1.0 Background

TPCODL has been in the forefront, in adoption of latest technology in the power utility sector pan Odisha. Together with its culture of Consumer Service Excellence, Continuous Learning, Performance Orientation, Innovation and Empowerment, it has been able to set benchmarks in accelerated reduction of tripping, equipment failure, enhance consumer satisfaction and improve employee productivity.

One of the significant challenges that the utilities face is restricting the fault at minimum possible section of the electrical network and clearing the fault in minimum possible time. To achieve this feature utility works round the clock to minimize equipment failure, equipment down time and faster restoration thus ensuring reliability and enhanced MTTR. All the utility across the globe moving towards deployment of technology to make the Grid smarter in order to ensure operation excellence and serve the consumer with green and continuous power supply with any interruption. To achieve the TPCODL Vision and Mission, TPCODL deploying the latest technology for automation of Primary Substation for Centralised monitoring and control of entire distribution network for faster decision making and corrective action for restoration of the network ensuring. TPCODL already deployed Substation Automation System in FY 20-21 and till now integrated 52 Nos. of R-APDRP stations and 112 Nos. of ODSSP stations from a centralized location in Bhubaneshwar and unmanned 58 Nos. of Substations.

In FY 21-22, 22 Nos. of 33/11 kV Primary substations are SCADA enabled and in a process of integration with SCADA/ADMS System being commissioned. In FY22-23, 45 Nos. 33/11 kV Primary Substations are in process of SCADA enablement and expected to be commissioned by end of FY22-23.

2.0 Existing Systems in Place

2.1 SCADA/DMS System at Bhubaneswar and Cuttack Town

The SCADA/DMS System was implemented in Bhubaneswar and Cuttack Town of TPCODL under R-APDRP (Part-A) Scheme in the year 2016. Some major components and functionalities of SCADA/DMS System are as below:

a. Independent SCADA Control Centre (SCADA CC) at Bhubaneswar and Cuttack

b. Disaster Recovery (DR) Centre at Berhampur for Data Recovery

c. DF8000 SCADA/DMS System have the following functions:

- SCADA Applications
- Information Storage and Retrieval (ISR)

d. Integration with R-APDRP Customer Care, GIS, Billing System & SLDC

In addition to SCADA / DMS implementation, the Remote Terminal Units were also installed at 56 nos. of 33 / 11 kV Substations. These RTUs was integrated over MPLS / VPN link with the respective Control

Centres (CC) located in Bhubaneswar, Cuttack and Puri. The protection BCPUs of 33 kV and 11 kV feeders are integrated to the respective RTUs on IEC61850. The Digital Input / Output (Status, Open/Close/Reset/Tap Change control, Protection Alarms) of the respective bay are acquired through these BCPUs on SCADA System. For monitoring of the Analog measurement, separate Multifunction Meters are used, which are integrated to the Station RTU over MODBUS (Serial) Protocol. The Communication link for integration of these RTUs is MPLS network of the Network Bandwidth Service Provider (i.e. Airtel).

In addition to BCPUs of the 33 kV and 11 kV feeders, some of the installed FRTUs of RMU and data concentrators of FPI of the 33 kV/11 kV network are also integrated with the respective SCADA System. The FRTUs and data concentrators of FPIs are communicating over GPRS/SIM modems for remote monitoring and control through respective SCADA System as applicable.

Currently appx. 190 Nos. of 33/11 kV Substations are integrated with the SCADA System at Bhubaneswar & Cuttack for remote monitoring & control from Centralize Power System Control Center (CPSCC).

2.2 Deployment of New SCADA/ADMS System with MCC & BCC:

The new SCADA/ADMS System with a concept of MCC and BCC is being commissioned at Cuttack Control Center. This system has capacity to handle more than 500 Primary Substation and is based with the Concept of Main Control Centre & Backup Control Centre working in Synchronization with shared operational philosophy in real-time. The deployed System Consist of Cyber Security infrastructure for addressing the cyber Vulnerabilities, automatic backups of servers for faster restoration of system in case of any failures, Network management Systems for health monitoring of OT equipment, Patch management & antivirus system for regular patch and definitions updates, Reporting and Analytics utility for analysis & MIS reporting. The deployed System provides a platform for training the workforce for different operational situations by simulation of different scenarios.

Both the SCADA/DMS Systems are operational and running in parallel till all the Substations are migrated and tested successfully in new SCADA/ADMS System.

2.3 SCADA Enabled Sub-station

Out of 371 Nos. of Substations, 205 Nos. of sub-Stations are SCADA enabled and remotely monitored and controlled from Centralised SCADA System.

TPCODL distribution area is spread over in 5 Circles, 20 Distribution Divisions and 64 Sub-divisions with 371 numbers of 33/11 kV Primary Sub-Stations. The substations are implemented under various schemes and broadly categorized as under:

Circle Name	Total No. of S/s	RAPDRP Scheme	ODSSP Scheme	PNP Scheme	Conventional Substation
BBSR-I	71	30	31		10
BBSR-II	90		30	4	56

Circle Name	Total No. of S/s	RAPDRP Scheme	ODSSP Scheme	PNP Scheme	Conventional Substation
Cuttack	75	22	22		31
Dhenkanal	70		27		43
Paradeep	65		24		41
Total	**371**	**52**	**134**	**4**	**181**

Table # 1 : 33/11 kV Primary Substations in TPCODL Network

Details of Substation Automation and its integration with SCADA System are as below

2.3.1 Sub-station Automation System under RAPDRP Scheme

56 Nos. of substations under RAPDRP and PNP Nabakalebar scheme are automated and equipped with 33/11 kV CRPs, Numerical Relays, VCBs, Battery Charger and Multi-Function Meters (MFMs). All these devices are integrated at sub-station level RTU. The numerical relays and Multifunction meters are communicating with RTU over IEC 61850/IEC-103 and Modbus protocol respectively. Equipment status, alarms and control are through BCPUs over IEC61850 and status of auxiliary system are provisioned through hardwiring to RTU. These RTUs are communicating to respective control Centre SCADA System i.e. Bhubaneswar and Cuttack over IEC60870-5-104 using service provider MPLS network.

2.3.2 Sub-station Automation System under ODSSP Scheme

The ODSSP scheme focused on supply of quality power to consumers and intends to address the problem of low voltage in rural areas. The scheme focusses on construction of 33/11 kV Sub-stations in the state; over 134 Nos. of 33/11 kV sub stations has been planned to commission under three phases in TPCODL Distribution network. All 134 Nos. 33/11 kV Substation are integrated with centralised SCADA System and being operated from Power System Control Centre, Bhubaneswar.

2.3.3 SCADA Enablement of 33/11 kV Primary Substations (Conventional Type Substations)

In TPCODL distribution network approx. 181 Nos. of 33/11 kV Primary Substations (*Refer Table # 1 : 33/11 kV Primary Substations in TPCODL Network*) are Conventional type (Old Substations Commissioned with mechanical and electromechanical Protection and Switchgear system). These Substations are not SCADA enabled and feeders are equipped with electromechanical or non-communicable static relays. These conventional type substations are locally monitored and controlled manually from CRP/Switchgear/Field panels under the coordination of Power System Control Centre.

It is planned to integrate these substations to SCADA/ADMS System for Centralized Monitoring and Control of entire distribution network in phased manner.

Phase # 1 : Under FY 21-22 Capex Scheme, 22 Nos. of 33/11 kV Primary substations are SCADA enabled and integrated with New SCADA/ADMS System.

Phase # 2 : Under FY22-23 Capex Scheme, 45 Nos. of 33/11 kV Primary Substations are planned for SCADA enablement. All RTU panels are commissioned and integration with SCADA/ADMS System is in progress.

Phase # 3 : Under FY23-24 Capex Scheme, 60 Nos. of 33/11 kV Primary Substations are planned for SCADA enablement and in progress.

Phase # 4 : Under FY24-25 Capex Scheme, 20 Nos. of 33/11 kV Primary Substations are planned for SCADA enablement.

Phase # 5 : Under FY25-26 Capex Scheme, 34 Nos. of 33/11 kV Primary Substations are planned for SCADA enablement.

SCADA enablement of all Substations are expected to be completed by FY25-26.

3.0 Purpose and Necessity

3.1 SCADA Enablement of 114 Nos. 33/11 kV Primary Substations (Conventional Type Substations)

To automate appx. 181 nos. of Conventional type sub-stations for centralize remote monitoring and control, phase wise implementation plan is as below:

Sl. No.	Phases	Total No. of Substations	Execution Timeline	Present Status
1	Phase#1	22	FY 2021-22	Capex Approved and Job Completed
2	Phase#2	45	FY 2022-23	Capex Approved Commissioning job completed and integration & testing is in progress
3	Phase#3	60	FY 2023-24	Capex Approved, In Progress
4	Phase#4	20	FY 2024-25	Capex Planned FY24-25
5	Phase#5	34	FY 2025-26	Capex Planned FY25-26

Table # 2A : 33/11 kV Primary Substations SCADA Enablement Plan

As per the above table this proposal is for SCADA enablement of 60 Nos. of 33/11 kV Primary Substations (Conventional Type) in FY23-24 under Phase # 3.

It is also proposed to replace the existing old and depleted low-capacity DC system by New Substation DC system to cater the load of existing electrical and protection equipment as well as substation automation system, which in turn will enhance the reliability and availability of the system. New Battery Charger (FC & FCBC) with Batteries are considered along with the SCADA enablement of conventional substations to maintain the DC Supply and adequate Backup for the substation equipment and automation system.

3.2 Remote Monitoring of RMUs

Standalone RMUs are being installed and commissioned across the distribution network to improve the reliability of the network. So, FRTUs with GPRS/3G/4G/5G modems are proposed to be installed at RMUs locations for remote monitoring and control. This enables centralized visibility of Secondary Distribution network at Centralised Power System Control Centre (PSCC) for faster decision-making and restoration of the network. This is also will be essential for implementation of ADMS applications for localization of fault, for faster isolation and restoration of the secondary distribution network.

To automate RMUs progressively and its integration with SCADA/ADMS system is planned in phased manner as per the table below :

Sl. No.	Phases	Approximate No. of RMUs to be Automated	Execution Timeline	Present Status
1	Phase # 1	50	FY 2023-24	Capex Planned FY23-24
2	Phase # 2	70	FY 2024-25	Capex Planned FY24-25
3	Phase # 3	50	FY 2025-26	Capex Planned FY25-26
4	Phase # 4	50	FY 2026-27	Capex Planned FY26-27
5	Phase # 5	50	FY 2027-28	Capex Planned FY27-28

Table # 3 : Secondary Distribution Network Automation Plan (RMU)

As per the above table this proposal is for SCADA enablement of 70 Nos. of RMUs in FY24-25 under Phase # 2.

In Phase#1, Site survey completed and commissioning is in progress for SCADA enablement of 30 Nos. of RMUs in FY23-24.

4.0 Statutory Compliance Requirement

All statutory requirement complied as and when required for the proposed CAPEX plan.

The communication infrastructure proposed for the integration of SCADA & Substation Automation System are from the services of Network Bandwidth Service Provider (NBSP). All statutory compliance with respect to communication infrastructure will be managed by NBSP in consultation with TPCODL.

The proposed SAS System will have the provision to comply all the guidelines issued of CERT-IN, NCIIPC during the implementation.

5.0 Proposal for the Capex Investment

TPCODL has identified a number of challenges related to Safety, 33KV/11KV/0.415KV network, Automation infrastructure and Technology usage. These challenges are planned to be addressed through a systematic investment plan by TPCODL. The proposed "Capex Plan" represents a justified and efficient level of total capital investment estimated by TPCODL to meet the service obligation; improving safety, reliability of network and level of service standards.

Summary of Capex requirement for FY 2024-25:

Sl. No.	Activity Planned	Capex Proposed (FY 2024-25)
1	SCADA Enablement of Conventional Substation – 20 Nos. of 33/11 kV Primary Substations	**3 Cr**
1.a	Substation Automation System for 20 Nos. of 33/11 kV Primary Substations (Conventional Type)	2.2 Cr.
1.b	DC System for 20 Nos. of 33/11 kV Primary Substations (Conventional Type)	0.8 Cr.
2	Remote Monitoring of RMUs – 70 Nos. of RMU Locations	**3 Cr**
3	**Total Cost in INR**	**6.00 Cr**

Table # 5 : CAPEX Proposal for FY24-25

6.0 Scope of the Proposal

6.1 SCADA Enablement of Conventional Substation

In TPCODL there are approx. 181 Nos. of 33/11 kV conventional Sub-stations and are planned to automate these substations in 4 phases as mentioned in the table below:

Sl. No.	Phases	No. of Substation	Execution Plan
1	Phase#1	22	FY2021-22
2	Phase#2	45	FY2022-23
3	Phase#3	60	FY2023-24
4	Phase#4	20	FY2024-25
5	Phase#5	34	FY2025-26
Total No. of Substation to be Covered		181	

Table # 2B : 33/11 kV Primary Substations SCADA Enablement Plan

As per the above table this proposal is for SCADA enablement of 20 Nos. of 33/11 kV Primary Substations (Conventional Type) in FY24-25 under Phase # 4.

It is also proposed to replace the existing old and depleted low-capacity DC system by New Substation DC system to cater the load of existing electrical and protection equipment as well as substation automation system, which in turn will enhance the reliability and availability of the system. New Battery Charger (FC & FCBC) with Batteries are considered along with the SCADA enablement of conventional substations to maintain the DC Supply and adequate Backup for the substation equipment and automation system.

6.2 Remote Monitoring of RMUs

As per the above table (Refer *Table # 3: Secondary Distribution Network Automation Plan (RMU))* this proposal is for SCADA enablement of 70 Nos. of RMUs in FY24-25 under Phase # 2.

7.0 Cost Estimation and Execution Timelines

Sl. No.	Activity Planned	Discovered / Estimated Cost	Execution Timelines	Remarks
1	SCADA Enablement of Conventional Substation – 20 Nos. of 33/11 kV Primary Substations	**3.0 Cr**	FY 2024-25	Substation Automation System / DC System
1.a	Substation Automation System for 20 Nos. of 33/11 kV Primary Substations (Conventional Type)	2.2 Cr	FY 2024-25	Appx. INR 12,00,000.00 for RTU System and MPLS Link per Substation
1.b	DC System for 20 Nos. of 33/11 kV Primary Substations (Conventional Type)	0.8 Cr	FY 2024-25	Appx. INR 4,00,000.00 per Substation
2	Remote Monitoring of RMUs – 70 Nos. of RMU Locations	3.0 Cr	FY 2024-25	Appx. INR 4,000,00.00 for FRTU and INR 25,000.00 for Modem, per RMU locations

Table # 6 : Cost Estimation for CAPEX Proposal of FY24-25

8.0 Benefits

8.1 Tangible and Intangible

Centralized operation would ensure optimum resource utilization of the hardware and software and functionalities used in the SCADA System. Other benefits include:

i. This will ensure efficient operation & monitoring under steady state, dynamic & transient condition of the system.

ii. To achieve improvement in operations considering complex Load- Demand cycle changes to bring in better and holistic visibility while making critical decisions.

iii. Optimize on unscheduled power interchange, maximize utilization of the assets

iv. Better Inventory management, low maintenance cost

v. Ease of Operation and Operational flexibility

vi. Multi-skilling of operational and maintenance personals

vii. Enhanced operational safety

viii. Better Control on Cyber Security Management, optimization of cyber security measures implementation.

ix. N-2 Communication redundancy will be provided at critical location for communication by using advanced MPLS Technology.

x. Improved reliability of service.

8.2 Benefits to Customer

i. Reduction in restoration time of outage

ii. Improved reliability of service

iii. Better control of power quality and enhanced use of reactive power sources

iv. Useful feedback information to the customer in terms of expected outage duration time etc.

v. Monitoring the potential quality problems and also the reliability problems due to supply interruptions.

8.3 Indirect Savings/Improvements

i. Reduction in overall maintenance and inventory carrying cost.

ii. Strengthening of existing operational technology infrastructure.

iii. Detection and protection of operational system from Cyber Security vulnerabilities.

iv. Improvement in reliability of power supply to consumers.

8.4 Cost Benefit

SCADA Enablement of Primary and Secondary distribution network will enable centralize operation through PSCC lead to optimization of resources and cost to company.

Currently all the substations are operated by the substation operators locally and there are 7 nos. of substation operators, operating each substation.

i. For each substation 3 manpower can be optimized & redeployed which result in saving of INR 2.52 L/Substation per year.

ii. Due to improvement in reliability, unserved unit will be available for distribution, which is contributing 2 % of total load.

9.0 Revenue Return/Pay Back Period

10.0 Recommendation and Conclusion

The above Capex proposal for SCADA enablement of Primary Substations, Secondary Distribution Network (RMU) and Real time Video Management system for primary substations will facilitate Centralized monitoring and Control, enabling Power System Control centre faster decision making and restoration with utmost safety.

Above Capex proposal also includes efficient monitoring of Operation Technology Communication Infrastructure along with resilient secured communication network.