

Annexure 1.6:

General Technical Requirements

Civil Structures and Track Work

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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 Civil Structures and Track 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 Civils and Track Component of the Works is, at a minimum, summarised as follows:
- a) Earthworks and drainage.
 - b) Permanent Way ("Perway") associated with the Signalling Works.
 - c) Perway associated with elimination of temporary and permanent speed restrictions as defined in the RFP.
 - d) Electrification associated with the Signalling Works.
 - e) Temporary changes to existing Signalling for interim work.
 - f) Railway platforms.
 - g) Civil Engineering structures and drainage.
 - h) Provide Perway changes and upgrades in line with the resignalling requirements or as specifically specified throughout the RFP.
 - i) Provide Equipment Rooms required for the Installation of the Railway Signalling System ("RSS") with Train Control System ("ETCS Level 2").
 - j) Upgrade Level Crossings ("LX") according to the specified standards.
 - k) Provide drainage solutions to address wash-aways and flooding of trackside Equipment.
 - l) Provide platform alterations as specified throughout the RFP.
 - m) Provide new fully functional platforms.
 - n) Provide access roads to Equipment Rooms.
 - o) Provide all required resources to deliver and maintain the Civil Structures and Track Works.

- p) Any other Civil Structures and Track 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 approach to the Design process shall include at least the following steps (where applicable) for each Section of the Works:

- a) Outline the scope of the alterations to the rail infrastructure required.
- b) Determine the parameters and condition of the existing infrastructure that shall be affected by or shall influence the alterations.
- c) Determine whether the requirements can be met as outlined in the scope for the specific workplace including site investigations.
- d) A detail topographical survey shall be done where required by the complications of the alterations.
- e) Submit to PRASA alternative option/s, with motivation/s, where the required infrastructure changes cannot be accommodated as envisaged in the scope.
- f) Obtain approval from PRASA to proceed with the Design alterations.
- g) Design the alterations required to change the existing infrastructure to the required new infrastructure.
- h) Submit Design report and layout drawings for each work package for review and approval.
- i) Issue approved Design report and drawings for Construction.
- j) The details and investigations at each workplace differ considerably. In this regard, site specific Method Statements shall be required address the execution of the Construction activities.
- k) Use as much existing designs, Plant and Material (supplied by a previous Bidder) as possible and if not possible then motivate why not in a robust but controllable manner.

2.1.2 The typical Design considerations and output is provided below and shall be subject to final approval by PRASA. Designers shall discuss and agree and formalise the Design and Design review processes, outputs and timelines at the start of the Project.

1. THE DESIGN REPORT		
	(i)	Collection of data and correlation
	(ii)	The report to be provided for each station/location or separately defined scope
	(iii)	Existing assets conditions and information
	(iv)	Define the exact scope of the package and support with Diagrammatic Layout where necessary.
	(v)	Details on any technical/ Construction non-compliances.
	(vi)	Construction methodology, delivery program and bills of quantities to be detailed separately in the method statement
2. INVESTIGATIONS		
		Provide enough information for the Design report and Construction methodology.

2.1	TOPOGRAPHICAL INFORMATION
2.1.1	Enough information for the layout Design (km distances, PI's, curves, structures, etc.) and to inform the Construction activities.
2.1.2	Vertical Alignment: Enough information for the vertical Design and to show Gradients, VC's
2.1.2	Site Detail: Enough information to do the layout Design (km distances, PI's, curves, structures, etc.) to inform the Construction activities
2.2	GEOTECHNICAL INFORMATION
2.2.1	Strength of existing formation for each formation layer (SB, A, B layers and bulk fill etc.)
2.2.2	Properties of in-situ Material for layers where strength is too low
2.2.3	Tests to improve strength where applicable (compaction; stabilizing; mixing, etc.)
2.2.4	Indication for necessity to lower water table, etc.
2.2.5	Source and quality of additional Material required
2.2.6	Dumping site for surplus Material to be removed: haulage conditions, permits etc.
2.2.7	Stockpile areas - haulage conditions, permits etc.
2.3	DRAINAGE
2.3.1	Existing drainage (longitudinal drains, cross drains, type, condition, etc.)
2.3.2	Drainage improvement solutions where applicable both in and out of scope
2.4	RAIL STRUCTURE TO BE UPLIFTED OR REABILITATED
2.4.1	Ballast
	Base Material (quartzite, dolerite, dolomite, granite, etc.), condition (roundness, grading, contamination); Profile - width, height, m ³ /km
2.4.2	Sleepers
	Type and condition of sleepers and fastenings, spacing, etc.
	What can be re-used - what is needed to make them suitable to re-use (pads, spacers, clips, springs (Fist pins are mostly rusted))
2.4.3	Rails
	Type, condition, Tests done to check reusability etc, junction between new and existing
2.4.4	Turnouts
	Type (1:9; 1:12 - RH, LH) - Dimensions (length, SRJ, PI, ES) of rail. Type of sleepers and condition
2.4.2	Sleepers
	Type and condition of sleepers and fastenings, spacing, etc.

3.	DESIGNS
3.	DESIGNS
3.1	EARTHWORKS
3.1.1	Layer Works
	For EACH of the layers: conformation to and Design requirements for remedial work
3.1.2	Sub-ballast
	Conformation to Design requirements and remedial work required.
3.2	OTHER
	Concrete work that shall be required for culvert extensions, structures, etc. Side drains - earth, concrete, precast, subsoil, upgrades required in and out of scope etc. Any other work required - fencing, boundary walls, removal of rubbish, etc.
3.3	TRACK WORK
	All Track Components: condition, upliftment, stacking and re-claiming: ballast condition, screening requirements: sleeper and fastening condition, reusability: Occupation requirements
4.	DRAWINGS
	<p>a) here it is required to make changes to existing drawings due to changes in Design, the Bidder shall be responsible for amending the drawings and all changes shall be submitted for approval.</p> <p>b) Upon request, the Bidder shall be supplied with existing as-built drawings where applicable and where available</p> <p>c) The Bidder shall be responsible for the preparation, checking and certification of all drawings. The Bidder must provide a title block showing "drawn by", "checked by" and "certified by".</p> <p>d) The Bidder shall submit all designs and amendments to PRASA for approval.</p> <p>e) No Installation shall be allowed before the PRASA approves drawings.</p> <p>f) All new drawings are to be drawn on CAD. Software must be supplied for all drawings. Autocad CAD software shall be used to produce drawings. Soft copies, in Autocad format, to be included for all drawings prepared and submitted by the Contractor.</p> <p>g) All drawings, Maintenance manuals and Spare parts catalogues shall form an integral part of the Equipment which shall therefore not be considered complete until all the above have been received.</p>
4.	METHOD STATEMENTS
	The detail program and methodology shall be supplied separately after approval of the Design Report. The following shall be addressed in the methodology A: - Construction program, B:-Civil Works and earthworks methodology, C:-Temporary Signalling methodology; D:- Occupations plan; E:-Testing and Commissioning , Decommissioning plan F: - Demolition, G:- Handover period plans

2.2 Railway Alignment Design

2.2.1 Design Parameters:

- a) Track alignment shall be designed in accordance with the PRASA Manual for Track Maintenance 2000.
- b) Gauge:
 - The gauge of the Track is 1065 mm. Gauge widening on 120m Curve: 20mm
 - The clearance profile is determined by the rolling stock requirements
- c) Design speed:
 - The Design speed for the existing suburban lines is maximum of 90 km/h. Where practicable, allowance should be made for raising the Design speeds to up to 120km/h. This requirement shall be finalised at preliminary Design stage for every location

- The intention is to improve the speed for each area under Design with as little horizontal realignment as possible. Alignment improvements should therefore, as far as possible minimise the effects on existing OHTE mast positions, platforms, tunnels, bridges and other similar fixed infrastructure
- Proposed speed improvements shall naturally require adjustments to Design parameters. The review shall be done between the Bidder and before the start of designs process

2.2.2 Horizontal Alignment:

a) Curves and transition curves:

- In general, the horizontal alignment consists of tangents, curves and transition curves
- The parameters for the horizontal alignment of the suburban lines are:
 - All curves shall be designed with transition curves at both ends
 - Curves with a radius of 300m or more shall have a transition of 80m
 - Curves with radii between 160m and 300m shall have transitions at both ends of at least 60m
 - Curves with radii less than 160m shall have transitions of at least 40m
 - Yard Track shall have transitions of at least 20m
- The following transition curve lengths shall be applied:

Table 2.2.1

Curve radius	Transition length	Speed
>300 m	80 m	70 km/h minimum
160m – 300 m	60 m	50 – 70 km/h
<160 m	40 m	40 km/h
Yard lines	20 m	8 km/h

Table 3.2.1: Length of transition curves

- The minimum radius for new or redesigned curves shall be 300m unless otherwise approved by PRASA
- The curves shall not have a radius sharper than 150m without check rails and 100 m with check rails

b) Super-elevation (cant):

- The super-elevation (cant) in curves shall be applied per existing Design standards. Consideration shall be made for section speed, location, traffic type and volume mix in determining the optimum applied cant

- Notes:

- Super-elevation (cant) in yards shall not exceed 10mm
- A straight Track of at least 6m shall be allowed for between the transition ends of two adjoining horizontal curves, whether in reverse or in the same direction
- A straight Track of at least 6m shall be allowed for between any two turnouts
- All turnouts shall be placed in tangent Track section

2.2.3 Vertical alignment:

a) Grades:

- The type of rolling stock determines the maximum gradient
- The gradients shall be applied as follows:
 - Steepest gradient for running lines = 1:66 (compensated)
 - Steepest gradient in platforms = 1:400
 - Steepest gradient in staging yards = 1:800
 - For safety reasons in stations the gradient must be designed without inclination
 - Grade compensation shall be allowed for when a curve is on a gradient

b) Vertical curves:

- The change in gradients is accommodated by vertical curves.
- The gradients shall be applied as follows:
 - Rate of change of vertical curvature in running lines:
 - 40mm/20m/20m (K value = 100)
 - Rate of change of vertical curvature in staging lines:
 - 24mm/20m/20m (K value = 16.67)
 - Formula for K: $K = L/(g_1 - g_2)$ (where g_1 and g_2 are the gradients adjoining the vertical curve and L is the horizontal length of the vertical curve)
- The general standards that shall be applicable where possible shall be as follows:
 - Running lines: Ruling grade of the existing line
 - Halts and stations where trains shall not turn around or be staged: Ruling grade of the running line

- The complete turnout plus 6m on either side of it shall be on the same plane. Turnouts shall always be on a straight vertical alignment including the 6m before the SRJ of the turnout and preferably also 6m after the ES. No section of a turnout shall be on a vertical curve.

2.3 Trackwork

2.3.1 Track:

- | | |
|----------------------------------|----------------------------------|
| a) Design speed: | 120 km/h |
| b) Maximum axle load: | 20 tons |
| c) Gauge of Track: | 1065mm |
| d) Rail: | 48/60kg/m |
| e) Rail inclination on Track: | 1:20 |
| f) Rail inclination on turnouts: | 1: ∞ |
| g) Sleepers: | Pre-stressed concrete mono-block |
| h) Sleeper spacing: | 500/600/650/700mm |
| i) Ballast: | 1200/1500m ³ /km |
| j) Ballast thickness: | 300mm |
| k) Ballast shoulder width: | 400 mm |
| l) Slope of ballast shoulder: | 1:1.5 |
| m) Ballast size: | maximum of 63 mm |
| n) Rail fastening System: | Elastic rail fastenings |
| o) Track: | Continuous welded rails |
| p) Welding procedure: | Flash-butt and thermite welding |
| q) Inclination of platform: | 1:20 |

2.3.2 Turnouts:

- a) Tangential turnouts are preferred both on main line and yard lines. Secant turnouts shall only be considered if motivated by:
- Geometry limitations
 - Signalling limitations
 - Use of free-issued Material
 - Other considerations
- b) Designs:
- Provision shall be made for at least 1:12 tangential turnouts on concrete sleepers on main lines where geometry restrictions allow

- Existing secant turnouts on wood sleepers be replaced with tangential turnouts on concrete sleepers where geometrically possible
 - Where secant turnouts on concrete exist and are in “A” standard, these shall not be replaced but Signalling designs shall make provision for future replacement with tangential turnout sets
- c) Sleepers for turnouts shall be pre-stressed concrete mono-block sleepers.
- d) All existing turnouts, slips, double slips, diamonds on mainline Track that are on wood sleepers shall be replaced with sets on concrete sleepers.
- e) No second-hand sleepers shall be used on new turnouts
- f) Turnouts must be placed in a straight section of rail line with at least 6m of straight Track on both sides of the turnout. The 6m of straight Track can be reduced or eliminated where there is a transition curve between the turnout and the curve.

2.4 Proposed Perway Materials

2.4.1 Rails:

- a) In view of the line characteristics and load, Rails of the types 48/60kg/m are recommended.

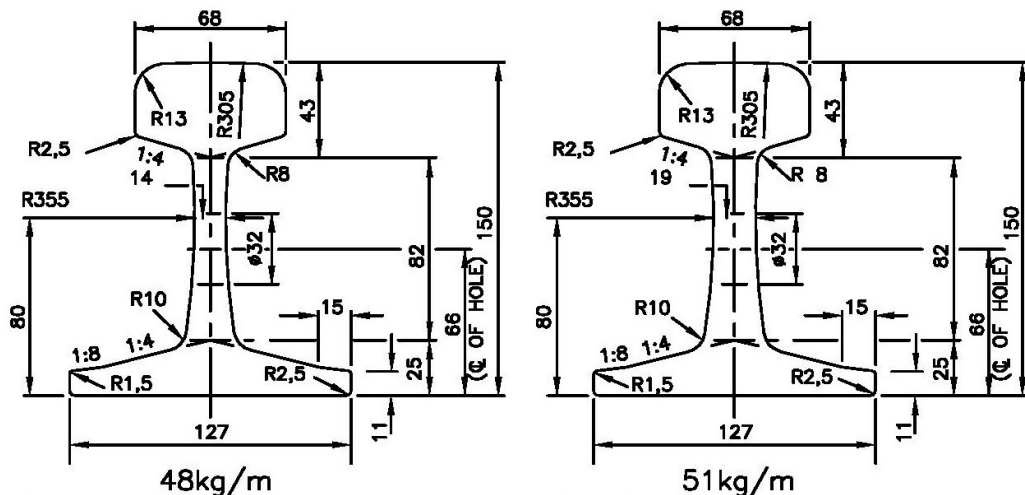


Figure 2.4.1: Cross sections of the rails 48 kg/m and 51 kg/m

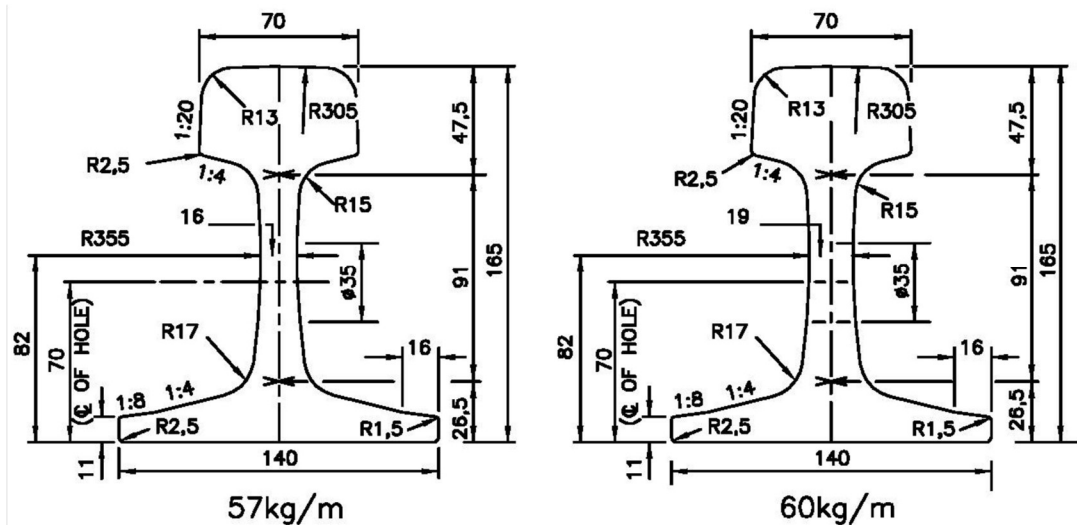


Figure 2.4.2: Cross sections of the rails 57 kg/m and 60 kg/m

- b) Rails between turnouts must be of equivalent size to eliminate unnecessary junction rails and/or junction welds.
- c) Rails to be used in rail lines that are used by freight trains as well as suburban trains must be either 57kg/m or 60kg/m.
- d) Rails in rail lines only being used by suburban trains can be 48 kg/m unless heavier rails are required by PRASA.
- e) Junction welds shall be used between 60 kg/m and 57 kg/m rails and between 57kg/m and 48kg/m rails. Junction rails shall only be used between 60kg/m and 48kg/m rails where 57kg/m transition rails cannot be used.
- f) Rails identified for removal shall be considered for re-use by the Bidder where applicable.
- g) Re-usable rails shall be free from any visible defects, excessive rail wear and be matched according to profile. Rails selected for re-use shall be ultrasonically tested by the Bidder for internal defects prior to Installation in Track.

2.4.2 Glued block joint:

- a) Where required, prefabricated glued insulated joints with six-bolt assembly are recommended. The Electrical resistance should be more than 1MΩ.

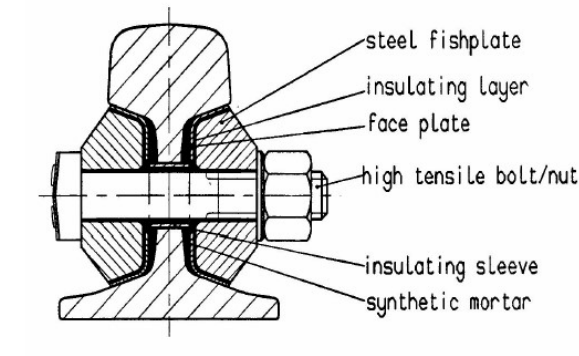


Figure 2.4.3 Cross-section of a glued insulated joint

2.4.3 Sleepers:

- a) With a view to the price and the service life of wood sleepers and the high unit price of steel sleepers the Installation of pre-stressed mono-bloc-concrete sleepers is recommended.

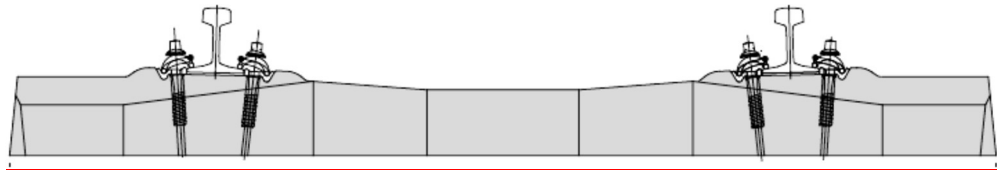


Figure 2.4.4 Prestressed mono-bloc-concrete sleeper

- b) New concrete sleepers must be either Fist (F4) or Pandrol (P2) to match the existing sleepers in a rail line section where alterations to the rail infrastructure shall be installed.
- c) New FY or PY concrete sleepers to match existing F4 and P2 sleepers must be supplied for at least 5 sleepers beyond the new or refurbished turnout sleepers.

2.4.4 Rail fastening System:

- a) Modern tracks with Continuous Welded Rail (CWR) require an elastic fastening System. Approved vandal-proof fastenings are to be provided as standard for all installations.

2.4.5 Track structure:

- a) The following Track structure shall apply for the suburban lines:

Curve Radius	Sleeper Type	Sleeper Spacing	Rail Profile	Ballast Profile
>600m	P2 or F4	700mm	48/57/60kg/m	1200m ³ /km
400m – 600m	P2 or F4	700mm	48/57/60kg/m	1500m ³ /km
300m – 400m	PY or FY	650mm	48kg/m	1500m ³ /km
200m – 300m	PY or FY	600mm	48kg/m	1500m ³ /km
<200m	PY or FY	500mm	48kg/m	1500m ³ /km

Table 5.5.1: Track structure at suburban lines

2.5 Perway Construction

2.5.1 Continuous Welded Rail and Rail Welding:

- a) The de-stressing temperature ranges when laying CWR in KZN are:

Region	Radius >400m	Radius 200-400m	Radius <200m*
Kwa-Zulu Natal	20 – 50	30 - 45	t.b.a.

Table 6.1.1: De-stressing temperatures

- b) Special de-stressing temperature ranges must be obtained from PRASA when heavier rails than 48 kg/m are used, and for curves sharper than 200m radius.

2.5.2 Ballast and Ballast Bed:

- a) Ballast shall be hard stone (i.e. granite) extracted from non-friable un-weathered igneous rock. The ballast shall conform to SABS 1073. The grading shall be about 31.5mm/73mm to enable a proper and long-lasting mechanical tamping of the Track.
- b) The figure below shows typical cross section with a ballast depth below the sleeper at the lower rail of $\geq 30\text{cm}$ and a ballast width of 40cm at shoulder.

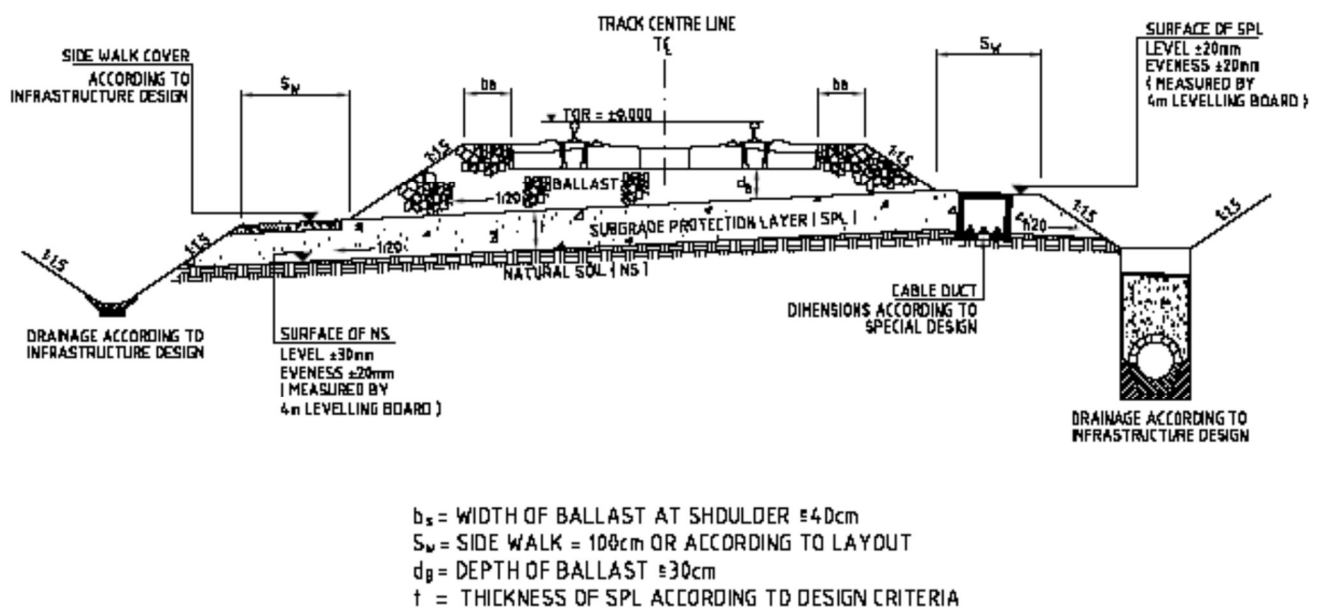


Figure 2.5.1: Typical Cross-Section

2.5.3 Earthworks:

- a) The formation shall only be rehabilitated where new rail structures (turnouts) shall be constructed and the existing formation does not conform to the required strengths of the earthworks layers below the ballast as per S410 standard requirements.

- b) Unsuitable Materials are to be removed and replaced with selected Materials from commercial sources and certified to be used according to the Engineering specifications.

2.5.4 Geotechnical Investigations:

- a) DCP Tests shall be done at each work area to determine the strength of the in-situ Material for the different layers.
- b) Test pits shall be done at work areas where the DCP Tests indicate that the strength of the sub-ballast layer is enough but there may be doubt whether the properties of the in-situ sub-ballast Material conforms. Test pits shall be done according to the designers' requirements.
- c) Soil profiling and core logging shall be done in accordance with the Guidelines for Soil and Rock Logging in Southern Africa, 1990".

2.5.5 Drainage Design:

- a) The overall purpose of drainage Design to prevent flooding of Track, Signalling of Equipment Rooms and all lineside Equipment. All new installations shall be protected from the risk of flooding.
- b) Design Reports shall indicate where existing drainage is insufficient to accommodate the required drainage at a work area and what actions or improvements shall be required from future projects to improve the drainage.
- c) However, are sites where drainage problems are specifically cited in the PTR for a specific area/location, the Bidder shall Design and build a complete drainage solution to prevent flooding of Track, Signalling of Equipment Rooms and all trackside Equipment. The Bidder's designers are therefore strongly advised to source as much background information / topographical and other detail on the sites in question ahead of submitting their offer. The newly designed drainage shall be linked into existing drainage Systems where possible.
- d) The typical cross section detail is shown in Figure 2.5.1: Typical Cross-Section. Earth side drains are typically used in cuttings where there is enough space to accommodate the drain. Concrete lined side drains shall typically be used where there is not enough space to accommodate earth drains or to extend existing concrete side drains. Sub-soil drainage shall be considered where the groundwater table shall be high and cannot be lowered with side drains. The Bidder is free to provide any other suitable solution for PRASA approval.
- e) The flood return period to be used in drainage designs shall be 25 years.

2.5.6 Level Crossings:

- a) The safety review of, the upgrading and Construction of permanent / temporary Construction level crossings shall be designed and protected in accordance with the requirements RSR and PRASA and any local authority for each case.

- b) Temporary level crossings shall be restricted to the absolute minimum required for the Construction of a specific workplace where alternative access is not available. Any such level crossing shall be removed upon completion of a work area.

2.6 Civil Works

2.6.1 Equipment Rooms:

- a) The Bidder shall Design and provide Equipment Rooms according the specific requirements of the RSS with ETCS Level 2 solution provided by the Bidder.
- b) The Equipment Rooms and Construction thereof shall comply with all relevant Standards, Specifications, Regulations and Procedures as specified throughout the RFP.
- c) The Equipment Room shall host at least all Signalling, ETCS Level 2, Telecommunications and Power Supply Systems ("PSS") Equipment as specified throughout the RFP.
- d) The Equipment Rooms shall, at a minimum, include:
- Safe parking for at least two (2) vehicles
- e) An air-conditioning System that shall ensure the correct temperature required by the RSS with ETCS Level 2 solution provided by the Supplier is maintained.
- f) The Bidder shall install a new earth mat at all Equipment Rooms to obtain an earth resistance value of one ohm or less.
- g) The Bidder shall install a complete security System to protect Equipment against theft and vandalism. The System shall at a minimum include:
- Outside CCTV System covering the complete fenced area around the Equipment Room, as per the requirements in the GTR Telecoms
 - Fence alarms
 - Door alarms
 - Indoor alarm System
 - Pepper spray
 - Audio bombs
- h) The Bidder shall provide emergency lighting inside the Equipment Room.
- i) The Bidder shall provide a suitable fire detection and suppression System inside the Equipment Room.
- j) The Bidder shall provide for a separate Generator Housing for Generators at critical stations.

2.6.2 Horizontal Clearance:

- a) The minimum horizontal clearance for new buildings and fences is 4m from the centre of Track.
- b) The horizontal distance from the edge of platforms to main buildings shall be 8 m.
- c) The horizontal distance from the edge of platforms to all other structures 3m

2.6.3 Platforms:

- a) The platforms shall be constructed to comply with “RSR/SABS Standards/ recommended practice for Railway Stations- Passenger Platforms for 1065mm gauge Track.”
- b) The minimum platform length for 14 coach sets on suburban lines is 275 m. Platforms shall comply to PRASA Norms Guidelines and Standards (NDS) for Facilities and Platforms.

2.6.4 Pedestrian Bridges:

- a) Pedestrian bridges shall be made of concrete. Bridge standards shall be as per the Bridge Code 1983.
- b) Horizontal clearances at new structures shall comply with section 12 of the Bridge code 1983.
- c) The minimum horizontal clearance for new bridges is 3m from the centre of Track.
- d) The vertical clearance at new structures shall comply with section 13 of the Bridge Code 1983 and The PRASA Manual for Track Maintenance 2000 Annexures.

2.7 Service Roads

2.7.1 Service roads are constructed to provide access to existing and new facilities, platforms and Equipment Rooms. They shall be designed and constructed to latest national SANRAL standards for the estimated type and level of traffic.

2.7.2 The minimum horizontal clearance for new service roads is 3m from the centre of Track or as directed by PRASA at specific locations.

2.8 Fences:

2.8.1 Equipment room fences shall be of 3m high solid welded mesh with electric wire on top.

2.8.2 The fence shall have a motorized sliding gate including anti-theft devices and access control

2.8.3 The minimum horizontal clearance for new fences is 3m from the edge of the ballast bed.

3 ENGINEERING

3.1 Design

- 3.1.1 All designs shall comply with all relevant Standards, Specifications, Regulations and Procedures as specified throughout the RFP.

3.2 Manufacturing and Assembly

- 3.2.1 Manufacturing and assembly shall comply with all relevant Standards, Specifications, Regulations and Procedures as specified throughout the RFP
- 3.2.2 The Bidder shall manufacture all Equipment locally as far as possible.
- 3.2.3 The Bidder shall assemble all Equipment locally.
- 3.2.4 The Bidder shall submit a detailed Quality Management Plan ("QMP") for the Manufacturing and Assembly process to PRASA for acceptance.

4 CONSTRUCTION

4.1 General

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

5 TESTING AND COMMISSIONING

5.1 General

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

5.2 Factory Acceptance Testing (“FAT”)

- 5.2.1 All relevant Civil Structures and Track related Works, sub-Systems and Equipment shall undergo and pass FAT before shipping to site.
- 5.2.2 The Bidder shall be responsible for all FAT.
- 5.2.3 All FAT shall be conducted at factory(s) at which the Plant and Materials are manufactured and assembled and by Civil and Structural Engineers or technologists, 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.
- 5.2.4 The person(s) responsible for the FAT shall not have been involved in any Design activities relating to the System, sub-System or Equipment to be tested.
- 5.2.5 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.
- 5.2.6 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.
- 5.2.7 The Bidder shall submit all duly signed FAT Test certificates and associated Test sheet to PRASA for information purposes, prior to Commissioning.
- 5.2.8 PRASA accepts no accountability nor liability for any FAT conducted, despite any checks done or inputs given by any of PRASA's agents.

5.3 Site Acceptance Testing (“SAT”)

- 5.3.1 All relevant Civil Structures and Track related Works, sub-Systems and Equipment shall undergo and pass SAT before Commissioning.
- 5.3.2 The Bidder shall be responsible for SAT.

- 5.3.3 The SAT shall be conducted by an Engineer, registered with the Engineering Council of South Africa (“ECOSA”) 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.
- 5.3.4 The person(s) responsible for the SAT shall not have been involved in any Design, FAT or Installation activities relating to the System, sub-System or Equipment to be tested.
- 5.3.5 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.
- 5.3.6 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.
- 5.3.7 The Bidder shall submit all duly signed SAT Test certificates and associated Test sheet to PRASA for information purposes, prior to Commissioning.
- 5.3.8 The PRASA accepts no accountability nor liability for any SAT conducted, despite any checks done or inputs given by any of PRASA's agents.

5.4 Final Testing and Commissioning

- 5.4.1 Final Testing and Commissioning shall be done by a PRASA approved Test and Commissioning Engineer provided by the Bidder.
- 5.4.2 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.
- 5.4.3 The Bidder shall submit a comprehensive Final Testing and Commissioning Method Statement to PRASA for approval before any Commissioning commence.
- 5.4.4 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.
- 5.4.5 The members of the Bidder's Testing team shall have not been involved in any Design, FAT or SAT activities relating to the System, sub-System or Equipment for which that member is responsible during the final Testing and Commissioning.

6 DECOMMISSIONING, DISMANTLING AND REMOVAL

6.1 General

6.1.1 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 old Civil Structures and Track related Equipment.
- c) The Bidder shall submit a Method Statement for the Decommissioning, dismantling and removal of all Equipment to the PRASA approval before commencing any work.
- d) The Bidder shall dispose of the Equipment according to the process described the RFP.
- e) The Bidder shall complete the Decommissioning and removal of visible signal cable within 14 calendar days after the Commissioning of any Section.
- f) The Bidder shall complete the Decommissioning, dismantling and removal of outdoor Signalling Equipment no later than 30 calendar days after the Commissioning of any Section.

7 MAINTENANCE

7.1 Overview

- 7.1.1 The Bidder shall Design the Civil Structures and Track related Works in such a manner to minimize Maintenance requirements and ensure overall maintainability.
- 7.1.2 The Bidder shall continue to function properly if maintained according to the current Maintenance strategy.
- 7.1.3 The Bidder shall develop a new improved Maintenance strategy. The new Maintenance strategy shall require less Maintenance and less Maintenance personnel.
- 7.1.4 Any failure shall be self-announcing and shall lead to a predetermined safe state.
- 7.1.5 The System shall incorporate a remotely accessible fault logging and analysis ability, to allow a fast and appropriate response to any normal, or abnormal, situation.
- 7.1.6 It shall be possible to mend Civil Structures and Track related breakdowns in a very short time and with a minimum impact on operations.

7.2 First Level Maintenance

- 7.2.1 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.
- 7.2.2 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.
- 7.2.3 It shall be possible to replace faulty Plant, Plant and Materials without the need to turn the power off.
- 7.2.4 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.

7.3 Second Level Maintenance

- 7.3.1 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.
- 7.3.2 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.
- 7.3.3 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.

7.4 Third Level Maintenance

- 7.4.1 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.
- 7.4.2 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.
- 7.4.3 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.

- 7.4.4 The Bidder shall train and develop a minimum of 2 local suppliers further ensuring comprehensive inclusion of the OEM throughout the process.
- 7.4.5 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.

7.5 Fourth Level Maintenance

- 7.5.1 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).
- 7.5.2 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
- 7.5.3 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.

8 WARRANTIES

8.1 General

- 8.1.1 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.
- 8.1.2 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 Civil Structures and Track related Works 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 Component failure due to corrosion