

PART 2: EMPLOYER'S REQUIREMENTS
Vol.II – TECHNICAL SPECIFICATION

CHAPTER 2: SCOPE OF WORK

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1. GENERAL

The scope of works includes Supply, Erection, Testing and Commissioning of Receiving Substation with incoming cabling from Grid Substation including 25 kV AC Traction cum 33kV Auxiliary Main Sub Stations, 25kV Overhead Equipment (FOCS), Auxiliary Power Supply and other associated works on Viaduct, At-grade & Stations including Soladevanahalli Depot and SCADA System for complete corridor 2 & 4 of BSTP and includes any modification in existing OHE/PSI if required along the alignment of C-2 and C-4.

A general description of the broad scope of work, relating to works covered in this Tender, is given below. It shall, however, be clearly understood that the description is for the purpose of general guidance only and is not exhaustive. For complete appreciation of the Scope, the Specifications, Drawings and other relevant paragraphs of the Tender documents shall be referred to.

1.1 ITEMS OF WORK

The following items of work are within the Scope of this Tender:

- a) Contractor shall carry out the verification of Traction Power Simulation and Load Flow Study for the complete Corridor C-2 and C-4 for the Normal and outage case, in case there is change in the alignment otherwise both the simulations reports may be obtained from the detailed design consultant. however, if contractor wish to repeat the simulation to ascertain the load requirement of the system to verify the sizes of the equipment, Contractor may do so and simulation report will be reviewed and approved by DDC, Employer/Engineer. Same is valid for balance power System studies also.
- b) Contractor is responsible for all works relating to Traction Overhead Equipment, Traction Sub Stations/Receiving Sub Stations, 33 kV Power Distribution Network, Auxiliary Substations and SCADA in the Corridors 2 & 4 and rolling stock depot.
- c) Transportation, storage, security, loading/unloading, insurance and safe custody till handing over of the facilities.
- d) Quality checking and quality management for all the works.
- e) Training to Employer's personnel, operation and maintenance personnel.
- f) Supply of spares, maintenance tools and operation & maintenance manuals.
- g) Preparation of documents required to be submitted to EIG, CRS / CMRS, RDSO, KPTCL etc.

1.2 CORRIDORS COVERED IN THIS TENDER

This Tender covers the relevant works in the following Corridors.

- **Benniganahalli to Chikkabanavara (Corridor-2)**
- **Heelalige to Rajanukunte (Corridor-4)**
- **Soladevanahalli Depot**

2. SCOPE

2.1. GENERAL

In general, Contractor is responsible for all works relating to Traction Overhead Equipment, Traction Sub Stations, Receiving Sub Stations, 33 kV Power Distribution Network, Auxiliary Substations and SCADA in the Corridors 2 & 4 including of Soladevanahalli Depot.

Prior to initiating any work, the contractor must submit all requisite necessary documents, construction drawings, and calculations to the Employer/Engineer for the issuance of a Non- Objection Certificate (NOC).

2.2 CONTRACTOR'S SCOPE

Si No	Name of Corridor	Scope
1	Corridor 2: Benniganahalli to Chikkabanavara	OHE, switching stations, Auxiliary and SCADA for both Elevated & At Grade section
2	Corridor 4: Heelalige to Rajanukunte	OHE, switching stations, Auxiliary and SCADA for both Elevated & At Grade section
3	Soladevanahalli Depot	OHE, switching stations, Auxiliary & SCADA
4	IR Modification works	OHE along the alignment of C2, C4
5	RSS works	220kV (GIS), 33kV (AIS) and 25kV (GIS)

2.2.1 Traction Overhead Equipment

Elevated Sections:

Design verification, Supply, Erection, Testing and commissioning including Integrated testing and commissioning of 25 kV Traction Overhead Equipment (sOHE) of Flexible Catenary System, for 'elevated sections' shall be within the scope of This Contract.

At Grade Section:

Design verification, Supply and Erection, Testing and commissioning including Integrated testing and commissioning of 25 kV Traction Overhead Equipment (OHE) of Flexible Catenary System, for 'At-Grade sections' shall be within the scope of the Contract.

Depots:-

In addition, supply and erection, Testing and commissioning including Integrated testing and commissioning of OHE in the following Metro Car Maintenance Depot (generally referred to as 'Depots'), shall also be within the scope of this Contract.

a) Soldevanahalli Depot

Switching Stations

The following works shall form part of this Tender Design verification, supply and erection, Testing and commissioning including Integrated testing and commissioning of all Switching Stations in the 'elevated/at grade' corridors, including, but not limited to

- 25 kV Switchgear
- Jumpers and connecting cables
- Measuring and protection equipment (if required)
- Marshalling Box
- LT and Control Cables from the Switching Station to the Station control room in the nearest station
- Structures and foundations (if necessary) to support the equipment's and all other related works to make the Switching Station complete and for its successful and satisfactory working.

Tentatively, the Switching Stations are located near the following Stations, in Corridor:

S.No	Name of Corridor	Switching Station				Total
		FP	SP	SSP	SS	
1	Corridor 2: Benniganahalli to Chikkabanavara	2	2	5	3	12
2	Corridor 4: Heelalige to Rajanukunte	2	4 (3 are NS Arrangement)	4	5	15

For complete appreciation of above Scope, the Specifications, and Bill of Quantities/ along with their Explanatory notes, and Drawings shall be refereed.

IR Modifications:

Modification of OHE along the alignment of C2 and C4 if required. This includes survey of the existing OHE, dismantling of OHE, erection of new OHE.

All the modifications in the existing OHE of IR should be carried out in accordance with IR standards/Specifications.

Taking and cancellation of necessary power block shall be the responsibility of the contractor in order to complete the above works. Assistance for availing power blocks shall be given by employer/engineer.

The contractor has to carry out the dismantling of OHE as per Indian Railway procedure and necessary clearance.

2.2.2 RSS

A general description of the broad scope of work, relating to Receiving Substation (RSS), covered in this Tender, is given below.

The scope of work comprises of design verification, manufacture, FAT, supply, delivery at site, installation, inspection, testing and commissioning (including integrated testing and commissioning) of following Gas insulated (indoor type) receiving sub stations including EHV cabling works.

For complete appreciation of the Scope, the Specifications, and Bill of Quantities/ along with their Explanatory notes, and Drawings shall be refereed.

The RSS Contractor is responsible to carry out the various works in the RSS as listed below:

S. No.	RSS Location	Corridor	Corridor No.
1	Mathikere	Benniganahalli - Chikkabanavara	Corridor- 2
2	Benniganahalli	Benniganahalli - Chikkabanavara Heelalige- Rajankunte	Corridor-2, & 4
3	Yelahanaka -	Heelalige- Rajankunte	Corridor- 4
4	Soldevanahalli Depot RSS	Depot section and corridor-2	Depot-1 and Corridor- 2

Note – At Mathikere, Benniganahalli and Yelahanaka it is planned to construct 2 nos. of RSS at each location. However, in the above table only one RSS pertaining to Corridor 2 and 4 is indicated for this tender only.

2.2.3 Design Verification Works- RSS Scope

Contractor shall be responsible for carrying out all the detailed design verification works associated with the construction of RSS cum TSS cum AMS including all electrical, civil, architectural and structural, drainage, plumbing works etc, (complete RSS work at 04 locations).

The Design as prepared by DDC and submitted to Employer/engineer shall be subjected to checking and verification by Contractor's Design Team. Any local level or required modification shall be carried by Contractor

The work at each receiving sub-stations cum traction substations and auxiliary main substation will broadly comprise of the following except if specifically stated otherwise in the PS, Drawings & the BOQ.

- The design life of the equipment structure shall be 100 years.
- Construction of substation building with boundary wall, approach road, cable trenches, foundations, supports, drainage and other civil works.
- Two nos. of receiving bays at 220 kV incoming voltage from the respective utilities
- One No. of Coupling Feeder to another RSS at Mathikere, Benniganahalli and Yelahanaka
- One no. of bus coupler bay
- Two nos. of outgoing bays for traction transformer
- Two nos. of outgoing bays for auxiliary main transformer
- Two nos. of spare bays of transformer for future requirement (Only Space).
- Provision of eleven bays or as specified for the TSS (2 incomings, 1 coupler & 8 outgoing feeder bays for feeding the 25kV, single Phase AC Traction supply to feed OHE on the viaduct, at grade and depot traction supply as per the detailed requirement.

- Supply, Installation, Testing and Commissioning of Auxiliary Main Substation with Provision of 11 Nos. or as specified of 33 kV indoor type bays for feeders in the AMS for feeding Auxiliary supply to the ASS at stations (2 Nos.), RSS auxiliary transformers (2 Nos.), bus coupler (1 No.), incomers (2 Nos.) and 2 spares. In addition to these 2 Nos. of bus riser & PT panel will also be there.
- Supply, Installation, Testing and Commissioning of two Nos. of 220kV/33kV main auxiliary transformers with NGR & on Load Tap Changers.
- Supply, Installation, Testing and Commissioning of two Nos. of 220kV/27.5kV traction transformers with OLTC.
- Supply, Installation, Testing and Commissioning of gantry structures, towers and associated arrangements
- Provision of earthing grid and lightening protection system.
- The main protective relay shall be numerical type, IEC-61850 compliant. The Substation, Automation System (SAS for monitoring, control, protection, disturbance recording, event logging etc.) shall be provided at each RSS integrating all the relays at 220 kV/33 kV/25 kV levels and the bay control units (BCUs) for 220 kV levels. The system architecture will be realized through IEC-61850 communication infrastructure. No external converters shall be used, and provision shall be there for connectivity to the Operations Control Centre & BCC on IEC 60870-5-104/101 protocol.
- A redundant (hot-hot) full-fledged industrial server (to run 24x7) shall be provided for each RSS.
- The BCPUs shall be provided on the 220 kV bays and housed in the indoor cubicles in the control room besides/ along with relay panels. The BCU shall have full-fledged graphic display for the position of switching elements.
- For 33 kV & 25kV bays, the controls of CBs are desired to be achieved through the numerical protective relays combined with control functions or the independent BCUs. In case the combined protection and control IEDs are used, and they shall have full-fledged graphic display for display of position of switching elements. Also the local remote switching key pad shall be available.
- All the station auxiliaries, AC/DC supplies, system alarms shall be taken into the substation automation system.
- Supply of spare parts, tools and equipment for maintenance/repair facility of RSS cum TSS and AMS.
- Provision of 110 V DC battery banks (One Main + One Standby) and battery chargers for the DC supply and one set of two UPS/Inverter for the emergency or control power supply.
- Provision of 2 x 200KVA or higher capacity specified in BOQ dry type transformers for Sub-Station Auxiliary supply.
- Supply, installation & commissioning of 220 kV, 25kV, 33kV or 415V cables & control wirings of suitable sizes or design for requirements within the RSS boundary location if not stated otherwise.
- Provision of complete building E & M services, circulating area lighting, landscaping and other requirements as per the normal standards maintained in BSTP RSS-cum TSS & AMS. The control room should be air-conditioned.

220 kV GIS:

i. For Each GIS At Mathikere, Benniganahalli, Yelahanka

Two nos. of GIS type incoming bays for receiving supply from the respective utilities, One no. of Coupling feeder bay, One no. of GIS type bus coupler bay & Bus PTs, Two Nos of GIS type outgoing bays for Traction transformer, Two Nos of GIS type outgoing bays for Auxiliary Main Transformer.

ii. SOLDEVANAHALLI:

Two nos. of GIS type incoming bays for receiving supply from the respective utilities, One no. of GIS type bus coupler bay & Bus PTs, Two Nos. of GIS type outgoing bays for Traction transformer, Two Nos. of GIS type outgoing bays for Auxiliary Main Transformer.

Traction & Auxiliary Main Transformers for each RSS:

Contractor shall verify the design and size of the transformer so that performance requirement is fulfilled, and transformer losses are as low as possible since power losses are a real concern. The contractor shall propose the designs, supported with references of designs adopted in other similar metros in India and worldwide most recently with improvements in the designs based on the Aesthetics, working experience or financial savings.

Supply, Installation, Testing and Commissioning of Two Nos of single phase, 220 kV / 27.5kV Traction Transformers of capacity and other technical details specified in relevant chapter of PS & On-Load Tap Changers.

Supply, Installation, Testing and Commissioning of Two Nos of 220 kV / 33kV Auxiliary Main Transformers of capacity and other technical details specified in relevant chapter of PS with NGR, & On Load Tap Changers.

25 kV GIS at each RSS:

Supply, Installation, Testing and Commissioning of 25kV Indoor GIS Traction Substation with 52 KV BIL, a Provision of bays as specified in Pricing/Milestone/PS Document for BSTP/BI-RIDE.

33kV VCB/SF6 Panels at each RSS:

Supply, Installation, Testing and Commissioning of Auxiliary Main Substation (33kV Indoor) with a Provision of bays as specified in Pricing/Milestone/PS Document for BSTP/BI-RIDE.

CRP & SAS at each RSS:

The main protective relays shall be numerical type & latest IEC compliant. The Substation, Automation System (SAS for monitoring, control, protection, disturbance recording, event logging etc) shall be provided at each RSS integrating all the relays at all voltage levels. All control and relay panels and substation automation system shall be installed in control room.

Each of the IED/BCU/BPU provided shall be provided with its similar backup IED/BCU/BPU to ensure redundancy. This means for each IED/BCU/BPU the second hot standby IED/BCU/BPU should be provided which should automatically take over the system in the event of failure of main IED/BCU/BPU.

The system architecture will be realized through IEC-61850 communication infrastructure. No external converters shall be used, and provision shall be there for connectivity to the Operations Control Centre & backup control center (BCC) on IEC 60870-5-104. In case of augmentation of existing RSS, a suitable converter etc, may be utilized to make communication on IEC 60870-5-104 protocol

A redundant (hot-hot) full-fledged server shall be provided for each RSS. The display unit, 32 inches, LED type shall connect to the station servers.

The LCC for 220 kV GIS bay shall be of conventional type. The BCUs shall be provided on its control and relay panel and housed in the indoor cubicles in the control room along with other relays. Similarly, for 25 kV the BCU shall be provided on its control and relay panel. For 33 kV, the BCU shall be provided on 33kV AIS bay (LV compartment).

The Control of all bays is to be achieved through the independent & similar type of BCUs for all voltage levels. However, the over current / Earth fault protection may be combined with BCU and shall have full flagged graphic display for display of position of switching equipments/elements. Also the local remote switching key pad shall be available.

All the station auxiliaries, AC/DC supplies, system alarms, indications and control of CBs shall be taken into the Substation Automation System (SAS) by using BCU of similar type used for other voltage levels. All IEDs/BCPU/Protective relay shall be IEC-61850 compliant.

All requirements for CRP and SAS (switches, patch chords for networking panels, servers etc) as mentioned above and in PS.

Control and LT supply at each RSS:

Provision of 110 V DC battery banks (one main + one standby) and battery chargers cum DCDBs for the DC supply and 2 numbers of online invertors shall be installed for SAS and its ancillary equipment.

Provision of 2 x 200 kVA or higher capacities specified in BOQ Dry type transformers for sub-station auxiliary supply and ACDBs.

Cables (EHV, HV, LV and Control) at each RSS:

Supply, Installation & Commissioning of all EHV 220 kV cable as applicable), HV Cable (33kV, 25kV as applicable), Medium Voltage (415V) cables & control wiring of suitable sizes or design for requirements within the RSS boundary location if not stated otherwise.

Other miscellaneous works at each RSS:

Supply, Installation, Testing and Commissioning of cable termination structures, towers or gantry if required.

Provision of earthing, earthing grid, metering, lighting and lightning protection system.

Supply of spare parts, tools and equipment for maintenance/repair facility of RSS cum TSS cum AMS.

Preparation of all type of drawings, interactive O&M training manuals, evaluation & checking of design and training of staff.

A standalone desktop PC shall be provided at each RSS with the O&M procedures for equipments under supply. The maintenance and the report forms shall be built in the O&M procedures.

RSS building and other civil works at each RSS:

Construction of substation building with Boundary Wall, Rail-Cum-Road, Approach Road, Cable Trenches, Foundations, Supports, Drainage and other civil works. Substation building includes GIS room, Cable cellar, Control room, Maintenance Room, Toilet etc. Control room should have false ceiling and foam concrete false flooring for installation of Control & Relay panels. The building shall have all the amenities and features to be at least similar to the RSS building built in relevant metro system.

The design shall also take into account that the BSTP intends to get Green Building certification of Platinum rating.

Provision of complete building E & M services, fire detection and alarm system, LED type lighting, landscaping, and other requirements as mentioned in specifications and as per the normal standards maintained in BSTP RSS-cum TSS-cum AMS. VRF shall be used for control room air-conditioning.

Power Transformers installation shall be Indoor/Outdoor type with all statutory requirements. In this decision of the Engineer in-charge shall be final & binding.

Scope of EHV Cabling: As per KPTCL specifications and Norms

The Contractor shall be responsible for Supply, Laying, Testing and Commissioning (including integrated testing and Commissioning) of EHV Cables (220 KV) for Receiving Substations at above mentioned locations. This includes all works such as excavation of ground, provision of HDPE pipes, restoration of ground and all other works required to make it fully functional Cable in all respects. The work will include but not be limited to:

Supply, Laying, Testing and Commissioning of EHV cables from GSS of Power supply Authorities to BSTP Receiving Cum Traction Cum Auxiliary Main Sub Station as per KPTCL specifications and Norms.

Interface for each RSS:

Interface with KPTCL and BESCOM (state DISCOM) for obtaining power supply at receiving substations including necessary requirements of protection schemes and insulation co-ordinations, interfacing with Govt./Civic agencies viz. Municipal authorities, traffic police, water supply authority, gas supply authority, Telecom utilities, Electricity supply utilities, PWD, Railways etc. is in the scope of the contractor. However, Employer/Employer's Representative will assist. For GPR survey of Cable route, **Contractor may get the Preliminary GPR survey Report from Detailed Design Consultant (DDC). However, if contractor can find out any other shortest alternative route which is feasible and got approval of all authorities then GPR survey shall be carried out by Contractor on his behalf.**

Leading Power Factor Compensation System:

BSTP Project has extensive use of EHV, MV cables in its distribution network, interconnecting 220 kV underground cables as applicable from power supply authority to the substation and 33kV and 25kV underground cables from RSS to feeding points. To substantiate the actual requirement of leading / lagging power factor compensation & operational issue and maintain close to unity power factor at interface point, contractor shall refer the simulation study done by DDC. After due verification and along with realistic data collected from field after commencement of operation. Accordingly, contractor shall recommend suitable reactive power compensation.

BROAD Items of Work in each RSS.

The term RSS includes the various facilities inside the RSS premises, bound by a fencing or boundary wall. The works include, but not limited to

- . 220 kV GIS Indoor type-High Voltage bays,
- . 220 kV / 27.5kV Traction and 220 kV / 33kV Auxiliary Main Transformer and its ancillary equipment,
- . 25 kV GIS type CB,
- . 33 kV VCB/SF6 Indoor Type CB
- . 200 kVA Auxiliary Transformers for Station supply.
- . Civil Works including the GIS room, Cable Cellar, AMS & Control Room Building,
- . Equipment inside the AMS Room,
- . Equipment inside the Control Room including control cables inside RSS,
- . EHV Cabling 220 kV inside and outside, 33 kV & 25 kV cabling, LV Power Cabling.
- Provision of suitable dynamic Reactive power compensation system.

RSS Contractor's Scope.

The broad items of work which are included in the RSS Contractor's Scope are described below, and wherever an item is excluded from the Scope, it is specifically brought out.

The Contractor shall submit Reliability, Availability, Maintainability and Safety (RAMS) Plan to the Employer for review and approval. After system's design has/have been completed, the Contractor shall re-verify, that the reliability, availability, maintainability and Safety (RAMS) requirements proposed by him in line with the contract requirements, shall be met.

Civil Works at each RSS:

Geo-technical investigations to determine the safe bearing capacity of the soil and other design parameters, including Soil conductivity and soil resistivity.

All Civil Works in the RSS, including but not limited to land preparation, inside drainage and connection to the Rain Water Harvesting system, Constructed wet land sewage treatment plant with automatic operation of suitable size of pump for lifting of reusable water from plant to overhead tank, water supply arrangement, access roads from existing main road to the substation and approach roads inside RSS of RCC, construction of the AMS and control room building complete in all respects and cable paths and cable trenches in the Switchyard, as well as inside the AMS room and control room.

Survey, Excavation, Backfilling, Barricading, etc for the EHV Cabling work of the RSS.

- Trenchless/pipe laying for the EHV Cabling work of the RSS.
- Yard lighting
- Lightning protection masts
- Landscaping
- Transformer Oil sump with suitable capacity of pumping arrangement.
- Baffle walls shall be fire rated for 4hrs.
- Boundary wall along with gates
- Installation of Earth Mesh
- Earthing arrangements in AMS and Control Room building
- Earthing of fencing/boundary walls.

220 kV HIGH VOLTAGE BAYS at each RSS:

Incoming Bays.

- Design verification and construction design, Supply and erection, testing and commissioning of the GIS type High Voltage Bays consisting of but not limited to all Switchgear, Measurement transformers, lightning arresters, busbars along with their foundations to support the various equipment / bus bars and any other component or material required to make the installation complete and operable.

Traction Transformer Outgoing Bays.

- Design verification and construction design, Supply and erection, testing and commissioning of GIS type for Traction Transformer Bays consisting of but not limited to all Switchgear, Measurement transformers, lightning arresters, busbars along with their foundations to support the various equipments / busbars and any other component or material required to make the installation complete and operable.

Auxiliary Main Transformer Outgoing bays.

- Design verification and construction design, Supply and erection, testing and commissioning of GIS type of Auxiliary Main Transformers Bay consisting of but not limited to all Switchgear, Measurement transformers, lighting arresters, bus bars along with their foundations to support the various equipment / busbars and any other component or material required to make the installation complete and operable. Contractor shall conduct Soil test /geo technical investigation and the report of the same shall be submitted for employer/engineer approval. Based on the same, the relevant grade of RCC (Reinforced cement concrete) shall be considered.
- Layout shall be planned in order to keep a spare space for two nos. of Main transformer

Coupling bays.

- Design verification and construction design, Supply and erection, testing and

commissioning of GIS type Coupling Bay consisting of but not limited to all Switchgear, Measurement transformers, busbars along with their foundations to support the various equipments / busbars any other component or material required to make the installation complete and operable.

Auxiliary Main Substations (AMS).

- Design verification and construction design, Supply and erection, testing and commissioning of Auxiliary Main Transformers and Neutral Grounding Resistors (NGR) and associated Fire Suppression System.
- All Civil works in the AMS, including, but not limited to Design/Construction of the AMS and Control room building complete with lighting (indoors / outdoors), fans, false ceiling and air-conditioning (wherever required), power sockets, fire-alarm and detection system, water supply, sanitary and sewage disposal and all other facilities needed to make the building functionally and operationally satisfactory.
- Earthing arrangements in the AMS and Control room building and interconnection of AMS earth with the main RSS earth mesh.
- Supply and erection, testing and commissioning of all equipments in the AMS room including 33 kV VCB/SF6 type Switchgear panels and associated cabling from the AMS Transformer to 33 kV Switchgear panels.
- 33 kV / 415 V Dry Type Station Transformers
- All other equipments in the AMS Room, such as Low Voltage distribution board (LVSB) complete with Incoming and outgoing breakers and feeders, DC-UPS including Batteries, Battery chargers and DC Distribution Boards.
- All 33 kV and 415 V cabling in the AMS and RSS.
- All HT and LT auxiliary system shall be provide with the panel inert gas flooding system.

Traction Substations.

- Design verification and construction design, Supply and erection, testing and commissioning of Traction Transformers and associated Fire Suppression System.
- Design verification and construction design, Supply and Erection, testing and commissioning of Indoor GIS type 25kV switchgear, including but not limited to circuit breakers, interrupters, isolators, along with foundations.
- Design verification and construction design, Supply and erection, testing and commissioning of all 25kV cables required inside the TSS, including those from the Traction transformer to 25kV switchgear

Equipments inside the Control Room.

- Design verification and construction design, Supply, installation, testing and commissioning and putting into operation of Bay Controllers, Workstations and PC's and linking with the HV equipments in the yard.
- Design verification and construction design, Supply, installation, testing and commissioning and putting into operation of all 33 kV and 25 kV control equipments and relay, and panels.
- Design verification and construction design & providing a 'Gateway' to support control and monitoring of all EHV / 33 kV / 25 kV systems from any of the two Operations Control Centers (OCC) located at SOLDEVANAHALLI Depot or any other locations. The gateway shall be Ethernet compliant.
- Design verification and construction design, Supply and erection, testing and commissioning of all other equipments in the Control room as necessary, to enable the protection, control and monitoring of all EHV /33 kV / 25 kV equipments, from Bay level /

Control room / Operations Control Centers.

BI-RIDE

SCOPE OF EHV CABLING.

The Contractor shall be responsible for Supply, Laying, Testing and Commissioning (including integrated testing and Commissioning) of EHV Cables for Receiving Substations at above mentioned locations. This includes all works such as excavation of ground, provision of HDPE pipes, restoration of ground and all other works required to make it fully functional Cable in all respects.

The work will include but not be limited to:

Supply, Laying, Testing and Commissioning of EHV cables from GSS of Power supply Authorities to BSTP, Receiving Cum Traction Sub Station and Auxiliary Main Sub Station. The concerned work would comprise of:

- Supply of EHV (220 kV) cables as per requirement specified in PS and in accordance with the International Standards.
- Submission of Method Statement for cable laying works covering the cable laying methodology and safety aspects for the approval of Engineer.
- Contractor may get the Preliminary GPR survey Report from Detailed Design Consultant (DDC). However, if contractor is able to find out any other shortest alternative route, which is feasible and got approval of all authorities then GPE survey shall be carried out by Contractor on his behalf. Contractor's scope includes Final location survey with GPR and confirmation of utilities, preparation of final construction /cable layout drawings indicating cable pull boxes, joint locations, any uncharted utilities, utility/route diversions if any and co-coordinating with the various State and Central Government Departments & utilities whenever and wherever necessary on the behalf of BSTP. The co-ordination with city agencies shall also be done for the purpose of crossing –over/under or minor shifting of utilities for cable laying etc. in case of major problems, BSTP may also assist. If for some stretch, road restoration work is to be done by the contractor, the price quoted in the BOQ shall be payable.
- Payment deposited to Govt./Civic agencies: Any amount deposited by contractor to civic agencies for obtaining cable laying permission shall be reimbursed by BI-RIDE on submission of documentary evidence.
- Any penalties on any account levied compensation for any damages or loss during the course of work shall be borne by the contractor.
- Security deposits to Govt./Civic agencies shall also be submitted / deposited by contractor
- Laying of the EHV and OFC cables Cable for SCADA & protection as per IS: 1255-1983 or any other relevant international standards and manufacturer's recommendations.
- Supply of complete kits with accessories for Jointing, Cross-bonding, mid-point bonding, single point bonding, termination of cables, cable termination structure and jumpering at GSS of PSA, its installation and commissioning using appropriate techniques as specified with the approval of employer.
- The joints to be located and secured in a pre-casted jointing bay (preferred) of suitable size as per approved drawing. Adequate Looping length at terminating points
- For bonding, Provision of required number of sheath voltage limiters (SVL's), all type of sections, earth electrodes/mesh shall be (Sheath voltage calculations) done as per IEEE 575 (latest).
- Provision of multi-Conduit HDPE pipes of adequate mechanical impact strength embedded in concretes as laid in ground with proper separation for road crossing or abutment (in the case of Cable crossing the rail/road) and making a bridge to cross the cables over nallah or

drains.

BI-RIDE

- Road Restoration: Temporary road restoration with proper compaction and PCC shall be done by the contractor (Civic agency civil specification preferred) to the satisfaction of Engineer-in-charge within one month as per standard practices and procedures. Final road restoration will be carried out by the contractor.
- Ground penetration survey (GPR): The contractor shall carry out the GPR survey of the complete cable system and submit the drawing marking the coordinates showing distance, depth along the cable path. The survey should be carried out before starting the cable laying work to ascertain the utilities and after the completion of cable laying work so as to prepare "As Built Drawing".
- Provision of chamber boxes etc. if required for locating/housing the cable joints, cross bonding and earthing etc.
- Providing necessary (RCC) protection covers, route markers & sand cushions for the cables.
- Testing and commissioning of EHV cables.
- Excavated area due to open excavation, trenchless, pulling pit or any other method shall be barricaded while executing the work. Each barricade shall be as per BSTP SHE standards. Penalty as per various clause of SHE, if barricading not provided, shall be imposed.
- Foot patrolling of the entire power cable route till handing over of the system (all type of cables)
- Interface with KPTCL and DISCOMs for obtaining power supply at receiving substations including necessary protection and insulation co-ordination. Employer/Employer's Representative will assist.
- Evaluation & checking of proposed design/ layouts as specified in tender, preparation of final or modified layout & construction drawings, protection schemes for approval of employer and final construction drawings.
- Preparation of drawings, O&M training manuals, evaluation & checking of design and training of staff. A standalone desktop PC shall be provided at each RSS with the O&M procedures for equipments under supply. The maintenance and the report forms shall be built in the O&M procedures.

Items of Works.

The following items of work are within the Scope of this Tender.

- Final location survey of the Route for EHV cables between the Grid Substation of Power Supply Authority and the BSTP RSS.
- Submission of details of possible alternative routes, together with their implications on Work Methodology, Execution time, cost, utilities affected to be diverted and acceptable to civic bodies.
- Preparation of cable paths as per the route accepted by the Employer and in accordance with approved designs.
- Laying of cables in accordance with the Methodology (pulling, running out or ploughing in) accepted by the Employer.
- Straight through joints

RSS EHV Cabling.

- Design verification and construction design, Supply, Laying, Testing and Commissioning of EHV cables from Grid Substation (GSS) of Power supply Authorities to BSTP, Receiving Cum

Traction Sub Station and Auxiliary Main Sub Station.

- Termination of the EHV cables at GSS/GIS end of Power Supply Authorities & BSTP RSS
- Design verification and construction design, Supply, Laying, Testing and Commissioning of Control, protection & communication (related to above work)

Supply and erection of:

- All 220 kV, 25kV and 33kV cables inside the RSS premises
- All traction Return current cables between Traction Transformer Secondary and the return current arrangement in the RSS.
- Supply and Erection of Copper bar.
- All LV cables and control cables
- All necessary termination and jointing for the various cables.

Design Verification Services: -

All detailed Design verification is in the Scope of RSS/PST Contractor. **It shall be noted that the rating mentioned in the tender document are indicative ratings.** The tenderer shall verify these ratings and quantities. The tenderer to carry out detailed design verification, at no extra cost to BSTP, if there are any change in the ratings. However, the same shall be intimated to the Engineer/Employer. The decision of Engineer/Employer shall be final and binding. The scope of Design verification of following design done by DDC shall be as following but not limited to: -

- To prepare the detailed equipment layout and other drawings and specifications pertaining to receiving substation as per the land availability, site conditions, track layouts keeping in view the various clearances to be observed.
- Selection of Lightning arrestors, isolators, bus bar ratings, circuit breakers, CTs, PTs, metering panels and other equipment at each RSS
- Protection coordination with DISCOMS /KPTCL and the detailed protection scheme to be adopted in all RSS and TSS and including those required for Feeders and auxiliary network. In addition, review and finalize the detailed technical and performance specifications of main traction power transformers, Main Auxiliary Power Transformer and Auxiliary distribution transformers.
- The work shall cover designing the incoming EHV 220kV Power Cable terminations as well as any outgoing power cable termination in the RSS. The work shall also include coordination of the protection system of the RSS with that provided by the Power Supply Authority for incoming/outgoing 220 kV cables at RSS. It would cover protection system of internal power supply network of BSTP. The Work will also include design of the protection scheme from source to the BSTP RSS.
- Plan for power and control cable run layout in the RSS premises control Room, cable trench, supporting and clamping arrangement, cable termination etc.
- Design, Drawing & specification of SCADA system giving due consideration to requirements SAS and the OCC protocols and their integration.
- Plan, Detail Design Control, co-ordinate and execute the design phase of the contract of production of drawings, documents and reports to meet the key schedule dates included in the agreement and as directed by the Employer/ Engineer.
- Calculations shall be checked according to the best professional standards and complied into sets that relate to particular aspect of design. Each set of calculations of power supply and SCADA system design shall include but not limited to the method statement including,

- Description of the substation structure design.
- Size of equipment foundations
- Size of cables, conductors including the earthing conductors. This would give due consideration in laying method, de-rating factors, voltage drops & other such factors before working down the final results.
- Capacity of circuit breakers, interrupters, disconnecting switches, Instrument transformers and other Equipment's.
- All the construction design shall be done by the contractor in accordance with the design

3. Traction Network and Power Supply Arrangements

The scope of work includes design verification, supply, installation, inspection, testing and commissioning of

- Modification of Indian railway OHE in the section of IR along the alignment of BSTP if required.
- Feeding arrangements to the overhead contact system with suitable protection at feeding post.
- Sectioning and paralleling feeding arrangement with suitable protection.
- Sub-sectioning and paralleling feeding arrangement with suitable protection.
- Sub-sectioning arrangement with suitable protection.
- Provision to segregate feed of operational section from under construction section during testing and commissioning (trial run).
- Supply of traction power through overhead contact system (Flexible & Retractable Overhead catenary system) with suitable earthing and protection arrangements.
- Associated galvanized steel structures, buildings, foundations, ancillary equipment, feeders, jumpers and connections to overhead contact system, etc.
- Interlocking and protection coordination of various equipment at TSS, FP, SS, SP & SSPs.
- Providing earthing arrangement for all equipment and structures in the TSS, FP, SS, SP & SSPs.
- Earthing & bonding on viaduct, Underground, Depot, Depot feeding post, Station etc.
- 25 kV, 3.3 kV, control cable laying & associated works.
- Structures and foundations to support the equipment.
- Emergency trip system for the RSS.
- Supply of spare parts and maintenance tools and operating and maintenance manuals.
- Other associated items of work.
- The contractor shall submit 3 hard copies and 3 soft copies of drawings including completion drawings.
- Interrupters to be used at Feeding post.
- Retractable Catenary System at IBL with Roof Platform of the Depot

3.1 Cabling

- The Contractor shall be responsible for Design verification, Supply, Laying, Testing and Commissioning (including integrated testing and Commissioning) of 25 kV & 3.3 kV Cables from RSS to Feeding Post. This includes all works such as excavation of ground, trenchless,

provision of HDPE (PN-4) (PN-6, PE80) pipes, restoration of ground and all other works required to make it fully functional Cable in all respects

- Barricading, excavation along the cable routes, preparation of trenches, sand cushioning, coverings, reconstruction as per site conditions & as per drawing. The works will be secured by adopting adequate safety measures.
- Laying of the 25 kV & 3.3 kV and OFC cables/Control Cables for SCADA & protection as per [IS: 1255-1983], international standards and manufacturer's recommendations.
- Supply of complete kits with accessories for Jointing, termination of cables, cable termination structure and jumpering at RSS, its installation and commissioning using appropriate techniques as specified with the approval of employer.
- Provision of multi-Conduit HDPE (PN-4) (PN-6, PE80) pipes of adequate mechanical impact strength embedded in concretes as laid in ground with proper separation for road crossing or abutment (in the case of Cable crossing the rail/road) and making a bridge of covered steel box & HDPE (PN-4) (PN-6, PE80) pipes inside steel box to cross the cables over nallah or drains.
- Restoration of the routes excavated for the cable laying and other concerned purposes to the original position within given time span.
- Provision of chamber boxes etc. if required for locating/housing the cable joints, cross bonding and earthing etc.
- Providing necessary (RCC) protection covers, route markers & sand cushions for the cables.
- Testing and commissioning of cables.
- All cable entry points and horizontal & vertical cut outs shall be sealed with EPDM.
- Providing barricades for protection of work, deployment of traffic marshals, watch & ward and traffic diversion works to the satisfaction/approval of the Traffic Police department.
- Evaluation & checking of proposed design/ layouts as specified in tender, preparation of final or modified layout & construction drawings, protection schemes for approval of employer and final construction drawings.
- Preparation of drawings, O&M training manuals, evaluation & checking of design and training of staff.
- RFID tags shall be provided on the buried cables.(if required)

3.2 Overhead Equipment

The following items of work are within the scope of work of this tender but not limited to

- All survey on site necessary to do in order to select/finalize OHE.
- The design verification of the OHE calculation and layouts, etc.
- Supply and Erection of 25 kV Traction Overhead Equipment for Elevated Lines, Depots and Underground sections.
- OHE masts with base plate for viaduct and without base plate at grade area.
- Portals with drop arms with base plate welded for viaducts and without base plate at grade.
- Drop arms attached to roof trusses in stations and in depot.
- Cantilever assemblies along with mounting arrangement with composite insulators (1600 mm creepage) for main line and depot.
- Overhead equipment conductors like messenger wire, contact wire, bridle wire for tramway OHE, RC, jumpers, and dropper wires etc.
- Retractable Catenary System in Inspection bays of Depot.

- Overhead Protection Conductor (OPC) and Buried earth conductor (BEC), Tunnel earth wire (TEW).
- Integral transverse link (ITL), earth electrodes, earth connectors, earth strips etc.
- Termination assemblies for conductors with silicon composite insulators.
- Anti-creep assemblies.
- Guy rod assemblies with base plate connection for viaduct and anchor loop embedded in concrete blocks for depot.
- Regulated OHE with ATD on at grade, viaduct & depot.
- Cut in insulators, Post Insulator, Tie rod insulator of 1600 mm creepage
- Adequate measures to be taken to minimize the EMI impacts on the neighborhood of hospitals, Airport, defense installations, Govt buildings etc.
- Anti-bird nesting and anti-climbing (if required) provisions on fabricated masts and portals
- 25 kV Motorized operated isolators and interrupters and circuit breaker. Motorized/manually operated isolators at depot. Manually operated isolators shall be provided with vertical/horizontal operating handle.
- Bonding and earthing including earth mats or electrodes in depot area and Track sides.
- Supply and Erection of SCADA System, including Equipment at OCC, BCC.
- All inspection, testing, integrated testing, and Commissioning of all erected equipment
- All OHE Mast foundations in depot & on Main line shall be done by Traction contractor. Muffing & grouting of masts in depot as well as main line shall be done by Traction contractor.
- Anti-bird disc at stay insulators & bracket insulators of cantilever. PVC net at Portals and masts to avoid bird nesting.
- Interlockings at IBL, FP, SP, Internal Cleaning Shed etc. shall be provided.
- No. plate, all type of caution boards & safety screen plate shall be provided.
- HDPE (PN-4) (PN-6) pipes, if required, for cable laying.
- Earthing of all Traction equipment.
- **OHE masts & other structural components shall be galvanized (zinc coated) not less than 1000 gm/sq meter**
- In Cantilever, it shall be ensured that split pins, locks nuts or spring washer or serrated washers are provided in all fittings.
- RC to ITL connection should be done through insulated cables.
- Wedge type PG clamps shall be used in case of RC /OPC down conductor connection to ITL.
- LA shall be provided with PT at main line.
- LA and safety screen shall be provided with PT/CS at Main line.
- Other miscellaneous works to make system complete & operational.

3.3 Auxiliary Sub-Stations

Auxiliary Sub-Stations (ASS) are required to be set up for feeding power to all passenger station auxiliary loads. 33 kV/ 415 Volts Dry type transformers will transform power from 33 kV to 415 Volts and distributed through Main to LT Panels and up to the final distribution

Contractor shall supply, install and commission the BCU & Network devices required for Control and

Monitoring of Battery Charger, ACDB, DCDB & OHE switching post/feeding post equipment with all required interface wiring work. These BCUs with all required equipment shall be house in HT Bus coupler/Adapter panel or other suitable provision may be done in ASS by Power supply contractor. IEC- 61850 ring shall be made by Power supply contractor and all BCU, BCPU, Protection Relays and Gateway shall be inter-connected in IEC-61850 ring through Switches, LIUs and Fiber connectivity

E&M Contractor will provide Main LT panel and connect cable/ bus duct to transformer secondary.

4. SUMMARY

The work to be performed on the Corridors shall include but not limited to Supply, installation, testing and commissioning of:

- 25kV flexible AC Over Head Electrification System on Mainline and in Depot
- Switching Stations for sectioning and supply of traction power to Rolling stock with necessary Protection of the RSS, main line and depot;
- Duplicate 25 kV feeder from TSS to Feed FP's in Elevated and At-Grade Sections.
- Duplicate 33 kV Auxiliary Power Network and associated protection
- Interconnections of 33kV systems, 25kv system from RSS and the with the inter-corridor
- 220kv Receiving Sub-station and associated protection study,
- Traction sub-station, Auxiliary Main Substation and associated protection study.
- 220kv cabling from GSS to RSS
- 33kV/415-Volt Auxiliary Substation and associated protection study.
- Power Supply with Existing Lines / New lines / Interlinking of 25 kV and 33kV system.
- Control & Monitoring for traction and auxiliary power supply, and necessary interface with OCC (Operation Control Centre) and BCC (Backup Control Centre).
- Provision of track bonding and earthing system including BEC, OPC, Buried Rail, ITL etc.
- Provision of all the construction drawings, documents and as-built drawings required to supply, install, test and commission the above installations.
- Supply of spare parts, tools and equipment for Traction Electrification, Power Supply, C&M Systems.
- Deal and resolve in co-ordination with the employer/Employer's Engineer the Interface with other Contractors to ensure timely completion of the Works;
- Ensure Technology Transfer and Training to Employer's staff.
- Design Verification and construction design of all the design documents, drawings, reports for the tendered works.

Note the entire installations shall:

- be realized to withstand the atmospheric pollution and ambient conditions furnished in General specifications relevant to the location where installed;
- meet the protective provisions relating to electrical safety;
- meet design requirements of fire safety in accordance with NFPA-130 Standard for Fixed Guide-Way Transit System, 1997 edition, except where amended by this PS.
- Meet the design requirements of Electromagnetic Compatibility in accordance the EN standard 50121-1 to 5 and EN 61000 series.

5. Miscellaneous

5.1 Interface

The purpose of the Interface Specifications is to provide Project Contractors involved in the interface with a clear overview of the purpose and functionality of each interface. It provides a framework such that Project Contractors can set to work in a co-operative way to produce the interfacing standard.

Details of the interfaces of Power supply system and OHE Contractor with the other contractors are in the Interface Specifications.

5.2 Documents and Manuals

List of deliverables

The Contractor shall supply to the Employer/engineer a list of deliverables for the procurement, design verification, construction design, manufacture, Inspection, testing, installation, training, maintenance and operation of the Works for approval.

The contractor shall be required to submit the list of deliverables as intended by employer/engineer for notice of no objection within the 30 days from the commencement date.

5.3 Maintenance and Training

This section describes the maintenance philosophy and training of maintenance staff (offshore. & on shore) for power supply, OHE, SCADA, protection relays and control & monitoring installations taking into account international standards and Regional Rail/Railway practices.

For the equipment of different stages, the contractor shall be responsible for the maintenance of the equipment supplied under the contract till the Employer's Taking Over of the whole works related to that stage.

The contractor shall be responsible for the supervision of maintenance of the equipment supplied under the contract during DLP period.

The Contractor shall provide supervisory maintenance staffs who are expert in all the different levels of fault finding, maintenance and repair of the various systems supplied under the Contract covering at least the following:

- a) Cabling system (220kV AC, 33 kV AC, 25 kV AC,)
- b) Receiving substation (220 kV/33 kV)
- c) Traction substation (220 kV/25 kV) including associated switchgear.
- d) 25kV Switching Station
- e) Auxiliary main substation
- f) 25 kV OHE (Flexible & Retractable)
- g) Auxiliary Substation (33 kV/415 V)
- h) SCADA

The contractor shall provide training that enable all the installations, to be operated and maintained in the most efficient and safe manner, so as to achieve the maximum reliability and economy required by such rail System.

5.4 Earthquake Warning system, Wind Speed Sensor & Viaduct Lighting

Earthquake warning system shall be provided at two RSS. (if required)

Wind speed sensor shall be provided at two stations. It shall be integrated with SCADA. Display shall

be provided in OCC, BCC & SCR with two stage alarm. (if required)

Viaduct Light shall be provided on the viaduct.

5.5 Defect Liability Period

Defect Liability Period shall be 2 years & commence from the date of ROD. Contractor shall investigate equipment failure cause & submit report to BI-RIDE. Contractor shall replace/repair the failed equipment without any cost implication to BI-RIDE.

The contractor shall be responsible for the supervision of maintenance of the equipment supplied under contract during DLP. During the Defects Liability Period the Contractor shall provide, free of cost, competent and skilled personnel and maintain adequate stock of spares so as to promptly fulfil his obligations during the Defects Liability period.

Maintenance during Defects Liability Period

Contractor shall establish an office in Bangalore at suitable location for the purpose with communication facility so as to facilitate communication for reporting failures and liaison with maintenance staff manning the stations round the clock. The supervisor in charge should be provided with mobile communication facility to ensure his presence at the site immediately after reporting. Contractor shall ensure restoration/rectification/replacement, within reasonable time, to the satisfaction of Engineer. The engineer in case of the delay as deems fit shall be empowered to carry out the maintenance at the risk and cost of the contractor.

Routine Maintenance

Submit Monthly status report to the Engineer/ Employer

Repairs

All equipment that requires repairing shall be immediately serviced and repaired.

Complaints

The Contractor shall receive calls for any and all problems experienced in the operation of the systems, attend to these within 120 minutes of receiving the complaints and shall take step to immediately correct any deficiencies that may exist.

Maintenance Logbook

The contractor shall maintain the maintenance logbook at each station, the format for which shall be approved by Engineer. In the Maintenance logbook the details about date of routine maintenance, routine maintenance activities performed, details of Call -Out visit/break-down maintenance etc. shall be maintained. Copy of relevant pages of the logbook to be submitted to the Engineer with the monthly status report.

Failure Analysis Report

The contractor shall submit a report for the failure analysis in the format approved by Engineer giving the details of the type of fault, cause of fault, analysis of faulty component etc. correlated with the details of last preventive maintenance.