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**ROMANIAN GOVERNMENT**

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Reabilitarea liniei de cale ferată Braşov - Simeria, parte componentă a coridorului IV Pan European, pentru circulația trenurilor cu viteză maximă de 160 km/h,

**Sectiunea 1 : Brasov-Sighisoara**

Rehabilitation of the railway line Braşov – Simeria, component part of the IV Pan-European Corridor, for the trains circulation with maximum speed of 160 km/h.

**Section 1 : Brasov-Sighisoara**

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## 1 Scope of the Document

In this document the requirements of ERTMS Innovative Signalling Sub-System applied to the Section 1 'Brasov-Sighisoara' shall be described as regards of technical, functional and performance features.

The requirements shall be highlighted with the tag [REQ], following the text of the requirement.

The specification of the on-board and traditional signalling sub-system requirements is out of scope of this document. As a consequence, whenever the on-board and/or traditional signalling sub-system features are described in order to make the explanation clear and complete, these are shown with the tag [NOTE].

The tag [NOTE] and [DEF] shall be used before generic description and /or definition that cannot be considered as requirements.

## 2 Revision History

The present document was developed taking into account the analog documents already delivered for another section of the corridor IV: Simeria-Sighisoara “Functional specification for ERTMS” code: EA5134C00FNSE00130015. In the following table is described the revision history of this document.

REV	History
1	First draft
2	<ul style="list-style-type: none"> <li>• OCC in Simeria (confirmed by CFR);</li> <li>• RBC shall send FS MA (deleted OS MA) with warning message and TSR of 5Km/h if ‘not controlled level crossing’ relation has been received from IXL system;</li> <li>• Deleted requirements related to ‘Out of order Area’ management;</li> <li>• Deleted requirements related to T_NVContact value set to 15 sec. CFR shall provide the value using specific annexes to this document;</li> <li>• Sleeping mode not applicable to this specific application (confirmed by CFR)</li> <li>• Joining/Splitting not applicable to this specific application (confirmed by CFR)</li> <li>• Fix BGs transmitting the telegram ‘Stop if in Staff Responsible’ shall be located in the same position of the station exit and entry signal (confirmed by CFR)</li> <li>• On Sight Operating Mode management: 100 m, length of On Sight Window (confirmed by CFR)</li> <li>• UNFITTED Operating Mode management: 160 Km/h, National Value of V_NVUNFIT (confirmed by CFR)</li> <li>• Powerless sections management: the Change Phase Post configuration (active/not active) in RBC shall be defined using a manual procedure (confirmed by CFR)</li> <li>• The train dispatcher shall allow a train to enter an active powerless section in SR mode using a specific procedure provided by CFR. If necessary value of SR Mode shall be increased (confirmed by CFR)</li> </ul>
3	<ul style="list-style-type: none"> <li>• Added paragraph related to ‘Revision History’;</li> <li>• Extended description to all section 3 Coslariu-Simeria;</li> <li>• Added as ‘Applicable Document’: TECHNICAL DESCRIPTION EA5103C00TRSE000X0020</li> <li>• Added as ‘Applicable Document’: TECHNICAL SPECIFICATION EA5103C00TRSE000X0010</li> </ul>

	<ul style="list-style-type: none"> <li>• Added as 'Applicable Document': CFR RBC Requirements – Beneficiary' version 3.2.1 – 21/12/2010</li> <li>• Added as 'Applicable Document': Support Document for the document CFR RBC Requirements – Beneficiary' version 2.0.0 – 21/12/2010</li> <li>• Added as 'Applicable Document': CFR Glosar ETCS – version 09/09/2010</li> <li>• Added as 'Applicable Document': CFR Beneficiary's General Requirements' – version 2.0.0 - 21/12/2010</li> <li>• Shunting is not under control of RBC (confirmed by CFR). Deleted description of related procedure /equipments(balise)</li> <li>• Added requirements for 'burned light bulb management'</li> <li>• Added requirements for 'cooperative shortening of MA' management</li> <li>• Added requirements for 'manual withdrawal of MA'</li> <li>• Added requirements for VMMI related to 'manual shut down of RBC' for maintainability reasons</li> <li>• Modified position of Level Transition Balise Group</li> <li>• Added 'hot back-up VMMI'</li> </ul>
4	<ul style="list-style-type: none"> <li>• Extended description to all section 2 and 3 Sighisoara-Simeria;</li> </ul>
5	<ul style="list-style-type: none"> <li>• Modified Release Speed application: RS given by the trackside for all the EoAs (requested by CFR);</li> <li>• Deleted Overlap and Supervised Location definitions not relevant anymore;</li> <li>• Unified the different items "stopping points protection in FS".</li> <li>• Modified: "Staff responsible", "On sight" and "Shunting" speed value.</li> </ul>

### 3 Acronyms and Definitions

ACK	Acknowledge
ATC	Automatic Train Control
BAT	Level - Crossing Automatic Gate Arms
BLA	Automatic Line Block
BLAI	Integrated Automatic Line Block
BG	Balise Group
BTS	Base Transceiver Station
CTC	Centralized Traffic Control
CFR	Romanian Railway
DMI	Driver Machine Interface
EoA	End of Authority
LoA	Limit of Authority
ERTMS	European Railway Traffic Management System
ETCS	European Train Control System
GSM-R	Global System for Mobile - Railway
I/O	Input/Output
IXL	Interlocking System
LoA	Limit of Authority
LRBG	Last Relevant Balise Group
MA	Movement Authority
MSC	Mobile services Switching Centre
OCC	Operation Command and Control Centre
RBC	Radio Block Centre
SIL	Safety Integrity Level
SSP	Static Speed Profile
SE	Specific transmission module European
SN	Specific transmission module National
STM	Specific Transmission Module
TAF	Track Ahead Free
TLC/LD	Long Distance communication system
TSR	Temporary Speed Restriction
UPS	Uninterruptedly Power Supply
VMMI	Vital Man Machine Interface



## 4 Applicable Documents

REF	EMITTED BY	DOCUMENT	DATE
[REF1]		UNISIG SUBSET 026 - System Requirements Specification ver. 2.3.0	2006
[REF2]	CEI	EN 50126 - Railway Applications. The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS)	1999
[REF3]	CEI	EN 50128 - Railway Applications: Software for Railway Control and Protection Systems	2001
[REF4]	CEI	EN 50129 - Railway Applications: Safety Related Electronic Systems for Signalling	2003
[REF5]	ERA	STI 2006/860/EC - Control and command Subsystem ERTMS	7/11/2006
[REF6]	ERA	STI 2008/386/EC - Control and command Subsystem ERTMS modifying Annex A to 2006/679 and Annex A to 2006/860	23/04/2008
[REF7]		UNISIG SUBSET 036 – FFFIS for Eurobalise ver. 2.4.1	
[REF8]		FRS ver.5.0.0	
[REF9]	ITALFERR/Scott Wilson/Obermeyer/Tecnic	EA51 01 C 00 TR SE 001 0 001 ' SIGNALLING TECHNICAL DESCRIPTION'	
[REF10]	ITALFERR/Scott Wilson/Obermeyer/Tecnic	EA51 01 C 00 TS SE 001 0 001 ' SIGNALLING TECHNICAL SPECIFICATION'	
[REF11]	CFR	CFR RBC Requirements – Beneficiary' version 3.3.4	02/02/2012
[REF12]	CFR	Support Document for the document CFR RBC Requirements – Beneficiary' version 2.0.0	21/12/2010
[REF13]	CFR	CFR Glosar ETCS – version 02/02/2012	02/02/2012
[REF14]	CFR	CFR Beneficiary's General Requirements' – version 2.0.0	21/12/2010
[REF15]	CFR	CFR Power supply requirements – version 2.0.0	21/12/2010

## 5 ERTMS Innovative Signalling Sub-System Architecture

### 5.1 Architecture

[NOTE]

The whole signalling system architecture is shown in the figure below. Equipments belonging to ERTMS Innovative Signalling Sub-system (ISS) are written in red color. Equipments/systems out of the scope of this document are outlined.

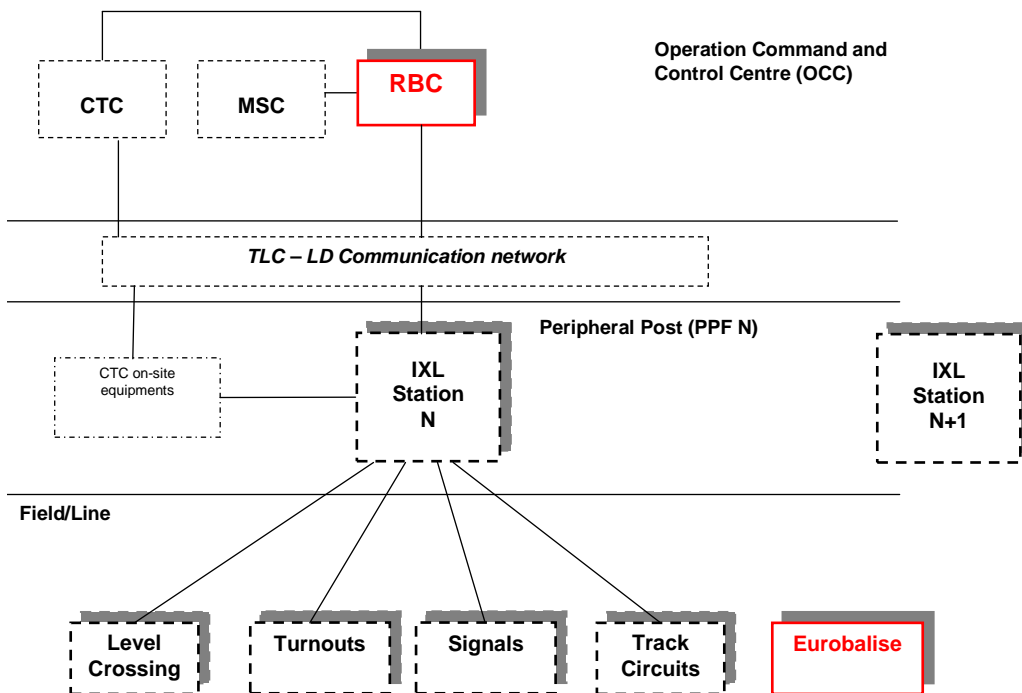


Figure 2: Signalling System Architecture

## 5.2 Technical Requirements of ERTMS Innovative Signalling Sub-system

### 5.2.1 RBC

[REQ]

The RBC shall be responsible for ensuring separation between trains taking into account the limitations imposed by the infrastructure, rolling stock and information about field equipment's status received from IXLS.

[REQ]

The RBC then shall realize safely (component SIL4) the spacing function of ERTMS level 2 and other related functions described by UNISIG (see REF[1]).

[REQ]

RBC consists of:

- a logic unit based on hardware platform with maximum safety integrity level (SIL4);
- a vital man-machine interface necessary to display safely (SIL4) the information about position, speed, on-board mode of all the train connected along the line and let the operator send emergency messages, set temporary speed restriction etc.;
- a juridical recorder, commercial equipment (SIL0);
- a maintenance/diagnostic unit, commercial equipment (SIL0);

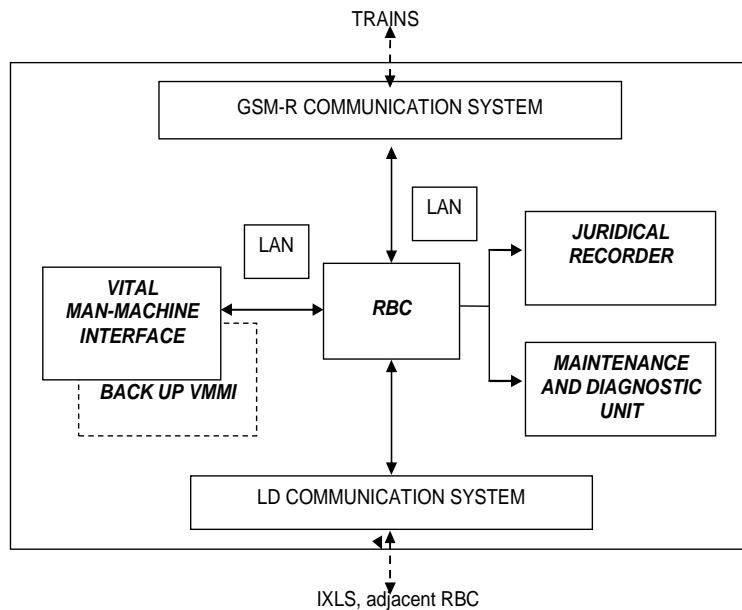


Figure 3: RBC Block Diagram

[REQ]

In Section 1 'Brasov - Sighisoara', RBC shall be installed in the OCC of Brasov.

[REQ]

Vital man-machine interface shall display:

- the status of the trains managed by ISS ERTMS,
- activation of commands from man-machine interface to trains (emergency and temporary speed restriction);
- status of powerless section (active/not active);

[REQ]

Vital man-machine interface shall let the operator:

- send emergency message to the trains,
- set temporary speed restriction;
- change the status of powerless section (active/not active);

- perform special order as ‘close the RBC’ (for maintainability reasons) or ‘manual withdrawal of MA’ (see related management of particular operating condition).

[REQ]

In order to guarantee an high level availability for the traffic management, the VMMI shall be duplicated. There will be two VMMI ‘hot back-up’, meaning that if one is out of order the second one shall be immediately in operation.

[REQ]

In order to guarantee an high level of traffic operation, necessary data shall be saved in appropriate flash memory and the function ‘automatic reset’ of RBC will be provided. At the end of reset procedure data exchanged between RBC and all IXL will be aligned.

### **5.2.2 Eurobalise**

[DEF]

Eurobalise are devices used to transmit information from ground to train, installed along the line.

[REQ]

The technological realization of Eurobalise shall fulfill the rules specified in the document UNISIG (see [REF27]).

[REQ]

Informations shall be transmitted at application layer in the form of telegrams, the structure and semantics are specified in the document UNISIG (see [REF24]).

[REQ]

Eurobalise shall have a total transmission capacity of 1023 bits and shall be energized by the transit of a specific antenna on the train.

[REQ]

Eurobalise shall be able to transmit fix or variable information, last case only when connected to an encoder. An encoder is an electronic device that generates the telegrams to be sent to Eurobalise on the basis of informations received from the IXLS.

[REQ]

A group of two Eurobalises functionally related is defined Balise Group (BG).

[REQ]

Different type of BG with different functionality can be realized using specific telegrams.

[REQ]

In the Section 1 'Brasov - Sighisoara' project, BG fix or variable will be provided when necessary in order to achieve the functionality of on-board recalibration, powerless section management, handover RBC etc...

## 6 ISS 'ERTMS' Functional Requirements

### 6.1 Introduction

[NOTE]

The functional requirements described in this chapter are related to the operation of the Innovative Signalling Sub-System (ISS) ERTMS within the specific application on Section 1 'Brasov - Sighisoara'.

Specific requirements related to spacing and command/control of trains are explained in detail.

Whenever it's possible to draw a match with the UNISIG requirements, this is shown as a reference.

[NOTE]

The national value of UNISIG variables and other configuration values etc.. (if not specified) shall be provided by CFR (see [REF11], [REF12], [REF13], [REF14]).

[REQ]

If a definition/procedure related to a specific system requirement is described in this document in a different way compared with CFR documents (see [REF11], [REF12], [REF13], [REF14]), these last ones shall prevail.

[REQ]

Specific requirements related to transition between national and innovative signalling system ERTMS (and vice-versa) could be modified as a result of testing sessions carried out in pilot project 'line Buftea - Brazi'.

### 6.1.1 Application Level of ERTMS

[REQ]

The 'Brasov - Sighisoara' will be equipped with ERTMS Level 2, whose characteristics are described in document Ref [1], 2.6.6.

[REQ]

All the main tracks and side tracks only when equipped with INDUSI of The 'Brasov - Sighisoara' will be equipped with ERTMS Level 2.

[REQ]

ERTMS Levels 0 or STM (for INDUSI/PZB and only if the specific module is installed on-board) will be applied in junctions with traditional lines.

[REQ]

ERTMS Level 2 shall be provided with the same block section of the national signalling system.

[REQ]

Each line block section shall be provided with an ERTMS marker board (see following figure) located in the same position of light signal block section and indicating the ending block section identification number, the location in km and RBC identification number.

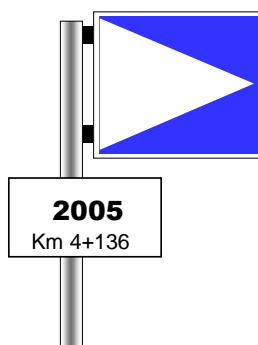


Figure 4: Line ERTMS Marker Board



[REQ]

Each entry/exit station light signal shall be provided with an ERTMS Station marker board (see following figure) located in the same position and indicating the name of station, the next the block section identification number and the location in km.



Figure 5: Entry/Exit Station ERTMS Marker Board

## 6.2 Main Features of the System

### 6.2.1 Balise Group and Linking Function (Rif [1], 3.4)

#### Balise group (Rif [1], 3.4.1)

[DEF]

Eurobalises are beacons installed along the line.

[REQ]

The Eurobalises shall realize the train location reference.

[DEF]

A group of two Eurobalises constitutes an Balise Group (BG).

[REQ]

Eurobalise of the same BG shall be placed at a minimum distance of  $3m \pm 0.6m$

[REQ]

Two BGs shall be placed at a minimum distance of 25m .

[REQ]

The BG shall be able to transmit different kind of information related to different system functionality as described following in this document.

#### **Linking Function (Rif [1], 3.4.4)**

[REQ]

The purpose of the linking function is: ([REF1], 3.4.4.1.1)

- Let the on-board system to determine failure on reading a BG by on-board sub-system. ([REF1], 3.4.4.1.1)
- Reset the error on the spacing measurement given by on-board odometer ([REF1], 3.4.4.1.1)

[REQ]

Reaction after lack of reading a BG by on-board sub-system will be set to the 'No reaction' value ([REF1], 3.4.4.2.3).

[NOTE]

The on-board equipment shall perform the emergency braking at standstill after two consecutive lack of reading BG.

### **6.2.2 Management of Communication via GSM-R System (Rif [1], 3.5)**

#### **Communication Session**

[NOTE]

Euroradio protocol will be used to encode information transmitted via GSM-R communication system (see Norm.[07] UNISIG – Subset 037 – Euroradio FIS).

[DEF]

Communication via GSM-R system is called 'Communication Session'.

[REQ]

Both RBC and On-Board system shall be able to initiate a communication session.

### 6.2.3 Location Principles and Train Position(Rif [1], 3.6)

#### Location Principles

[DEF]

Location and/or line configuration data will be: ([REF1], 3.6.1.1)

- related to specific point along the line (i.e. transitions, linking, etc... see [REF1], 3.6 .1.1)
- valid for a defined distance (i.e. static profiles, gradients, etc... [REF1], 3.6.1.1)

[REQ]

Location reference data are always transmitted by RBC, except of some informations transmitted by Eurobalise telegrams as follows:

- level transition order (by RBC as well);
- national values (by RBC as well);
- "Stop if in Staff Responsible"

[REQ]

Location reference system shall be provided by fix RECALIBRATION BG located 200m before each ERTMS line block section marker board. Recalibration BG shall also contain the number of the RBC (packet 42).

[REQ]

Location reference system shall be provided by fix RECALIBRATION BG located 100m before each ERTMS exit station marker board. Recalibration BG shall also contain the number of the RBC (packet 42).

[NOTE]

The on board equipment uses linking BG as location reference.

[DEF]

The last BG, correctly read by on-board, is called LRBG (Last Relevant Balise Group).

[REQ]

RBC shall send to the on-board equipment information referred to specific point along the line or valid for a defined distance can be specified taking into account the LRBG.

#### **Train Position (Rif [1], 3.6.4)**

[DEF]

The train position confidence interval is referred to the distance from LRBG and includes on-board tolerances (odometric error) and location accuracy of balises (transmitted by RBC)

[NOTE]

The odometer error is reset, after reading of an BG and taking into account location accuracy.

Train position is referred to the front end of Driving Cabin related to the running direction.

[DEF]

Train front end position can be identified as following:

- Estimated position;
- max safe front end, that is the estimated position increased by the measurement error (the position is in advance compared with the estimated position);
- min safe front end, that is the estimated position decreased by the measurement error (the position is behind compared with the estimated position);

[REQ]

RBC shall know the train position.

[NOTE]

On-board equipment shall inform the RBC about its position, sending a 'Position Report' message.

[REQ]

The 'Position Report' message shall contain as a minimum:

- distance between the LRBG and estimated train front end;
- confidence interval of previous distance;
- identity of reference BG (LRBG);
- train speed;
- train operational mode;

- ERTMS level;

[REQ]

Parameters about way of sending 'Position Report' message shall be sent to the on-board equipment by RBC when the train is entering Level 2 area or within the first MA.

[REQ]

As a minimum RBC shall command the on-board equipment to send a Position Report after reading each BG.

[REQ]

Apart from the latest parameters, Position Reports shall be sent from on-board to RBC when:

- reaching the standstill (if applicable to the current mode);
- changing operating mode;
- the train max safe front end passes a RBC/RBC border;
- changing ERTMS level;
- establishing a communication session;

[REQ]

RBC shall check the validity of Position Report message, that is LRBG identity, train position, train orientation compared with LRBG.

All LRBG variables shall be different from 'unknown', otherwise the Position Report shall not be validated.

### 6.3 Data necessary for a complete safe train movement (Rif [1], 3. 7)

[REQ]

In order to command and control the running of the train, RBC shall send to on-board equipment data about path availability and features, as following:

- a) Movement Authority (MA);
- b) Restrictions related to the Movement Authority (i.e. On Sight or Shunting Mode Profile, Temporary Speed Restriction Rif [1], 3.7.1.1);
- c) Path description (long at least as the MA length), containing (Rif [1], 3.7.1.1):
  - Static Speed Profile (SSP);
  - Gradient Profile;
  - Axle Load Speed Profile;
  - Track Condition (Non stopping area due to powerless sections, tunnel, bridges etc..)
  - Suitability Data (axle load, loading gauge)
  - Track Adherence factor (Optional)
- d) BG Linking data

[REQ]

RBC shall have the responsibility to check that the on-board equipment has correctly received data necessary to cover the whole MA extension. As a consequence RBC shall ask to the on-board equipment the acknowledgement (ACK) of MA.

[NOTE]

MA shall not be accepted by on-board equipment if SSP and Slope data don't cover the whole MA extension.

[REQ]

RBC shall send to the on-board equipment other information, when necessary, as follow: (Rif [1], 3.7.2.4)

- a) Emergency Messages;
- b) Temporary Speed Restriction;
- c) National Value;
- d) Condition in order to perform the level transition;

[REQ]

RBC shall send National Value packet when the train is entering Level 2 area, during Start of Mission procedure or in a new MA after a Train Trip.

[REQ]

RBC shall include in the MA all active Temporary Speed Restriction (TSR), if existing, in the path covered by MA.

[REQ]

RBC shall include in the MA information about any RBC/RBC border and/or transition area if existing in the path covered by MA.

[REQ]

The maximum number of TSR packet that can be managed in one MA is equal to 10 (see UNISIG – Subset 040 – Dimensioning and Engineering Rules).

RBC shall limit the MA extension in order to respect this constraint.



## **6.4 Movement Authority (Rif [1], 3.8)**

### **6.4.1 Movement Authority Features (Rif [1], 3.8.1)**

[DEF]

Movement Authority Features are listed following:

- a) The End of Authority (following EoA) is the fixed point along the line as far as the train is authorized to run. In this application EoA shall be located by the section block light signals.
- b) The Target Speed is the permitted speed at the EoA and its value is 0 or at LoA and its value is greater than 0.
- c) If an Overlap (following OL) is not configured, the Danger Point (following DP) is defined as the point beyond the EoA that can be reached by the front end of the train without risk of dangerous situation;

[REQ]

RBC shall identify the MA using a well defined section of the line and a direction of running.

[REQ]

The MA shall contain all the information necessary to the train in order to adjust its running safely and to respect the constraint.

### **6.4.2 MA Configuration (Rif [1], 3.8.3)**

[NOTE]

The MA can contain several block sections.

[NOTE]

A block section is constituted:

- along the line, by one or more track circuits;
- in station, by a complete and locked route (from IXL)

[REQ]

The ERTMS level 2 block sections shall be the same of national signalling system.

### 6.4.3 MA Assignment

[REQ]

The procedure of MA assignment allows the train to run safely along the path covered by MA.

[REQ]

RBC shall assign a specific MA to only one train and the same train shall have only that MA assigned.

[REQ]

RBC shall assign MA depending on the line condition and train position.

[REQ]

RBC shall assign MA to a train only if/when:

- Train positions:
  - the train has a valid position (the Position Report sent to RBC is 'Valid');
  - the train is connected to RBC;
  - between this one and EoA, there's not any other train (controlled by RBC);

- the train is in Level 2 area or has successfully completed the entering Level 2 procedures;
- Line conditions:
  - Route from IXL is locked and free (Full Supervision Operating Mode follows) or route from IXL is locked but not free (On Sight Operating Mode follows);
  - There are not any active alarms from IXL;
  - Level crossing closed and controlled (Full Supervision Operating Mode follows) or Level crossing not controlled (Full Supervision Operating Mode follows with specific TSR and text message to the driver)
  - Burned light bulbs: Full Supervision Operating Mode follows with specific Text Message to the driver

#### **6.4.4 MA Update**

[REQ]

A new MA shall always replace the previously received by on-board equipment. All data contained in previously MA shall be replaced by the new ones.

#### **6.4.5 MA request**

[NOTE]

It shall be possible for the on-board equipment to request a MA.

[REQ]

RBC shall inform on-board equipment about MA request parameters.

[REQ]

It shall be possible to define if MA request shall be repeated until receiving new MA and the time between the requests.

[NOTE]

Driver shall be able to request to RBC a new MA.

#### **6.4.6 MA length**

[REQ]

There are not restrictions on the minimum length of MA.

[REQ]

The MA shall be composed of maximum 4 block sections in order to maintain the right spacing between two train avoiding the braking activation at maximum speed (160 km/h) and in order to not overload the communication channels.

#### **6.4.7 Checking the correct occupation of block sections**

[REQ]

RBC shall be perform the checking of correct occupation sequence of block sections.

[REQ]

RBC shall send a conditional emergency message o a new MA if the second section, beyond the one occupied by the train, turns occupied unexpectedly.

[REQ]

RBC shall send a conditional emergency message if the first section, beyond the one occupied by the train, turns occupied unexpectedly. If the on-board equipment detects to have already overpassed the section shall ignore the conditional emergency message

### 6.4.8 Releasing the MA

[NOTE]

The train with an assigned MA and running along direction given by MA towards the EoA releases the last block section overpassed with its last axis.

[REQ]

RBC shall use sections that have been released by train in order to assign a new MA if needed by another train.

[NOTE]

Along the line the release of block sections shall be performed time by time.

[NOTE]

In station, IXL equipment shall perform the 'elastic release' in order to allow simultaneous train movements.

## 6.5 Speed profiles and infrastructure constraints

### 6.5.1 Introduction

[NOTE]

Maximum speed permitted is limited by Fixed Speed Restriction and by EoA/LoA.

[DEF]

Fixed speed restriction are related to infrastructure features, train characteristics, on-board equipment mode operation and operating condition.

Fixed speed restriction are listed following:

- a) Static Speed Profile;
- b) Axle Load Speed Profile;
- c) Temporary Speed Restrictions;
- d) Maximum Train Speed;
- e) On-Board equipment Mode related speed restriction;

[NOTE]

Fixed speed restriction groups shall be independent of each other. This means that a single group shall not affect, or shall not be affected by, any other group.

The minimum value of the several speed restriction active along a specific line shall be defined as the Most Restrictive Speed Profile to be considered by on-board equipment in order to control the train running.

Depending on the kind of speed restriction, the train length could be used in order to guarantee that the whole length of the train has passed the speed discontinuity before taking into account an increase of speed.

[REQ]

RBC shall determine that the full length of the train has passed the speed discontinuity due to restriction type a), b) or c) before admitting an increase of the permitted speed.

### 6.5.2 Static Speed Profile

[NOTE]

The definition of a Static Speed Profile is necessary in order to guarantee the protection of the train running related to line layout maximum speed permitted for a specific train.

Speed Restriction can be related to the maximum line speed, to track layout curves, slopes, diverted route, tunnels, viaducts etc...

Relation between track and train characteristic determines an unique and specific SSP for each train.

[REQ]

Protection related to SSP shall take into account tolerances due to measurement errors in length and speed by on-board equipment.

[REQ]

Static Speed Profiles in diverted routes to be taken into account in this project are:

- a) Diverted route, tangent 1/9: 40Km/h
- b) Diverted route, tangent 1/12: 60Km/h
- c) Diverted route, tangent 1/14: 80Km/h
- d) Diverted route, tangent 1/18.5: 100Km/h

### **6.5.3 Axle Load Speed Profile (Rif [1], 3.11.4)**

It shall be possible to define an axle load speed profile.

### **6.5.4 Temporary Speed Restriction (Rif [1], 3.11.5)**

[REQ]

Temporary Speed Restrictions (TSR) shall be used to manage temporary infrastructure constraint due to civil/technological work along the line.

[REQ]

TSR shall be independent of each other. This means that a specific TSR shall not be affected by any other TSR.

[REQ]

The identity of TSR (NID\_TSR) shall be chosen from the range defined by UNISIG (REF[1]) and reserved to TSR sent from RBC.

[REQ]

RBC shall inform the on-board equipment (using specific UNISIG variables) if the increase of speed shall be performed taking into account the whole train length.

[REQ]

If two or more TSR are overlapped, RBC shall send to the on-board equipment the profile of the more restrictive one.

[REQ]

Each TSR has an unique identity tag. RBC shall use this identity tag to revoke the TSR.

[NOTE]



The on-board equipment shall immediately cancel TSR after the order received by RBC without taking into account train length.

[REQ]

RBC shall inform the on-board equipment if it shall be possible to revoke a TSR (using specific UNISIG variables). Only RBC shall ask for a TSR revocation.

[NOTE]

The on-board equipment shall not substitute a TSR if a TSR with a different identity tag has been received. On-board equipment shall substitute a TSR with the same TSR of a previously received one except in case this latter is defined as not revocable (only NID\_TSR=255 is defined as not revocable).

[NOTE]

The on-board equipment going to Stand By mode shall cancel all TSR if performing a change of orientation.

[REQ]

TSR shall be activated by:

- a specific command by RBC operator, using RBC Vital Man Machine Interface;
- automatically, after receiving a specific IXL control related to Level crossing not controlled;

[REQ]

RBC VMMI, located in OCC, shall allow the operator to introduce TSR with a speed value between 5 Km/h and 155 Km/h. with 5 Km/h as step.

[REQ]

RBC VMMI shall allow the operator to define the TSR extension with step of 10 meters.

[REQ]

VMMI RBC shall allow the RBC operator to cancel the TSR.

It shall be possible to cancel the TSR only by VMMI command by RBC operator.

[REQ]

VMMI RBC shall be designed and realized taking into account the maximum safety integrity level (SIL4).

[REQ]

Setting-up, activation and cancel of TSR shall be protected versus human errors using specific Romanian procedures.

[REQ]

If a TSR extends over the transition area between ERTMS Level 2 and traditional signalling system, specific Romanian procedures shall be provide to guarantee the correct application of the whole speed restriction.

### **6.5.5 Maximum Train Speed (Rif [1], 3.11.8)**

[NOTE]

It shall be possible to define a maximum train speed related to performance and configuration of the specific train, using the on-board system.

### **6.5.6 Mode related speed restriction (Rif [1], 3.11.7)**

[REQ]

RBC shall send to the on-board system the configuration of speed restriction related to operational mode of the train (national value).

### **6.5.7 Protection as regards of gradient profile**

[REQ]

RBC shall transmit to the on-board equipment information about gradient profile of the line.

### **6.5.8 Protection as regards of specific Track Condition (Rif [1], 3.12.1)**

[REQ]

RBC shall inform the on-board equipment and driver about specific Track Condition.

[REQ]

Following track condition shall be used:

- Powerless section (Powerless Section – Switch Off Main Power Switch);

### **6.5.9 Protection as regards of route suitability (Ref [1], 3.12.2)**

[DEF]

Route suitability data defines which values concerning loading gauge, power supply and axle load a train must meet to be allowed to enter the route.

[REQ]

RBC shall inform the on-board equipment about route suitability data when needed.

## 6.6 Train Running Protection

### 6.6.1 Dynamic speed Monitoring

[NOTE]

Protection of train running shall be reached by on-board equipment taking into account the actual train speed, in order to respect the most restrictive speed profile and the limit of EoA/LoA.

Speed monitoring includes:

- a) A 'ceiling speed' monitoring, related to the most restrictive speed profile;
- b) 'target speed' and braking curve monitoring;
- c) 'Train Trip' function if EoA/LoA has been passed;
- d) 'Release Speed' monitoring;

Speed monitoring shall take into account the following input data:

- a) Traction and braking mathematical model;
- b) Track adhesion factor;
- c) Most restrictive speed profile;
- d) Gradient/slope profile;
- e) MA data (LoA – EoA – SL);
- f) On-board estimated train speed;

### 6.6.2 Supervision Limits

[NOTE]

On the basis of input data previously described, the on-board equipment shall evaluate the supervision limits in order to protect the train running (monitoring of 'ceiling speed', 'target speed', 'release speed'). The on board equipment shall also give indication to the driver about automatic braking intervention.

[NOTE]

**Limit of the Permitted speed:** it shall be displayed on the driver-machine interface. Driver shall respect that limit.

**Limit of the Warning curve:** if overpassed, it shall be produced an acoustic warning in order to let the driver avoid the automatic braking intervention. The warning shall persist until the train speed is equal or lower than the permitted one.

**Limit of the Service Brake intervention:** it shall be the first limit of automatic intervention in the following circumstances:

- a) Monitoring of 'ceiling speed';
- b) Monitoring of 'Target Speed';

except service brake intervention is not available on the train or the 'emergency brake application' is considered for the monitoring of target speed.

Service brake intervention shall be applied when actual speed overpasses the specific limit Service brake intervention shall be displayed on the driver-machine interface (DMI).

Service brake application shall be revoked as soon as the actual train speed is equal or lower than the permitted one.

[NOTE]

After the service brake intervention (it is not considered safe), the Emergency Brake intervention shall be applied in the following circumstances:

- a) Monitoring of the Release Speed;
- b) Train Trip function application;
- c) Monitoring of Target speed (if the service brake is not present);
- d) Whenever service brake is not available;

Emergency brake intervention shall be applied when actual speed overpasses the specific limit.

Emergency brake activation shall be revoked as follows:

- If used as a second limit of intervention (service brake is available), when the actual speed is equal or lower than the permitted one;
- If used as first limit of intervention:
  - If the service brake is not available when the actual speed is equal or lower than the permitted one;
  - If activated by monitoring of Release Speed or after application of Train Trip function at standstill.

**Indication of the limit:** the on-board equipment shall displayed the limit in the DMI in order to let the driver start braking before the permitted begins to decrease.

### 6.6.3 Train Trip Function

[NOTE]

Train Trip function shall be immediately applied by the on-board equipment if an active EoA has been passed by the train front end.

It shall be possible for the driver to release at standstill the Train Trip function and to overpass an EoA using a specific procedure (see 'Override EoA').

### 6.6.4 Brake Command Handling and Protection against Undesirable Train Movement

[REQ]

RBC shall be configured with the national value about the maximum distance related to the roll away protection.

[NOTE]

If the emergency brake has been activated by Train Trip function, the command shall be released only at standstill and after driver's acknowledgement.

[NOTE]

If the speed dynamic monitoring determines a service break application, the command shall be released when the actual speed is equal or lower than the permitted one.

[NOTE]

If the brake intervention has been activated in order to assure a roll away protection, reverse movements or standstill control, the command shall be released only at standstill.

[NOTE]

If the brake intervention has been activated after a linking error or belises message inconsistency, the command shall be deleted only at standstill.

[NOTE]

The on-Board equipment shall display on DMI when it shall be possible to release the brake intervention and if the driver is asked for an acknowledgement.

## **6.7 Train running management**

### **6.7.1 Stopping points protection in FS**

**Line and stations: Train stop at the end of its MA in FS within open line and station (entry and exit signals).**

[REQ]

The RBC configuration shall foresee an EoA in the same position of each light signal.

[REQ]

For the EoAs corresponding with the light signals a Release Speed of 20 km/h, shall be given by RBC as national value.

[NOTE]

In this occurrence it cannot be ensured that the train will come to a stop before the EoA. There should be a dangerous situation (hazard) if the driver overpass the EoA (corresponding to the Danger Point) with the RS of 20 km/h. Train trip shall be initiated when the on-board equipment will detect that the minimum safe front end has passed the EoA, but the train will be already inside the next block section (detected as occupied).

CFR will provide specific procedure in order to mitigate the hazard previously described (see letter 17/UIP/7/361/04-08-2011 and meeting CFR/VIOTOP/ITALFERR 13th September 2011).

## 6.7.2 Marker Boards

### Line

[REQ]

On the pole of the signal shall be installed an ERTMS marker board indicating:

- End of section ID
- RBC Area (RBC ID)
- Location (km + m)



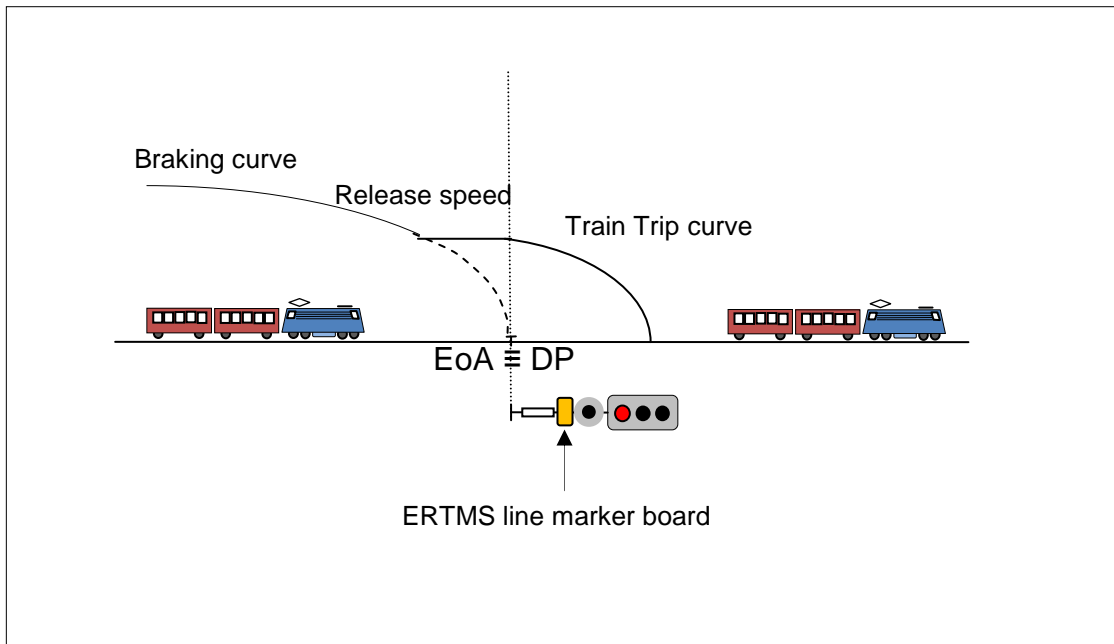


Figure 1: Open Line EoA

### Station entry signal.

[REQ]

On the pole of the entry signal shall be installed an ERTMS Station marker board, different in comparison to the one used in open line, indicating:

- End of section ID
- RBC Area (RBC ID)
- Location (km + m)
- Name of station

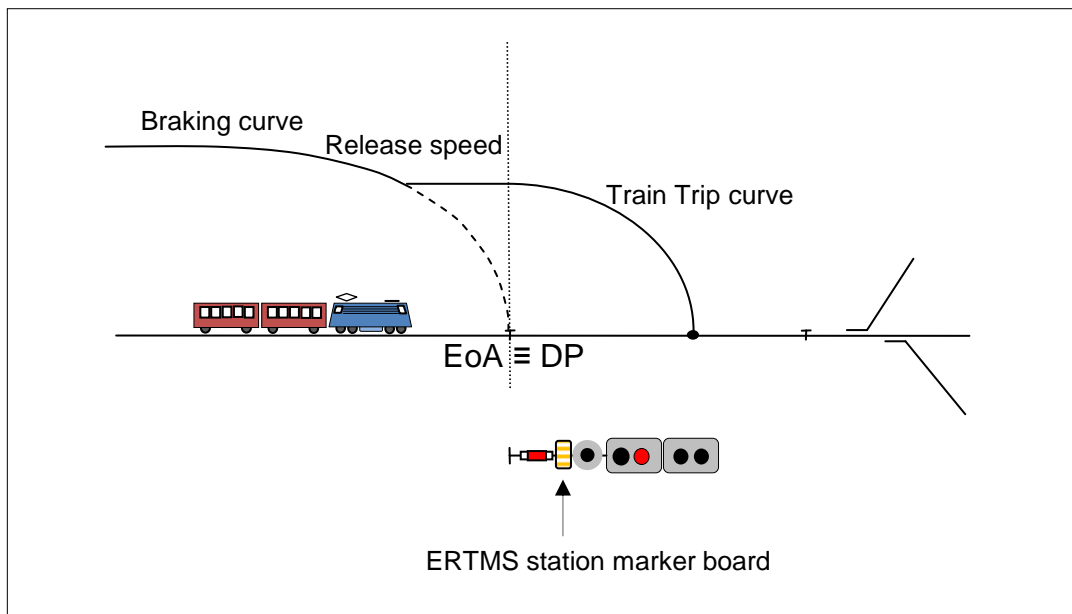


Figure 2: EoA at a station entry signal

### Station exit signal

[REQ]

On the pole of the exit signal shall be installed an “end of section” marker board, different in comparison to the one used in open line, indicating:

- End of section ID
- RBC Area (RBC ID)
- Location (km + m)
- Name of station

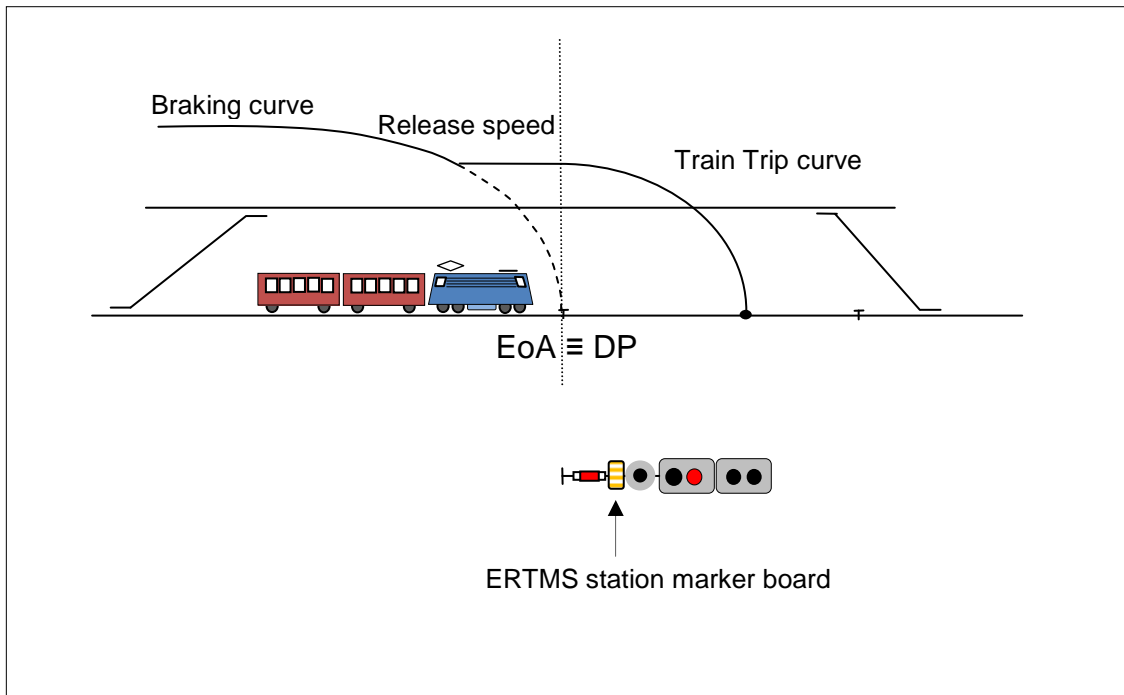


Figure 3: EoA at a station exit signal

## **6.8 The on board Operational Modes and Procedures**

### **6.8.1 Isolation (Ref [1], 4.4.3)**

[NOTE]

See Ref [1], 4.4.3.

### **6.8.2 No Power (Ref [1], 4.4.4)**

[NOTE]

See Ref [1], 4.4.4

### **6.8.3 System Failure (Ref [1], 4.4.5)**

[NOTE]

See Ref [1], 4.4.5

### **6.8.4 Sleeping (Ref [1], 4.4.6)**

[NOTE]

Sleeping on-board operating mode shall not be applicable to this specific application (confirmed by CFR).

### **6.8.5 Non Leading (Ref [1], 4.4.15)**

[NOTE]

Non Leading on-board operating mode shall not be applicable to this specific application (confirmed by CFR).

### **6.8.6 Joinig/Splitting (Ref [1], 4.4.15)**

[NOTE]

Joining/Splitting on-board operating mode shall not be applicable to this specific application (confirmed by CFR).

### **6.8.7 Reversing (Ref [1], 4.4.18)**

[NOTE]

Reversing on-board operating mode shall not be applicable to this specific application.

### **6.8.8 Stand By (Ref [1], 4.4.7)**

[NOTE]

In Stand-By Mode the on-board equipment shall be initialized and shall execute the self-test procedures.

In Stand-By Mode the driver shall perform the procedure of entering train data ('Start of Mission' Procedure).

In Stand-By Mode the on-board equipment shall apply the standstill control.

### **6.8.9 Shunting (Ref [1], 4.4.8)**

[NOTE]

In Shunting Mode the on-board equipment shall control the train movements as regards of a ceiling speed, national value ( $V_{NVSHUNT} = 20$  Km/h);

[NOTE]

In Shunting Mode the on-board equipment shall not request for entering train data.

[NOTE]

In Shunting Mode the on-board equipment shall control the train position.

[NOTE]

The transition to Shunting Mode shall be considered as End of Mission (see Procedure).

[NOTE]

In Shunting Mode the on-board equipment shall not manage level transition, that is there will be no RBC/RBC handover and/or announcement of level transition.

[NOTE]

Driver shall be able to select Shunting Mode only at standstill and the on-board equipment shall ask for the RBC acknowledgement.

[REQ]

RBC shall not order the on-board equipment to pass into Shunting Mode without driver's request.

[REQ]

RBC shall authorize the Shunting Mode request by driver. After that the management of shunting process shall follow the national procedures.

[NOTE]

The on-board equipment shall inform the driver about the actual speed and the maximum speed permitted using the DMI display.

[NOTE]

The supervised speed shall be displayed on request by Driver.

### **6.8.10 Full Supervision (Ref [1], 4.4.9)**

[NOTE]

In Full Supervision mode all trackside and train data (necessary to command/control the train running) shall be available.

[NOTE]

The transition to Full Supervision shall be possible when all the necessary conditions are fulfilled (track sections in front of the train are free and there's no emergency condition activated) and without any driver selection.

[NOTE]

The transition to Full Supervision shall be possible after the Track Ahead Free procedure (see)

[NOTE]

The on-board equipment shall control the train running as regards of the dynamic speed profile.

[NOTE]

The main features displayed by on-board equipment shall be the actual speed, the permitted speed, the remaining distance to target, target speed.

### **6.8.11 Unfitted (Ref [1], 4.4.10)**

[NOTE]

The Unfitted mode shall be used when the train is outside the ERTMS fitted area or INDUSI signalling system is not present or if trackside equipments are temporary out of service.

[NOTE]

The on-board equipment shall control the speed as regards of a ceiling speed. The ceiling speed shall be set to the minimum value between the train maximum speed and the maximum speed permitted on the specific line (national value,  $V_{NVUNFIT} = 160 \text{ km/h}$ ).

[NOTE]

The on-board equipment shall control the temporary speed restriction as well.

[NOTE]

The on-board equipment shall display the actual train speed on the DMI.

#### **6.8.12 Staff Responsible (Ref [1], 4.4.11)**

[NOTE]

The on-board equipment in Staff Responsible mode shall allow the driver to move a train inside ERTMS area under his responsibility.

[NOTE]

The Staff Responsible mode shall be used when the route is unknown.  
Examples:

- a) during Start of Mission;
- b) to override an EoA;
- c) in degraded condition (ex. crash of GSM-R communication system)

[REQ]

RBC shall not send to the on-board equipment a list of linked BG. In this way all BGs can be passed by train.



[REQ]

Fix BGs transmitting the telegram 'Stop if in Staff Responsible' shall be located in the same position of the station exit and entry signal. The telegram shall be valid only in the same direction of the signal.

[NOTE]

The on-board equipment in Staff Responsible mode shall control the train movements as regard of:

- a) A ceiling speed defined with a national value ( $V_{NVSTFF} = 20$  Km/h);
- b) A distance defined with a national value ( $D_{NVSTFF} = \infty$ );
- c) The BG telegram 'Stop if in Staff Responsible'; train shall be tripped if that BG has been read.

[NOTE]

The on-board equipment in Staff Responsible mode shall allow the driver to modify the national value of speed related to Staff Responsible. This procedure is possible only at standstill.

[NOTE]

In Staff Responsible mode, driver shall be able to select the 'Override EoA' on DMI in order to prevent activation of Train Trip when overpassing the BG with 'Stop if in Staff Responsible' telegram.

### 6.8.13 On Sight (Ref [1], 4.4.12)

[NOTE]

The on-board equipment in On Sight mode shall allow the train to enter in a occupied block section.

[REQ]

The RBC shall be able to authorized a train to enter an occupied block section in On Sight mode only if there's no any other train controlled by RBC in that section.

[REQ]

The RBC shall be able to authorized On Sight mode not covering more than a single block section.

[REQ]

The RBC shall send a MA in OS mode only when the block section ahead is occupied and the signalman, after he performed all the checks and verifications in applying of the rules of the national signaling system, gives a specific command by means the RBC VMMI (Man Machine Interface). This last command shall be replaced from an automatic dispatch if available in the interlocking system.

[REQ]

The management of the stopping points related to the EoAs in OS mode, shall be compliant with the rules used for the EoAs in FS mode.

[NOTE]

The driver shall acknowledge the On Sight mode.

[REQ]

RBC shall send to on-board equipment a request of acknowledgement of On Sight mode to be displayed to the driver at least before the ERTMS block section marker board related to the occupied block section.

[NOTE]

If the driver has not acknowledged after a 5 seconds delay, the service brake command shall be triggered. The brake command is released when the driver acknowledges, except if brakes are also applied for another reason(s).

[NOTE]

The on-board sub system shall perform the transition from OS mode to FS mode when its front end goes beyond the EoA in OS mode.

[NOTE]

The on-board equipment in On Sight mode shall control the train running as regards of a dynamic speed profile and a national value of ceiling speed ( $V_{NVONSIGHT} = 20 \text{ Km/h}$ ).

[NOTE]

The on-board equipment in On Sight mode shall display the actual train speed. Permitted speed, target speed, target distance will be displayed only on driver selection.

[REQ]

The RBC shall ask and achieve the TAF(see related procedure) acknowledgement both to perform the transition from OS mode to FS mode and to send a new MA in OS mode on the next block section, if all the other conditions are verified.

[REQ]

The RBC shall send the TAF request when the train which is running the occupied section is within a distance of 100 m before the end of the section (TAF window).

#### **6.8.14 Trip (Ref [1], 4.4.13)**

[NOTE]

The on-board equipment in Trip mode shall apply the emergency brake up to standstill (no brake release is possible).

[NOTE]

The on-board equipment in Trip mode shall activate a warning to the driver.

[NOTE]

Only at standstill the on-board equipment shall request for the driver acknowledgment in order to switch to Post Trip mode and start running again.

#### **6.8.15 Post Trip (Ref [1], 4.4.14)**

[NOTE]

The on-board equipment shall automatically switch to Post Trip mode after the driver train trip acknowledgment.

[NOTE]

The on-board equipment in Post Trip mode shall release the emergency brake.

[NOTE]

The on-board equipment in Post Trip mode shall allow the driver to select 'Start' (see Start of Mission procedure).

[NOTE]

The train is allowed to move backward for a defined distance (national value, D\_NVOVTRP =200 m). The on-board equipment shall control that distance and apply emergency brake if necessary.

[NOTE]

Train Trip is inhibited in moving backward movement.

#### **6.8.16 STM (Ref [1] 4.417)**

[NOTE]

The SN mode (Indusi) shall be used in the current application where INDUSI signalling system is available and outside the ERTMS Level 2 area.

The SN mode enables a STM module to access the following resources via the ERTMS/ETCS on-board equipment: DMI, train interface and brakes.

[REQ]

No signalling supervision functionality is provided by the ERTMS/ETCS on-board equipment.

[NOTE]

The ERTMS/ETCS Onboard is responsible for providing the STM with access to various resources such as DMI, Juridical Recorder and train interface.

[NOTE]

The ERTMS/ETCS Onboard is responsible for taking safe action in case of a failure detected on the STM interface (to be confirmed by CFR if the reaction is only an alarm or the brake application)

[NOTE]

The Indusi STM is responsible for all train supervision and protection functions.

[NOTE]

The Indusi STM is responsible for issuing and revoking brake command.

[NOTE]

The Indusi STM is responsible for maintaining national system behavior and interact with Romanian trackside equipment.

#### **6.8.17 Start of Mission Procedure**

[NOTE]

The following requirements shall be applied to the specific application taking into account the procedure described in Ref [1] 5.4.

[NOTE]

The driver shall inform the dispatcher about the departing train position and wait for the dispatcher acknowledgement (following Romanian operating rules) in order start running.

[NOTE]

After the driver has successfully performed the procedure to establish a communication session with RBC. he shall select the START option on DMI.

[NOTE]

The driver shall acknowledge the Staff Responsible mode and start the train running.

[NOTE]

The on-board equipment shall send to RBC a Position Report after reading the first BG met.

[NOTE]

The driver shall approach the train in front of the ERTMS block section marker board.

[END\_NOTE]

[REQ]

During Start of Mission three circumstances shall be possible:

- Track section is free: RBC shall perform the TAF procedure and after the TAF granted received from on-board equipment (by driver acknowledgement) shall send a MA in Full Supervision mode;
- Track section is not free: RBC shall perform the TAF procedure and after the TAF granted received from on-board equipment (by driver acknowledgement) shall send a MA in On-Sight mode;
- If none of the previously condition is satisfied: RBC shall not send any data/message to the train and the on-board equipment shall remain in Staff Responsible mode. Train shall be able to start running again only following Romanian operating rules.

### **6.8.18 Track Ahead Free Procudure**

[REQ]

RBC shall send a Track Ahead Free message to the on-board equipment.

[NOTE]

The on-Board equipment shall be able to manage Track Ahead Free message from RBC.

[REQ]

Track Ahead Free message shall contain:

- a) Position where the display of track ahead free shall be start for driver (TAF\_Window set to 100 meters before end of section marker board/block section light signal);
- b) If driver doesn't acknowledge, position where the request shall not be displayed anymore.

[NOTE]

The Driver shall be able to acknowledge the track ahead free request.

The on-board equipment shall inform the RBC about the driver's acknowledgement the track ahead request. After the driver's acknowledge, the on-board equipment shall not display the request on DMI anymore.

If driver doesn't acknowledge there will be no restrictions for the on-board equipment.

#### **6.8.19 End of Mission Procedure**

[NOTE]

See Ref [1], 5.5.

#### **6.8.20 Override EoA Procedure**

[NOTE]

See Ref [1], 5.8.



### **6.8.21 Level Transition**

[NOTE]

See chapter 'Management of entrance and exit to/from ERTMS Level 2'

### **6.8.22 Change Train Orientation**

[NOTE]

In case of change orientation, the driver shall perform the End of Mission procedure on a desk and the Start of Mission on the new desk.

### **6.8.23 RBC/RBC Handover**

[NOTE]

See Ref [1], 5.15.

## **6.9 Management of particular operating condition**

### **6.9.1 Requirements for 'Level Crossing' management**

[NOTE]

RBC shall be informed of the status (controlled/not controlled) of a level crossing using a specific relation from IXL system.

[REQ]

RBC shall let the train enter a block section containing a not controlled level crossing in FS mode.

[REQ]

If the relation of 'not controlled level crossing' has been received from IXL sub-system, RBC shall activate a Temporary Speed Restriction (5 Km/h).

[REQ]

If the relation of 'not controlled level crossing' has been received from IXL system, RBC shall always send a warning text message to be displayed on the DMI when the train is approaching to the level crossing. The message shall be displayed on DMI until the driver confirm.

### **6.9.2 Requirements for 'Burned Light Bulb' management**

[NOTE]

RBC shall be informed of the status (active/out of order) of the signal's light bulbs using a specific relation from IXL system.

[REQ]

RBC shall let the train enter a block section after a burned light bulb in FS mode without any restriction.

[REQ]

If the relation of 'burned light bulb' has been received from IXL system, RBC shall always send a warning text message to be displayed on the DMI when the train is approaching the related signal. The message shall be displayed on DMI until the driver confirm.

### **6.9.3 Requirements for 'Cooperative Shortening of MA' management**

[REQ]

The function 'cooperative shortening of MA' shall be implemented in RBC.

[REQ]

The function shall be applied when RBC receives a request to unlock a route from IXL, using a specific relation.

[REQ]

After receiving the request to unlock the route from IXL, RBC shall be able to check the presence of assigned MA along the route and:

- If no, RBC shall send to the IXL system the confirmation to unlock the route;
- If yes, RBC shall ask to the train if it can stop to the new EoA. If the answer is positive the RBC shall send to the IXL system the confirmation to unlock the route, unless (the train's answer is negative or not arrived to RBC in a pre-fixed time) RBC shall send to the IXL system the negative answer about unlocking the route.

#### **6.9.4 Requirements for 'Manual Withdrawal of MA' management**

[REQ]

If the connection between train and RBC has failed or the on-board unit of the train is out of order, it shall be possible for the operator of RBC to remove manually the MA using a specific command of VMMI.

[NOTE]

This function should be used only in degraded situation; normally the cooperative shortening of MA should be performed.

## **6.10 Messages to the trains**

### **6.10.1 Introduction**

[REQ]

RBC shall be able to send both specific message to the train in order to protect the train running and auxiliary message related to the driver operation.

### **6.10.2 Emergency Messages**

#### **6.10.3 Stop Messages**

[REQ]

RBC shall send emergency messages using the high priority channel of GSM-R communication system.

[REQ]

RBC shall send emergency messages revocation using the standard channel of GSM-R communication system.

[REQ]

RBC shall be able to send an 'Unconditional emergency stop' to a single train or to all trains a specific area of the line. EoA shall be immediately placed coinciding with the front end of the train.

[NOTE]

As a consequence the on-board equipment shall immediately apply the Train Trip function.

[REQ]

RBC shall be able to send a 'Conditional Emergency Stop' to a single train in order to stop the train in a specific point of the line.

[NOTE]

The on-board reaction shall take into account the train position as regards of the stopping point. If the train has already passed the stopping point there will be no reaction, else the on-board equipment shall apply the train trip.

[REQ]

RBC shall be able revoke an emergency message in order to allow the train to run again only at standstill.

#### **6.10.4 Text Messages**

[REQ]

RBC shall be able to send Text Message to be displayed on DMI.

[REQ]

RBC shall always set a valid value on text messages parameters about conditions and place where message shall be shown to the driver (and eventually if an acknowledgment is required).

#### **6.10.5 Geographical Position of the train**

[NOTE]

Geographical position of the train shall be displayed on DMI on request by driver.

[REQ]

Recalibration BG shall always transmit the variable related to the Geographical Position (Packet 79) for the nominal direction of running.

## 6.11 Management of entrance and exit to/from ERTMS Level 2

### 6.11.1 Introduction

[DEF]

Let us define as 'Border' the transition point between the innovative (ERTMS) and traditional signalling system and vice-versa (exiting border/entering border).

[REQ]

The entering and the exiting borders shall always be located corresponding to a light signal.

[REQ]

The entering and the exiting borders shall always be shown trackside by means marker boards installed on the poles of the related light signals.

[DEF]

Let us define as 'Border area' the transition area valid only for the direction from traditional to ERTMS Level 2 area. It is delimited by the first BG met on the side of traditional signalling system and the 'Border'.

[DEF]

Let us define as 'ERTMS Level 2 area' the area managed by RBC and located inside the borders.

### **6.11.2 Transition between traditional signalling system and ERTMS Level 2**

[NOTE]

The train that is going to enter the ERTMS level 2 area shall be in Level 0 (Unfitted Mode) or Level STM (SN/SE Mode), depending on its on-board equipment.

[REQ]

The entering in ERTMS level 2 area in nominal condition shall be performed without any speed reduction due to the level transition.

[REQ]

In the Border Area the on-board equipment shall begin the connection procedure with RBC using a 'CONNECTION' duplicated BG.

[REQ]

'CONNECTION' BGs shall be located along the line taking into account the GSM-R performance requirements in order to achieve the connection between the on-board equipment and RBC before the train requests to the RBC the MA to overpass the border in ERTMS mode (first MA).

[REQ]

In the entering ERTMS Level 2 Border area, RBC shall send the first MA to the on-board equipment.

[NOTE]

This last MA shall be displayed on DMI only when the train overpasses the border.



[REQ]

'ANNOUNCEMENT' duplicated BGs shall be located along the line between the 'CONNECTION BGs' and the border in order to allow the train to request the first MA to the RBC. The distance between the 'ANNOUNCEMENT BGs' and the border shall be estimated considering the performances of the system allowing the train to receive the first MA before it reaches the border.

[REQ]

The entry borders shall coincide with:

- The warning signal of the Brasov home signal, Darste facing side;
- The warning signal of the Apata home signal, Augustin facing side;
- The warning signal of the Racos home signal, Augustin facing side;
- The warning signal of the Racos home signal, Rupea facing side;
- The warning signal of the Cata home signal, Rupea facing side;
- The warning signal of the Vanatori home signal, Odorhei facing side;

[REQ]

The light signals corresponding with the entry borders shall be controlled by traditional signalling system and their aspect shall not be affected by ERTMS Level 2.

[NOTE]

National rules shall permit to a train equipped ERTMS Level 2 to pass the ENTRY BORDER light signal, even if it has not received the MA due to degraded condition (failure of ERTMS Level 2 equipment or GSM-R communication system etc...)

[REQ]

A 'LEVEL TRANSITION L0/L2' BG shall be placed before the 0.5 Indusi inductor.

[REQ]

The 'LEVEL TRANSITION L0/L2' BG shall send to the on-board equipment a telegram with the order to switch immediately to ERTMS Level 2.

### **6.11.3 Transition between ERTMS Level 2 and traditional signalling system**

[NOTE]

The train that is going to exit the ERTMS Level 2 area shall be in Full Supervision, On Sight or Staff Responsible mode.

When the train overpasses the border, the on board system shall switch to Level 0 (Unfitted Mode) or Level STM (SN/SE Mode), depending on its equipment.

[REQ]

The exit from ERTMS level 2 area in nominal condition shall be performed without any speed reduction due to the level transition.

[REQ]

The exit borders shall coincide with:

- The signal of the first block section exiting from Brasov, Darste facing side.
- The exit signal from Brasov, Brasov Triaj facing side.
- The signal of the first block section exiting from Apata, Augustin facing side.
- The signal of the first block section exiting from Racos, Augustin facing side.
- The signal of the first block section exiting from Racos, Rupea facing side.
- The signal of the first block section exiting from Cata, Rupea facing side.
- The signal of the first block section exiting from Vanatoti, Odorhei facing side.

[REQ]

RBC shall send the last MA within a value of LoA in agreement with the speed permitted by traditional signalling system.

[NOTE]

Driver shall acknowledge the transition order, shown in the 'transition window', or the train shall be tripped.

[REQ]

The 'transition window' shall be included in the 'light signal visibility area' (Romanian value) in order to let the driver be ready for the transition to traditional signalling system

[REQ]

A 'LEVEL TRANSITION L2/L0' BG shall be placed before the 0.5 Indusi inductor.

[REQ]

The 'LEVEL TRANSITION L2/L0' BG shall send to the on-board equipment a telegram with the order to switch immediately to ERTMS Level 0.

[REQ]

The 'DISCONNECTION' BG shall send to the on-board equipment a telegram with the order to close immediately GSM-R connection.

## 6.12 Management of Powerless Section of Traction Power

### 6.12.1 General Requirements

[NOTE]

25 kV Traction Power imposes the presence of powerless sections for changing the AC phase (Change Phase Post, CPP), in order to guarantee the correct distribution of electric loads.

[DEF]

A CFP is:

- Active: if there's a powerless section
- Not Active: if there's no powerless section

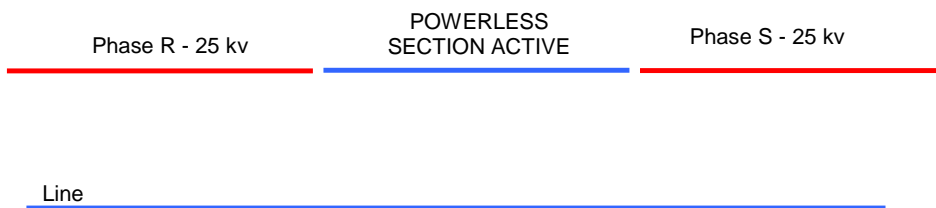


Figure 3: Active Powerless Section

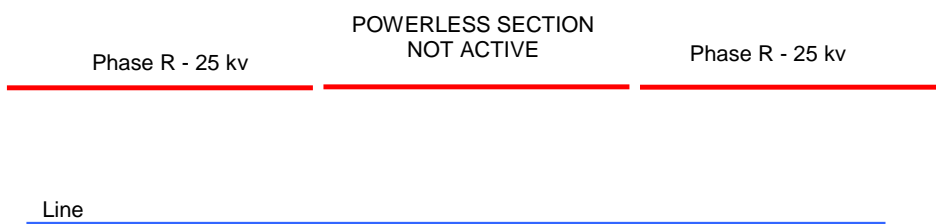


Figure 4: Not Active Powerless Section

[NOTE]

The CPP configuration (active/not active) in RBC shall be defined using a manual procedure.

[REQ]

RBC operator shall enter the same CPP configuration using VMML.

[REQ]

RBC shall be able to manage the protection as regards of powerless section (CPP configuration input by VMML) by sending to the on-board equipment the appropriate information.

[NOTE]

The on-board equipment shall be able to display on DMI the correct information to the driver and shall be interfaced with the train's automatic powerless section manager unit (to be confirmed by CFR).

[NOTE]

Close to the active powerless section, the on-board equipment shall command the disconnection of train traction before the pantograph has reached the powerless section.

[NOTE]

The on-board equipment shall command the connection of train traction after the pantograph has overpassed the powerless section.

[REQ]

RBC shall take into account the train's power unit transition response times as regards of powerless section management.

[REQ]

On board the train, powerless section management shall be possible in manual or automatic way.

[REQ]

RBC shall not allow the on-board equipment to pass into OS mode before an active powerless section. The train could not be able to overpass the active powerless section due to the reduced speed in OS mode.

[REQ]

The train dispatcher shall not allow a train to enter an active powerless section in SR mode using a specific procedure provided by CFR. The train could not be able to overpass the active powerless section due to the reduced speed in SR mode.

[REQ]

The location of EoA before the powerless section shall allow the train that is going to start running at standstill to pass the powerless section.

[REQ]

The location of EoA beyond the powerless section shall allow the train to pass with its whole length.

[REQ]

RBC shall inform the on-board equipment about the powerless section length if active.

[REQ]

RBC shall inform the on-board equipment about the distance between the 'POWERLESS SECTION' BG and the beginning of powerless section, if active.

[REQ]

RBC shall send to the on-board equipment the track condition of NON STOPPING AREA with information about extension and distance from the LRBG, if powerless section is active.

[REQ]

If powerless section is not active, RBC shall send to the on-board equipment the message text of 'Powerless section not active'.

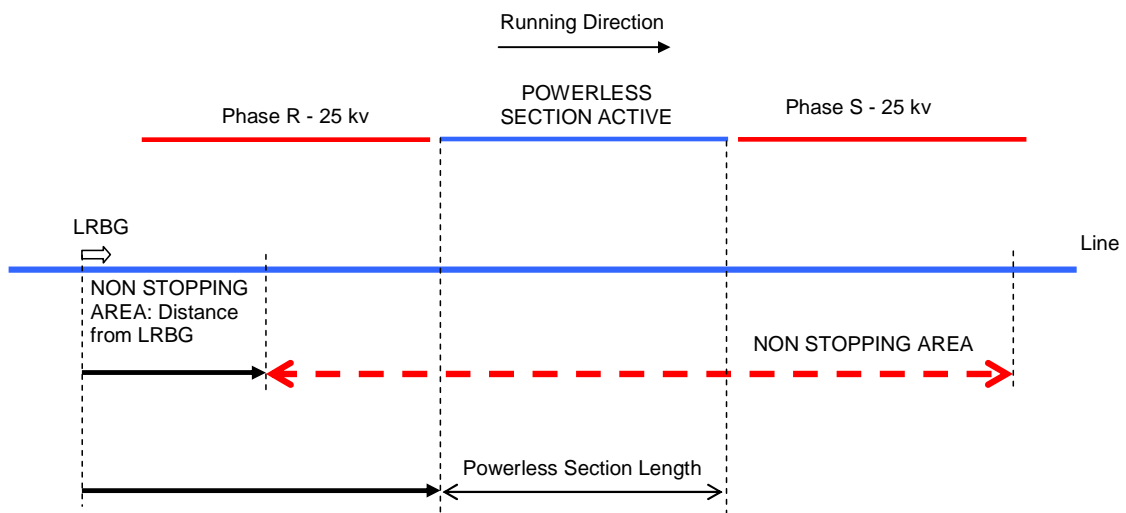


Figure 5: Non Stopping area configuration

[DEF]

Disconnection of Train Traction Space (DTTS), is the space necessary to the train in order to perform the disconnection of traction power at the maximum speed.



[REQ]

'POWERLESS SECTION' BG shall be placed outside the DTTS area.

[REQ]

'POWERLESS SECTION' BG shall be placed 200m (BG1) and 750m(BG2)  
before the axis of the powerless section for each direction of running.