/IED/RTU/ (to be installed in substation switch yard) and its configuration in TAMS software (to be installed in substation control room) is to be done.

Following functionality and features are min. required in TAMS system

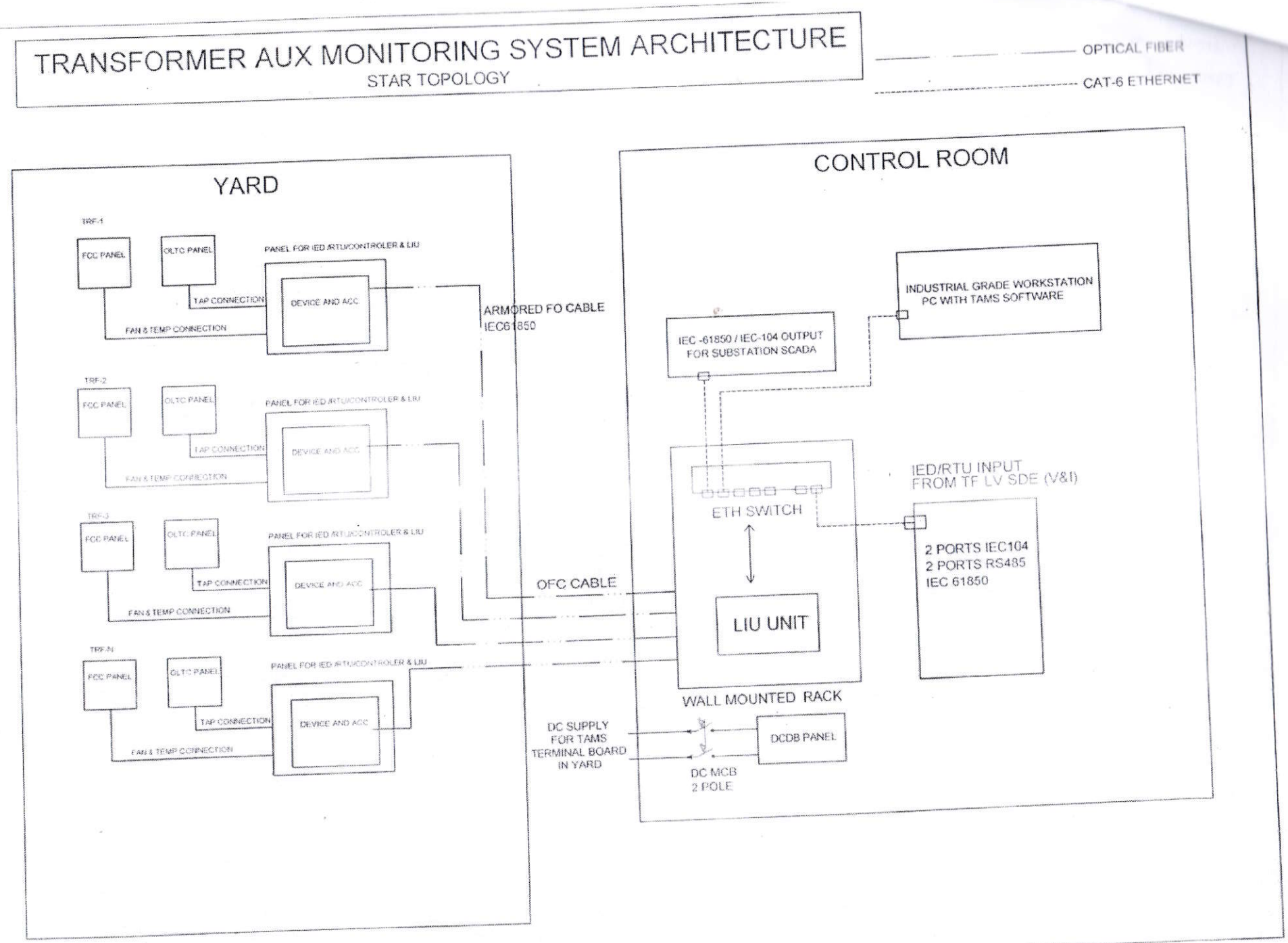
i. Monitoring of FAN status, HV and LV winding temperature, Oil temperature, TAP position, Number of TAP operation, and LV voltage.
ii. Manual & Auto operation of FAN, TAP.
iii. BI/ BO/ AI/ Temperature readings.
iv. **Automatic Voltage Regulation (AVR) function required.**
v. Auto/ Manual, Master/follower mode selection for AVR / Tap operations.
vi. Report extraction tool for temperature values, BI/ BO signals values and Tap position.
vii. Reports, trends / graphs extracted in excel sheet & pdf formats.
viii. Time based data log record for HV& LV- WTI, OTI, TAP Position, Tap Count & HV, and LV Voltage.
ix. Real time summary view, individual transformer screen, temperature setting, AVR setting page & Alarm pop up & master follower.
x. Event & Alarm list in TAMS as per operation.
xi. Load temperature curve (current vs Temperature graph).

2. Option for 02 types of Architecture are proposed, one with Ring topology & other with Star topology.

3. The PLC controller / IED/RTU output on IEC 61850 / IEC 60870-5-104 communication protocol to be verified.

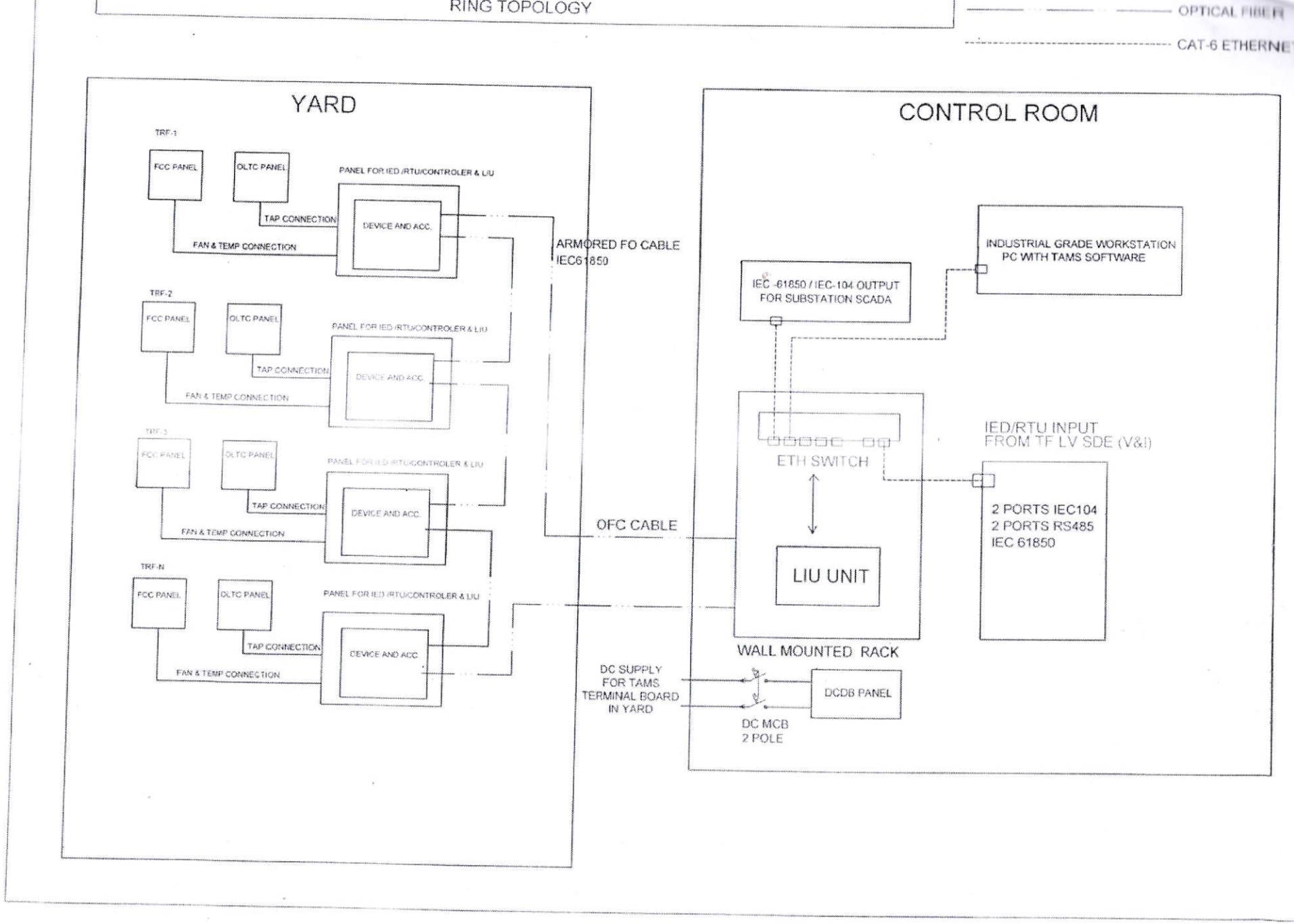
TRANSFORMER AUX MONITORING SYSTEM ARCHITECTURE

STAR TOPOLOGY



TRANSFORMER AUX MONITORING SYSTEM ARCHITECTURE

RING TOPOLOGY



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General Bill of Material / Qty. for TAMS

Item	Description	Product Details	Quantity
TAMS Software with necessary Customization as per S/s. requirement	This software collects data from various IED installed in the field near T/F and process it as per S/s. requirement and it provides easy to use graphical user interface for substation operating staff. Software should support scalability	MSETCL approved / Std. make	1 Nos. for Multiple T/F
TAP Changer Controller cum Transformer Monitoring Unit (TF IED)	This device collects the data from Fan Control Cubicle and On Load Tap Changer Drive Mechanism and applies the necessary interlocks and logic and process the data and forward it to TAMS software installed in the control room. Usually one IED installed per T/F. This IED should be capable of accepting inputs such as 4-20 mA , RS485 Comm. And it should work on 220V DC/110V DC whichever available at S/s. And this communicates on 61850 / 104 protocols.	MSETCL approved / Std. make	1 Nos. for Each T/F
RTU/ PT IED	This device is required for configuration of transformer LV side voltage & current (for AVR & temperature curve purpose). Also it shall act as a data exchange unit on protocol such as IEC 61850, 104, Modbus. This device shall have minimum 02 ports for each of above protocol.	MSETCL approved / Std. make	1 Nos. for Multiple T/F
Terminal Board (Yard Cabinet)	This IP 65 rated panel with necessary stand of almost 4 feet height installed near each T/F in the field and grounded using cement in the field. IED and necessary devices installed in this panel. As it occupies one of the important device i.e. IED/RTU, this should follow all the standards of panel to be installed in harsh environment.	MSETCL approved / Std. make	1 Nos. for each T/F
Industrial Grade PC along with Standard Kiosk in the Control Room	Industrial grade PC used as it runs important TAMS software and as it runs 24X7 and used for monitoring and controlling various parameters of T/F auxiliaries, this should be enclosed in KIOSK as per MSETCL standards OR Industrial Grade furniture for work station PC can be provided.	MSETCL approved / Std. make	1 Nos. for Multiple T/F
Armoured Fibre Optic Cable	Fiber optic cable drawn from each IED installed in the field to control room accompanied by ring / star topology to achieve maximum uptime of TAMS. As this runs throughout the cable trench of the substation it is recommended to use armored fibre optic along with HDPE pipe for safety from rodents throughout the trench length.	MSETCL approved / Std. make	RMT at actual
12 & 4 Core Copper Cable	Copper Cable for configuration/wiring of FCC/OLTC with TAMS IED.	MSETCL approved / Std. make	RMT at actual
FO Joint Box / LIU	As IED gives communication O/P in Ethernet/ FO Patch cords, LIU and convertor to be installed for conversion of Ethernet / FO Patch Cords to armoured FO in the field and same needs to be reversed in the control room to establish necessary communication. Each T/F will require 1 Joint box.	MSETCL approved / Std. make	1 Nos. Required for each T/F
Managed Ethernet Switch	Managed ethernet switch will be used to build communication infrastructure.	MSETCL approved / Std. make	1 Nos. for Multiple T/F

D) Benefits:

Following benefits are to be achieved from this solution at MSETCL substations –

1. The unit shall be useful at substation where frequent tap change operations are required for Voltage regulation. AVR helps in achieving this easily by operating automatically as per requirement.

2. Getting history & records of tap change as well as temperature and cooling system status through report generation.

3. Easy to commission at substations where existing RTCC are out of service. Saving in the cost as control cables for transformer auxiliary signals are not required from yard to control room.

4. Substation wherein there is space problem for accommodating new bay control & relay panel commissioning, at such places RTCC panel can be replaced by retrofitting of TAMS unit thereby creating free space.