

## D4.6 Exported constraints

### for the development of an STM ATB

CHANGE REVISION 406871 versus current revision 406871A

For publication purposes chapter 6 of revision 406871 has been declared not applicable in current revision 406871A. This is the only change in this document.

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## 1 Preface

**Text, STMA-21896** - In the current document the "exported constraints" necessary for the STM ATB to comply with the input requirements are defined. The concerning input documents concern:

- ¶ STMA-10707 - D3.1 Requirements from Regeling Indienststelling Spoorvoertuigen 9/2016
- ¶ STMA-6553 - D3.2 ATBv requirements v11
- ¶ STMA-10239 - D3.4 Additional User Requirements

In addition the above requirements the ETCS on-board shall comply with the relevant requirements concerning the interface between the STM ATB and the ETCS on-board.

**Requirement, STMA-15229** - The ETCS on-board shall be compatible with an STM which is compliant with:

- ¶ STMA-10814 - D4.7.4 Specific Transmission Module (SS035 v3.2.0)
- ¶ STMA-11331 - D4.7.2 STM FFFIS Safe Time Layer (SS056 v3.0.0)
- ¶ STMA-11326 - D4.7.1 STM FFFIS Safe Link Layer (SS057 v3.1.0)
- ¶ STMA-10810 - D4.7.3 STM FFFIS Application Layer (SS058 v3.2.0)
- ¶ STMA-7262 - D4.7.5 Performance requirements (SS059 v3.1.0)

**Text, STMA-21897** - Subsets 56, 57 and 58 completely apply to the STM ATB and ETCS on-board. Subsets 35 and 59 contain requirements which are applicable only to the STM ATB and requirements which are applicable only to the ETCS on-board. In annex A of this document an overview of requirements assigned from subset 35 and subset 59 to the ETCS on-board is given.

In chapter ¶ STMA-7239 - ETCS on-board of this document, exported constraints to the ETCS on-board are defined. A part of these requirements, described in paragraph ¶ STMA-14930 - Generic STM controller functions concern requirements which are also covered by the relevant subsets. The requirements are made more specific but every compliant ETCS system is expected to meet those requirements.

Additional requirements concern:

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- ¶ STMA-14926 - [Timing requirements](#); the performance specified in the standards is not, in all cases, sufficient to implement the ATB functions according to the input specifications. Therefore more stringent requirements are defined.
- ¶ STMA-14927 - [Odometer requirements](#); ATBEG is a speed monitoring function. The speed levels communicated by the ATBEG infrastructure depend o.a. on the available braking distance between the signals. The inaccuracy in speed measurement taken into account for those distances is smaller than than required from a standardized ETCS on-board. Therefore more strict requirements are defined.
- ¶ STMA-14928 - [DMI requirements](#); The STM ATB will use the "customizable DMI services" as defined in subset035. Therefore the ETCS on-board shall provide a number of functions to make the integration of STM ATB plus ETCS on-board compliant with the input specifications.
- ¶ STMA-14929 - [ATB isolation](#); the ERA specifications (a.o. subset035) describe a method to isolate an STM via a contact at the TIU provided by the ETCS on-board. The train (train borne equipment) shall provide a signal indicating that the specific STM shall be isolated. To comply with input requirements concerning the possibility to switch off the ATBEG equipment (functionality), this optional requirement shall be implemented at the ETCS on-board and in the train borne equipment.
- ¶ STMA-14931 - [RAMS](#); RAMS requirements concerning the ATBEG and ATBVv functionality shall be divided between the STM ATB, the ETCS on-board and the train (train borne equipment).

In chapter ¶ STMA-7242 - [Train borne equipment requirements](#) concerning the train (train borne equipment) are gathered. These requirements concern input information needed for the STM ATB, the EM environment and means to isolate the STM ATB as described in the ERA specifications (a.o. in subset035).

The ATBEG coils (antennas) and their installation are not in the scope of the STM ATB as the prime use of the STM ATB will be for retrofit purposes. In case of retrofitting rolling stock, there will already be ATBEG coils installed. In chapter ¶ STMA-7243 - [ATBEG coils \(antennas\)](#) the requirements concerning the coils and their installation, which are necessary for integration with the STM ATB are defined.

## 2 References

### **Text, STMA-14296 - Reference documents**

All the documents references used in this document can be found in the document  P6.1

[Bibliography](#) available in the Polarion folder  Processes

### **Abbreviations, definitions and terminology**

An overview of the abbreviations, definitions and terminology used in this document can be found in document  P6.2 [List of abbreviations, definitions and terms](#) available in the Polarion folder  Processes

### **Requirement identification**

The STM ATB project makes use of an automated requirement management system. In this system each requirement has been identified as a work item. Each work item has been automatically assigned with a unique ID, with the format "STMA-<number>". As a result requirement ID's are not in logical order. An overview of all the used STMA-numbers is given in document  P6.3 [Requirement Overview](#) available in the Polarion folder  Processes

**Requirement, STMA-28795 - Required legal standards and norms applicable to the STM ATB project and product** are listed in document  D3.0 [Legal framework standards and norms](#)

## 3 ETCS on-board

**Text, STMA-21895 -** In this chapter exported constraints concerning the ETCS on-board are defined.

### **3.1 Generic STM controller functions**

#### **Requirement, STMA-2653 -**

The ETCS on-board shall take care of the responsibility for guarding the train speed (thus not rely on the STM ATB) if

- the ETCS mode is different from "system national" (SN), or
- the state reported by the STM ATB is different from "data available" (DA).

#### **Requirement, STMA-9496 -**

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After reconnection with the STM ATB, the STM manager (STM controller) shall resend the maximum train speed and braking percentage.

**Requirement, STMA-10382 -**

If the ETCS MODE is "SN" and the "override function is activated" then

The ETCS on-board shall still execute EB commands received from the STM ATB as if the override function is not activated.

**Requirement, STMA-2686 -**

If the STM ATB function (and/or the ETCS on-board) is switched off (i.e. the STM ATB is not responsible) no ATB information shall be shown at the DMI.

**Requirement, STMA-2681 -**

If the "STM state" of the STM ATB (as reported by the STM) is different from DA, then the ETCS on-board shall not display any ATB information as sent by the STM ATB directly to the DMI. (thus delete the information if the state changes from DA to another state).

**Requirement, STMA-2683 -**

If the STM ATB reports an "STM state" different from DA, then the ETCS on-board shall ignore (existing) brake commands from the STM ATB, i.e.:

- not brake if an EB command is received.
- release the brake if there is no other reason (from another STM or from ETCS on-board) to command the EB.

**Requirement, STMA-2685 -**

If

- a cabin is selected and the driver (has) selected level STM ATB, and
- The STM state reported by the STM ATB is CS or HS

then the ETCS on-board shall change the ETCS state to SN and send a DA order to the STM ATB.

**Requirement, STMA-2692 -**

The response on switching on the ETCS on-board plus STM ATB is a responsibility of the ETCS on-board equipment.

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The ETCS on-board shall guarantee a safe response if switched on while driving.

### 3.2 Timing requirements

#### Requirement, STMA-2702 -

If the STM sends an EB command via the Profibus then the ETCS on-board shall command the EB within 300ms.

*note: a shorter time shall be aspired, to allow a longer response time for the driver.*

#### Requirement, STMA-2760 -

The sum of the following delays:

- The time between the moment the driver operates the brakes and the moment the train provides information to the STM ATB indicating that the brake handle is applied (  STMA-10889).
- The time between the moment the STM ATB provides the information that the "bel" shall sound (via profibus and parallel wiring), and the moment the "bel" sounds in the cabin

shall not exceed 200 ms

*note: a shorter delay time shall be aspired, because it will automatically lead to an increased reaction time for the driver*

*note: A separate sound generator may be used for this purpose.*

#### Requirement, STMA-2716 -

The difference in communication time between any order to sound the "gong" and any order to sound the "bel" shall not exceed 100ms.

*note: A separate sound generator may be used for this purpose.*

#### Requirement, STMA-5126 - If

- The BIU considers the STM ATB to be in the state data available (i.e. the last received packet STM-15 indicated state DA), and
- The BIU hasn't received any telegram from the STM ATB during at least 1700 ms

then the BIU shall command the EB

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### 3.3 Odometer requirements

#### Requirement, STMA-2763 -

The ETCS on-board shall provide a speed value to the STM ATB which is less than 0.8 s older than the real speed value, i.e.

The delay in speed measurement plus the maximum delay in the communication including the time between two speed values being sent via the profibus shall be less than 0.8 s

#### Requirement, STMA-5113 -

The difference between the "upper bound of the measured speed" and the "estimated speed" reported by the ETCS on-board shall not exceed  $3 \text{ km/h} + 2 \%$  of the "upper bound of the measured speed".

*note: exceeding with more than 2% will lead to a difference between the speed displayed to the driver and the train speed assumed for the speed monitoring function.*

### 3.4 DMI requirements

#### Requirement, STMA-2694 -

The ETCS on-board shall display ATB icons according to the information in the packets STM-32 and STM-35 in combination with a DMI configuration table according to ¶ STMA-10814 - D4.7.4 Specific Transmission Module (SS035 v3.2.0) (provided by the principle: ¶ STMA-8277 - DMI configuration table according to . Description Values NID\_STM of the STM 1 (...).

#### Requirement, STMA-2813 -

The resulting layout as specified using the DMI configuration table shall comply with the requirements in CENELEC: CLC/prTR 505497 as far as this doesn't conflict with ETCS indicators used in level STM ATB.

#### Requirement, STMA-14422 -

The ordering of the cab signals (indicatorID = positionID from 1 to 6) shall be such that the ordering of the indicators is from left to right or top-down for increasing indicatorIDs.

#### Requirement, STMA-10025 -

If the STM sends new Cab signals via the profibus then the ETCS on-board shall display the cab signals within 280ms.

#### Requirement, STMA-2704 -

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If the STM sends an EB command via the Profibus, the ETCS on-board shall initiate switching off traction (this requirement can be further exported to the train).

**Requirement, STMA-2795** - If a packet STM-46 containing the order to trigger the "gong" (one stroke signal) is received from the STM ATB then

The ETCS on-board shall trigger the sound "gong" as specified in the ATB DMI configuration table (gong.wav).

**Requirement, STMA-2796** - If a packet STM-46 containing the order to trigger the "BD-signal" (stroked signal) is received from the STM ATB then

The ETCS on-board shall trigger the sound "BD-signal" as specified in the ATB DMI configuration table (BD signal.wav).

**Requirement, STMA-2797** - If a packet STM-46 containing the order to trigger the "losbel" (stroked signal) is received from the STM ATB then

The ETCS on-board shall trigger the sound "losbel" as specified in the ATB DMI configuration table (losbel.wav).

**Requirement, STMA-2798** - If a packet STM-46 containing the order to start the "bel" (continuous signal) is received from the STM ATB then

The ETCS on-board shall start the sound "bel" as specified in the ATB DMI configuration table (bel.wav).

**Requirement, STMA-2799** - If a packet STM-46 containing the order to stop the "bel" (continuous signal) is received from the STM ATB then

The ETCS on-board shall stop the sound "bel" as specified in the ATB DMI configuration table (bel.wav)

**Requirement, STMA-15230** - If a packet STM-46 containing the order to trigger the "bel damping" (one stroke signal) is received from the STM ATB then

The ETCS on-board shall trigger the sound "bel-damping" as specified in the ATB DMI configuration table (bel-damping.wav).

**Requirement, STMA-2794** -

One pixel as defined in the DMI configuration table shall be displayed with a size of at least 0.32x0.32mm.

*note: using a 10" screen with a resolution of 480x640 pixels leads to a size of 0.32x0.32mm per pixel.*

**Requirement, STMA-2806** -

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The minimum size of an icon to be used for cab signals shall be 40x50 pixels (W x H)

**Requirement, STMA-2812 -**

The minimum font size to be used on the indicators for the cab signals shall be 30

**Text, STMA-21899 -** The STM ATB can send diagnostic information via a JRU message.

**Requirement, STMA-14921 -** If the STM ATB reports an intervention due to abuse of the override function then the ETCS on board or other train borne equipment shall display a message to the driver to indicate the reason of the intervention.

### 3.5 ATB isolation

**Requirement, STMA-5116 -**

The ETCS on-board shall isolate the STM ATB according to subset035, v3.2.0, paragraph 4.2.1.1, if this is indicated by the "national system isolation" signal provided by the train according to subset119.

**Requirement, STMA-10869 -**

Once the STM ATB is isolated, the ETCS on-board shall enter level ATB if ordered by track-side, however without any speed nor distance monitoring.

**Requirement, STMA-10848 -**

If the STM ATB is isolated then the ETCS on-board or Train borne equipment shall report the isolation of the STM ATB to the juridical recorder and indicate the state to the driver (remark: the ETCS on-board shall not display the information sent by the STM ATB to the DMI)

**Requirement, STMA-22545 -** If the STM ATB is isolated then the train shall switch off the power supply of the STM ATB

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### 3.6 RAMS

**Requirement, STMA-10897** - The ETCS on-board failure rate concerning failures leading to unsafe false ATB information at the DMI shall be  $< 2 \cdot 10^{-5}$ /hour.

**Requirement, STMA-16884** - The unavailability fraction of the ATBEG function due to ETCS on-board failures shall be less than  $60 \cdot 10^{-5}$ /hour

### 3.7 Profibus safety levels

**Requirement, STMA-17352** - The minimum safety level implemented for the connection between the STM ATB and the STM controller function shall be SL2

**Requirement, STMA-17349** - The minimum safety level implemented (and communicated in packet STM-2) for the connection between the STM ATB and the BIU function shall be SL2

**Requirement, STMA-17350** - The minimum safety level implemented (and communicated in packet STM-2) for the connection between the STM ATB and the DMI function (DMI channels) shall be SL2

**Requirement, STMA-17347** - The minimum safety level implemented (and communicated in packet STM-2) for the connection between the STM ATB and the TIU function shall be SL2

**Requirement, STMA-17348** - The minimum safety level implemented (and communicated in packet STM-2) for the connection between the STM ATB and the JRU function shall be SL0

## 4 Train borne equipment

**Definition, STMA-10889** -

Brake handle applied information can consist of:

- Digital information from a brake handle contact (switch)
- Digital feed back from the braking system that the brakes are applied
- Analogue feed back from the brake pipe pressure sensor.

**Requirement, STMA-14987** - The train shall provide brake handle supplied information (  )

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STMA-10889)

**Requirement, STMA-5115 -**

The train shall provide a switch to turn off power from the STM ATB.

A second contact in the switch shall indicate that the STM ATB is switched off ("isolated").

The operation of the switch shall be logged.

*note: the signal shall be provided as "national system isolation" signal acc. to subset-119 to the ETCS on-board.*

## 5 ATBEG coils (antennas)

**Requirement, STMA-14994 -** The train borne equipment shall include ATBEG coils mounted above the center of each rail (left and right) at each front-end (cabin side) of the train. The coils shall be mounted in front of the first axle (seen in the concerning driving direction), according to the installation requirements of the supplier of the ATBEG coils.

**Requirement, STMA-35032 -**

The maximum deviation of the ATBEG antenna signal due to EM-interference other than via the track current and due to antenna movements shall be limited to +/- 10% (☒ STMA-40585 ). This shall at least take into account:

- Movement of the antenna
- EM sources different from the current through the rails (e.g. motor cabling)
- EM field due to currents in the wheels at the first axle

**Requirement, STMA-7250 -** In case of a constant 75Hz current through the rails, the variation in the signal level due to antenna movements (vertical + horizontal) shall be less than +/- 5% compared to the average 75Hz level

**Requirement, STMA-7251 -** In case of an equal 75Hz current through the left and right rail the signal difference between the left and right coil signal shall be less than 10%

**Requirement, STMA-7252 -** EM sources in the train shall not cause a 75 Hz signal level at the STM ATB coil signal inputs higher than 10 % of the signal caused by a 4.7A@75Hz current through the rail.

**Requirement, STMA-7261 -** The coil signal caused by the current floating through the wheels

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at the first axle of the train, shall not exceed 10% of the signal caused by the same current floating through the rail.

**Requirement, STMA-15037** - The sum of the disturbances mentioned in  **STMA-7250**,  **STMA-7252** and  **STMA-7261** shall not exceed 15% of the average 75 Hz signal level.

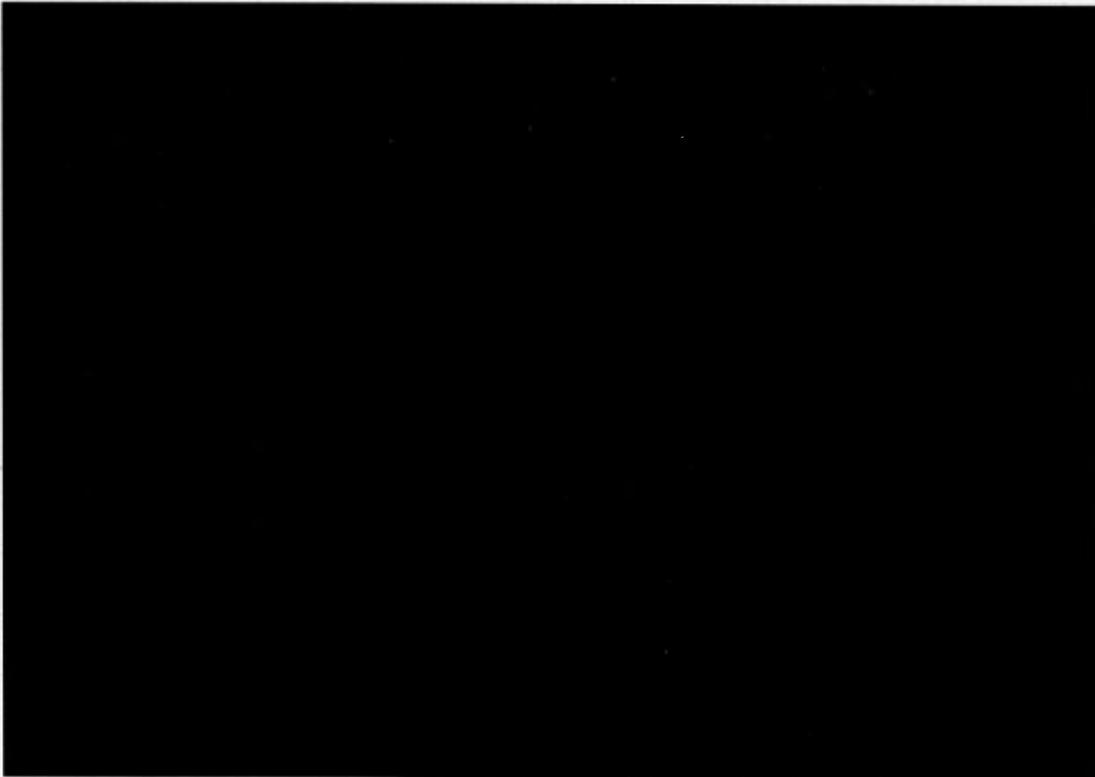
**Requirement, STMA-14951** - The risk on having intermittent interruptions of the connection to (or inside) the ATB coils (antenna's) , simultaneously in the left and right coil circuit shall be less than  $1 \cdot 10^{-9}$ /hour.

**Requirement, STMA-9955** - Antenna's shall not saturate due to traction return currents up to 8000A/rail.

*note: based on the RIS 4000A/rail should be sufficient, however the maximum current has been increased without updating the RIS.*

**6 Usage of packet 44**

not applicable



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not applicable

