

PART 2: EMPLOYER'S REQUIREMENTS
CHAPTER: EXPLANATORY NOTES-
SCADA

BILL NO.D1 CM1 OCC & BCC: CONTROL & MONITORING (MAIN OCC and Backup OCC)

The following notes give a broad definition of various hardware & all software (including Anti-Virus, firewall etc.) required at Main OCC (Operation Control Centre) and Backup OCC (Backup Control Centre).

Item 49.0: Server

Item 49.1: Dual Redundant SCADA Database Servers (Main and Standby) For Corridor 01, Corridor 2, Corridor 3 & Corridor 04

The price shall include the cost of supplying two SCADA Database Servers (1 Set of main and standby), needed for storage & handling the complete database and shall include supply of external storage (network connected storage) facility with removable storage media for the historical storage and backup of database records and software included in the scope of work, from the OCC & BCC.

The price of one set shall essentially include, but not limited to the following:

- Two SCADA Database Servers (one main & one standby in redundant configuration)
- Basic Software's (Operating System, All Drivers, MS office etc.)
- RDBMS Software
- 1 No. 24" LED display with Keyboard and Mouse for each set of servers
- 1 No. KVM switch with cables & connectors for Monitor, Mouse & Keyboard interface for each set of servers
- External bulk Storage Media facility
- Any other components/accessories required for completion of the works

Item 49.2: Dual Redundant SCADA Communication Servers (Main and Standby) For Corridor 01, Corridor 2, Corridor 3 & Corridor 04

The price shall include the cost of supplying two SCADA communication Server (1 Set of main and standby), needed for the control & monitoring of electrical installations included in the scope of work, from the OCC & BCC.

The price of one set shall essentially include, but not limited to the following:

- Two SCADA Communication Front-End Servers (one main & one standby in redundant configuration)
- Basic Software's (Operating System, All Drivers, MS office etc.)
- 1 No. 24" LED Monitor with Keyboard and Mouse for each set of servers
- 1 No. KVM switch with cables & connectors for Monitor, Mouse & Keyboard interface for each set of servers
- Any other components/accessories required for completion of the works

Item 49.3: SCADA Archive and Backup Server For Corridor 01, Corridor 2, Corridor 3 & Corridor 04

The price shall include the cost of supplying One Archive and Backup server shall be provided at OCC & BCC server room needed for backup storage and historical data/event storage for analysis and reporting. In case of Archive system failure, provision of storage in Main server to be provided.

The price of one set shall essentially include, but not limited to the following:

- One SCADA Archive and Backup Server (dual redundant server to be considered)
- Basic Software's (Operating System, All Drivers, MS office etc.)
- 1 No. 24" LED Display with Keyboard and Mouse
- Any other components/accessories required for completion of the works

Item 49.4: Rack for servers with Power Supply Arrangement for Corridor 01, Corridor 2, Corridor 3 & Corridor 04

The price shall include the cost of supplying the racks for the C&M equipment installed in the OCC & BCC.

- 19" Server Rack
- 1 Set means racks required for OCC/BCC irrespective of numbers of Servers and Computers and their associated equipment.

Item 50.0: Workstations**Item 50.1 Operator Workstation with dual Monitor (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)**

The price shall include the cost of supplying the workstations needed as man machine interface for the control, monitoring, and supervision of the electrical installations included in the Scope of Work, from the OCC & BCC.

The price of one set shall essentially include, but not limited to the following:

- One Workstation Computer
- Basic Softwares (Operating System, All Drivers, MS office etc.)
- Dual 24" LED Monitors with wireless Keyboard and Mouse
- Any other components/accessories required for completion of the works

Item 50.2: Workstation for Network Management System (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price shall include the cost of supplying a Network Management System (NMS) for monitoring the status, performance, statistics, errors and alarms of all switches, routers and all other active nodes of SCADA dedicated FO network system for corridor 01, Corridor 02, Corridor 03 & corridor 04.

The price of one set shall essentially include, but not limited to the following:

- One Workstation Computer
- Basic Softwares (Operating System, All Drivers, MS office etc.)
- 1 No. 24" LED Monitor with wireless Keyboard and Mouse
- Any other components/accessories required for completion of the works

Item 50.3: Disturbance Recorder (DR) Workstation (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price shall include the cost of supplying one workstation with provision to download the disturbance records from each relay/IED for fault analysis purpose and for configuration/modification in relay settings.

The price of one set shall essentially include, but not limited to the following:

- One Workstation Computer
- Basic Softwares (Operating System, All Drivers, MS office etc.)
- 1 No. 24" LED Monitors with wireless Keyboard and Mouse
- Any other components/accessories required for completion of the works

Item 50.4: Engineering Workstation (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price shall include the cost of supplying of SCADA Engineering Workstation for SCADA HMI engineering, RTU Configuration, Testing and other development and maintenance purpose.

The price of one set shall essentially include, but not limited to the following:

- One SCADA Engineering Server Workstation Computer
- Basic Softwares (Operating System, All Drivers, MS office etc.)
- 1 No. 24" LED Display with wireless Keyboard and Mouse
- Any other components/accessories required for completion of the works

Item 50.5: O&M workstation (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price shall include the cost of supplying of O&M Workstation for maintenance purpose. The price of one set shall essentially include, but not limited to the following:

- One Workstation Computer
- Basic Softwares (Operating System, All Drivers, MS office etc.)
- Dual 24" LED Monitors with wireless Keyboard and Mouse
- Any other components/accessories required for completion of the works

Item 51.0: SCADA software

Item 51.1: SCADA Software OCC (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price shall include the cost of supplying the complete set of software with licenses for the

concerned Line Main OCC.

1 set shall consist of 1 original set and one additional set, for the Remote supervision and Control, as per specifications. This will be loaded in servers, video wall servers and workstations (wherever required).

Item 52.2: SCADA Software BCC (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price shall include the cost of supplying the complete set of software with licenses for the concerned Line Backup OCC or BCC.

1 set shall consist of 1 original set and one additional set, for the Remote supervision and Control, as per specifications. This will be loaded in servers, video wall servers and workstations (wherever required).

Item 53.3: DR Analysis and Relay Configuration Software for DR Workstation (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price shall include the cost of supplying the complete DR fault analysis software which shall be provided for analysis of downloaded disturbance records, fault logs, events list from each relay/IED. It shall also include the cost of Relay configuration software which shall be provided for online configuration/modification of relay settings from OCC/BCC. This will be loaded in DR Workstation at OCC and BCC.

The price of one set shall essentially include, but not limited to the following:

- Complete set of DR analysis and relay configuration software's with licenses.

Item 54.4: Network Management System software (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price of one set shall include the cost of supplying the complete Network Management System (NMS) software with licenses for corridor 01, corridor 02, Corridor 03 and Corridor 04 This will be loaded in NMS workstation at OCC/BCC.

Item 55.0: Communication Equipment's, Cables & Security Systems

Item 55.1: Redundant SCADA LAN including managed switches, FO & LAN cables and all accessories for communication over SCADA dedicated/dark Fiber Network (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price shall include the cost of supplying redundant SCADA LAN, Light Interface Unit (LIUs), Managed Ethernet Switches, Communication cables etc. in OCC & BCC for data exchange between various SCADA equipments (Servers, Workstations, Printers, Video

Control Panel etc.) and integration with field RTUs through SCADA dedicated fiber optic network over Telecom OFC backbone as per specifications.

The price of one set shall essentially include, but not limited to the following:

- a. Dual Redundant Managed Ethernet Switches (Industrial Hardware) each for Server Room.
- b. Dual redundant managed ethernet switch (industrial hardware) for Theatre room as per technical specifications.
- c. Redundant Fiber optic cable (SM, Armoured, FRLS-OH) for linking all concerned SCADA communication equipments and links to TER at OCC.
- d. CAT 6 or latest communication cable (STP, Armoured, in case of cable laying outside the panel in a trench or cable tray) for connecting all concerned SCADA equipments in dual LAN network.
- CAT 6 or latest communication cable (STP, Unarmoured, in case of cable laying inside a panel) for connecting all concerned SCADA equipments in dual LAN network.
- If required communication cables shall be laid inside flexible metallic conduit.
- e. LIU (Light Interfacing Unit) Box
- f. Patch Cables RJ 45 / FO
- Any other components/accessories required for completion of the works

Item 55.2: Firewall and Security system (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price shall include the cost of supplying the security system (hardware & software) inclusive of firewalls, anti-intrusion / intrusion prevention system, Antivirus software as per requirement.

The price of one set shall essentially include, but not limited to the following:

- a. Dual Redundant firewall/L-3 Routers (Industrial Hardware) as per technical specifications
- Antivirus software with 5 years of license subscription from the date of commissioning for each server, workstations, LVDS display controllers, Training Simulator System
- Any other components/accessories required for completion of the works

Item 56.0: Printers

Item 56.1: LaserJet B/W A4/A3 (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price shall include the cost of supplying the required set of printers at the OCC & BCC, but not limited to the following:

- LaserJet B/W printer A3/A4 size – 1no. for OCC
- Their Support & other accessories

Item 56.2: LaserJet Colour A4/A3 (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price shall include the cost of supplying the required set of printers at the OCC & BCC, but not limited to the following:

- LaserJet Color printer A3/A4 size – 1 no. each for OCC & BCC
- Their Support other accessories

Item 57.0: Auxiliary Feeding Distribution

Item 57.1: 2x20kVA UPS with Battery Set for minimum 3 hr backup at OCC only (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price shall include the cost of supplying the cables and the power distribution supply to the equipments installed in the OCC.

The price of one set shall essentially include but not limited to the following,

- 2x20 KVA Redundant UPS as per technical specifications
- Ni-Cd Battery set with minimum 3 hr backup
- Stand for Battery set
- Incoming cables from DB to UPS
- Output cables from UPS to DB
- Any other components/accessories required for completion of the works

Item 57.2: Auxiliary Power Feeding Distribution including cables, ACDBs and all other accessories (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price shall include the cost of supplying the cables and the power distribution supply to the equipments installed in the OCC & BCC

The price of one set shall essentially include but not limited to the following,

- Supply of redundant cables for distribution of 415V UPS supply from the UPS feeder to DB, ATS (Auto-transfer switch for 2 supplies).
- Distribution boards/sub distribution boards for power supply to various SCADA equipments and power outlets.
- Supply of cables from Distribution board to the equipments or Sub- distribution board including power outlet wherever required.
- Earthing of all equipments
- Cable paths (modular Cable management system (metallic) in server rooms or OCC in exposed places, trays, brackets...etc in hidden places) for laying of cables/earth connection etc.
- Any other components/accessories required for completion of the works

Item 58.0: Large Video Display Screen (LVDS) at OCC only (6*2 MATRIX 70" LASER BASED REAR PROJECTION)

The price shall cover the cost of supplying one Large Screen Visual Display Panel, at the OCC as per specifications, for displaying the Traction Overview and Auxiliary Network overview of the complete concerned Line. The price shall essentially include, but not limited to, all Hardware & Software (operating system) required for displaying status of Traction and Auxiliary Network of concerned line. Price for the Items shall include the cost of additional cubes if required and their erection, testing & commissioning cost respectively.

The price of one set shall essentially include but not limited to the following,

- Display cubes – 6 columns wide and 2 rows high, 70" LASER lit Cubes
- Dual redundant Graphic Display Controller with keyboard and mouse
- Base stand
- Wall Management Software
- Any other components/accessories required for completion of the works

Item 59.0: Training Simulator

Item 59.1: Training Server cum Workstation and Trainee Workstations (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price shall include the cost of supplying one set of training Simulator (as per specification) comprising the following,

- a. One No. Trainer server cum workstation
 - Two Nos. 24" LED Monitor with wireless Keyboard and Mouse for Trainer
 - Three Nos. Trainee workstation
- b. Two Nos. 24" LED Monitor with wireless Keyboard and Mouse for each Trainee
 - Basic Softwares (Operating System, All Drivers, MS office etc.)
 - Any other components/accessories required for completion of the works

Item 59.2: Training Simulator Software (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price of one set of this item shall essentially include but not limited to the following:

- Training Simulator software with License for one no. Trainer, three nos. Trainees and one no. Training RTU

Item 59.3: Training RTU (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The price shall include the cost of supplying One Training RTU The price shall essentially include but not limited to the following,

- One no. Training RTU Panel complete with internal wiring
- Processor/CPU Card, Power Supply Card, Communication cards etc. all in redundant Hot-Standby configuration
- All applicable Input-Output modules & Transducers etc. for training purposes
- Power Supply Converter & subsequent distribution inside panel
- Dual redundant Networking Switch
- AC/DC input power supply connection cables upto RTU
- Any other components/accessories required for completion of the works

Item 59.4: Training Room Furnitures (For Corridor 01, Corridor 2, Corridor 3 & Corridor 04)

The item includes suitable and aesthetically designed furniture at SCADA Training Simulator room.

It shall essentially include but not limited to the following:

- a. The Table/Desk and set of drawers for 1 Trainer and 3 Trainees – 4 Set
- b. Roller chairs – 4 nos.
- c. Any other components/accessories required for completion of the works

Note: The Contractor shall submit proposal for furniture type and design to Engineer in charge for approval.

Item 60.0: Control Room Furniture

The price shall include the cost of supplying the desk/table and chairs, as per specifications in the SCADA server room at OCC & BCC.

The price of one set shall essentially include, but not limited to the following:

- d. The table/desk and set of drawers suitable for all SCADA servers display console, workstations console, printer etc. in SCADA Server room.
- e. Rollers Chairs for each table/desk

Note: The Contractor shall submit proposal for furniture type and design to Engineer in charge for approval.

Item 61.0: Erection

The price shall include complete erection, of all new SCADA's equipments at OCC & BCC including softwares installation, programming configuration, cables laying, Earthing etc.

Item 62.0: Testing and commissioning

The price shall include the cost of testing and commissioning, as per Employer's Requirements and Specifications, the entire C&M equipment, systems and Software, at OCC & BCC for complete integration of all controlled stations including both RSS and Depot.

BILL NO. D2 CM2 RTU: LINE EQUIPMENTS CONTROL & MONITORING

Station equipments-RTU

The price shall include the cost of supplying RTU (hardware/software) needed for control, monitoring, protection, interlocking and Automatic sequencing of:

- the 25 kV switching stations and feeding posts
- the 33 kV Auxiliary Substations

The price shall essentially include, but not limited to,

- Redundant Central Processing Units (CPU), hot and standby.
- Input-Output Racks with extension racks if required (No redundancy for IO cards)
- Redundant Power Supply units, hot and standby and subsequent distribution inside panel.
- Redundant Communication cards, hot and standby.
- Communication cables for communication with relays (at a designated port in

switchgear panel).

- Interface converters, LIUs, Dual Managed Ethernet switches, communication ports, Transducers, surge arrestors etc. as required.
- RTU Panel/Rack complete with internal wiring as per specifications needed for the installations of the RTUs.
- Redundant OFC Communication cables & accessories (FO Patch chords, RJ45 Patch chords etc.) for linking RTU to TER as per SCADA Dedicated FO network design.
- Earth Connection from MET to RTU.
- RTU Programming.
- RTU shall be configured to communicate with at least 3 OCCs.
- Any other components/accessories required for completion of the works.

Item 63.0: Elevated Stations

Item 63.1: RTU for Elevated ASS

The price shall include the cost of supplying the RTU needed for the control, monitoring, protection and automatic sequences of the ASS at elevated stations. The RTU shall be located in the ASS room.

The price shall also include the cost of communication cables for linking RTU to TER or intermediate switch and earthing connection from MET to RTU.

Item 63.2: Extra for each OHE switching station (SS/SP/SSP/FP)

The price shall include the extra cost of clubbing of each switching station (SS/SP/SSP/FP) within the ASS's RTU. This includes cost of all extra components, I/O modules and associated cables, fittings etc. as required to make it one combined RTU unit. There shall be separate I/O card modules for ASS and switching station.

Item 64.0 C&M Cables

Item 64.1: Cables from Elevated ASS equipments to RTU

The price shall cover the cost of supplying all control and monitoring cables, required for interconnection of the equipment's at the ASS with RTU. The prices of all connectors, terminals, clamps etc. required for the connections with RTU be included in this item.

Item 64.2: Cables from Elevated SP/SS/SSP/FP equipment to RTU

The price shall cover the cost of supplying all control and monitoring cables, required for interconnection of all equipment's at each SP/SS/SSP/FP with RTU. The prices of all connectors, terminals, clamps etc. required for the connections shall be included in this item.

Item 64.5: Communication Equipments and Cables from RSS Gateway/ port to TER Connection

The price shall include cost of OFC cable, Dual Managed Ethernet switches, Converters, LIUs, FO/RJ45 Patch chords, Power Supply Units etc. for OFC link for RSS Gateway signals and meter data.

Item 65.0: Erection

The price shall include complete erection, of all equipments covered under this BOQ schedule at the designated location.

Item 66.0: Testing and commissioning

The price shall include the cost of SCADA integration testing and commissioning, as per Employer's Requirements and Specifications, the entire C&M equipment, systems and Software, at all controlled stations covered under various sub items of BOQ.

BILL NO. D3 CM3 DEPOT: CONTROL & MONITORING

(Soladevanahalli Depot)

Item 67.0: Station Equipments-RTU

The price shall include the cost of supplying RTU (hardware/software) needed for control, monitoring, protection, interlocking and Automatic sequencing of:

- the 25 kV feeding post
- the 33 kV Auxiliary Substation

The price shall essentially include, but not limited to,

- Redundant Central Processing Units (CPU), hot and standby.
- Input-Output Racks with extension racks if required (No redundancy for IO cards)
- Redundant Power Supply units, hot and standby and subsequent distribution inside panel.
- Redundant Communication cards, hot and standby.
- Communication cables for communication with relays (at a designated port in switchgear panel).
- Interface converters, LIUs, Dual Managed Ethernet switches, communication ports, Transducers, surge arrestors etc. as required.
- RTU Panel/Rack complete with internal wiring as per specifications needed for the installations of the RTUs.
- Redundant OFC Communication cables & accessories (FO Patch chords, RJ45 Patch chords etc.) for linking RTU to TER as per SCADA Dedicated FO network design.
- Earth Connection from MET to RTU.
- RTU Programming.
- RTU shall be configured to communicate with at least 3 OCCs.
- Any other components/accessories required for completion of the works.

Item 67.1: RTU at Depot ASS

The price shall include the cost of supplying the RTU, needed for the control, monitoring, protection and automatic sequences of the depot ASS. The RTU shall be located in the Depot ASS.

The price shall also include the cost of communication cables for linking RTU to TER or intermediate switch and earthing connection from MET to RTU.

Item 67.2: RTU at DEPOT FP

The price shall include the cost of supplying the RTU, needed for the control, monitoring, protection and automatic sequences of the depot Feeding Post. The RTU shall be located near the Depot Feeding Gantry.

The price shall also include the cost of communication cables for linking RTU to TER or intermediate switch and earthing connection from MET to RTU.

Item 67.3: Cables from ASS equipments to RTU

The price shall cover the cost of supplying all control and monitoring cables, required for interconnection of the equipment's at the ASS with RTU. The prices of all connectors, terminals, clamps etc. required for the connections with RTU be included in this item.

Item 67.4: Cables from FP equipments to RTU

The price shall cover the cost of supplying all control and monitoring cables, required for interconnection of all equipment's at Depot FP with RTU. The prices of all connectors, terminals, clamps etc. required for the connections shall be included in this item,

Item 67.5: Erection

The price shall include complete erection, of all equipments covered under this BOQ schedule at the designated location.

Item 67.6: Testing and commissioning

The price shall include the cost of SCADA integration testing and commissioning, as per Employer's Requirements and Specifications, the entire C&M equipment, systems and Software, at all controlled stations covered under various sub items of BOQ.

Item 68.0: SCADA SPARES

The item is supply of Spares for SCADA (for Viaduct & At-Grade) at site. The items and quantity provided is indicative and contractor will finalize the quantity in consultation and agreement with Engineer/Employer.

Bill No. D5 AMC1: AMC FOR VARIOUS CONTROL & MONITORING SCADA EQUIPMENTS COVERED UNDER VARIOUS BOQ SCHEDULES (INCLUDING ALL SOFTWARE AND HARDWARE)**Item 69.0: AMC cost for C&M equipments covered under CM1 OC & BCC Schedule**

The price shall include the AMC cost for all the C&M equipments installed at Main OCC and Back up OCCs.

The maintenance shall be performed according to a contract for 3 years after 2 years of DLP.

Item 70.0: +/- Variation AMC cost for addition/deletion of C&M equipments covered under CM1 schedule

The Price shall include the $\pm$ variation AMC cost for 3 year after 2 years DLP for equipment/software for the following items

Item 70.1 Workstation

Item 70.2 Large Screen video Display Unit

Item 70.3 LVS (Large video screen) video wall additional cubes

Item 71.0: AMC cost for Line equipments covered under CM2 & CM3 schedules

The price shall include the annual maintenance for all the RTUs with associated cables, switches etc. installed at various ASS, RSS and Depots covered in various BOQ schedules as under:

Item 71.1 S1 CM2 F

Item 71.2 S2 CM2 Item

71.3 S3 CM3

The maintenance shall be performed according to a contract for 3 years after 2 years of DLP.

Item 72.0: +/- Variation AMC cost for addition/deletion of C&M equipments covered under CM2 & CM3 schedules

The Price shall include the AMC cost for 3 years after DLP for the addition/deletion of following items covered under various CM2 & CM3 BOQ schedules as follows

Item 72.1 ASS RTU (Main Line or New Yelahanka Depot)

Item 72.2 Extra for each switching station SS/SSP/SP/FP integrated with ASS RTU or another station RTU

GENERAL: BILL OF QUANTITIES

The Bills of Quantities consists of bills; the Tender total collects all prices in the Bills.

The tenderer shall bring forward totals of all bills and show them in the Tender Total (Base Tender). The prices shall be appropriately shown with the imported part expressed in Foreign Currency and local part expressed in Indian Rupees.

The contractor shall provide the reference of economical conditions of prices.

The cost of supplies shall comply with Employer's requirement and cover:

- Equipment and required materials
- In plant and acceptance tests,
- Packaging,
- Transportation and handling,
- Storing and/or placing the equipment and materials in formation
- Documentation and drawings of equipment and materials

The cost of erection testing and commissioning shall comply with Employer's requirement and cover:

- Wages and compensations
- Administrative equipment
- Precaution to avoid damage to existing buildings, structures, services and utilities,
- Temporary works (traffic, access, water, electricity, soils, supply management)
- Erecting materials (screw, bolts...)
- The cost of complying with the employer's requirement.

The Tenderer shall complete and submit all bill sheets endorsed by the signature of his representative.