



PARADIP PORT TRUST

BUDGETARY OFFER

FOR

Supply, Installation, Testing & Commissioning Supervisory Control and Data Acquisition (SCADA) of Main receiving substation with other 09 substations installed different location of Paradip Port Trust with 5 yrs AMC after warranty periods.

SUBMISSION ON OR BEFORE **02/04/2019**

THE EXECUTIVE ENGINEER (ELECT)

PORT ELECTRICLA DIVISION - II

PARADIP PORT TRUST,

PARADIP, JAGATSINGHPUR,

ODISHA - 754142

Contact No.9777-180-842

Email Id: rnsahooeppt@gmail.com

REQUEST FOR BUDGETARY OFFER

a) GENERAL INFORMATIONS:

Sl.	Item	Details
1.	Name of Work	Supply, Installation, Testing & Commissioning Supervisory Control and Data Acquisition (SCADA) of Main receiving substation with other 09 substations installed different location of Paradip Port Trust with 5 yrs AMC after warranty periods.
2.	Department / Organization	ELECTRICAL & MECHANICAL DEPARTMENT / PARADIP PORT TRUST
3.	Executive Division	Port Electrical Division.
4.	Officer Inviting the Offer	Executive Engineer
5.	Immediate Next Authority	Superintending Engineer
6.	Sanctioning Authority	Dy. Chairman, PPT
7.	Executing Authority	Executive Engineer

b) OTHER INFORMATIONS:

Sl. No.	Item	Date	Time
1	Publication date	13.03.2019	17:00 Hrs.
2.a)	Document download start date	13.03.2019	17:00 Hrs.
b)	Document download end date	02.04.2019	17:00 Hrs.
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b)	Last date for seeking Clarification on-line	20.03.2019	17:00 Hrs.
4.	Date of uploading response to Clarifications sought	29.03.2019	17:00 Hrs.
5.	Offer Submission end date	02.04.2019	17:00 Hrs.
6.	Offer Validity period	120 days	
7.	Currency of Offer	Indian Rupee	
8.	Language of Offer	English	

Name of the Work: Supply, Installation, Testing & Commissioning (SITC) Supervisory Control and Data Acquisition (SCADA) of Main receiving substation with other 09 substations installed different location of Paradip Port Trust with 5 yrs AMC after warranty periods.

SCOPE OF WORK

Paradip Port Trust invites budgetary offer for Supply, Installation, Testing and Commissioning (SITC) of Supervisory Control & Data Acquisition (SCADA) system of main control Room and other 09 substations located different location of PPT. The following works are to be taken up under this system

1. The SCADA system shall cover Main Receiving Substation (132 / 33 / 11KV) and another 09 nos. of distribution substation of Paradip Port Trust as followings:
 - (i) V-Point S/S; (ii) Madhuban-II S/S; (iii) Radar S/S; (iv) Sector-9 S/S; (v) NAC S/S; (vi) Clean Cargo S/S; (vii) Harbour S/S; (viii) 11 kV IOHP S/S; and (ix) BOT S/S.

The Contractor has to design the SCADA system for above substations considering the requirement of numeric protection relay, energy meters / multi-function meters / tri-vector meters, RTU panels and networking through OFC or wireless communication with each other substations. The control room or command centre shall be installed in the 132 kV / 33 kV main receiving substation building. The communication with other substation should be through only wireless system, i.e. RF / WIFI / GSM / GPRS / 3G / 4G network. The SCADA system shall have provision to add 40 substations (as future extension) for data storage, monitoring & control.

The details of existing feeders & relays available in the substations are attached herewith as **ANNEXURE - A (07 sheets)**. By going through the details of existing relays, the Bidder / Contractor has to select the type & quantity of numeric relay required for SCADA solution. The Contractor has to replace the existing relay with advance with numeric relay suitable for SCADA control system. Standard type of relay, RTU panel & data interface module shall be used so that material of other standard manufacturer can be replaced in future and there should be compatible with each other.

The Contractor shall supply RTU panels of reputed brands such as Siemens / ABB / Schneider or other reputed manufacturer at Main Receiving Substation & other substations for transmission and receiving data for SCADA control system.

The software, hardware and all materials & consumables required for SCADA control system shall be supplied by the Contractor.

- 2.1 The Contractor has to supply numeric protection relay with following major technical parameters besides other facilities:
 - a) Directional/Non Directional O/C protection relay:(67/50/51)
 - b) Earth fault protection: :(67N/50N/51N)
 - c) Voltage Controlled Over current: (51V)
 - d) Sensitive earth fault/Restricted earth fault: (64R)
 - e) Over voltage and under voltage; (59/27)

- f) Over frequency/Under frequency /Rate of change of frequency (81O/81U/81R)
- g) Power protection (32R/32L/32O)
- h) Breaker fail protection (50BF)
- i) Differential protection (87)

2.2 The following additional features of the relays are desirable:

- a) Thermal overload protection.
- b) Negative sequence over current protection.
- c) Circuit breaker maintenance information.
- d) CT supervision.
- e) VT supervision.
- f) Broken conductor detection by measuring I_2/I_1 .
- g) Cold load pickup function to change the settings when the protected object is connected to a network i.e. at starting allowing the set value being lower than the connected inrush current.
- h) Trip Circuit Supervision.
- i) Contact & LED test capability without using any testing instrument.

Besides that the relay shall have at least four independent setting groups. The relay shall automatically switch from one setting group to another depending on system conditions (such as failure of incomer supply, which causes fault level to decrease etc.).

2.3 The relay should be modular draw out type, suitable for either rack or panel mounting. Standard terminal blocks should be located at the rear of the relay providing connections for all input and output circuits. Relay should work with Auxiliary supply of 110V to 250V D.C. & 100V to 240V A.C. Relay should have total 5 nos. of CT (range 1A or 5A selectable at site) & 3 nos of VT input (Range 110V to 120V A.C.).

2.4 The relay in addition to protection and control should store all parameters in non volatile memory so that in case of failure of auxiliary supply relay parameters remain intact. The feature of the relay should be accessed through a front panel backlit LCD display with minimum 32 character alphanumeric type display. The relay should record all the events affecting and affecting the relay performance and shall store at least 500 nos of time tagged events with 1 mili second resolution in its battery backed memory. The relay shall also store at least 5 nos of latest fault records containing the following information and same shall accessible from front panel LCD display

- i) Indication of faulted phase.
- ii) Protection operation.
- iii) Active setting group.
- iv) Date and time.
- v) Current, voltage and frequency.

2.5 Disturbance recorder shall have memory to store minimum 50 nos. of records with 0.5 second record duration. Disturbance record wave form shall consist of minimum 3 nos of voltage channels, 5 nos of current channels and 32 nos of digital channels. Recorded disturbances can be stored in local PC and/or station PC in complete format for further analysis. The relay shall have RS232 or USB front port for communication with laptop, fibre optic and R145 rear port for communication to SCADA or any other station communication system. The relay should have at least 8 optically isolated inputs and at least 7 programmable outputs apart from one dedicated output relay (N/O & N/C type) should be permanently assigned for self-supervision. The relay shall have minimum 8 nos. of freely programmable LED. The digital output contact ratings of the relays shall be as follows:

- a) Rated voltage 300V.
- b) Continuous current: 10A
- c) Short duration current: 30A for 3s
- d) Mechanical Durability > 10000 operations.

2.6 The relay PCB shall have conformal coating so that the relay can be used in harsh & corrosive environment. The relay shall have the facility of communication on industry standard open protocols. The relay should have a RS 485 port for local engineering station. There shall have a facility to have IEC61850 protocol inbuilt without use of any external converter and should support GOOSE message of class-1 type to support faster transmission of message with 4ms. The relay shall have facility for time synchronisation on SNTP, RS485 and through digital input. The relay should measure the following standard quantities with accuracy \pm 1% of the full scale,

- a) Phase current (positive, negative and zero sequence currents).
- b) Phase voltage (positive, negative and zero sequence voltages).
- c) Neutral current.
- d) Frequency.
- e) Thermal state.
- f) Active and Reactive Power.
- g) Energy

IEC 60529: 1992 for enclosure protection: IP 52, IP 50 & IP 10 for front, side & rear side of the relay respectively and

Operating temperature range: 25⁰C to + 55⁰C,

Ambient Humidity Range As per IEC 60068-2-3, 56 days at 93 % relative humidity.

Corrosive Environments As per IEC60068-2-60:1995, to elevated concentrations of H₂S, NO₂, CL₂, SO₂. Insulation: As per IEC 60255-27:

High Voltage (Dielectric) Withstand: As per IEC 60255-27: 2kV rms AC, 1 minute.

Immunity to Electrostatic Discharge: As per IEC 60255-22-2: Class 4.

Radiated Immunity from Digital Communications: As per EN61000-4-3.

Vibration Test: As per IEC 60255-21-1

Shock and Bump: As per IEC 60255-21-2

Seismic Test: As per IEC 60255-21-3

The relay shall have Cyber-Security facilities (NERC compliant) to avoid unauthorised access and control.

3.1 The RTU shall cover the following requirements:

- Proven track records to various utilities for their Transmission and Distribution network. It shall be demonstrated that the same range of RTUs have already been installed, commissioned and in operation in High Voltage environment for period of more than 5 years.
- The RTU shall be based on a truly distributed design allowing any flexible combination and distribution within the various substation areas or building being able to cope new configuration with serial IEDs as well as for refurbished substations where large IO quantities are required (around 20 or more, dealing with 2000 data points).
- The RTU shall allow flexible, scalable and reliable integration of control, monitoring; metering, power quality, fault recording and automation functions. It can be used for a wide range of bays from medium-voltage substations.
- The RTU shall comply with latest state of the Art Ethernet Based technology hence using open system standard, at least 32 bit processor on the CPU board, possibility to integrate some Optical Ethernet switches interface under 100Mbit/s technology. Should several racks be used all the required interfaces between racks shall be embedded within the rack hardware and not require any external switches.
- The RTU shall allow latest HMI LCD display technology to be used on main RTU rack allowing operator to access detailed substation alarms and events data without the absolute necessity to use laptop computers. In the meantime laptop port should be available for any major local database changes to be managed.
- The RTU shall comply with applicable standards and shall equally satisfy the technical requirements stated in European (CE) and International specifications (IEC - International Electro technical commission).
- The RTU shall be rugged and offer cyber-security facilities (NERC compliant), to avoid unauthorised local access and control.

3.2 The RTU shall offer the most flexible and innovative communication speeds including at least:

- Standard open SCADA protocol for data master-slave exchange through lower bandwidth communication medium at least IEC60870-5-101 on master as well as slave.
- For substations equipped with higher bandwidth communication data access (typical optical backbone access) Ethernet based SCADA protocols shall be available at least IEC 60870-5-104
- Ethernet based substation protocols for substation operator and asset managing engineers (Ethernet IEC 61850)

- For serial interface with Substation IEDs RS485 links using IEC 60870-5-103, DNP3 and MODBUS shall be available. The Modularity of the racks shall be made so that 20 IEDs can be connected serially to a rack through these links without jeopardizing the expected response time at the SCADA level.
- Should local Ethernet communications be required within the Substations the option to include integrated Ethernet switch board shall be available.
- Local SCADA HMI for local control & monitoring

3.3 Substation Local Interface:

The RTU shall include a local LCD screen to cover the need of operators to access data while located into the Substations. These LCD shall cover the following functions:

- Optionally the possibility to control (Open/Close) the main substation switching devices (Incoming breaker)
- Access to all Substation time stamped alarms ; while some configurable LEDs should be available within the RTU front displays for the main groups of alarms, the operator shall be able to navigate within this screen to further analyse the root cause of a given alarm
- Access to all event logs

The basis of operation of this front display is to allow SCADA operators to inform Substation operator of any alarm of event within a given substation, while the substation operator keep access to all data history within the substation once they are there for troubleshooting purposes.

3.4 Communication with SCADA/DMS Master:

For distributed configuration consisting of several RTU racks, any rack can have the flexibility to be designed as a the data concentrating interface to the upstream SCADA, concentration data from any other rack without jeopardizing the response times expected at the master station level. At least the following serial data port options shall be available: IEC 60870-5-104, IEC 60870-5-101 and DNP3.0 (serial and IP).

The RTU shall also have the capability to interface with several master stations of different types in the same time, covering the possibility to at least interface through 4 independent redundant ports (more than 8 ports in total).

Physical interface options shall cover the following possibilities: RS232, RS485, RJ45, Optical Multi-mode medium or Optical Mono-mode medium.

3.5 Digital Input Processing:

All standard processing algorithms shall be provided for the standard signal types such as single digital inputs, double digital inputs, transformer tap indications, etc.

Each of these signal types shall have the required number of conditioning parameters associated with them, e.g. inversion of input state, filter times, scaling parameters etc. These shall be configurable on a point by point basis.

All status changes shall be time stamped to a resolution of 1mS. Detection of multiple changes of status between scan (MCD – Momentary change detection) shall be supported and the MCD data is reported by exception for IEC 870-5-101 protocol.

3.6 Pulse accumulators:

These are assumed to be either single pulse accumulators / counters. Each pulse accumulator shall be presented to the RTU as a single digital input or a complemented digital input respectively. The points regarding the digital input above would therefore equally apply to these inputs.

The value of the counter represents the number of pulses counted since the loading of database or since the counter roll over or since a voluntary reset.

3.7 Digital Outputs:

Digital output card shall allow pairs of trip / close outputs. In addition to this, depending on the configuration the output shall be configurable of Transient or Persistent type.

The outputs shall be presented as single pole Form A contacts. As applicable to the protocol (IEC60870-5-101), the Controls shall be configurable of immediate type or of Select Before Operate mode.

RTU shall support Dummy breaker (simulated CB to check end to end Communication with the SCADA).

3.8 DC Analogue Inputs

The DC analogue input can be acquired by the RTU through transducers; each input is to be isolated and shall be selectable individually among various ranges:

Current inputs: +20mA, 4-20mA, 0-5mA, 0-10mA, 0-1mA

or Voltage inputs : 0-5Vdc , 0-10Vdc, +-10Vdc

Analog input accuracy shall be $\leq 0.1\%$. The CAD converter type is: 15bits + Sign.

3.9 AC Analogue Inputs (Current/Voltages)

The AC analogue input (current/voltage) shall be acquired by the RTU through transducerless acquisition when no transducers exist yet or through transducer inputs for existing substations.

For RTUs covering several circuit the RTU shall have the flexibility to interface up to 16 CT/VT interfaces directly. These CT/VT interface shall allow for each circuit measuring of all key parameters, at least Frequency, Watt, VA, Vars, Phase angle, Power factor.

The DC analog input option shall be converted through a 16bit A/D converter (15 bit + sign). These signals correspond to the voltage and current DC delivered by Transducers

3.10 DC Analogue Outputs

The DC analogue outputs are to be secured and powered with an external source (output maintained when the RTU power is Off).

Each output is to be isolated and shall be selectable individually among various ranges: +-20mA, 4-20mA, +-5mA, +-10mA, 0-5mA, 0-10mA

Analog output accuracy shall be $\leq 0.1\%$.

Each analog output is associated to a "read-inhibit" output contact, signaling the stability of the output value.

4.1 Automation

For each feeder a sectionaliser automated function shall be provided. It shall open automatically the switch during the absence of voltage during recloser cycles. The number of faults and the cycle duration shall be configurable. In addition, a general purpose automation language shall be integrated and shall be compliant with IEC 61131-3 standard

4.2 Local MMI

On the front panel of RTU, LEDs and push buttons shall provide the following statuses and controls:

- Status of all communication ports
- Switch position status
- Switch position control. The switch position control shall be validated by pressing simultaneously 2 buttons in order to avoid unexpected manual control orders.
- Earth switch position
- Fault current detection
- Battery and power supplies status
- Local remote status
- Local remote control push button
- Automation status and control push button
- Fault detection reset control push button

The control and status related to each of the switchgear shall be presented in a clear and ergonomic way, assuming that for each switchgear a clear area is dedicated to each switchgear on the front panel.

4.3 Other local MMI

Locally, a Web Server interface shall be provided for connection of a laptop PC, a tablet or a Smartphone in order to access to more details data such as alarms log, statuses and position, and measurement.

4.4 Communication with SCADA

The RTU shall be able to communicate with the SCADA on 2 channels. In case of redundancy the SCADA will activate the backup communication channel. The RTU shall be able to initiate also a communication on the backup channel in case of detection of inactivity on the main channel. The RTU shall accept communication with 2 SCADA simultaneously.

4.5 Protocol

The RTU shall comply with IEC 870-5-104 IEC 870-5-101 DNP3.0 standard protocol. The RTU shall support Secure Authentication according to IEC 62351-5.

4.6 Transmission

The communication system is based on GPRS/3G/4G/ RF(free frequency band) / optical fiber. The RTU power supply shall be sized to supply the communication modem. RTU shall transmit data to the SCADA all the status and measurement. Each data shall be individually configurable to be sent or not to the SCADA.

The measurement shall be spontaneously sent to SCADA according to configuration of :

- Threshold
- Dead band

4.7 WiFi:

A WiFi communication port shall be offered to access locally to the RTU. It shall be secured by means of

- Activation/deactivation from the SCADA
- SSID visibility configurable
- Passphrase
- Automatic disconnection by timeout

5. Communication LAN for other devices

In order to ensure that future needs should be covered, the RTU shall be able to provide additional communication ports:

- Ethernet port
- RS232/RS485 port

6.1 Power supply

The RTU shall include a power supply which integrates a 12Vdc battery charger

The battery charger shall be compensated in temperature and protected against deep discharge and overvoltage. A single 12Vdc battery is mandatory in order to limit the maintenance constraints.

In case of absence of the battery, the power supply shall be able to supply at least the RTU.

The power supply, from the battery voltage, provides the following:

- 110Vdc or 48Vdc \pm 10% for the motorisation. This voltage shall be connected only in execute phase.
- 12Vdc for the transmission devices.
- 12Vdc for the RTU modules.

6.2 Power supply input

Input voltage: 230Vac± 10%

The power supply shall be insulated to 10kV and surge protected up to 20kV , in compliance with IEC60255-5.

6.3 Battery

The battery capacity shall maintain a backup time of 10 hours for all the voltage outputs and shall permit 10 Open/Close cycles of the switchgear.

The single 12Vdc battery shall be periodically checked, and a battery fault shall be transmitted to the SCADA.

The maximum battery charging time shall be 24hours

6.4 Monitoring

The power supply shall deliver the following statuses to the SCADA

- End of life detection
- Battery disconnected
- Absence of power input
- Voltage output faults
- Battery fault

Any other data should be available through a serial link communication.

7.1 Cyber Security

In order to secure all controls and data acquisition, the RTU shall be designed to be compliant with NERC and IEC62351 requirements. The RTU shall support secure access based on RBAC, with the possibility to configure the roles.

Local and remote access connection shall be secured for maintenance (locally and remotely) with HTTPS, SFTP and SSH protocols.

Authentication shall be based on a Radius server.

7.2 Interface minimization

Each interface shall support only the data types and protocols needed to meet the functional requirements.

Unused interfaces and ports shall be removed. If removal is not possible, the unused interfaces and ports shall be disabled.

A complete list of supported data types and supported communication protocols per interface shall be provided.

All hardware interfaces that are used for programming or debugging shall be completely removed after production.

Communication

Compliance to Security standards

The RTU shall follow the IEC 62351 standards and at least:

IEC 62351-5: 2013

IEC 62351-3

Configuration

Access to the RTU by configuration tool shall be possible only through secured connection: HTTPS for Web server and SSH for console and configuration tool.

Access control

RBAC

The RTU shall support the implementation of Role-based Access Control in compliance with IEC 62351-8.

It must be possible to configure the privileges of individual roles. It must be possible to carry out changes by configuration files through a secure way.

It must be possible to define more roles for future applications.

It shall be possible to assign each role individual security credentials.

It shall be possible to bind roles to individual user accounts on the RTU.

The minimum following function and data shall be controlled through RBAC:

Configuration files

Software update

User management

Executing program or shell command

I/O on local maintenance access

A specific tool shall permit to configure the security policy, role and password.

Management of Security passwords

The RTU service application shall support individual user passwords.

Passwords shall be stored together with a salt using an allowed cryptographic hash function.

The RTU service application shall enforce a high complexity of passwords.

The RTU shall lock the access after several password error.

User Authentication

The RTU shall authenticate the communication parties on the WAN interface using a challenge-response protocol based on message authentication codes. The RTU shall terminate the connection if the user authentication fails.

The RTU shall authenticate the communication parties on the Local Maintenance interface.

It shall be possible to configure the RTU so that it blocks authentication requests, either temporarily or permanently, from an account after a number of failed login attempts. The number of failed login attempts and the time the account is blocked shall be configurable.

Central Management of user account

The RTU should allow to manage user authentication through a Radius server.

Security Log

The RTU shall provide a local audit trail for all security events that occur.

Log files shall be produced in Syslog format.

Security events shall be logged locally in a dedicated security log or/and on a SYSLOG server.

Documentation

Secured Versioning

All released versions (hardware, firmware, software) of a device or product shall be uniquely identifiable.

Exchangeable hardware modules shall be versioned separately.

8. Design Documentation:

The Protocol Implementation Conformance Statement as in IEC 62351 and IEC 60870-5-7 shall be provided on request.

General characteristics

Dielectric compatibility:	IEC60255-5	Insulation: 10kV, surge: 20kV
Electrostatic discharge:	IEC6100-4-2	Level 4: 15kV in air; 8kV at contact
RF fields:	IEC61000-4-3	Level 4: 30V/m
Fast transient:	IEC 61000-4-4	Level 3: ±2kV (5kHz to 100kHz)
Surge:	IEC61000-4-5	Level 3 (CM) : 2kV
Conducted RF disturbance:	IEC61000-4-6	Level 3: 10V (150kHz to 80MHz)
Power frequency magnetic field:	IEC61000-4-8	Level 5 : 100 A/m
Pulse magnetic field:	IEC61000-4-9	Level 5: 1000 A/m
Damped oscillatory wave:	IEC61000-4-12	Level 3 (CM): ±2.5 kV
Operating temperature:	IEC610068	-40°, to +70°C
Damp heat steady state:	IEC610068-2-78	93%, 56 days
Damp heat cycles:	IEC60068-2-30	95%, 144h
Salt spray test:	IEC60068-2-11	168h
Protection:	IEC60529	IP3x (cabinet)
Robustness:	IEC62262	IK07 (Cabinet)

SCADA TECHNICAL REQUIREMENTS

TECHNICAL SPECIFICATION

System Architecture Included in the SCADA system's family of products shall be a Graphical User Interface (GUI), a fully integrated Real-Time sub-system, and a fully integrated Relational Database Management System (RDBMS).

The SCADA system shall also provide for easy and open integration with third-party application software via non-proprietary industry standards.

The SCADA system shall provide capability to extend real-time data from the field to the enterprise by providing access to operational and historical data anytime, and anywhere.

The SCADA system shall allow Corporate Information Systems and specialized applications packages access to the SCADA data.

The SCADA system architecture shall utilize non-proprietary industry standards to enable transparent connectivity to other hardware, software and networks.

The Vendor shall adhere to Customer security policies and procedures in order to ensure the overall security of the Vendor's proposed SCADA system, Corporate Information Systems, and associated specialized applications.

Where such policies and procedures require further clarification because of this SCADA project, the Vendor shall provide security specialists for consultation with Customer IT and security staff.

The SCADA system shall leverage the infrastructure of the native operating system using the Kerberos authentication protocol. Users accessing the SCADA system via the Internet shall authenticate using the x.509 standard certificates.

The SCADA system shall provide for single sign-on that shall reduce redundancy and shall simplify user security management by permitting central administration of security from the common Active Directory Service (ADS) and/or AD LDS (Active Directory Lightweight Directory Service).

The SCADA system shall use the Active Directory Service, which may include AD LDS, to manage all users, security and resources.

SSO (Single Sign-on) strategies shall centralize security administration tasks and definitions and shall free the SCADA system from proprietary control of user name and passwords, as well as reducing the burden on users to re-authenticate.

Use of the SCADA system and its security shall not cause end users to come into conflict with the Customer's enterprise-wide security practices and standards.

A SCADA system management application or application bundle shall provide an overview of which hosts and subsystems are active in the SCADA system network, what role they are performing, and what their health is. The management application shall be very quick to call up, and/or constantly running on SCADA workstations and servers. With due consideration of user privilege and restrictions, the application shall permit start/stop and change-role control over the various hosts, and redundant systems and distributed systems.

Administrators shall be able to quickly assess, diagnose and respond to the health of components on the SCADA network.

It shall be possible to use the above-mentioned SCADA management application to configure and administer:

(i) Sub-systems; (ii) services; (iii) computers; (iv) devices; and (v) users, authorities and permissions

It shall be possible to use the above-mentioned SCADA management application to monitor:

(i) service states; (ii) processes; (ii) machine health; and (iii) error logs

The SCADA management application requirements are described further in 0.

The SCADA system architecture shall utilize non-proprietary industry standards such as TCP/IP, ANSI SQL, ODBC and Extensible Mark-up Language (XML) encoding.

The SCADA system shall provide tools to view trends of historically-collected data.

The SCADA system shall be configured using industry standard, unmodified hardware and operating systems. The hardware and Operating System shall be suppliers' standard products and shall constitute the primary components for the system.

The SCADA system shall not be dependent upon specialized, unique, or proprietary equipment or third-party software components available from only a single supplier.

Under normal operating condition, in no case shall it be necessary to shutdown and/or restart any systems in order to activate or deactivate the processing of data at a system.

Distributed System Architecture

The SCADA system shall conform to the concepts of a distributed information system.

Components provided as part of the Vendor's SCADA system must have the ability to share real-time and historical data between independent SCADA subsystems and geographical locations. This shall enhance the overall system reliability and functionality by providing shared access to components and applications.

The Vendor's distributed system shall provide configuration options that allow multiple systems to share telemetry data, alarming, eventing, telecommunication, and control functionality.

User permissions and security restrictions regarding all aspects of the SCADA system shall propagate seamlessly across the SCADA system's distributed architecture.

All computers in the SCADA system shall connect with each other using the latest industry standard Local-Area Network (LAN) and Wide-Area Network (WAN) technology.

The SCADA system peripherals shall connect either directly to the SCADA LAN, through servers connected directly to the system's LAN, or attached to workstation parallel or serial ports. This shall allow access to any device from any computer in the system with the appropriate access authority.

The SCADA system shall provide support for distributed network equipment such as terminal servers, networked printers, networked PC's, and mass storage/backup devices.

The SCADA system shall provide item by item replication of data across the SCADA system's distributed architecture. The direction of the replication shall be configurable based on data groupings that pertain to data ownership (where the data originates) and where the data is required. To handle the large amounts of data being exchanged between systems without requiring excessive WAN bandwidth usage, real-time data shall only be shared between those systems with defined relationships within the distributed architecture.

It shall be possible to define these system relationships to share all records or only specified fields within records. To further reduce the network load between locations, it shall be possible to store historical data locally by each system, or to store historical data only on the owning system and replicate the historical data to other systems.

The SCADA system shall employ a mechanism to allow simultaneous configuration of database points or records from two or more systems across the SCADA system's distributed architecture, while still maintaining database integrity.

Supported Architectures

The SCADA system shall provide flexibility and expandability of the initial system to accommodate changes with a minimum of cost and effort.

The Vendor's base product shall also support PRIMARY/BACKUP, PEER TO PEER, MASTER/SUB-MASTER, and TEST/DEVELOPMENT architectures. (The Vendor's "base product" refers to the version of the product as developed and released by the Vendor's R&D group. The "base product" means that the requested configuration can be accommodated without customization, recompilation or regeneration of the entire system. It is understood that some changes may require licensing additional Vendor products or modules.)

Each SCADA system (consisting of real-time and historical servers, required functionality of which are discussed later on in this document) shall be capable of single or redundant real-time and historical servers.

It shall be possible, but not obligatory, to conflate the real-time and historical roles onto one server or set of redundant servers. Conversely, it shall be possible to host those services on separate servers, depending on load. This is a one-time, initial setup decision, agreed to in the System Configuration Plan (SCP).

Each SCADA system shall be capable of supporting a Decision Support Server (DSS) or servers to supply data to Corporate and other non-SCADA users. The DSS shall operate in a view only mode (having no control or configuration capability).

PRIMARY BACKUP:

It shall be possible to configure the Vendor's base product such that one system operates as the primary control and operation system, and second system operates as the backup system.

PEER TO PEER:

It shall be possible to configure the Vendor's base product such that each system nominally monitors and controls a subset of the overall data, and each system also functions as the backup for the other.

MASTER/SUB-MASTER(S):

It shall be possible to configure the Vendor's base product such that one system monitors and controls all field data, with many sub-master systems responsible for field communications.

OFFLINE TEST/DEVELOPMENT:

It shall be possible to configure the Vendor's base product such that one of the systems may operate as an offline Test and Development (T&D) system used to implement and verify changes to the SCADA system before deploying them to the production environment.

Depending on the configuration and the relationships defined between SCADA subsystems across the SCADA system's distributed architecture:

- a) field devices owned by one system shall be controllable by another system
- b) systems can act as backups for other systems
- c) all or part of the real-time and historical data belonging to a given system can be shared with other systems

In this way, real-time functional elements of the SCADA system shall inter-operate regardless of their physical location, allowing elements in separate locations to "know" what the other systems are doing.

It shall be possible to add layered applications onto the Vendor's base product without shutting down a dual-redundant system.

Middleware Requirements

Data Publishing

The Vendor's software shall make real-time data available via a publishing mechanism such that third-party applications can capture data that is of interest, such as changing states or values. This mechanism shall allow distributed "event-driven" applications.

The data publishing capability shall permit one application to transmit or publish information to other applications without waiting for the other applications to receive the information.

Additional data subscribers shall have no impact on the performance of publishers or the other subscribers.

The Vendor shall ensure that the publisher/subscriber middleware provided consists of the following attributes:

- a) distributed
- b) bi-directional
- c) guaranteed message delivery during normal operations
- d) data integrity update after network connectivity restoration
- e) high performance
- f) multithreaded
- g) able to deliver messages across multiple routed network segments
- h) able to integrate with non-real-time publisher/subscriber systems

API Data Access and Functionality

An API shall permit third-party applications to obtain and modify real-time and historical data, as well as performing actions from system user defined or third-party applications, such as (but not limited to) creating alarms and events, or acknowledging them.

Updates to the API components shall not require downtime. If downtime is necessary, it shall be kept to a minimum and the downtime that shall be covered through the use of the distributed system architecture.

Remote Access

The SCADA system shall support a protocol that provides the data communications corridor through which all Controller-Machine Interface (CMI) clients exchange data with the system's servers, complete with encryption and compression for the transported data. Users will be presented the choice of service the CMI clients are able to connect to.

SQL (Structured Query Language) Access

Data access and update capability to both real-time and historical data shall be possible through the use of SQL.

ODBC, OLEDB, ADO and similar industry standard SQL interfaces shall function with the SCADA real-time and historical databases.

System Redundancy through a Distributed Architecture

Due to the critical nature of SCADA system functions, there shall be no single point of failure on any critical system component. A critical component is any component whose failure directly and adversely affects the SCADA system's overall performance or its ability to continue performing critical functions of monitoring and control.

The SCADA system shall make use of modular components such that the failure of a single component does not render inoperative other components.

The SCADA system shall provide redundancy for all critical processes.

The components comprising the standby system shall receive continually updated data, as appropriate, to provide a "hot-standby" capability in case of a hardware or software initiated fail-over.

The SCADA system shall make connection(s) to any Corporate or other networks in such a way that a failure of any of these networks shall not affect the SCADA system's ability to perform its critical functions.

The redundancy model shall be self-healing with critical processes and devices being monitored by health monitoring software provided by the Vendor. This shall be considered a key component of system robustness and for ease of support and administration.

The health monitoring software shall check critical processes and devices for failures, and take the least intrusive course of action to recover from any failure.

Self-healing may mean that the SCADA system could end up in a non-default yet functional state, with administrative intervention required to return the system to its default state once the cause for failure has been determined and acted upon.

Self-healing capability must function to the level of preventing any single failure from rendering the SCADA system inoperative. For combinations of failures (more than a single point of failure) additional redundancy may exist, such as the ability to transfer duties to another site (e.g. DRC) or another system in the SCADA system's distributed architecture, but such decisions will require administrative action.

System Overview and Design

The SCADA system shall provide a real-time platform exposing data and functionality by open connectivity standards such as ODBC, XML, ADO, JDBC, OLEDB, SQL, JAVA, and SOAP.

The SCADA system shall accommodate interconnectivity options and data store connectivity portals for legacy and future third-party enterprise IT systems.

The SCADA system shall include open connectivity standards that enable integration with applications and systems such as:

- a) Microsoft® Reporting Services
- b) Microsoft® Excel, Microsoft® Access
- c) Crystal Reports
- d) Large enterprise applications such as SAP, PeopleSoft, Siebel, and ERP systems
- e) Internet or Intranet
- f) Sybase, OSI soft PI, Aspen Tech, Oracle, DB2, and MSSQL data stores

It shall be possible to add, remove, upgrade or replace Applications in a building block fashion.

The SCADA system shall functionally consist of three main components:

- a) real-time and time-critical applications
- b) Controller interface applications
- c) historical data storage

The real-time and time-critical applications, and Controller interface applications, shall be considered critical and essential to the safe operation of the SCADA system.

The historical data storage shall provide data capture for historical data analysis, enterprise application integration, and regulatory reporting needs.

These categories shall further be subdivided into the following types of functions in each category:

- a) Real-time SCADA and time-critical applications:
 - (i) Application specific time-critical processes; (ii) real-time database applications / support; (iii) application specific non-time-critical processes; and (iv) system security applications and processes.

- b) Controller interface applications
 - (i) interface support; (ii) applications; and (iii) Controller interface.
- c) historical data storage
 - (i) historical database; (ii) historical data capture; and (iii) application specific historical data manipulation processes

The real-time SCADA and time-critical applications provided by the Vendor shall be considered the most critical category of functionality as they provide the basic monitoring and control capabilities of the SCADA system. Typical functions in the real-time SCADA and time-critical applications category include:

- a) data acquisition
- b) engineering units conversions
- c) alarm detection and annunciation
- d) alarm/event logging
- e) interaction with the CMI
- f) general control output and status change validation
- g) maintenance of the system's real-time database
- h) monitoring of the system performance
- i) capture of instantaneous data to support historical and regulatory data requirements
- j) topological analysis
- k) switching validation
- l) switching plan writing and execution
- m) Maintenance of the network model.

Typical real-time database support functions provided by the Vendor shall include applications such as:

- a) on-line calculations/derived values
- b) database save/transfer utilities
- c) real-time data sampling

Typical graphical interface support functions provided by the Vendor shall include applications such as:

- a) output of Controller and software initiated control commands
- b) alarm annunciation/alarm logging
- c) updating alarm displays
- d) responding to periodic requests to display real-time data
- e) publishing of real-time data for display

The Vendor shall provide Controller applications comprising the next most critical area of functionality for the system, and shall include the following functions:

- a) data presentation

- b) display navigation
- c) data manipulation
- d) control actions
- e) alarm presentation
- f) Controller entry of parameters or data
- g) report generation
- h) display printing operations

Supporting functionality for Controller applications includes:

- a) display generation
- b) display format editing/SCADA system maintenance

Notwithstanding the importance of data capture to feed the historical data storage module (see (i), above), the historical data storage module provided by the Vendor is considered the least critical function. Although the functions of this module support the operation of the field system, none of the functions shall require data in real-time. The SCADA system shall provide the following typical functions in this category:

- a) data archival/retrieval
- b) historical data manipulations/calculations
- c) device operating times
- d) interface to the Corporate network

The data acquired through real-time data acquisition shall be buffered for a limited time (up to 24 hours) should the ability to store the data in the historical data module be temporarily unavailable.

SCADA System Configuration, Monitoring and Control Management Environment.

The Vendor shall provide a single management environment (application or suite) for SCADA software configuration, monitoring and control.

This management environment shall include the following attributes:

- a) accessibility from any machine in the SCADA installation
- b) enable monitoring of SCADA software and machine states
- c) enable viewing of machine log files
- d) enable viewing/modification of all SCADA machine/database/application privileges and user Areas of Responsibility
- e) enable viewing/modification of SCADA system and machine properties
- f) enable addition/removal of SCADA software systems from the SCADA domain
- g) enable addition/removal of SCADA machines
- h) enable SCADA software and third-party integrated component control (i.e. start up/shutdown/failover)

Communications

There shall be three primary forms of communication which shall be inherent in the SCADA system as follows:

- a) synchronous/asynchronous communications (dedicated circuits and dial-up circuits)
- b) Local-Area Networks
- c) Wide-Area Networks

The SCADA system shall support various types of physical networking media (e.g., fiber optics, shielded twisted pair, microwave, radio, satellite, etc.). The use of any particular type of networking media shall be transparent to the system.

The SCADA network interface hardware and software shall handle any inherent differences between these various types of physical network media.

The redundant SCADA LAN shall use an industry standards compliant LAN technology operating at a minimum speed of 100 Mbps with support for 1Gbps.

The SCADA LAN shall be fault-tolerant and shall utilize a network configuration, which shall prevent any single point of failure disabling the system.

The LAN shall be redundant and shall support shared data paths or 100 percent operation on either LAN.

All Wide-Area Networks shall be logical extensions of the Local-Area Networks. Any interfaces between LANs and WANs shall be through routers, bridges and/or concentrators and data control units.

All LAN/WAN communication equipment shall support the following common features, as applicable to the type of equipment used:

- a) network management - SNMP (Simple Network Management Protocol), CMIP (Common Management Information Protocol), or both
- b) multiple Protocol - TCP/IP, X.25, etc.
- c) IP routing
- d) destination address filtering
- e) protocol filtering
- f) source address filtering
- g) spanning tree algorithm

The SCADA system shall include system management tools for monitoring/analyzing/troubleshooting of all system Local-Area Networks, Wide-Area Networks and connected equipment.

Network Interface Cards

Each SCADA server shall have two network interfaces, implemented as two separate Network Interface Cards (NICs), or as dual ported NICs. Each port shall plug into a separate switch.

Failure of a NIC shall not affect any of the SCADA server processes.

Each NIC shall support IPsec to encrypt all data traffic on the LAN.

Data Acquisition Equipment

The SCADA system shall be capable of gathering data from various RTU/PLC and IED units in the field. The communication media may be leased lines, dial-up telephone circuits, fiber optic cables, radios, and microwave or satellite channels.

The SCADA system shall be capable of supporting more than one alternative communication paths.

The SCADA system shall also provide for automatic failover to the alternate path(s). If the Automatic Failover to Alternate Path is set, the system shall monitor the alternate path on a regular basis, and fail over to the alternate path when the primary path is declared failed.

The SCADA system shall be capable of supporting the required protocol(s) over communications path, provided the appropriate ancillary communication hardware is available.

The SCADA system shall be capable of supporting any number of communication link paths (connections) from the SCADA host to any single RTU/PLC or IED.

Though a different communication path may be used when the primary one or ones fail(s), the protocol used by the field device shall remain the same.

OTHER COMMERCIAL CONDITIONS

1) Payment Terms:

The payment will be made as follows:

- i) Initially material cost 50% will be paid against supply and delivery of materials at Paradip Port in good condition and verification & acceptance thereof by the Engineer In-charge (EIC). However, the Contractor must ensure that the materials are delivered to site in parallel with the progress of site activities and approved BAR chart otherwise the payment shall not be released.
- ii) The material cost 40% will be paid against installation equipment & panels and commissioning of system with satisfaction of EIC.
- iii) The material cost 10% shall be retained by PPT towards Performance Security Deposit. The Performance Security Deposit shall be released after successful completion of the warranty period only. The Contractor may furnish a Bank Guarantee of equal value valid till one month after expiry of the warranty period in which case the balance 10% money will be released for payment.
- iv) 100 % of the AMC cost shall be paid monthly after based on the satisfactory performance.

2) Security Deposit:

A sum of 10% of accepted value of the tender shall be deposited by the successful bidder (Contractor) as Security Deposit (SD). This will be deposited initially 1% value of the contract as initial security deposit (ISD) in shape of a Bank Guarantee or Demand Draft (DD) / Banker's Cheque drawn in favour of FA&CAO, Paradip Port Trust (DD/ Banker's cheque shall be payable at Paradip) within 15 days of issue of Letter of Intent (LOI). After deducting the EMD and ISD from the stipulated security deposit, the balance amount will be recovered in instalment through deduction at the rate of 10% of the value of each running account bill subject to attaining the required amount by the last running bill. In case of exemption of EMD, the successful bidder has to deposit initially 3% of the contract value as ISD instead of 1% of contract value.

The Contractor may submit Bank Guarantee for the balance amount after deducting the EMD and ISD from the stipulated security deposit in which case there will be no deduction from the running bills towards security deposit.

EMD of the successful bidder may be refunded to the bidder after receiving an equivalent amount of Bank Guarantee only after issue of work order and signing of agreement.

The Contractor may also submit Bank Guarantee for a sum of 10% of accepted value of tender as Security Deposit (SD) within 15 days of issue of Letter of Intent (LOI) in which case (i) deposit of 1% ISD will not be required; (ii) there will be no deduction from the running bills towards security deposit; and (iii) EMD of the successful bidder will be refunded to the bidder after issue of work order and signing of agreement.

The security deposits shall be returned to the Contractor within 45 days of successful execution and acceptance of the work. The BG shall be valid till 45 days after the scheduled date of completion of the work.

3) Execution Period:

The execution period of the work shall be 180 days from the date of issue of work order.

4) Annual Maintenance Contract (AMC):

The Contractor has to carry out AMC of entire SCADA system for a period of 05 years including supply of spares, software, hardware, etc. as required for smooth functioning of the system. The Contractor has to attend the fault developed in system and rectify the fault as quickly as possible on receipt of information from PPT. If the fault persists along with non-functioning of SCADA system for more than 04 days, then a sum @ Rs. 10000/- per day or part thereof shall be recovered from the contractor's bill. If the penalty amount exceeds Rs.1, 50,000/- in an occasion it will be treated as non performance of contractor and then, contract may be terminated.

5) Warranty:

The warranty period shall be valid up to 03 years on the entire work inclusive of the supply items with effective from date of acceptance of the work.

- The Contractor shall warrant the Board that the goods and services under this contract will comply strictly with the contract, shall be first class in every particular case and, shall be free from defects. The Contractor shall further warrant the Board that all materials, equipment and the supplies furnished by him/her will be new and fit for their intended purposes.
- The Board shall promptly notify the Contractor in writing of any claim arising under this Warranty. Upon receipt of such notice, the Contractor shall promptly repair or replace the defective goods and/or services at no cost to the Board.
- If the Contractor, having been notified, fails to remedy the defects in accordance with the contract, the Board may proceed to take such remedial action as may be necessary, at the Contractor's risk and cost.

- 6)** Any query in this regard may be raised to the following email id prior to dt.20.03.2019 to 17:00 hrs.) which will be clarified by dt.29.03.2019 by uploading in the website for facilitating submission of a competitive budgetary offer.

Note:

- a) The firm is also requested to obtain the view and also technical specification, if any, for additional requirement for well functioning of the system along with budgetary offer.
- b) Budgetary offers shall be submitted to the following address (through email or by Registered Post):

Executive Engineer (Elect),
Port Electrical Division – II,
Paradip Port Trust.

PO:- Paradip, Dist:-Jagatsinghpur, Odisha – 754142.

Contact No. 9777-180-842

Email Id: rnsahooeppt@gmail.com

BILL OF QUANTITY

Sub.: Supply, Installation, Testing & Commissioning Supervisory Control and Data Acquisition of Main receiving substation with other 09 substations installed different location of Paradip Port Trust with 5 yrs AMC after warranty periods.

Sl. No.	Description of Work	Qty.	Unit	Rate (in Rs.)	Amount (in Rs.)	Remarks
1	Supply, Installation, Testing & Commissioning of Complete Supervisory Control and Data Acquisition (SCADA) System at Main Receiving Substation with other 09 substations.	01	Set			
2	AMC of the complete SCADA system with required software, hardware & consumable and service for a period of 05 years after completion warranty period.	05	years			
TOTAL:						

Note: GST percentage to be mentioned extra against each item.

Details Relays Data of 10 Substations

Sl No.	Name of Installation	Name of feeder	Details of Relay	Type of relay	No. of relay	No of old Energy Meter	No of Protection Relay	Remarks	
1	132/33/11KV Control Room	Incomer -I	CDG 11AF-O/C	Electro Mechanical Relay	0		1		
			CDG 11AF-O/C		0		1		
			CDG 11AF-O/C		0		1		
			CDG 11AF-E/F		0		1		
			CDD-21PF D/O/C		0		1		
			CDD-21PF D/O/C		0		1		
			CDD-21PF D/O/C		0		1		
			CDD-21PF D/E/F		1				
			VAPM 31AF FUSE FAILURE		1				
			VAJHM23BF TS		1				
			VAX31ZG TCS		1				
			VAX31ZG TCS		1				
			VAX31ZG TCS		1				
			VAJC11BF CR		1				
			SECURE METER		0	1			
			Incomer -II		CDG 11AF-O/C	0		1	
					CDG 11AF-O/C	0		1	
					CDG 11AF-O/C	0		1	
		CDG 11AF-E/F			0		1		
		CDD-21PF D/O/C			0		1		
		CDD-21PF D/O/C			0		1		
		CDD-21PF D/O/C			0		1		
		VAPM 31AF FUSE FAILURE			1				
		VAJHM23BF TS			1				
		VAX31ZG TCS			1				
		VAX31ZG TCS			1				
		VAX31ZG TCS			1				
		VAJC11BF CR			1				
		SECURE METER			0	1			
		BUSCOUPLER			VAA21YF	1			
			VAA21ZG		1				
			TVM(SECURE)		1				
		TRF-I	CDG 21AF-O/C		0		1		
			CDG 21AF-O/C		0		1		
			CDG21AF-O/C		0		1		
			CDG 21AF-E/F-INVERSE		0		1		
			CDG11AF- EF		0		1		

		CAG 14AF-REF		0		1	
		VAA33ZG AR		5			
		DTH-31 DIFF.		1			
		VAX31ZG TCS		3			
		VAZHM23BF12D		1			
		VAZC11BF CR		1			
	TRF-II	CDG 21AF-O/C		0		1	
		CDG 21AF-O/C		0		1	
		CDG21AF-O/C		0		1	
		CDG 21AF-E/F-INVERSE		0		1	
		CDG11AF- EF		0		1	
		CAG 14AF-REF		0		1	
		VAA33ZG AR		5			
		DTH-31 DIFF.		1			
		VAX31ZG TCS		3			
		VAZC11BF CR		1			
		VAZHM23BF12D		1			
	TRF-III (New)	7UT613 SIPROTECH	NUMERIC RELAY	1			
		7SR		1			
		AX.RELAY	Electro Mechanical Relay	8			
		TSR1MYN		2			
		RXMV2		1			
		MFM METER		1			
33 KV PANEL BOARD	INCOMER -I (NEW)(P-11)	CDG 31EG - O/C(R,Y,B)		0		1	
		CDG11AF-E/F		0		1	
		CDG12-SE/F		0		1	
		CAG14AF-IE/F		0		1	
		VAA11YF AR		3			
		VAX31ZG TCR		1			
		VAJC11BF CR		1			
		VAJHM23BF ZG MT		1			
		ENERGY METER		0	1		
	INCOMER -II(P-6)	CDG 31EG - O/C(R,Y,B)		0		1	
		CDG11AF-E/F		0		1	
		CDG12-SE/F		0		1	
		CAG14AF-IE/F		0		1	
		VAA11YF AR		3			
		VAX31ZG TCR		1			
		VAJC11BF CR		1			
		VAJHM23BF ZG MT		1			
		ENERGY METER		0	1		
	INCOMER -III(P-24)	MI COM 122	NUMERIC RELAY	1			

		MI COM 120	NUMERIC RELAY	1			
		1MYN56 MTR	Electro Mechanical Relay	1			
		TCS1MYN		1			
		SECURE ENERGY METER		1			
	33KVOG(OLD) P- 1,5,12,16)	CDG 31EG-O/C(R,Y,B)	Electro Mechanical Relay	4		4	
		CDG 11AF-E/F		0		4	
		VAJC11AF CR		4			
		VAA11YF		12			
		VAJH23ZG		4			
		VAX31ZG		4			
		SECURE ENERGY METER		0	4		
		HORN4 RF		8			
	33KVOG TRf(OLD)(P-2,4,13,14)	CDG 31EG-O/C(R,Y,B)	Electro Mechanical Relay	0		4	
		CAG14AF-E/F		0		4	
		MBCH 12D1AB DIFF		12			
		VAA11YF AR		12			
		VAX31ZG		4			
		VAJH23ZG MT		4			
		VAJC11BF CR		4			
		VAX13ZG AR		4			
		ENERGY METER		0	4		
	33KVOG(NEW) P-17,22,23	MI COM 122	NUMERIC RELAY	3			
		HORN4		6			
		TCSYMYN	Electro Mechanical Relay	3			
		1MYN56 RELAY		3			
		SECURE ENERGY METER		0	3		
	33KVOG TRF P-21,20 (NEW)	MI COM 122	NUMERIC RELAY	3			
		DTH31FF DIFF		3			
		YMYN56 AR	Electro Mechanical Relay	6			
		TCSMYN56 RELAY		3			
		SECURE ENERGY METER		0	3		
11KV VCB PANEL	INCOMER -I ,II,III,IV,V (NEW)	MICOM P-127	NUMERIC RELAY	5			
		YMYN56 AR	Electro Mechanical Relay	5			
		TCSMYN56 RELAY		5			
		SECURE ENERGY METER PREMERE-300		0	5		

		INCOMER-VI (OLD)	CDG 31EG-O/C &EF	Electro Mechanical Relay	0		3				
			VAJH13YF		1						
			ENEGRY METER		0	1					
		11KVOG(NEW) P-2,3,4,8,9,10,14,15,16,20,21,22,27,28,&29.		MICOM P-122	NUMERIC RELAY	15					
					Electro Mechanical Relay	YMYN56 AR	15				
						TCSYM 56	15				
				SECURE ENERGY METER PREMERE-300		0	15				
		11KVOG(OLD)(P-1,31)		ABB-RED616	NUMERIC RELAY	1					
		11KVOG(OLD)(P-32)		CDG 31EG-O/C &EF	Electro Mechanical Relay	0		1			
						CDG-R/F	0		1		
2	MADHUBAN 11KV S/S	INCOMER-I	CDG31EG-O/C(R,Y,B)	Electro Mechanical Relay	0		1				
			CDG11AF-E/F		0		1				
			VAX31ZG TCS		1						
			VAJH13YF TR		1						
			SECURE ENERGY METER		0	1					
		INCOMER-II	CDG31EG-O/C(R,Y,B)		0		1				
			CDG11AF-E/F		0		1				
			VAX31ZG TCS		1						
			VAJH13YF TR		1						
			SECURE ENERGY METER		0	1					
		11KV O/G(8 No)	CDG31EG-O/C(R,Y,B)		0		8				
			CDG11AE-E/F		0		8				
			VAX31ZG TCS		8						
			VAA33ZG AR		16						
			VAJH13YF TR		8						
			SECURE ENERGY METER		0	8					
		BUS COUPLER	VAX31ZG-TCS		1						
			VAJH13YF-TR		1						
		3	NAC 11KV S/S		INCOMER-I	CDG31EG-O/C(R,Y,B)	Electro Mechanical Relay	0		1	
						CDG11AF-E/F		0		1	
VAX31ZG TCS	1										
VAJH13YF TR	1										
SECURE ENERGY METER	0			1							
INCOMER-II	CDG31EG-O/C(R,Y,B)			0		1					

			CDG11AF-E/F		0		1	
			VAX31ZG TCS		1			
			VAJH13YF TR		1			
			SECURE ENERGY METER		0	1		
		11KV O/G	CDG31EG-O/C(R,Y,B)		0		5	
			CDG11AF-E/F		0		5	
			VAX31ZG TCS		5			
			VAA33ZG-63A		5			
			VAA33ZG-63B		5			
			VAA33ZG-63B		1			
			SECURE ENERGY METER		0	5		
		BUS COUPLER	VAX31ZG TCS		1			
			VAJH13YF TR		1			
4	RADAR 11 KV S/S	INCOMER-I	CDG31EG-O/C(R,Y,B)	Electro Mechanical Relay	0		1	
			CDG11AF-E/F		0		1	
			VAX31ZG TCS		1			
			VAJH13YF TR		1			
			SECURE ENERGY METER		0	1		
		INCOMER-II	CDG31EG-O/C(R,Y,B)		0		1	
			CDG11AF-E/F		0		1	
			VAX31ZG TCS		1			
			VAJH13YF TR		1			
			SECURE ENERGY METER		0	1		
		11KV O/G	CDG31EG-O/C(R,Y,B)		6			
			CDG11AF-E/F		6			
			VAX31ZG TCS		6			
			VAJH13YF TR		6			
			VAA33ZG AR		12			
			SECURE ENERGY METER		0	6		
		BUS COUPLER	VAX31ZG TCS		1			
			VAJH13YF TR		1			
5	SECTOER-9 11 KV S/S	INCOMER-I	CDG31EG-O/C(R,Y,B)	Electro Mechanical Relay	0		1	
			CDG11AF-E/F		0		1	
			VAX31ZG TCS		1			
			VAJH13YF TR		1			
			SECURE ENERGY METER		1	1		
		INCOMER-II	CDG31EG-		0		1	

			O/C(R,Y,B)					
			CDG11AF-E/F		0		1	
			VAX31ZG TCS		1			
			VAJH13YF TR		1			
			SECURE ENERGY METER		0	1		
		11KV O/G	CDG31EG-O/C(R,Y,B)		0		6	
			CDG11AF-E/F		0		6	
			VAX31ZG TCS		6			
			VAJH13YF TR		6			
			VAA33ZG AR		12			
			SECURE ENERGY METER		0	6		
		BUSCOUPLER	VAX31ZG TCS		1			
			VAJH13YF TR		1			
6	V-POINT 11KV S/S	INCOMER-I	CDG31EG-O/C(R,Y,B)		0		1	
			VAJH13YF-TR		1			
			ENERGY METER		0	1		
		INCOMER-II	CDG31EG-O/C(R,Y,B)		0		1	
			VAJH13YF-TR		1			
			ENERGY METER		0	1		
		11KV O/G	CDG31EG-O/C(R,Y,B)		0		6	
			CDG11AE-E/F		0		6	
			VAX31ZG TCS		6			
			VAA33ZG AR		6			
			VAJH13YF TR		6			
			ENERGY METER		0	6		
				Electro Mechanical Relay				
7	CCT 11KV S/S	INCOMER-I (NEW)	MI COM P-141		1			
			SeCURE ENERGY METER		0	1		
		INCOMER-II (NEW)	MI COM P-141	NUMERIC RELAY	1			
			SeCURE ENERGY METER		1			
		11KV O/G	MI COM P-141		6			
			SeCURE ENERGY METER		0	6		
8	BOT 33 KV S/S	INCOMER-I (NEW)	MI COM P-120		1			
			MI COM P-122		1			
			SeCURE ENERGY METER	NUMERIC RELAY	0	1		
		INCOMER-II (NEW)	MI COM P-120		1			
			MI COM P-122		1			

			SeCURE ENERGY METER		0	1			
		33KVOG(NEW)	MI COM 122-O/C		4				
			SeCURE ENERGY METER		0	4			
		33KV TRF(NEW)	MI COM 122-O/C		1				
			OTI-CV202J	Electro Mechanical Relay	1				
			WTI-CV202J		1				
			BUCHHLOZ - CV202J		1				
			SeCURE ENERGY METER		0	1			
9	IOHP 11 KV S/S	INCOMER-I	CDG31EG-O/C(R,Y,B)	Electro Mechanical Relay	0		1		
			CDG11AF-IE/F		0		1		
		CDG12AF-SE/F	0			1			
		VAJC11BF CR	1						
		VAX31ZG TCS	1						
		VAJH13YF TR	1						
		VAG11YF NVC	1						
		ENERGY METER	0		1				
		INCOMER-II	CDG31EG-O/C(R,Y,B)		0		1		
			CDG11AF-IE/F		0		1		
			CDG12AF-SE/F		0		1		
			VAJC11BF CR		1				
			VAX31ZG TCS		1				
			VAJH13YF TR		1				
			VAG11YF NVC		1				
			ENERGY METER		0	1			
		11KV O/G	CDG31EG-O/C(R,Y,B)		0		8		
			CDG11AF-IE/F		0		8		
			VAJC11BF CR		8				
			VAX31ZG TCS		8				
			VAJH13YF TR		8				
			ENERGY METER		0	8			
			BUS TRANSFER		CDG31EG-O/C(R,Y,B)	0		1	
					CDG17AF-IE/F	0		1	
		VAJC11BF CR			1				
			VAA33JG (T/A) AR		2				
			VAX31ZG TCS		1				
			VAJH13YF TR		1				
		BUS COUPLER	VAJC11BF CR		1				
			VAX31ZG TCS		1				
			VAJH13YF TR		1				

10	HARBOUR 33/11 KV S/S	INCOMER-I	CDG31EG-O/C(R,Y,B)	Electro Mechanical Relay	0		1	
			CDG11AF-IE/F		0		1	
			CDG12AF-SE/F		0		1	
			VAJC11BF CR		1			
			VAX31ZG TCS		1			
			VAJH13YF TR		1			
			VAPM31AF21A FFR		1			
			VAG11YF NVC		1			
			ENERGY METER		0	1		
			INCOMER-II		CDG31EG-O/C(R,Y,B)	0		1
		CDG11AF-IE/F			0		1	
		CDG12AF-SE/F			0		1	
		VAJC11BF CR			1			
		VAX31ZG TCS			1			
		VAJH13YF TR			1			
		VAPM31AF21A FFR			1			
		VAG11YF NVC			1			
		ENERGY METER			0	1		
		33KV TRF			CDG31EG-O/C(R,Y,B)	0		1
			CDG12ZF-SE/F		0		1	
			VAJC11BF CR		1			
			VAA23ZG AR		1			
			VAA33ZG AR		2			
			VAX31ZG TCS		1			
			VAJH13YF TR		1			
		33KV TRF	CDG31EG-O/C(R,Y,B)		1			
			CDG12ZF-SE/F		1			
			VAJC11BF CR		1			
			VAA23ZG AR		1			
			VAA33ZG AR		2			
	VAX31ZG TCS		1					
	VAJH13YF TR		1					
	BUS COUPLER	VAJC11BF CR	1					
		VAX31ZG TCS	1					
	HARBOUR 11 KV S/S	INCOMER-I	CDG31EG-O/C(R,Y,B)		0		1	
			CDG11AF-IE/F		0		1	
			CDG12AF-SE/F		0		1	
			VAJC11BF CR		1			
			VAX31ZG TCS		1			
			VAJH13YF TR		1			
			ENERGY METER		0	1		
		INCOMER-II	CDG31EG-		0		1	

		O/C(R,Y,B)			
		CDG11AF-IE/F	0		1
		CDG12AF-SE/F	0		1
		VAJC11BF CR	1		
		VAX31ZG TCS	1		
		VAJH13YF TR	1		
		ENERGY METER	0	1	
	11KV O/G	CDG31EG-O/C(R,Y,B)	0		8
		CDG11AF-IE/F	0		8
		VAJC11BF CR	8		
		VAX31ZG TCS	8		
		VAJH13YF TR	8		
		ENERGY METER	8	1	
	11KV TRF	CDG31EG-O/C(R,Y,B)	0		1
		CDG17AF-IE/F	0		1
		VAJC11BF CR	1		
		VAX33ZG TCS	1		
		VAJH13YF TR	1		
		VAA33ZG(A/T) AR	2		
		ENERGY METER	0	1	
	BUS COUPLER	VAJC11BF CR	1		
		VAX31ZG TCS	1		
		VAJH13YF TR	1		
		TOTAL	523	110	179