

**Annexure 1.5:**  
**General Technical Requirements**  
**Electrical**

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## 1 GENERAL

### 1.1 Purpose of the Document

- 1.1.1 The purpose of this document is to provide the General Technical Requirements ("GTR") which form part of the minimum Requirements of the Passenger Rail Agency of South Africa ("PRASA") for the Electrical related Works that form part of the planning, design, supply, construction, installation, testing, commissioning and maintenance of a new fully integrated, functional, complete and future-proofed PRASA Train Control System ("PTCS") in PRASA's KwaZulu-Natal ("KZN") service region ("the Project") that the Bidder shall meet and deliver at the Bidder's cost therefore within the Bid Price.

### 1.2 Executive Overview

- 1.2.1 Notwithstanding any other PRASA Requirements stated throughout the RFP, the Bidder shall uncompromisingly deliver the whole of the Works required to achieve successful delivery of the Project.
- 1.2.2 The Electrical Component of the Works is, at a minimum, summarised as follows:
- a) Do the modification of the traction power Supply System as part of the project changes to infrastructure to improve the PRASA train service.
  - b) Improvement and adaption of the electrification and traction power Supply Systems to be changed in respect to the planned changes on the Signalling System. This includes the corresponding changes on infrastructure caused by Resignalling, like the Track work and the overhead traction System.
  - c) A complete and functional System regardless to the facts that some or all the necessary details for the System components may not have been included in the document.
  - d) Any other Electrical Works, activities and resources required to achieve a fully integrated, functional, complete and future-proofed PTCS and meet any other requirements and specifications as requested throughout the RFP or as otherwise instructed in writing by PRASA.

## 2 MINIMUM SYSTEM REQUIREMENTS

### 2.1 General

2.1.1 The Bidder shall perform the following Design task, as a minimum, prior to the Installation and modernisation of the sub-Systems:

- a) Perform the required load flow analysis for maximum load under various scenarios to determine Equipment size and define the power Supply requirements from the power Supply company.
- b) Perform short circuit calculation to determine maximum and minimum short circuit current for the purpose of demonstrating Equipment capability to withstand the available MVA duty and determine proper setting of the protection devices.
- c) Perform voltage drop calculations.
- d) Prepare composite diagrams showing the characteristic curves of the protection Equipment to demonstrate the upstream co-ordination of these devices and prepare a selectivity study report for approval.
- e) Perform the required detailed Design for Construction and modernisation of the overhead line Equipment modernisation and renewal projects.
- f) Perform the required earthing and bonding analysis and stray current protection Design.
- g) Perform the Fire and Emergency Protection Design for the Plant.
- h) Perform the detailed Design for necessary power Supply changes, required by third parties, like the Signalling department.
- i) Perform the detailed Design for the required power Supply changes, including optimising switching for Maintenance purposes.
- j) Perform the required interface coordination with other departments and Third Parties involved in this project.

2.1.2 All Plant and Equipment supplied as part of the Specification shall comply with the existing Railway and PRASA requirements. These requirements shall be taken to be generally applicable in accordance with good practice, and they shall not relieve the Bidder from ensuring that all Plant and Equipment incorporated in the Works are suitable for their intended purposes and environments.

2.1.3 The Bidder is responsible for any changes on existing Equipment and shall therefore perform any necessary work to re-establish the proper and safe function of the Equipment (like re-regulation of OHTE in the corresponding sections).

## **2.2 Design**

- 2.2.1 Several conceptual Design studies for the modernisation and renewal of the traction power, power Supply and electrification Works have been carried out. These have been carried out under specific feeding arrangements including those that would be used under specified outage conditions. The conceptual Design studies shall be used to produce a detailed Design that forms the basis of the Bidders work.
- 2.2.2 The Bidder shall develop the detailed Design that meets the requirements, at minimum cost.
- 2.2.3 The detailed Design proposed by the Bidder shall recognise the requirements of the Local Safety Rules and shall be constructed in such a manner that Plant and Equipment can be operated and maintained safely. As far as is possible, this shall be achieved without the need for site specific operating procedures to be written. If they are required, however, they shall be written by the Bidder and approved by PRASA.
- 2.2.4 Where an interface exists with a Third Party, the Bidder shall coordinate the Design and Works to ensure a fully functional System in accordance with PRASA requirements and good industry practice.

## **2.3 Specific Tests**

- 2.3.1 In addition to the routine Tests and any type Tests forming part of the Factory Acceptance Tests ("FAT"), special Tests may be required in the manufacturers' Works to demonstrate the suitability of the Equipment in a railway-operating environment.
- 2.3.2 The Bidder shall, as part of the Bid, propose all special Tests considered necessary.

## **2.4 Applicable Rules and Regulations**

- 2.4.1 All International Standards ("IEC"), European Standards ("EN") and CENELEC Harmonisation Documents ("HD") relevant to the Equipment of the types to be supplied under this contract shall apply, whether they yet exist as Local South Africa Standards.
- 2.4.2 Local Distribution Safety Rules, Railway Design Standards and PRASA Standards shall also be applied to the Design.

## **2.5 Reliability**

- 2.5.1 The reliability of the power Supply Systems shall be as near to 100% as is reasonably practicable and they shall have a minimum Design life of 30 years. In addition, auxiliary Supply, protection and control Systems shall be Designed to maintain supplies to the CTRL on the loss of any one element, i.e. there shall be no single point of failure which results in an interruption in power Supply.

2.5.2 The MTBF for the following items of Plant shall exceed the values listed:

- a) Circuit breaker – 1 x 105 hours
- b) Motorised switch – 5 x 104 hours
- c) Motorised disconnect – 5 x 104 hours
- d) Protection relay – 1 x 105 hours
- e) Workstation or Programmable Logic Controller (PLC) – 1 x 104 hours
- f) HV power cable – 1 x 105 hours

2.5.3 The MTBF for major Equipment shall exceed at least 20 years for minor faults and 40 years for major faults. For these purposes, a minor fault is defined as a fault causing loss of output capability for less than 24 hours, a major fault being one which causes a loss for 24 hours or more.

## **2.6 Power System Data**

2.6.1 The Bidder shall provide Equipment rated for the operating conditions.

## **2.7 Earthing and Bonding and Stray Current Protection**

2.7.1 Earthing is to be carried out to the requirements of the relevant earthing standards applicable in South Africa for the railway Construction and operation. The principles of earthing, bonding and corrosion protection established shall be no less onerous than the relevant requirements of the current applicable standards (see section Standards).

## **2.8 Interfaces**

2.8.1 The Bidder shall be fully responsible for the interface co-ordination. It shall be his responsibility to ensure that all interfaces, which might arise with the existing Metro System, are properly co-ordinated and are fully understood by the various Construction groups employed under the Contract.

2.8.2 The Bidder shall also ensure that during Installations no conflicts shall take place with connections from other Sections of the Contract

2.8.3 The Signalling interfaces and the Civil interfaces at the Track, covers the Track bonding, S-bonds and the connections thereto for the traction and current return. The Signalling and power Supply shall agree the bonding arrangements throughout the extensions.

2.8.4 At switch and crossing areas, jumpering connections and at expansion joints, bonding arrangements for the continuity of the power and Signalling shall be also jointly agreed.

2.8.5 The Bidder shall not modify the bonds or equivalent devices on the operating segments of the Metro without prior review and approval.

- 2.8.6 To equalise the traction current in both rails, connections to the rectifier substations for return current purpose, shall be installed not more than 30m from the centre of the S-Bonds or Terminal Bonds.
- 2.8.7 The Equipotential Bonds shall be placed not more than 10m from the centre of the S-Bonds or Terminal Bonds. The Bidder shall submit drawings showing the location of the connection to the rectifier substations (if applicable).
- 2.8.8 Interfaces shall exist between the Plant provided under this section of the Works and the Plant provided under the other Sections of the Works and where the plants are dependent or interactive for satisfactory operation.
- 2.8.9 The Bidder shall perform all Design duties and provide the Materials, Equipment and Installation necessary for the satisfactory operation, at the interfaces between these sections of the Works, other sections.
- 2.8.10 The Bidder shall be responsible for Testing and Commissioning of all of Equipment provided under this contract including the necessary interfaces with the operating segment where applicable.
- 2.8.11 In certain cases, PRASA may instruct the Bidder to discuss and agree upon the interfaces between various disciplines, in which case the Bidder shall inform PRASA in writing of all discussions, agreements and conclusions.

## **2.9 Inspection Testing, Packing, Storage, Handling and Safety**

- 2.9.1 In addition to the requirements stated throughout the RFP, the Bidder shall ensure that all instructions fully implemented and covered in the Contract Price. It shall be also the Bidder's responsibility to guarantee that there is no damage to the Equipment while received in storage and when delivered to site and the Equipment on-site is well protected against damage from physical and environmental conditions.

## **2.10 Service Experience and Conditions**

- 2.10.1 All items offered to this Specification shall have proven performance, and evidence shall be provided to show satisfactory operation of similar Equipment whilst in commercial service in a similar environment for at least 2 years at the date of submitting the Bid.

## **2.11 General Explanations and Guarantee**

- 2.11.1 Approvals granted by PRASA shall not relieve the Bidder of any of his responsibilities under the Contract.
- 2.11.2 The Bidder shall demonstrate that all Equipment offered for this Contract is state of art, in compliance with the most recent applicable standards and is of a proven reliable Design.

## 2.12 Bidder's Responsibility

- 2.12.1 The Bidder is responsible for the Design and layout of the Works to ensure reliability, safety in operation, freedom from undue stresses and with an adequate Safety Factor in-built with satisfactory performance in all other aspects in accordance with the Specification requirements.
- 2.12.2 The information given in the conceptual Design shows the preferred arrangement of the Works. The Bidder shall be responsible for the Design, detailed layout and arrangement to suit his proven standard Design taking due account of the preferred arrangements.
- 2.12.3 The obligations of the Bidder under the Contract include, inter alia, the Design, manufacture, Civil Works, delivery to site, erection, Testing, Commissioning and completion of the Works, the remedying of defects therein and the performance of all other obligations under the Contract. These shall be strictly in accordance with the standards of skill, care and diligence adhered to by an experienced and competent international Contractor specialising in work of the type and magnitude.
- 2.12.4 The Bidder shall be responsible for the true and proper setting-out of the Works and for the correctness of the position levels dimensions and alignment of all parts of the Works and for the provision of all necessary instruments, appliances and labour in connection therewith.
- 2.12.5 If at any time during the progress of the Works any error shall appear or arise in the position levels dimensions or alignment of any part of the Works the Bidder on being required so to do by PRASA shall at his own cost rectify such an error to the satisfaction of PRASA unless such error is based on incorrect data supplied in writing by PRASA in which case the cost of rectifying the same shall be borne by PRASA.
- 2.12.6 The checking of any setting-out or of any line or level by PRASA shall not in any way relieve the Bidder of his responsibility for the correctness thereof and the Bidder shall carefully protect and preserve all bench-marks sight rails pegs and other things used in setting out the Works.
- 2.12.7 The Bidder shall ensure that where necessary the lines and levels of parts of the Works are set out in such time to enable Works by others to be carried out.
- 2.12.8 The Bidder shall ensure that all surveying Equipment used for the Setting Out of the Works is properly maintained and that the performance of the Equipment complies with the manufacturer's specification for accuracy.
- 2.12.9 Key changes to the OHTE are required to support the general Track alignment changes in the Network. The OHTE shall be removed in areas where tracks are to be removed.

### 3 CONSTRUCTION

#### 3.1 General

- 3.1.1 Electrical Construction work shall comply with all relevant Standards, Specifications, Regulations and Procedures as specified throughout the RFP.
- 3.1.2 The Bidder shall submit method statements for all Electrical Construction work to be performed to PRASA for review and approval before commencement of the work.
- 3.1.3 All Construction work on or near the railway line shall be performed under Occupation-between-trains ("OBT") or Total Occupation conditions.
- 3.1.4 The Bidder to perform all the Construction work, except if expressly stated otherwise in the GTRs or PTRs.
- 3.1.5 The outdoor Installation shall cover all Electrical Works and enabling Civil, Telecommunications and other Works.

## 4 TESTING AND COMMISSIONING

### 4.1 General

- 4.1.1 All Testing and Commissioning activities to comply with all relevant Standards, Specifications, Regulations and Procedures as specified throughout the RFP.

### 4.2 Factory Acceptance Testing (“FAT”)

- 4.2.1 All relevant Electrical Systems, sub-Systems and Equipment shall undergo and pass FAT before shipping to site.
- 4.2.2 The Bidder shall be responsible for all FAT.
- 4.2.3 All FAT shall be conducted at factory(s) at which the Plant and Materials are manufactured and assembled and by an Electrical Engineer or technologist, registered with the Engineering Council of South Africa (“ECSA”) as a professional Engineer or professional technologist and who has undergone training for the specific System, sub-System or Equipment and have experience in FAT.
- 4.2.4 The person(s) responsible for the FAT shall not have been involved in any Design, Manufacturing or assembling activities relating to the System, sub-System or Equipment to be tested.
- 4.2.5 The Bidder shall submit a FAT Method Statement to PRASA for acceptance before any FAT commence. The Method Statement shall clearly indicate:
- a) All Systems, sub-Systems and Equipment that shall be included in the FAT and which shall be omitted.
  - b) Specification against which the FAT shall be conducted.
  - c) Method of conducting the FAT for each System, sub-System and Equipment.
  - d) Details, including experience reports, of people which shall be conducting the FAT.
- 4.2.6 The Bidder shall invite PRASA to all FAT taking place at least 40 working days prior to commencing of the FAT. Should PRASA not be able to attend, PRASA shall give the Bidder permission to continue or request the dates for the FAT to be changed. PRASA shall not be held liable for any delays caused by this unavailability.
- 4.2.7 The Bidder shall submit all duly signed FAT Test certificates and associated Test sheet to PRASA for information purposes, prior to Commissioning.
- 4.2.8 PRASA accepts no accountability nor liability for any FAT conducted, despite any checks done or inputs given by any of PRASA's agents.

### 4.3 Site Acceptance Testing (“SAT”)

- 4.3.1 All relevant Electrical Systems, sub-Systems and Equipment shall undergo and pass SAT before Commissioning.

- 4.3.2 The Bidder shall be responsible for SAT.
- 4.3.3 The SAT shall be conducted by an Engineer, registered with the Engineering Council of South Africa ("ECSA") as a professional Engineer or professional technologist and who has undergone training for the specific System, sub-System or Equipment and have experience in SAT.
- 4.3.4 The person(s) responsible for the SAT shall not have been involved in any Design, manufacturing, assembling, FAT or Installation activities relating to the System, sub-System or Equipment to be tested.
- 4.3.5 The Bidder shall submit a SAT Method Statement to PRASA for acceptance before any SAT commence. The Method Statement shall clearly indicate:
- a) All Systems, sub-Systems and Equipment shall be included in the SAT and which shall be omitted.
  - b) Specification against which the SAT shall be conducted.
  - c) Method of conducting the SAT for each System, sub-System and Equipment.
  - d) Details, including experience reports, of people which shall be conducting the SAT.
  - e) Where practical, all SAT shall be done under OBT conditions, prior to the final Testing and Commissioning Occupation.
- 4.3.6 The Bidder shall invite PRASA to all SAT taking place at least 40 working days prior to commencing of the SAT. Should PRASA not be able to attend, PRASA shall give the Bidder permission to continue or request the dates for the SAT to be changed. PRASA shall not be held liable for any delays caused by this unavailability.
- 4.3.7 The Bidder shall submit all duly signed SAT Test certificates and associated Test sheet to PRASA for information purposes, prior to Commissioning.
- 4.3.8 The PRASA accepts no accountability nor liability for any SAT conducted, despite any checks done or inputs given by any of PRASA's agents.

#### **4.4 Final Testing and Commissioning**

- 4.4.1 Final Testing and Commissioning shall be done by a PRASA approved Test and Commissioning Engineer provided by the Bidder.
- 4.4.2 Once the Bidder is convinced the Bidder shall be ready for Final Testing and Commissioning, he shall agree with PRASA on a suitable date for the activity, at least 90 working days prior to proposed date.
- 4.4.3 The Bidder shall submit a comprehensive Final Testing and Commissioning Method Statement to PRASA for approval before any Commissioning commence.
- 4.4.4 The Bidder shall be responsible to provide a complete Testing and Commissioning team as per the Method Statement, as well as all Tools and Equipment required for introducing, Testing and Commissioning of the System.

- 4.4.5 The members of the Bidder's Testing team shall have not been involved in any Design, manufacturing, assembling, FAT or SAT activities relating to the System, sub-System or Equipment for which that member is responsible during the final Testing and Commissioning.

## 5 DECOMMISSIONING, DISMANTLING AND REMOVAL

### 5.1 General

5.1.1 The Bidder shall, at a minimum, ensure that:

- a) The Decommissioning, dismantling and removal shall comply with all relevant Standards, Specifications, Regulations and Procedures as specified throughout the RFP.
- b) The Bidder shall be responsible for the Decommissioning, dismantling and removal of all Electrical Equipment.
- c) The Bidder shall remove all visible cables and all visible (above ground level) steel and/or concrete bases from any decommissioned OHTE structures
- d) All buried cables may be abandoned.
- e) The Bidder shall submit a Method Statement for the Decommissioning, dismantling and removal of all Equipment to the PRASA approval before commencing any work.
- f) The Bidder shall dispose of the Equipment according to the process described the RFP.
- g) The Bidder shall complete the Decommissioning and removal of visible cable within 14 calendar days after the Commissioning of any Section.
- h) The Bidder shall complete the Decommissioning, dismantling and removal of outdoor Equipment no later than 30 calendar days after the Commissioning of any Section.
- i) The dismantling and removal of indoor Equipment shall not run behind more than one phase after the Signalling work.

## 6 MAINTENANCE

### 6.1 Overview

- 6.1.1 The Bidder shall Design the Electrical System in such a manner to minimize Maintenance requirements and ensure overall maintainability.
- 6.1.2 The Electrical System shall continue to function properly if maintained according to the current Maintenance strategy.
- 6.1.3 The Bidder shall develop a new improved Maintenance strategy. The new Maintenance strategy shall require less Maintenance and less Maintenance personnel.
- 6.1.4 The Electrical System shall incorporate a remotely accessible fault logging and analysis ability, to allow a fast and appropriate response to any normal, or abnormal, situation.
- 6.1.5 It shall be possible to mend Electrical breakdowns in a very short time and with a minimum impact on operations.

### 6.2 First Level Maintenance

- 6.2.1 The Bidder shall perform First Level Maintenance for each Section that has been tested, commissioned and handed over to PRASA from the date of interim hand over to the Completion Date thereafter for 730 calendar days commencing on the Completion Date for the whole of the Works until PRASA issuance of the Performance Certificate thereafter PRASA shall take over Maintenance.
- 6.2.2 First Level Maintenance shall, at a minimum consist of:
  - a) A detailed Maintenance and lifecycle financial model.
  - b) Pre-defined preventative Maintenance.
  - c) Pre-defined corrective Maintenance based on visual inspection of faulty Equipment.
  - d) Modular replacement of faulty Equipment, without the need for any Software or hardware configuration.
  - e) Visual condition assessment.
- 6.2.3 First Level Maintenance shall not require any computer based diagnostic Tools.
- 6.2.4 It shall be possible to replace faulty Equipment without the need to stop the System or turn the power off.
- 6.2.5 The Bidder shall ensure that the transition of Maintenance responsibilities from the Bidder to PRASA (commencing 90 working days prior to the expiry of the Bidder's total Maintenance period) shall be effortless, that there shall be enough training of PRASA personnel. The Bidder shall further ensure that all documentation, policies, procedures and the like relating to the successful continuation of Maintenance, by PRASA, is transparently and effectively handed over to PRASA.

### 6.3 Second Level Maintenance

- 6.3.1 The Bidder shall perform Second Level Maintenance for each Section that has been tested, commissioned and handed over to PRASA from the date of interim hand over to the Completion Date thereafter for 730 calendar days commencing on the Completion Date for the whole of the Works until PRASA issuance of the Performance Certificate thereafter PRASA shall take over Maintenance.
- 6.3.2 Second Level Maintenance shall, at a minimum, consist of:
- a) A detailed Maintenance and lifecycle financial model.
  - b) Pre-defined corrective Maintenance based on System diagnostics.
  - c) Modular replacement, with the need for basic Software or hardware configuration.
  - d) Condition assessment by means of diagnostic Tools and Equipment.
- 6.3.3 The Bidder shall ensure that the transition of Maintenance responsibilities from the Bidder to PRASA (commencing 90 working days prior to the expiry of the Bidder's total Maintenance period) shall be effortless, that there shall be enough training of PRASA personnel. The Bidder shall further ensure that all documentation, policies, procedures and the like relating to the successful continuation of Maintenance, by PRASA, is transparently and effectively handed over to PRASA.

### 6.4 Third Level Maintenance

- 6.4.1 The Bidder (with assistance from PRASA) and the Original Equipment Manufacturer ("OEM") (under management of the Bidder and for whom the Bidder shall ensure availability and compliance), shall perform Third Level Maintenance for each Section that has been tested, commissioned and handed over to PRASA from the date of interim hand over to the Completion Date thereafter for 730 calendar days commencing on the Completion Date for the whole of the Works until PRASA issuance of the Performance Certificate thereafter PRASA shall take over Maintenance.
- 6.4.2 Third Level Maintenance shall, at a minimum, consist of:
- a) A detailed Maintenance and lifecycle financial model.
  - b) Undefined and irregular corrective Maintenance based on advanced System diagnostics.
  - c) Modular replacement, with the need for advanced Software or hardware configuration.
  - d) System configuration changes to accommodate infrastructure upgrades and layout changes.
- 6.4.3 The Bidder shall do local Supplier Development, training and certifying local Suppliers to perform third level Maintenance on the System further ensuring comprehensive inclusion of the OEM throughout the process.

- 6.4.4 The Bidder shall train and develop a minimum of 2 local suppliers further ensuring comprehensive inclusion of the OEM throughout the process.
- 6.4.5 The Bidder (with direct support from the OEM) shall ensure that the transition of Maintenance responsibilities from the Bidder and the OEM to PRASA (commencing 90 working days prior to the expiry of the Bidder's total Maintenance period) shall be effortless, that there shall be sufficient training of PRASA personnel. The Bidder shall further ensure that all documentation, policies, procedures and the like relating to the successful continuation of Maintenance, by PRASA, is transparently and effectively handed over to PRASA.

## **6.5 Fourth Level Maintenance**

- 6.5.1 The Bidder and the OEM (under management of the Bidder and for whom the Bidder shall ensure availability and compliance), shall perform Fourth Level Maintenance for each Section that has been tested, commissioned and handed over to PRASA from the date of interim hand over to the Completion Date thereafter for 730 calendar days commencing on the Completion Date for the whole of the Works until PRASA issuance of the Performance Certificate thereafter the OEM shall take over Maintenance (under supervision from PRASA).
- 6.5.2 Fourth Level Maintenance shall, at a minimum, consist of:
- a) System upgrades
  - b) Changes to the System's core Software
  - c) Component level corrective Maintenance
- 6.5.3 The Bidder shall ensure that the OEM contractually commits to having representation, and providing all necessary Maintenance and/or support, in South Africa for a minimum period of at 240 calendar months post the Bidder's Maintenance, Warranty and Defects Liability period.

## 7 WARRANTIES

### 7.1 General

- 7.1.1 The Bidder shall, take interim Warranty responsibility and liability for each Section of that has been tested, commissioned and handed over to PRASA from the date of interim hand over to the Completion Date.
- 7.1.2 The Bidder's full Warranty responsibility and liability period shall be 730 calendar days commencing on the Completion Date for the whole of the Works until PRASA issuance of the Performance Certificate.
- a) Warranties shall, for all Electrical related Works, at a minimum, be valid and cover:
    - Replacement of all faulty Plant and Materials, Components and labour for all Maintenance Levels described elsewhere in this document
    - Tracking and tracing and correcting of any Software faults
  - b) Failures caused by the environmental and infrastructure conditions as specified throughout the RFP including, but not limited to:
    - Any Plant and Materials or Components damaged due to exposure to extreme direct sunlight and elevated temperatures
    - Any Plant and Materials or Components damaged due to continues exposure to high humidity
    - Any Plant and Materials or Components failure due to corrosion