TECHNOLOGY MANAGEMENT

FUNCTIONAL SPECIFICATION

BAD LOAD DETECTION SYSTEM (BLDS)

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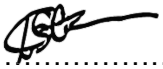
Approved	Acting Senior Engineer Rail Network	Lusizo Gqiba	
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REVISION SHEET

Keywords	Description
Modified	Improved sentence construction or wording on version 1 to give the sentence aim more clarity on version 2. This does not change the information conveyed by the statement but makes it clearer and direct.
Changed	Information or clause contained on version 1 that is completely transformed into a different information (e.g. requirements, limits etc.). This changes the aim conveyed by the information/clause.
Added	New information/clause introduced on version 2 that is not part of version 1
Updated	Information contained in version 1 that is replaced with the latest information on version 2
Removed	Information contained in version 1 that is not part of version 2.

REV	Section	Description	Date	Authorized
1	ALL	First release	November 2010	B. Steyn
2	1.1	Added more explanation details on system "identification"	July 2021	N. Gobhozi
2	1.2	Added more functional definition on "System Overview"		
2	1.3	Modified "Document Overview" statement		
2	2.1	Updated and added "Applicable Documents" in a table form		
2	2.2	Added a "Scope of Work Document" requirement		
2	3.1	Updated Context Diagram for the BLD		
2	3.2	Added new interface requirements and updated some of the old requirements		
2	4	Modified and updated functional requirements		
2	5.1 and 5.2	Added Measurement sites requirements		
2	7.1	Modified and updated "communication" section		
2	9	Added a security section		
2	10	Changed Documentation Requirements		
2	11	Added "QUALITY ASSURANCE" description that clearly specify Transnet position on approving or rejecting the system.		

1 SCOPE

1.1 Identification

The Bad Load Detector (BLD) system specified measures the total mass of a wagon, the total mass of each bogie, total mass of each side (left or right) as well as total mass of each wheel automatically, whilst a train is traversing over the system.

The BLD is required to provide a visual aid (photograph) of the interior of each wagon for which a bad load alarm is generated.

1.2 System Overview

Transnet has had various incidents in the past associated with wagons that were not correctly off-loaded. This can lead for example to loaded wagons being part of an empty train or vice versa. These wagons pose a significant safety risk for Transnet and can easily lead to catastrophic disasters.

The measurements and the calculated parameters generated by the BLD, identify wagons that pose a safety risk to the Transnet rail network.

The BLD is therefore installed as close as possible to the off-loading facility and weighs each wagon and identify partially off-loaded wagons and report alarms to pre-defined alarm terminals. The BLD consists mainly of a non-assized in-motion weighing system with the added functionality of sending alarms and also of adding a visual aid (photograph) of the interior of each wagon for which an alarm was raised.

1.3 Document Overview

This specification describes all the functional requirements that a BLD system needs to meet in order to be successfully installed, commissioned, approved, operated, monitored, maintained and retired.

2 TECHNICAL DOCUMENTS AND REQUIREMENTS

2.1 Applicable Documents

The following specifications, standards and drawings form part of this functional specification. In the event of conflict between the referenced documents and this specification, the contents of this specification shall be considered a superseding requirement.

BBH 0126	BLD site identification specification
BBC 1040	Installation of earthing and lightning protection in relay room & signalling enclosures & track side enclosures
BBC 5665	Single phase UPS specification 3 – 10KVA

BBB 0481	Manual for track maintenance (sleeper spacing etc)
BBF 1353	Container specification
BBH 1091	Surge and lightning for electronic track side equipment
CSE 1154	Environmental & signalling and equipment specification
CSE 1159	Documentation requirement specifications
BBH 1870	Interface requirement between the Integrated Train Condition Monitoring System (ITCMS) and Train Condition Monitoring Systems
BBH 1359	Scope of Work document
BBD 5249	Alarm Limits for The Measurements Of Weighbridges, Wheel-Impact Monitors And Skew Bogie Detectors
BBF 9193	GPRS failback between APN's for measurement systems
BBD 6353	Radio Frequency Identification (RFID)Tag Programming and Installation On Transnet Freight Rail Vehicles
BBD 7546	Locomotive Harmonics
BBB 2274	Electrical Harmonics
BBH 2201	Training Requirements
BBH 2202	Maintenance Requirements
BBH 2203	Communication Requirements
BBH 2204	Security Requirements
RD_RD_KLP_SPEC 20_0053	Intelligent Rail Information System Interface (IRIS)

2.2 Scope of Work Document

The SCOPE OF WORK (SOW) document will be drafted after the first site tender meeting discussion has been finalised by relevant parties. Once all the related queries and questions from the interested suppliers are resolved and signed off the document shall be finalised. Technology Management shall obtain a document number and issue this document to the Transnet Project Manager to send to all the suppliers interested in submitting a tender bid inclusive of all the SOW requirements.

SCOPE OF WORK document will cover the following: site location, power and communication requirements, integration software into TFR, container and security requirements. (Contact of Technology Management technology owner)

3 SYSTEM CONTEXT AND INTERFACE REQUIREMENTS

3.1 Context Diagram

The context diagram describes the different entities that the BLD shall interface with as indicated in Figure 1.

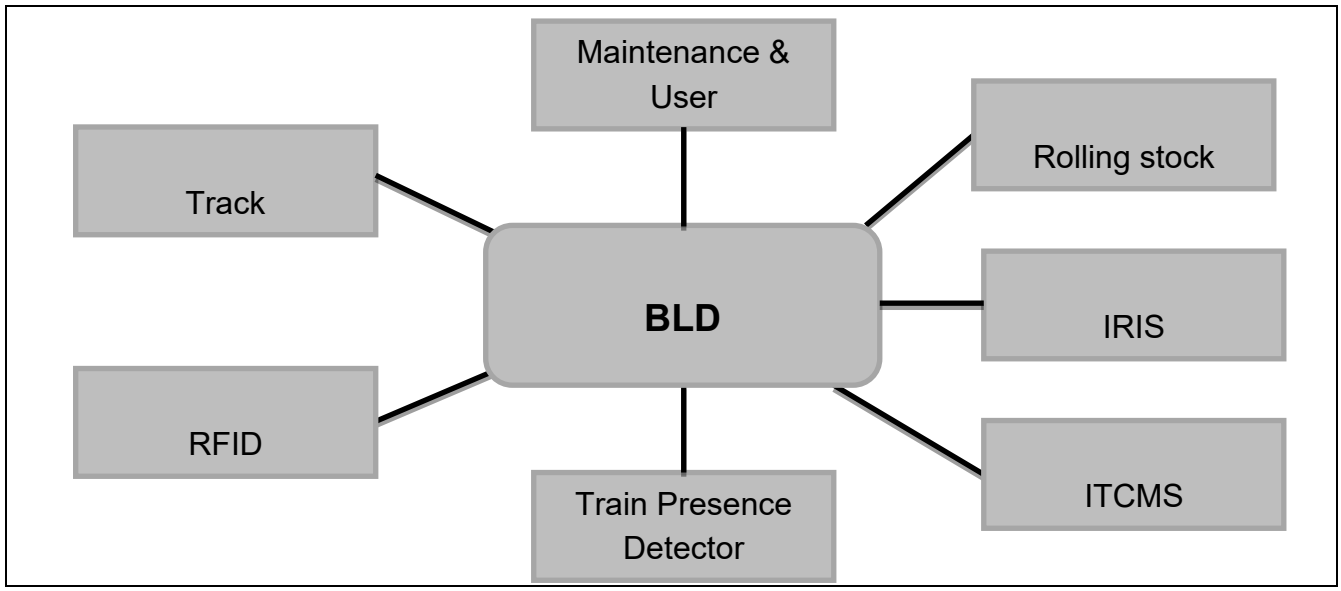

Figure 1: Context Diagram of the BLD

3.2 BLD Required Interfaces

The following is a description of each of the required interfaces for the BLD:

3.2.1 **BLD to Track Interface**

3.2.1.1 The BLD shall interface with the rail track mainly by installing transducers/sensors on the track.

3.2.1.2 All installed equipment on the track shall not affect the safe travelling of trains over the system.

3.2.1.3 The BLD shall not have any influence whatsoever on the operation of all types of track circuits in use by TFR. This means that the BLD shall not under any circumstance alter the electrical impedance between the rails.

3.2.1.4 The installed measuring equipment shall comply with the following track interface requirements:

- The BLD shall cause no discontinuity in the rail track.
- The BLD shall adhere to the specific type of the rail and track structure used at the measurement site typically 48kg/m, 57kg/m, 60kg/m.
- The sleeper spacing shall not be altered. In a case where there is a need to alter sleeper spacing, an approval letter shall be obtained from Track Technology Management before work commences.
- The super-structure as well as the sub-structure of the track shall not be disturbed by the installation or maintenance of the system.
- In a case where there is a need to drill the rail, an approval letter shall be obtained from Track Technology Management before work commences. All relevant specifications and instructions shall be complied with.
- In a case where there is a need to cut or weld the rail, an approval letter shall be obtained from Track Technology Management before work commences. All relevant specifications and instructions shall be complied with.
- Only exothermic or flash butt welding shall be done on the approval and specification shall be obtained from Track Technology Management.
- In a case where the system requirements disturb the track structure (cant, ballast and formation) an approval letter shall be obtained from Track Technology Management before work commences. All relevant specifications and instructions shall be complied with.
- New proposed fastening system shall be submitted for approval by Track Technology Management.
- The cant/ super-elevation of the rail shall not be disturbed.
- The rail fastening system shall be compatible to the rail to sleeper fastening system employed at the measuring site.
- No single - or double failure of field equipment shall cause a short circuit or impedance less than 10 ohm between the rails. No on track equipment shall protrude above the level of the rail crown.
- The BLD system shall be configured such that routine track maintenance work such as tamping, stabilising, longitudinal stress management and rail grinding can be done without disturbing the system in any way.

3.2.1.5 Should the installation of the BLD require any significant change to the existing infrastructure and/or does not comply with the above-mentioned requirements, information about the non-conformances of the BLD shall be submitted for a comprehensive engineering evaluation. Furthermore, written approval by a responsible authority from TFR Technology Management shall first be obtained before the system can be considered for installation.

3.2.2 BLD to Rolling Stock Interface

Rolling stock moving over the BLD have the characteristics presented below and the BLD shall interface with these vehicles in the specified manner:

3.2.2.1 Train consists can contain 4 and/or 6 axle locomotives, as well as 4 axle wagons. The locomotives can be located anywhere within the train consists. The BLD shall maintain measurement integrity irrespective of the types of vehicles on a train.

3.2.2.2 Trains can contain up to 500 vehicles and be up to 5 km long which translates to more than 2000 axles. The BLD shall be able to measure all required parameters on any train without loss of measurement integrity.

3.2.2.3 Trains can travel at speeds between 0 – 20km/h. Train speeds may vary significantly during the passage of the train over the systems. The BLD shall be able to accurately measure all required parameters as the train traverses over the system

3.2.2.4 The system shall determine the speed of each vehicle in the train as it traverses over the system with an accuracy of ±1km/h.

3.2.2.5 The system shall determine the direction that the vehicles travel over the system.

3.2.2.6 BLD shall be able to maintain measurements integrity even when the train has stopped and / or reversed on the system.

3.2.2.7 The system shall be able to measure wheel vertical load of trains irrespective of direction of travel which are termed “Up” or “Down”.

3.2.2.8 The system shall maintain measurement integrity with all types of rolling stock travelling on the Transnet rail network.

3.2.2.9 The system shall be able to measure all required parameters irrespective of the orientation of vehicle (travelling in the forward or reverse direction).

3.2.2.10 The system shall produce measurements for at least 99.9% of the wagons for each train passing over the system for trains with 300 or more wagons.

3.2.2.11 The system shall not “miss” any individual wagon consecutively on consecutive passes of that wagon over the system.

3.2.2.12 It is not anticipated that the system will produce any “anomaly” measurements. Should this not be the case, the supplier must specify how many anomalies are to be expected and how these can be identified.

3.2.2.13 The wheel vertical load can go up to 35 tons and more per wheel. The BLD shall be able to operate, without damage, degradation, or loss of calibration.

3.2.3 BLD to Radio Frequency Identification Tags

3.2.3.1 All Transnet Freight Rail wagons and locomotives are fitted with Radio Frequency Identification (RFID) tags, which contain the vehicle number and other information. The tags employed are the Transcore™ AT 5118 tag. Details about how the tags are fitted on the vehicles and what information is programmed into these tags is specified in document BBD 6353 (latest Version) which shall be read in conjunction with this specification.

3.2.3.2 The program structure of tags is configured into 15 lines, each consisting of 10 bytes (characters). TFR only utilizes the first two lines. All tags are programmed according to the definition in Table 1.

3.2.3.3 In the case of a locomotive, the second line consists of a locomotive number field consisting of 8 characters. If the locomotive number is shorter than 8 characters, padding spaces are used to complete the field of 8 characters. This is followed by a banked space separating it from the next field, which is 1 character for the orientation of the locomotive (1 for front or 2 for rear).

All the data on the tag shall be read which includes vehicle type, asset owner, vehicle number and vehicle orientation. Please refer to table 1 and table 2 below

Table 1: Fields Programmed on the Vehicle Tag

Vehicle Type	**Tag Type Field** (max 6)	**Owner code field** (always 2)	**Number Field** (max 8)	**Orientation Field** (1)
Locomotive	34D400 22E	00	D34123 E18325	1 or 2
GFB wagon	FZJ7	00	87654321	1 or 2
Coal Line wagon	CCR11 Jumbo	00 00	63512345 63512345	1 or 2 1 or 2
Ore Line wagon	CR13	00	12345678	1 or 2

Table 2: Examples Vehicle Tag Contents

Field No.	**Field Description**	**Definition of field**	**Field Size (max 10 characters) - show example.**									
1	Asset Type & Owner (for both Wagons and locos)	Type of asset consisting of 7 characters and 2 characters for owner code	S	M	L	J	1	3	space	Banked space	0	0
2	Wagon Number	The unique number of the asset (8 char) plus 1 char for orientation (1 or 2)	5	2	1	2	3	4	5	6	Banked space	1
2	Locomotive Number	The unique number of the locomotive (7 char) plus 1 char for orientation. The number must include a prefix for locomotive type (E = Electric, D = Diesel or S = Steam)	E D	7 3	0 4	1 1	1 2	4	space	Banked space	Banked space	2

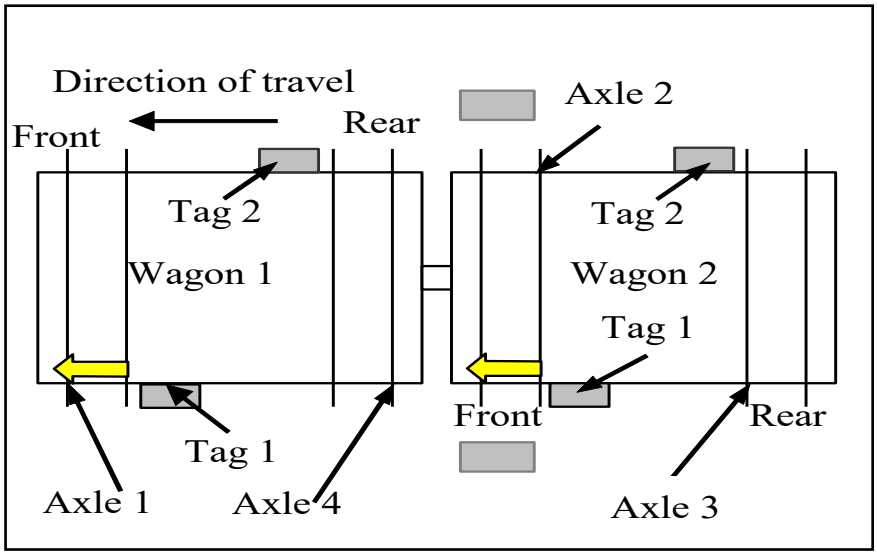

Figure 2: Tag fitments relative to wagon orientation

To determine an absolute reference for consistent readings, the convention on figure 2 is used for determining vehicle orientation.

3.2.3.4 Tag 1 (programmed “1”) is always on the front (F) left hand side when looking towards the front of the wagon (yellow arrow points to front of wagon), and tag 2 (programmed “2”) on the right hand rear (R) side. If Tag#1 is read on the left hand (near) side of the rail in the direction of travel, it implies that the front (F) of the wagon is facing the direction of travel. If Tag#2 is read on the left hand side of the rail in the direction of travel, it implies that the rear (R) of the wagon is facing the direction of travel.

3.2.3.5 A similar convention is used for locomotives when the front of the locomotive (normally the cab side) has been determined.

3.2.3.6 Tags are mounted behind the second axle of a vehicle at a height of 980-1100 mm meter above the rail.

3.2.3.7 All RFID components shall be approved by ICASA and this shall be indicated by an “ICASA approved” sticker on the components as well as the certificate.

3.2.4 BLD to Integrated Train Condition Monitoring System Interface (ITCMS)

Integrated Train Condition Monitoring System (ITCMS) is an interface developed to integrate the information from all track side condition assessment systems. The details of the requirements for the interface are specified in BBH1870 (Latest Version).

3.2.5 BLD to Intelligent Rail Information System Interface (IRIS)

IRIS is an interface developed to integrate all multimedia data/information from the trackside monitoring systems. The details of the requirements for this interface are specified in RD_RD_KLP_SPEC 20_0053 (latest Version).

3.2.6 BLD to Maintenance/ User Interface

3.2.6.1 The BLD shall provide a maintenance interface for the maintainer/user to interact with the system on site and remotely.

3.2.6.2 The interface shall allow the maintainers/users to determine whether the system is operational and to access the measurements and configuration parameters. This interface shall assist the maintainer/user in fault finding and in performing maintenance on the system.

3.2.6.3 The maintainer/user interface can make use of various user interface technologies locally at the site and remotely such as a computer screen, web-page, data communication port with interfacing software etc.

3.2.6.4 The maintainer/user interface shall display the overall status of the system and of each of its major components.

3.2.6.5 The maintainer/user interface shall provide a means to allow the maintainer to request any self-checks on the system and to provide him/her with the necessary results.

3.2.6.6 The maintainer/user interface shall display the status (activity) of the system such as:

- Self-check in progress, or
- System in process of acquiring train information etc.

3.2.6.7 The BLD software shall have the capability to present the raw data in a form of signal traces.

3.2.6.8 The BLD system shall include a calibration procedure for all required measurement parameters. The calibration procedure shall be available for use by Transnet personnel on site.

3.2.6.9 The interface shall enable the maintainer to modify configuration parameters in the BLD. The typical configuration parameters under his/her control shall be:

- Date and time.
- The communication settings of the communication interfaces.
- Calibration settings.
- Parameter re-naming.
- Alarm limits.

3.2.6.10 Provision shall be made for an “Ultra VNC” or compatible type connection (or similar) to be established between any computer on the Transnet Intranet and the track side measurement system.

3.2.6.11 The security shall be put in place to limit the access to the measurement system to specifically authorised individuals.

3.2.7 BLD to Train Presence Detector Interface

3.2.7.1 The BLD shall sense or detect the presence of a train in case it stopped on the system to prevent the system from timing out while the train has not cleared the measurement site.

3.2.7.2 The BLD shall retain its measurement integrity regardless of trains stopping on the system.

3.2.7.3 The BLD system shall use a Train Presence Detector to determine when a train is approaching the system.

4 FUNCTIONAL REQUIREMENTS

4.1 Photographs

The following section describes all the Transnet Freight Rail functional requirements for the BLD. The primary function of BLD is to measures the total mass of a wagon, the total mass of each bogie, total mass of each side (left or right) as well as total mass of each wheel automatically, whilst a train is traversing over the system. Furthermore, BLD shall also provide a visual aid (photograph) of the interior of each wagon that activated a bad load alarm.

4.1.1 The BLD shall contain at least one high quality industrial type camera which shall be used to automatically take pictures of the interior (inside) of wagons. These pictures shall be stored on the BLD and made available for access over the specified communication medium

4.1.2 The camera(s) shall be able to take clear pictures in all weather conditions during day and night.

4.1.3 The supplier shall also provide all the required overhead structures for the mounting of the camera(s).

4.2 Weighing of Vehicles

4.2.1 The BLD shall automatically (i.e. without an operator present) weigh individual vehicles (locomotives and wagons) whilst in motion at an accuracy of atleast 99% to its verified static mass, i.e. a maximum 1% measurement error is allowed

4.2.2 The BLD shall be able to provide the following measurement results as a minimum:

- Mass of the vehicle
- Side to side wagon mass (Left and Right)
- Front to back wagon mass
- Mass of each wheel

4.3 Report Alarms

4.3.1 The BLD shall report alarm conditions directly to the relevant data base with an alarm message as specified in BBH 1870 for the ITCMS and as specified in RD_RD_KLP_SPEC 20_0053 for IRIS and according to the BLD protocol specification.

4.3.2 The system shall store the alarms which were generated along with the corresponding photographs of the wagons triggering bad load alarms in the BLD memory for a period of at least 6 months.

4.3.3 The photographs shall be stored in a compressed form and the resolution shall be limited such that the load and inside of the wagon is clearly visible.

4.3.4 The alarm limit settings shall be password protected.

4.3.5 The BLD shall keep a log of alarm configurations setting changes linked to the user who made the changes.

4.3.6 The sending of an alarm message shall take highest priority in the communication of messages to the ITCMS/IRIS.

4.4 Determine Train Composition

4.4.1 The system shall construct the train composition and identify the vehicle type of all vehicles irrespective of their position in the train. This shall be done by determining the axle spacing and employing pattern recognition algorithms. See appendix A for all the axle spacing of Transnet Freight Rail vehicles.

4.4.2 When the vehicle tag information (i.e. tags) is absent. The system shall report the vehicles as follows:

- Locomotive. "L"
- Wagon. "w" (lower case)
- Unidentified or unknown vehicle "?"

4.4.3 The BLD shall read the vehicle number from the TRANSCORE tag mounted on the vehicle and uniquely couple this information with the measured data of this vehicle.

4.4.4 The BLD shall employ algorithms to prevent the BLD from coupling a measurement to the wrong vehicle.

4.4.5 In cases where measurement errors occur, such as conflicting numbers of axles, it is required that the error is identified and the erroneous train information flagged for correction, or automatically discarded to ensure the integrity of measurement records is maintained.

4.4.6 The BLD's train composition shall not be influenced by tags of vehicles running on an adjacent line.

4.4.7 The system shall determine train composition of every train passing over the system. The following composition information shall at least be obtained**:**

- The vehicle number (tag) or left blank if none is available.
- The type of vehicle.
- The orientation of the vehicle.

- Asset owner (if available).
- Number of axles on each vehicle.
- The speed of each vehicle in the consists.

4.4.8 The system shall keep track of axles, vehicles and the train composition even if the train stops and / or reverses on the measurement site.

4.4.9 When a train reverses over the site, the BLD shall keep data integrity and ensure that all axles and tags are measured accurately.

4.4.10 The system shall determine the train composition of trains irrespective of the direction of train movement and shall determine and report the direction of movement.

4.4.11 The system shall include algorithms to account for and incorporate information measured on vehicles without tags and to include the vehicles in the train consist without misallocating measured data.

4.5 Process the Measurement Data

4.5.1 The system shall measure, store and process all measurements for trains irrespective of speed and direction of travel.

4.5.2 The system shall provide time and date stamp for each measured axle.

4.5.3 Processing of the measured data after a train has cleared the measurement site shall not exceed 30 seconds.

4.5.4 The system shall store raw data (primary measurements from the sensors) on site for a minimum period of one year. The data shall be retrievable at any time and mechanisms shall be put in place to enable the processing of this data such that it can be transferred to other platforms for further processing. The data shall be stored in an unencrypted non-proprietary format.

4.6 Communicate Data to the Relevant Database (ITCMS or IRIS)

4.6.1 The BLD shall communicate all measurements together with other relevant data to ITCMS as per specification BBH1870 and IRIS as per specification RD_RD_KLP_SPEC 20_0053.

4.6.2 The BLD shall communicate all measurement system component failures notification messages to the relevant (ITCMS/IRIS).

4.6.3 The BLD shall acknowledge the transfer of data to and from the ITCMS/IRIS to ensure transmission integrity.

4.6.4 The ITCMS/IRIS shall communicate periodic time synchronisation messages to the BLD system. The BLD system shall update all system clocks with the time and date received.

4.7 Health Monitoring

4.7.1 Adequate self-checks to verify the functionality of the BLD shall be employed.

4.7.2 The timing of automatic self-checks shall be configurable in the system. Possible self-check configurations shall include:

- Execute the self-check after the passage of a train.
- Execute the self-check after a certain period of time has elapsed. The duration between self-checks shall be configurable.
- Upon request received from the ITCMS/IRIS.
- Upon request from the maintainer via the maintainer interface.

4.7.3 The system shall record and communicate the self-check results to the source initiating the self-check. The result shall include:

- Measurement system identifier to identify the unit.
- Date and time when the self-check was executed.
- Information on the equipment that has failed the self-check as well as any failure description.

4.7.4 If the system detects the presence of a train while performing a self-check the system shall abort the self-check and communicate to the self-check initiator that the self-check has been aborted due to the presence of the train.

5 TRANSNET FREIGHT RAIL SUPPLIED PROPERTY LIST

5.1 Measurement sites

Transnet Freight Rail and the supplier of technology shall select suitable sections of track for the positioning of measurement sites according to the site specification BBH 0126 (latest version).

5.2 Power Supply

5.2.1 Electricity supplies will be provided by TFR at every measurement site where required. The supply voltage shall be 220V at 50 Hz or 110V at 50Hz.

5.2.2 The system shall be suitable for operation in high voltage railway lines, 3KV DC, 25KVAC and 50KVAC.

6 MAINTENANCE

6.1 Maintenance Requirements

6.1.1 The maintenance of the BLD shall be according to Rail Network maintenance requirements specification BBH 2202 (latest version).

7 COMMUNICATION

7.1 Communication Interface Requirements

7.1.1 The BLD shall be able to communicate through communication interfaces and mediums that are specified in the TFR communication requirements specification BBH 2203 ((latest version)).

7.1.2 The BLD shall at least be able to communicate in all listed minimum communication interfaces.

- Ethernet TCP/IP.
- Packet Switched communication mediums (LTE/3G/GPRS).
- USB2.0 and USB3.0 compatible interface in addition to RS232.
- Wide Area Network entry points including termination equipment (hubs) shall be provided by TFR.

8 TRAINING

8.1 Training Requirements

8.1.1 The supplier shall provide detailed maintenance and operating training in all aspects of the BLD.

8.1.2 The supplier shall submit all course material for approval by Transnet Freight Rail prior to training taking place.

8.1.3 The training and training material shall be according to the school of rail training requirements specified on BBH 2201 (latest version).

9 SECURITY

9.1 Security Requirements

9.1.1 The security for the BLD shall be according to the TFR system security guide lines BBH 2204 (latest version), to protect the system from theft and vandalism.

10 GENERAL REQUIREMENTS

10.1 Environmental Conditions

10.1.1 The BLD shall be fully functional and unaffected by the following environmental conditions:

- The measuring equipment shall be exposed to temperatures ranging from -10◦C up to 75◦C, fully exposed to sunlight. Processing equipment shall be exposed to temperatures ranging from -10◦C up to 50◦C ambient.
- The processing equipment (inside trackside enclosure) shall be exposed to humidity ranging from dry to 95%. All trackside equipment (outside trackside enclosure) shall be water resistant.
- The processing equipment shall be fully exposed to fine and coarse dust. The processing equipment may be exposed to fine dust filtering into the trackside cabinet.
- The measuring equipment shall be exposed to contact with flying ballast stones. Requirements are as specified in specification CSE-1154-001.
- The BLD shall be exposed to vibration as specified in CSE-1154-001.
- The measuring equipment may be exposed to chemicals including lime, sulphur, petroleum products and phosphates, which may spill from wagons.
- The BLD may be exposed to electro-magnetic interference (EMI) as specified in CSE-1154-001.
- All track-mounted, track-side, communication and office equipment shall have comprehensive lightning protection to enable the equipment to withstand, without damage or loss of functionality, severe lightning activity, except for a direct hit. The lightning protection design shall be submitted to Transnet Freight Rail Technology Management for approval prior to installation.
- The BLD shall be compatible to harmonics generated by locomotives as specified by BBD7546 (latest version).

- The BLD shall be compatible to harmonics generated by electrical as specified on BBB2274 (latest version).
- . The system shall maintain its measurements integrity even when installed in 3 Kilovolts DC traction, 25 Kilovolts AC traction and 50 Kilovolts traction areas.

10.2 Documentation

10.2.1 The system and its components shall be fully documented in English in compliance with Infrastructure (Signals) standard specification no. CSE-1159-001. The list of documents that shall be supplied and their contents is described in Standard Specification CSE-1159-001 which is as follows:

- System wiring diagram with test points and values (e.g. voltage)
- Operations manual
- Maintenance manual
- Training manual
- Calibration manual
- Field enclosure drawings
- System diagnostic fault finding guideline
- Complete system overview block diagram showing connecting sub systems and major component inputs and outputs

10.2.2 In addition to the requirements of CSE-1159-001, the technical documentation shall also contain all the relevant information of the interfaces to the system. It shall include a full description of the hardware, protocols and message contents used on all interfaces. This shall be adequate to enable the technical staff of Transnet Freight Rail to interface with the system for the purpose of upgrading the BLD, extraction of information or integration into existing infrastructure systems.

10.2.3 All software used by the system shall be fully documented.

10.2.4 All technical documentation required above shall be made available during tender submission to enable Transnet Freight Rail Technology Management to perform the technical evaluation.

10.2.5 The quality and completeness of the documentation shall form part of the technical evaluation.

10.3 Design, Construction and Installation

10.3.1 All hardware shall be equipped with durable manufacturer's data plates bearing at least unit identification, the BLD manufacturer name, date of manufacture, a serial

number, revision number with the current revision status marked, operating voltage and power requirements.

10.3.2 All materials used in the system shall be at least industrial grade. Where possible, materials used shall be SABS approved. Parts shall be supplied with a certificate of origin. All dimensions and bolt and nut sizes shall use the metric standard.

10.3.3 Systems that will be installed in coastal areas are to be hot dip galvanised to prevent corrosion.

11 QUALITY ASSURANCE

Transnet reserves the right to accept or reject any system that does not fully comply with the functional specification, including failure to comply with the installation standards as specified in the supplied documentation.

Technology Management & Rail Network shall evaluate the system according to the clause-by-clause mandatory requirements stipulated in the functional specification.

11.1 Acceptance Test Procedure

11.1.1 The test procedure according to clause by clause shall be drawn up and documented by the contractor in an ACCEPTANCE TEST PROCEDURE document. Technology Management and Rail Network shall review and approve the ATP document.

11.1.2 The data made available from the system on the ITCMS will be the primary source used to evaluate the performance of the system. If the measurement and self-diagnosis data is not available on the ITCMS, system evaluation for acceptance will not be possible.

11.1.3 The contractors shall be responsible for the execution of the tests to prove the system's compliance to the BLD specification.

11.2 Four Testing Phases

During the system acceptance testing period visual inspections and any other verification method may be used on in-service vehicles to verify that the BLD meet mandatory requirements. Any non-compliance will reset this system acceptance testing time.

The system shall be subjected to four (Phase 1 – Phase 4) different phases of testing which will be conducted through a period of 12 months (4 seasonal cycle).

A. Before phase 1 of the evaluation period commences the supplier shall ensure that the system is fully installed and operational.

B. Technology Management (TM) and Rail Network (RN) shall form part of the initial installation of the pilot site to determine if the supplied system meets the Scope of Work document requirements (agreed by parties at tender site meeting). The number of pilot sites is to be agreed in writing. Until the final approval report of Phase 4 is circulated, no further sites will be installed.

C. The contractor shall submit all the required documentation for the "as-built" condition of the system.

11.2.1 PHASE 1: Initial Testing (Beginning of 12 months circle)

A. TM and RN shall inspect and verify the following:

I. **Main incoming power:** Earth spike, Surge protection and Phase protection modules are correctly installed.

II. **Infrastructure:** Validate all electrical bonding, track condition, track geometry, nearby signalling equipment and consult the relevant departments.

III. **Maintenance interface:** Assess the maintenance interface tool for both local and remote access.

IV. **Installed Measurement System:** Validate the compliance to regulations (e.g. ICASA for radio frequency identification), equipment labelling and numbering.

V. **Communication:** The system integration to ITCMS/database shall be checked to validate that all measured data and system status messages are correctly sent to the ITCMS/database using the test train or normal in-service trains.

VI. **Data Analysis:** TM shall conduct continuous data analysis of the system performance on all measured parameters.

B. TFR and the contractors shall be jointly responsible for the execution of the functional tests with reference to the specification.

C. TM reserves the right to conduct tests that are outside the specified tests at their sole discretion.

D. The responsibility for verification and validation of the test results shall reside with Technology Management and the contractor.

E. The test results shall be documented and shared amongst the stakeholders for review and approval before proceeding to the next phase.

F. The TFR and the contractors shall continuously monitor the environmental impact on the system.

11.2.2 PHASE 2: System Settlement Time

A. The settlement time of the system is approximately 3 months and during this time the system shall be subjected to the following tests:

I. Detailed data analysis using normal in-service trains shall be conducted by TM as well as the contractor.

II. Field verifications shall be conducted by the responsible personnel from TM.

III. Where necessary, test train shall be arranged to perform tests that requires an independent test train.

11.2.3 PHASE 3: system approval period

A. TM and Contractor identify all the shortcomings of the system and the supplier shall be given an opportunity to rectify, in parallel to that, the system shall be validated against the following:

I. Fit for purpose.

II. Technology Performance in TFR environment.

III. System protection against surges and lightning.

IV. The effect of environmental impact to the system.

B. TM and RN shall evaluate the results of the tests and if all the requirements have been met, the system shall become eligible for approval.

11.2.4 PHASE 4: 12 months cycle - approval of the pilot/system technology

A. Once the system has fully complied with all requirements without a snag, TM, RN and Project Manager shall initiate the official sign off and hand over of the system.

B. In a case were the installed system fails to comply with the functional requirements, Transnet reserves the right to request the contractor to remove the equipment from TFR Rail network.

C. Final reports regarding the performance of the system against TFR specification will be generated.

APPENDIX A: VEHICLE FOOT PRINT

ClassType	Spacing 1	Spacing 2	Spacing 3	Spacing 4	Spacing 5
6E	3430 mm	4418 mm	3430 mm		
7E	2200 mm	2200 mm	5000 mm	2200 mm	2200 mm
7E1/7E2	2030 mm	2030 mm	5340 mm	2030 mm	2030 mm
8E	3280 mm	4570 mm	3280 mm		
8E	1640 mm	1640 mm	4570 mm	1640 mm	1640 mm
9E	1970 mm	1970 mm	8410 mm	1970 mm	1970 mm
10E	2030 mm	2030 mm	5340 mm	2030 mm	2030 mm
11E	2200 mm	2200 mm	6360 mm	2200 mm	2200 mm
12E	3430 mm	4418 mm	3430 mm		
14E	3100 mm	6200 mm	3100 mm		
15E	2100 mm	2100mm	8400 mm	2100 mm	2100 mm
18E	3430 mm	4418 mm	3430 mm		
19E	3000 mm	8200 mm	3000 mm		
20E	2700mm	6600mm	2700mm		
21E	2700mm	6600mm	2700mm		
22E	1980mm	1900mm	6900mm	1900mm	1980mm
23E	1850mm	1850mm	9600mm	1850mm	1850mm
D37	1816 mm	1816 mm	7468 mm	1816 mm	1816 mm
D35D1	1562 mm	1740 mm	6071 mm	1740 mm	1562 mm
D34D1	1594 mm	1594 mm	6628 mm	1594 mm	1594 mm
D35D2	1594 mm	1594 mm	4406 mm	1594 mm	1594 mm
D33D1	1594 mm	1911 mm	5233 mm	1911 mm	1594 mm
D33D2	1600 mm	2007 mm	6686 mm	2007 mm	1600 mm
D34D2	1816 mm	1816 mm	7468 mm	1816 mm	1816 mm
D36D1	2082 mm	6618 mm	2082 mm		
D36D2	2438 mm	5029 mm	2438 mm		
D31	2438 mm	5242 mm	2438 mm		
D38	2600 mm	6500 mm	2600 mm		
D43	1850mm	1850mm	8174mm	1850mm	1850mm
D44	1850mm	1850mm	8479mm	1850mm	1850mm
D45	1900mm	1700mm	8870mm	1700mm	1900mm
Wagon	1792 mm	4292 mm	1792 mm		
Wagon	1753 mm	4557 mm	1753 mm		
Wagon	1753 mm	4839 mm	1753 mm		
Wagon	1753 mm	5139 mm	1753 mm		
Wagon	1804 mm	5457 mm	1804 mm		
Wagon	1753 mm	5794 mm	1753 mm		
Wagon	1753 mm	6153 mm	1753 mm		
Wagon	1753 mm	6937 mm	1753 mm		
Wagon	1753 mm	7366 mm	1753 mm		
Wagon	1753 mm	7822 mm	1753 mm		
Wagon	1753 mm	8306 mm	1753 mm		
Wagon	1753 mm	8820 mm	1753 mm		
Wagon	1753 mm	9365 mm	1753 mm		
Wagon	1753 mm	9944 mm	1753 mm		
Wagon	1753 mm	10559 mm	1753 mm		
Wagon	1753 mm	11213 mm	1753 mm		
Wagon	1753 mm	11906 mm	1753 mm		
Wagon	1753 mm	12643 mm	1753 mm		
Wagon	1753 mm	13425 mm	1753 mm		
Wagon	1753 mm	14255	1753 mm		
Wagon	2134 mm	11971 mm	2134 mm		