Automatic Train Protection: Signalling Principles

Engineering Standard

Rail Commissioner

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Government of South Australia
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DOCUMENT CONTROL

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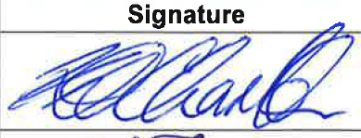
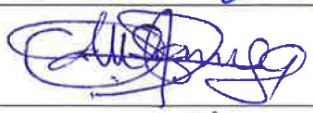
Prepared By:	Name: Keith Charlton Title: Manager Rail Technical & Operational Assurance		28/2/18
Reviewed By:	Name: Oluwole Odusanya Title: Team Leader – Signals Engineering		28/02/18
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1. Introduction

The Department of Planning, Transport and Infrastructure (DPTI) owns and operates the Adelaide Metropolitan Passenger Rail Network (AMPRN) under the Rail Accreditation assigned to the Rail Commissioner. This Automatic Train Protection Signalling Principles Standard forms part of the engineering management system used to ensure that the signalling system is not subject to any risks not deemed to meet the So Far As Is Reasonably Practicable (SFAIRP) principles under Rail Safety National Law (RSNL).

European Rail Traffic Management System (ERTMS) is a European standard rail management system. European Train Control System (ETCS) is the communications-based signalling and ATP component of ERTMS. DPTI has selected ETCS Level 1 as the Automatic Train Protection (ATP) system for the AMPRN.

DPTI's current baseline for ETCS Level 1 complies with SUBSET-026 System Requirements Specification (SRS) version 2.3.0 d. This shall not preclude the fitment of a more current baseline for ETCS level 1, subject to DPTI approval.

ETCS equipment produced by members of Unisig is preferred.

Equipment with in-service use on a multi-vendor rail environment is preferred. Equipment that is not currently in use in an ETCS interoperable environment will not be accepted.

All signal designs undertaken in relation to the implementation of these principles shall be based on, and adopt processes which comply with, the requirements of AS.4292.4-2006 "Railway safety management - Signalling and telecommunications systems and equipment" or the most recent version of the South Australian Rail Safety National Law Act.

2. Purpose

This document states the principles that the ETCS system must perform when applied to AMPRN infrastructure.

This document then describes how these principles will be fulfilled by the ETCS system, and gives values for many of the ETCS parameters.

3. Scope

These principles shall be applied for all areas on the AMPRN where Automatic Train Protection introduced.

4. Supporting Information

4.1. Related Documents

DOCUMENT NAME	DOCUMENT NUMBER
Signalling and Communications Project for AMPRN – ATP Principles Specification (KNet # 10526371)	AR-RS-EM-SPC-03100031
Signalling Principles & Practices for the AMPRN (KNet # 6288618)	PTS-AR-10-SG-STD-00000068

4.2. References

- ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 1, Introduction, Ref: SUBSET-026-1, Version: 2.3.0d, Date: 24-02-2006
- ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 2, Basic System Description, Ref: SUBSET-026-2, Version: 2.3.0, Date: 24-02-2006
- ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 3, Principles, Ref: SUBSET-026-3, Version: 2.3.0d, Date: 11-04-08

- ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 4, Modes and Transitions, Ref: SUBSET-026-4, Version: 2.3.0d, Date: 11-04-08
- ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 5, Procedures, Ref: SUBSET-026-5, Version: 2.3.0d, Date: 11-04-08
- ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 6, Packets, Ref: SUBSET-026-6, Version: 2.3.0d, Date: 11-04-08
- ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 7, Messages Ref: SUBSET-026-7, Version: 2.3.0d, Date: 11-04-2008
- ERTMS/ETCS – Class 1, Glossary of UNISIG terms and abbreviations, Ref: SUBSET-023, Version: 2.0.0, Date: 30-03-2000
- ERTMS/ETCS – Class 1, Dimensioning and Engineering Rules, Ref: SUBSET-040, Version: 2.0.0, Date: 30-03-2000
- ERTMS/ETCS – Performance Requirements for Interoperability, Ref: SUBSET- 41, Version: 3.1.0, Date: 01-03-2012
- BC-WS-EL-SPC-03180591 - OS9 ATP Trackside Concept Design, Version B, Date: 23-06-201
- AR-RS-EM-SPC-03180814 - AWS Disable Technical Description, Version D, Date: 12-02-16

4.3. Acronyms

ACRONYM	FULL NAME
AMPRN	Adelaide Metropolitan Passenger Railway Network
ATP	Automatic Train Protection
AWS	Automatic Warning System
BG	Balise Group
CB	Controlled Balise
DMI	Driver Machine Interface
DMU	Diesel Multiple Unit
DP	Danger Point
DPTI	Department of Planning, Transport and Infrastructure
EBI	Emergency Brake Intervention
EMU	Electric Multiple Unit
EVC	European Vital Computer
FB	Fixed Balise
LEU	Lineside Equipment Unit
LX	Level Crossing
MA	Movement Authority
RBC	Radio Block Centre
OS	Operable Stage
PLOD	Patrolman's Lockout Device
RAMS	Reliability, Availability, Maintenance, Safety
RS	Release Speed
SBI	Service Brake Intervention
SPAD	Signal Passed At Danger
SRS	System Requirements Specification
SSP	Static Speed Profile
STM	Specific Transmission Module
TSR	Temporary Speed Restriction

5. ATP System Principles

5.1. Protected Situations

For fitted trains operating on fitted infrastructure (Level 1 track), protection against the following situations shall be provided:

- A train exceeding the line speed by more than a set margin;
- A train exceeding the safe limits of its movement authority;
- A train exceeding the turnout speed through a junction by more than a set margin. The supervised speed shall be maintained until either the rear of train, or rear bogie of the train, is clear of the turnout dependent upon odometry inaccuracies against the measured path of the train;
- A fitted train resulting in a dangerous situation due to Signal Passed At Danger (SPAD),
- In circumstances where the track layout does not allow for a minimum overlap or where the distance from a signal to its Danger Point (DP) is less than the braking distance for a Fixed Release Speed (RS) infill or calibration balises shall be provided.

The following shall be provided for fitted trains running on infrastructure irrespective of whether trackside equipment is fitted or not (Level 1 and Level 0 track):

- Undesirable train movements, including roll away, reverse movement and standstill supervision;
- A train exceeding the maximum speed of that class of train.

5.1.1. Absolute Signal Enforcement

A limit of authority shall be enforced for any fitted train and fitted absolute signal displaying a stop aspect. In this instance, braking shall be applied if the approach speed exceeds safe limits or the signal is passed.

5.1.2. Permissive Signal Enforcement

A limit of authority shall be enforced for any fitted train and fitted permissive signal displaying a stop aspect. If the train wishes to pass a permissive signal displaying a stop aspect (as permitted by PTS-AR-10-SG-STD-00000068 *Signalling Principles & Practices for the AMPRN*) the driver is required to select the ‘Override’ function (see Section 5.7) and continue on to the next signal in ‘Staff Responsible’ mode.

The ‘Override’ function can only be selected when the train is at standstill as set by the National Value V_NVALLOWOVTRP (see Appendix)

The ATP shall not enforce a one-minute stop at permissive signals; this remains the responsibility of the driver.

5.1.3. Low Speed Subsidiary Signals

An ‘On Sight’ mode Movement Authorities (MA) shall be applied for any fitted train passing a low speed subsidiary signal displaying a stop aspect and illuminated low speed signal (see Section 8.1.10). To prevent a brake application, the driver is required to acknowledge this mode within a configured time and a ceiling speed is applied until the next signal.

5.1.4. Approaching Locking Enforcement

Movement authorities received by a train shall be time limited. This shall mirror, so far as reasonably practicable, the effect of approach locking timers within the signalling interlocking on the assumption that a train dispatcher attempts to cancel a route just after a train has passed an update balise.

5.1.5. Overspeed Margins

Speed supervision shall be governed by the following margins:

5.1.5.1. Warning Curve

The ETCS onboard equipment shall trigger an 'Overspeed' warning when the train speed exceeds the 'Warning' (W) limit allowing the driver to take corrective action. This limit is calculated as the difference in speed against the permitted speed

5.1.5.2. Service Brake Curve

The ETCS onboard equipment shall trigger an 'Overspeed' service brake intervention when the train speed exceeds the 'Service Brake Intervention' (SBI) limit. This limit is calculated as the difference in speed against the permitted speed.

5.1.5.3. Emergency Brake Curve

The EVC shall trigger an 'Overspeed' emergency brake intervention when the train speed exceeds the 'Emergency Brake Intervention' (EBI) limit. This limit is calculated as the difference in speed against the permitted speed.

5.1.6. TSR Enforcement

Temporary Speed Restrictions (TSR) shall be enforced for any fitted trains, this means the onboard system will apply the most restricted speed by taking into account Static Speed Profile (SSP), Release Speed, TSR and braking curves etc.

5.2. Safety Targets

The complete ETCS system when configured for use on AMPRN shall conform to:

- All vital safety systems shall be supervised by systems designed to CENELEC 50128, SIL 4 standard;
- The system shall 'fail safe' in all situations where the alternative could lead to an unsafe situation.

5.3. Limits of Fitment

The protection system shall be fitted to the following rolling stock and infrastructure:

5.3.1. Trackside

Within an area of infrastructure on which it has been decided to fit the protection system, the following signals shall be fitted:

5.3.1.1. Signals

All main line (Absolute and Permissive) signals shall be fitted, with the following exceptions:

- Shunt signals;

- Signals within non-passenger yards;

5.3.1.2. Buffer Stops

Buffer stops that are approached by trains shall have protection to limit the approach speed (see Section 10.4).

5.3.1.3. Bi-directional Signalling

The system shall be applied for both normal and reverse movements. The same level of protection shall be provided for both directions.

5.3.1.4. Setting Back

In case of a SPAD, trains will be allowed to set back a distance equal to the National Value D_NVPOTR (see Appendix A). If the train is required to set back a distance greater than this allowed value, the driver shall select 'Shunt' mode and continue. AMPRN Operational Rules must still be followed in all cases

5.3.2. Rolling Stock

A risk assessment shall be conducted by DPTI to assess the risks and benefits of fitment or non-fitment for any rolling stock that operates on fitted infrastructure.

5.3.3. Future Proofing

The design of the train protection and cab signalling system shall not preclude the future fitment of any trains currently running on the AMPRN which were not initially fitted with onboard equipment. The design shall not preclude the expansion of the area of fitted infrastructure.

5.4. Precedence of Cab Signalling

The cab signalling protection system shall provide continuous speed signalling with intermittent update. The driver shall be informed of the maximum safe speed at the current location, and of any approaching speed restriction or limit of authority of which the train may be within braking distance.

The train driver in a fitted area with operational onboard equipment will receive information from the cab display and also from conventional line-side signals and signs. Although the system shall generally ensure consistency between the two sets of information, they may be inconsistent in the following situations:

(i) When the signal ahead of the train changes aspect after the train has passed the last controlled balise group (normally at the last signal).
(ii) With a failure of trackside ATP equipment or interface to signalling system, the onboard system may present more restrictive information than the conventional signalling.
(iii) With a failure of trackside conventional signalling equipment, the onboard system may present less restrictive information than the conventional signalling. A discrepancy would arise if the failure occurs after the train has passed the last controlled balise or the failure is not detectable by the interlocking (for example a lamp failure without detection).
(iv) If onboard ATP equipment fails, the driver will be instructed by Train Control to isolate the onboard equipment and proceed as though the train were unfitted.

For a train with operational onboard ATP equipment, the driver shall apply the most restrictive of the line-side signals/speed signs and onboard display unless

line-side equipment is overridden through use of ‘Staff Responsible’ mode. Procedures for operation with signalling equipment failures shall still apply.

For a train with operational onboard ATP equipment, the Driver Machine Interface (DMI) shall be used as the primary speedometer. This is necessary to minimise interference from the ATP system.

5.5. Conventional Signalling Principles

The conventional signalling system is based on a route signalling system (refer PTS-AR-10-SG-STD-0000068 *Signalling Principles & Practices for the AMPRN*). The ETCS system shall enforce whatever speeds are necessary to ensure that the train does not exceed its limit of authority, or the safe line/curve speed, as required in Section 5.1 and 5.4 The limits calculated onboard by the ETCS equipment will be similar to the conventional signalling caution and medium speed aspects, but will generally be less restrictive in ‘Full Supervision’ mode as the onboard equipment is able to calculate limits for that particular train class, whilst conventional signalling has to be designed for all types of rolling stock able to use the line.

The fitment of ETCS on any area of the AMPRN shall not preclude the operation of trains not fitted with the necessary onboard hardware. Indeed, under normal operation, only some of the trains operating on the network may be fitted. Therefore the conventional Signalling Principles (refer PTS-AR-10-SG-STD-00000068 *Signalling Principles & Practices for the AMPRN*) must be sufficient for the operation of the railway without any of the functions discussed in this document.

In particular, there is a direct relationship between the following Signalling Principles and the ETCS system discussed in this document:

- Overlaps
- Approach Locking

Therefore the content of this document must be reviewed in the light of any change to the above Signalling Principles. Conversely, the Signalling Principles must be reviewed if there is a change to the Principles within this document.

5.6. Automatic Warning System

This section describes how the AWS system will be managed by ATP systems.

5.6.1. EMU Trains

The ATP system shall operate independent to the Automatic Warning System (AWS). The AWS may be manually suppressed only when ATP is operational at DPTI discretion.

5.6.2. DMU Trains

The Onboard ATP system shall automatically suppress the AWS when supervision is being provided by ATP and enable the AWS otherwise.

The purpose of the automated enabling/disabling function is to ensure that there is always an active safety system operating on the train and relieve the driver of the responsibility of a potentially error-prone manual AWS suppression.

AWS system shall be suppressed by the ATP Onboard system when:

- The operating mode allows disabled AWS; and
- The ATP is operating in Level 1.

The Onboard system shall enable the AWS system when:

- The operating mode requires AWS enabled; or
- The ATP is operating in Level 0.

The AWS operating modes are as follows:

ATP MODE	AWS
Full Supervision (FS)	Disable
On Sight (OS)	Disable
Staff Responsible (SR)	Disable
Trip (TR)	Disable
Post Trip (PT)	Disable
Non Leading (NL)	Enable
Stand By (SB)	Enable
Shunt (SH)	Enable
Unfitted (UN)	Enable
Sleeping (SL)	Enable
Isolation (IS)	Enable

The Onboard system allows an input to detect AWS availability and prevent train movement when AWS is enabled but not available. The AMPRN Onboard system shall operate with this input permanently energised to indicate the AWS is always available. This is to prevent the ATP from restricting train movement in the event of a failed AWS.

The risk of a failed AWS system shall be managed outside the ATP system.

5.7. Override

The ETCS system shall allow the driver to 'Override' the ETCS system in accordance with the relevant rule book procedure when authorised by a rule or a Train Controller to pass a signal which is controlled at danger. This 'Override' shall only be active for a short period of time and distance. Supervision by the onboard equipment shall be resumed as soon as possible. Any such override shall require a positive action from the driver.

5.8. Line-side Equipment Failures

The system shall be engineered to minimise the operational impact of failures of single items of hardware. The connection of consecutive signals to the same LEU shall be avoided where possible.

5.9. Temporary Speed Restrictions

The ETCS system shall also be able to include provision for the enforcement of Temporary Speed Restrictions to fitted trains by means of temporary balises placed in the track by maintenance staff. The temporary balises do not require linking and shall be pre-programmed.

5.10. PLOD

Where a TSR block functionality is activated within the Patrolman's Lockout Device (PLOD), the system will enforce a 25 km/h speed limit over the relevant section(s) of track to the back of the train. For more details on the PLOD operation refer to the signalling principles (refer PTS-AR-10-SG-STD-00000068 *Signalling Principles & Practices for the AMPRN*).

5.11. Block of Line

If a Block of Line is applied to a track section, all the signals within that section will be reduced to a stop aspect. The ETCS system will enforce this by updating all the relevant balise groups to contain the corresponding stop MA.

5.12. Level Crossings

The ETCS system shall not have any interlocking controls directly with any Level Crossing (LX), however this shall not preclude the provision of such where deemed appropriate.

Where a level crossing is located in the signalling overlap, the nearest edge of the crossing shall be defined as the ATP overlap if the protecting signal inhibits the level crossing.

Where a signal before a level crossing does not inhibit the crossing operation, the normal signal overlap is to be used to determine the ATP overlap.

Some signals at level crossing are provided with Express and Stopper controls. Since these are enforced by Approach Clearing timers in the interlocking, the balise groups will contain the corresponding MAs appropriate for the route selected.

6. ETCS Level 1 Implementation

The system principles described above shall be implemented on the AMPRN by an ETCS Level 1 solution.

6.1. ETCS Version

The version of ETCS for all currently installed components comply with version 2.3.0d of the UNISIG ETCS Systems Requirement Specification (SRS) – refer to:

- *RTMS/ETCS – Class 1, System Requirements Specification, Chapter 1, Introduction, Ref: SUBSET-026-1, Version: 2.3.0d, Date: 24-02-2006*
- *ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 2, Basic System Description, Ref: SUBSET-026-2, Version: 2.3.0, Date: 24-02-2006*
- *ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 3, Principles, Ref: SUBSET-026-3, Version: 2.3.0d, Date: 11-04-08*
- *ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 4, Modes and Transitions, Ref: SUBSET-026-4, Version: 2.3.0d, Date: 11-04-08*
- *ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 5, Procedures, Ref: SUBSET-026-5, Version: 2.3.0d, Date: 11-04-08*
- *ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 6,Packets, Ref: SUBSET-026-6, Version: 2.3.0d, Date: 11-04-08*
- *ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 7, Messages Ref: SUBSET-026-7, Version: 2.3.0d, Date: 11-04-2008*

If versions of systems later than 2.3.0d are being used, then these must be compatible with other trains and sections of infrastructure running version 2.3.0d.

6.2. Upgrade Path

Although the current approved ETCS system implemented on AMPRN is ETCS Level 1 system, all ETCS design shall not unnecessarily preclude an upgrade to a level 2 system at some time in the future.

7. ETCS Levels

Two ETCS levels are applicable to the AMPRN. Transitions between levels shall occur automatically, the preferred locations for transitions shall be in automatic sections and areas where the driver is less likely to be distracted.

7.1. Level 0

All areas not fitted with ETCS trackside equipment shall be classed as level 0, except for yard sections and sidings which have the 'Full Supervision' or 'On Sight' routes set into them from main signals of ETCS Level 1 lines

7.2. Level 1

All areas fitted with ETCS trackside equipment shall be classed as level 1.

Sidings and yards (even if not signalled) connected only to level 1 running lines shall be designated ETCS Level 1 areas.

7.3. Level Transition 0 to 1

Trackside signage shall be provided at the point of transition for trains in normal operation.

The transition from level 0 to 1 shall occur as the train passes the signal prior to the first signal to be fully ETCS fitted. The exact location for the transition will depend on the position of the balise antenna on the train, as it will occur as the balise antenna passes the last balise in the group. See Figure 1: Entry to ETCS L1 area.

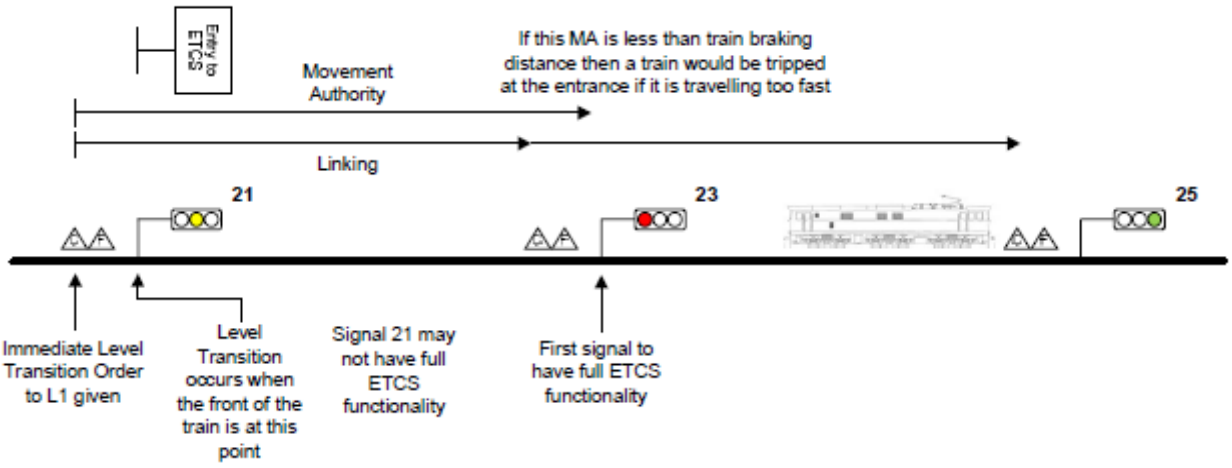


Figure 1: Entry to ETCS L1 area

It should be noted that if the next signal is at danger and not at braking distance (for all classes of trains) then there is the risk that a train will be emergency braked upon the transition if it is travelling greater than the onboard calculated speed for stopping at this signal. This risk shall be considered on a site by site basis, and avoided if reasonably practicable. Signalling design shall ensure that there is full braking distance for every class of ETCS train at line/curve speed between the transition signal and the first ETCS signals.

The first signal (21 in Figure 1: Entry to ETCS L1 area) will have 'train stop' ETCS functionality, i.e. a train that attempts to pass it at danger will be tripped at the signal.

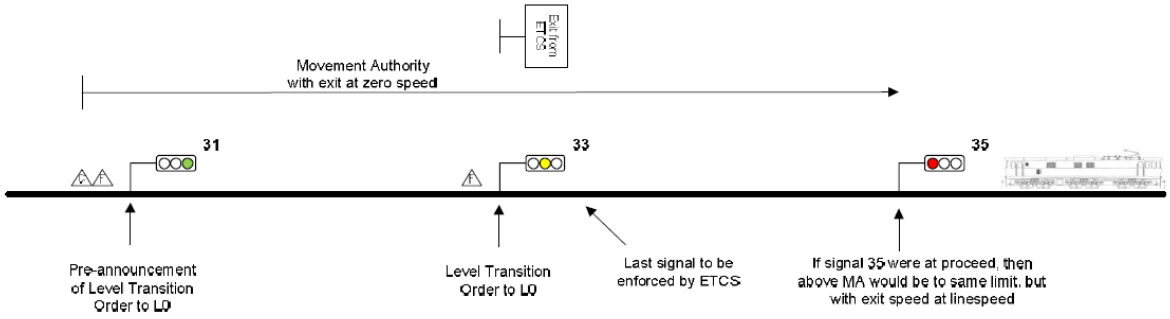
A full set of National Values (see Appendix A) shall also be included in the first balise group at the ETCS entry area, exit from any depot, yard or terminal station at which it is likely that the onboard ETCS equipment has been reset.

Note: For DMU trains the level transition from L0 to L1, the AWS system will stay enabled until a “Level Transition packet” to Level 1 is read from the trackside balises, and then the Onboard system manages the transition from AWS system to ATP system (Full Supervision Mode and disabling the AWS system).

7.4. Level Transition 1 to 0

Trackside signage shall be provided at the point of transition for trains in normal operation.

A level transition from 1 to 0 shall be pre-announced in all balise groups giving



MAs as far as the level transition. This is illustrated in Figure 2: Exit from ETCS territory.

Figure 2: Exit from ETCS territory

The approach to signal 33 in Figure 2 shall be enforced by ETCS, trains passing the signal balise group when the signal is at red shall be tripped, also the balise shall be updated to reflect a change in status of 33 signal.

The transition from level 1 to level 0 (unfitted) requires acknowledgement by the driver due to the reduction in the level of supervision. The acknowledgement shall be offered to the driver 400 m (an ETCS parameter), where it is practicable, prior to the point of exit from level 1. The driver must acknowledge this transition within this 400 m area, or up to five seconds (T_{AMT} in Appendix B) after leaving the level 1 area. A failure to acknowledge this transition will result in a service brake command.

Note: For DMU trains the level transition from L1 to L0, the Onboard system manages the transition from ATP system to AWS system when “Level Transition packet” to Level 0 (Level 0 + AWS), is read from the trackside balises. Also, the text message is showing during the transition “TRANSITION TO L0 WITH AWS”.

7.5. Signage

A sign bearing the words “Entry to ETCS” or “Exit from ETCS” (as appropriate) shall be provided on each track at the position of entry and exit from ETCS.

8. Onboard ETCS Application

8.1. ETCS Modes

The following ETCS modes shall be supported for the stated purposes on the AMPRN, for a full description of the ETCS Modes refer to *ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 4, Modes and Transitions, Ref: SUBSET-026-4, Version: 2.3.0d, Date: 11-04-08*

8.1.1. Isolation

This mode shall be applicable when the onboard ETCS equipment is isolated by means of the isolation switches operated by the driver or other authorised personnel. In this mode, no protection is provided by the ETCS system.

The isolation switches shall be sealed so that its operation requires a seal to be broken. The operation of these switches shall be recorded by the data recorder when the system is operational.

8.1.2. No Power

This mode shall be applicable when the onboard ETCS equipment is not powered. In this mode, the emergency brake is permanently commanded.

8.1.3. System Failure

This mode shall be applicable when the onboard ETCS equipment detects a failure that affects safety and is no longer able to fulfil its safety function. The emergency brakes are applied in this mode.

8.1.4. Sleeping

This mode shall be applicable in any non-leading rolling stock in a coupled train formation. The mode shall be automatically selected through the train interface.

8.1.5. Stand-by

This mode shall be applicable when the onboard ETCS equipment is in the process of starting up.

8.1.6. Shunting

This mode shall be used for un-signalled yard areas.

Entry into this mode shall be by the driver when the train is at a standstill. The trackside shall not automatically command this mode to the train. This will mean that, after a train has entered a yard under a low speed signal (‘On Sight’), at the end of this movement the train will have to stop before selecting shunting and then continuing.

The operational rules shall permit the driver to select shunting mode manually in many degraded situations. The rules shall also instruct the driver to leave ‘Shunting’ mode and enter ‘Staff Responsible’ mode before approaching the first ETCS-fitted signal on the exit from an area in which shunting has been taking place.

At every exit from yards and areas where shunting is likely, the trackside shall issue the command ‘stop if in shunting mode’.

A maximum speed of 20 km/h shall be applicable to this mode.

8.1.7. Full Supervision

This mode shall be used for all MAs issued in conjunction with a main signal proceed aspect (including main caution aspects).

8.1.8. Unfitted

This mode shall be applicable when a fitted train is operating in an area in which the trackside is not fitted with ETCS equipment, or when such ETCS equipment is not commissioned.

8.1.9. Staff Responsible

This will be the mode used by the driver to pass an absolute or permissive signal displaying a stop aspect at danger when authorised to do so from Train Control or when permitted as per the signalling principles (refer to PTS-AR-10-SG-STD-00000068*Signalling Principles & Practices for the AMPRN*) This mode is entered via the driver selecting 'Override'.

This mode is also entered at train start up before the train receives an MA from a balise group and subsequently enters 'Full Supervision' mode.

A maximum speed of 25 km/h shall be applicable to this mode.

8.1.10. On Sight

This mode shall be used for all MAs issued in conjunction with a low speed subsidiary signal illuminated on a stop aspect absolute signal.

This mode shall commence from when the train passes over the balise group of the low speed subsidiary signal. The driver shall then be required to acknowledge this mode transition within five seconds of passing this point. A ceiling speed on 25 km/h is enforced when in 'On Sight' mod

8.1.11. Trip

This is the mode automatically entered by the onboard ETCS equipment when the train passes the end of authority or an absolute signal at red or a permissive signal in red before time defined in DPTI Rules and Procedures for this type of signal.

8.1.12. Post Trip

This is the mode automatically entered into by the onboard ETCS equipment after the driver acknowledges the trip.

8.1.13. Non Leading

This ETCS mode is for slave locomotives not electrically coupled to the leading engine.

This mode shall not be used by AMPRN as no protection is provided while in this mode.

This mode is a standard ETCS mode, so is made available to the driver and cannot be disabled. Driver training must include the instruction not to misuse this mode. The selection of the mode is recorded in the JRU; this can be used as a deterrent.

8.1.14. STM

Specific Transmission Module (STM) mode shall not be used by AMPRN

8.1.15. Reversing

The Reversing mode is designed for areas in which reversing is required without overriding the system. When operating in 'Reversing' mode, roll away protection is inverted. Reversing out of long tunnels in emergency situations is the primary use of this mode. Reversing mode shall not be used by AMPRN.

Note that the ETCS system allows the train to reverse up to a configurable distance in 'Post Trip' mode in order to move back past a SPAD. This does not require a specific mode activation.

8.2. Adhesion Selection and Roll Away Protection

Although ETCS supports the trackside commanding a change to the adhesion factor applied onboard the train, it is not proposed to use this feature on the AMPRN. The default adhesion shall be for normal/dry conditions. Responsibility for selecting low adhesion rests solely with the train driver.

Roll away protection shall be provided, with a train permitted to roll away a distance equal to D_NVROLL (see Appendix A) before the brakes are automatically applied by the ETCS system. This shall be applied to directional train movements which conflict with the position of the train's direction controller, or to prevent forward and reverse train movements if the direction controller is in neutral position (see *ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 3, Principles, Ref: SUBSET-026-3, Version: 2.3.0d, Date: 11-04-08* Section 3.14.2).

8.3. Train Interface

The train interface is heavily influenced by the characteristics of the particular class of train to be fitted. This document is generic in terms of different train classes. However there are some general characteristics that are stated here:

- Service Brake as well as Emergency Brake interfaces shall be used. Service Braking is implemented as a non-vital output from the ETCS system, and will be wired into the non-failsafe braking system of the train.

- In general, after an Emergency Brake Intervention, the train shall be forced to come to a complete standstill. The Emergency Brake output from the ETCS system is a failsafe output, and is wired into the Safety Brake of the train (which is usually a totally different circuit to the service brake). The time of the train is forced to remain at a standstill depends on the operation of the train emergency brake recharge rate, not the ETCS system.

- The manual user selection of as many of the train parameters as possible shall be minimised where practical. This is in order to reduce the workload on the driver, and to reduce the probability of human error. Where any of the information cannot be derived automatically, it shall be entered manually by the train driver. Train length and braking characteristics are examples of automatically derived parameters.

- The ETCS system shall also interface to the traction control of the train and cut power when a brake application is requested.

- Legacy System interfaces shall be used for the AWS Enable/Disable Function which is not a standard function of the ATP/ETCS system. The driver must maintain vigilance when activating the AWS system ON/OFF in an unexpected situation.

- Other interfaces that may be added as required by DPTI on a case by case basis include traction power control (i.e. for neutral sections).

8.4. Train Consist

Each EVC shall be pre-configured with a train type that defines valid train consists and characteristics of the consist. The driver shall be prompted to select the applicable consist at system start up.

9. Trackside ETCS Application

9.1. Balise Group Configuration and Positioning

The Balise Group (BG) is a group of trackside transmission devices that can send telegrams to the onboard subsystem.

Although the BG may contain between one and eight balises, the BG shall generally consist of two balises: one Controlled Balise (CB) followed by (in the direction of normal train travel) one Fixed Balise (FB). Additional fixed balise groups added solely for odometry update will consist of a single fixed balise. Infill balises (if provided) may consist of a single controlled balise, or a fixed and a controlled balise.

The key principles of BG position are:

- The BG for a signal shall be positioned such that the normal stopping position of a train at that signal results in the train's ETCS antenna being in rear of the BG and not being able to receive a signal from any of the controlled balises.

- The BG position shall also be such that the train's antenna has passed over the controlled balises in the balise group and can no longer receive updates from the controlled balise before the first axle of the train occupies the next track section and replaces the signal to danger.

The location of BG and train antennae is specified by ERTMS/ETCS Dimensioning and Engineering Rules - Subset 040 (*ERTMS/ETCS – Class 1, Dimensioning and Engineering Rules, Ref: SUBSET-040, Version: 2.0.0, Date: 30-03-2000*) as follows:

(i) At least 2 m from front of the train to the antenna has been selected to ensure that two antennae on coupled locomotives will not interfere with each other.

(ii) Antenna is no more than 12.5 m from the axle closest to the front of the train.

This means that the minimal distance of a controlled balise from train detection section limit is 13.8 m (allowing for 1.3 m maximum reading window plus 12.5 m maximum antenna distance). A controlled balise location of 14.0 m (-0.2 m, +1.0 m) has been implemented across AMPRN. The above dimensions are illustrated in Figure 3: Balise group positioning.

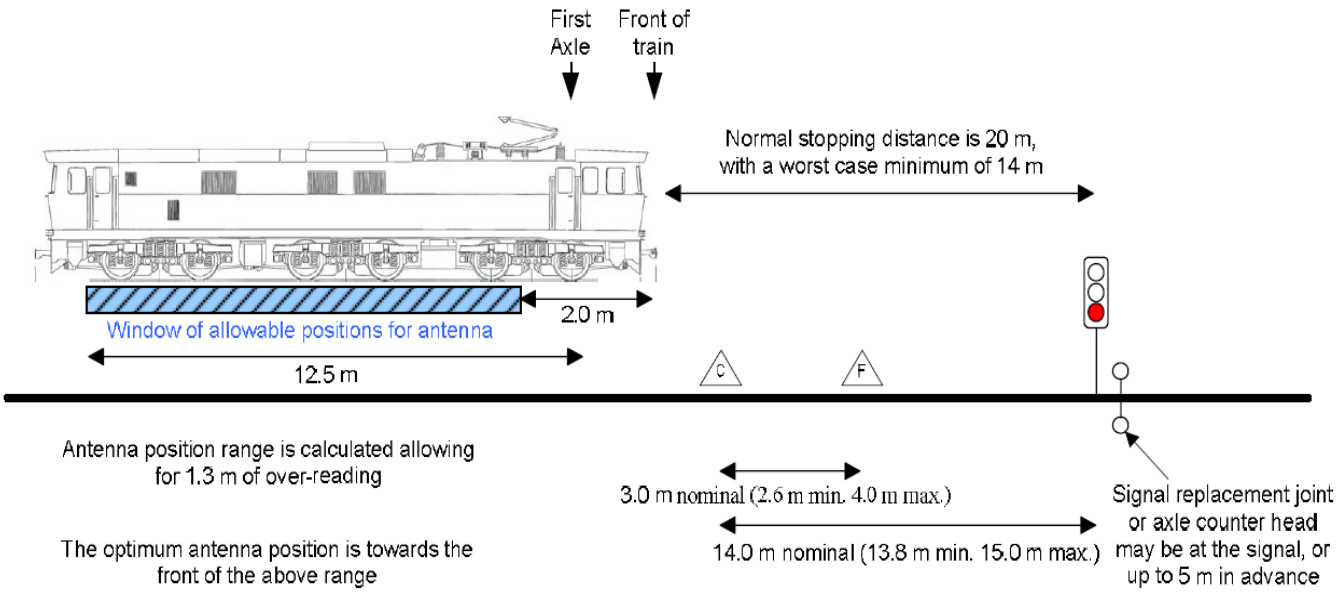


Figure 3: Balise group positioning

There are operational advantages in the train antenna being towards the front of this range, as this would permit updated MAs to be received earlier by the train. There are also safety benefits in the train antenna being towards the front of this range, as this would trip a train exceeding its MA (at the RS) earlier.

If at a particular location it is not possible to locate the balise group 13.8-15.0 m from the signal, then the balise group should be moved further in rear of the signal, and trains advised to stop further back. Consideration shall be given to installing a Stop
Marker in such cases. It is not recommended to move the balise group closer to the signal as a train with its antenna positioned at the back of the allowable range would then replace the signal to danger and cancel the MA whilst the balise antenna was still within range of the controlled balise.

The ETCS Dimensioning Rules remain applied for balise location unless approved explicitly by DPTI. One example may be where the normal train stopping location places the antenna past the controlled balise.

If a train stops closer to the signal than 14 m, then it may have already passed the balise. In such cases, if the driver does not receive a proceed MA consistent with the displayed signal aspect then the driver must select ‘Override’ mode, followed by
‘Staff Responsible’ mode. The train will have to proceed in this mode until the next controlled balise.

9.2. Balise Group Linking

9.2.1. Balise Linking

All balise groups shall be linked, except for any temporary groups used for Temporary Speed Restrictions (see Section 9.7). Each main balise group shall be linked at least to the next main balise group. The Linking Reaction parameter shall be configured as ‘Service Brake’ for all fitted signals. The reason for this is to increase the system safety and it allows

for quick fault rectification due to faulty balise groups being reported to the driver immediately.

Linking Accuracy of 5 m shall be used. This gives around ±2.5 m tolerance for the position of signals without a change to the data.

The maximum distance between adjacent linked balises shall be 1500 m. If balises are not otherwise required closer than 1500 m apart, then additional single fixed balises shall be provided with linking reaction as 'No Reaction'.

The 1500 m balise separation would give a positional error of ±85 m. This figure is calculated as 5% of the linking distance (maximum odometry error of the EVC as required for compliance with *ERTMS/ETCS – Performance Requirements for Interoperability, Ref: SUBSET- 041, Version: 3.1.0, Date: 01-03-2012* Section 5.3) plus 5 m plus the Linking Accuracy (5 m – see above). If such an error would lead to operational difficulties, then additional odometry update balises shall be used. It should be noted that the lengths of Danger Points (and hence Release Speeds – see Section 9.3.3) are reduced by this uncertainty.

On the Belair Line passing loops, a special FB is placed in the middle of each loop track, the main balise group on the home signal with JRI will link up to these FBs, and each FB will link to its relevant destination BG to update the onboard system of the final signal ID of where the MA will end (see *PTS-AR-10-SG-STD-00000068Signalling Principles & Practices for the AMPRN*)

9.2.2. Balise Cable or LEU Failures

If a controlled balise cable or a LEU fails, the balise's default telegram will be sent to the train, the failure will be recorded in the EVC log, and the balise linking reaction will be applied by the onboard system (as per previous section information). The two types of default telegrams that are sent are as follows:

- "LOST COMMUNICATION LEU-BALISE" - controlled balise cable or LEU failure
- "LOST COMMUNICATION LEU-WESTRACE" – LEU has lost communication with the interlocking (except for Belair Line)

The linking reaction will also be applied in the case where the balise is read incorrectly or missed entirely.

9.3. Movement Authorities

A Movement Authority shall be sent from the balise group associated with each main signal to the train.

9.3.1. Length of Movement Authorities

When sufficient routes are set and the signals clear for normal direction running, MAs shall be at least one signal section longer than the longest braking distance of any train travelling at line speed, i.e. two sections long in a three aspect signalling area. Passenger trains are normally able to brake within a single signal section.

9.3.2. Signal Aspect Proving

ETCS movement authorities are independent of the actual signal aspect being displayed on parts of AMPRN (currently Seaford Line). They reflect the aspects that the signalling interlocking is commanding to be clear. Therefore a signal lamp failure will not alter the MA, unless the interlocking reacts to this by reverting a signal to a more restrictive aspect. In such situations (i.e. the interlocking returning a signal to danger due to an aspect failure) the ETCS system shall enforce the stop aspect.

In situations where lamp failures are not detected by the interlocking, ETCS may provide a more permissive authority. It is recommended that drivers follow the procedures for the more restrictive aspect in these instances.

On the Belair line, ETCS movement authorities are dependent on the actual signal aspect being displayed. They reflect the aspects of the Entry signal through current sensing via the LEU. Therefore a signal lamp failure will alter the MA.

9.3.3. Release Speeds and Danger Points

9.3.3.1. Release Speeds and Danger Points Study

A Release Speed (RS) shall be associated with each MA. This is the speed below which a train may approach a stop signal (or end of MA) for the purpose of passing over the balise group to obtain a new movement Authority. It is allowed on the basis that there is an overlap available past the signal. When under the RS the braking curve to 0 km/h is indicated to the driver but no longer enforced. Release speeds need to be as high as possible, as this will be the speed that a train is limited to when approaching a signal which has cleared from stop since the train passed the previous signal. Equally, the RS must be sufficiently low such that all trains tripped by the signal balise group (or passing the signal position if the balise group has failed) are able to stop before any point of conflict. It is considered that the minimum acceptable value of a RS is 10 km/h, as it is not practical to drive all types of train consistently at a speed less than this.

A Danger Point (DP) is associated with each MA. This is the distance ahead of each signal before the first point of possible conflict. The ETCS system ensures, taking into account odometry errors, that a train in ‘Full Supervision’ mode does not pass the DP (or the ETCS Overlap where used) in a SPAD situation (whether the RS is calculated onboard of Fixed). Thus the DP shall be less than or equal to the signalling overlap and must be before the toe of facing points, or before the clearance point of trailing points. This is illustrated in Figure 4.

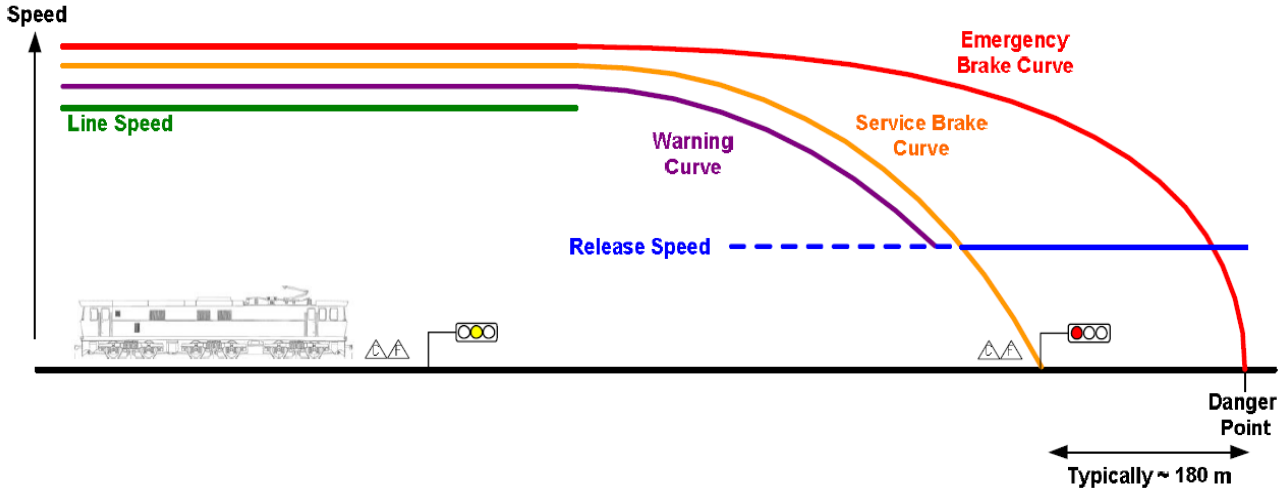
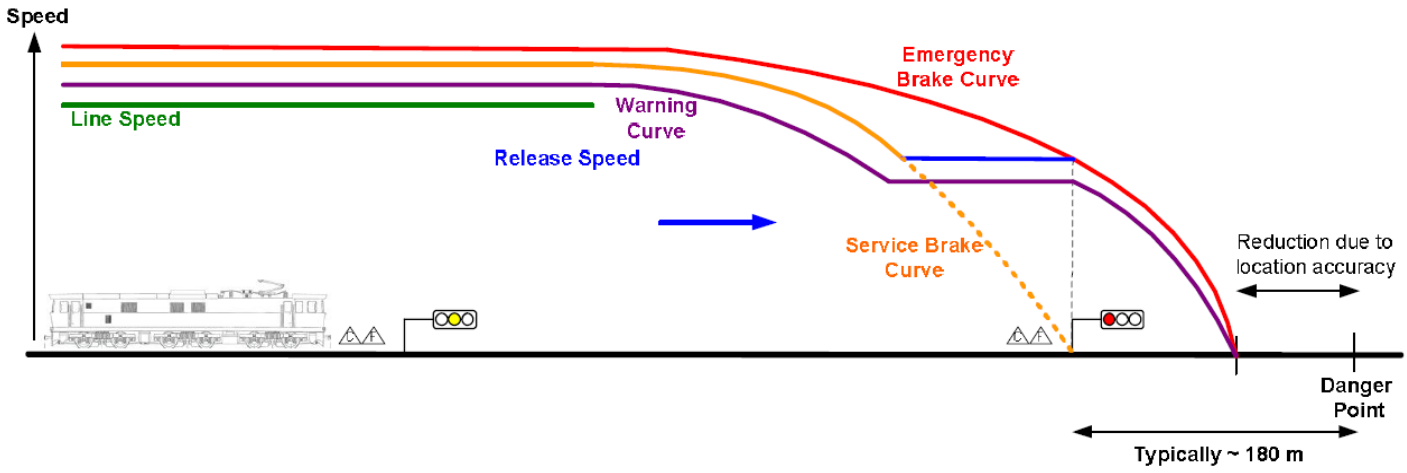


Figure 4: Train speed supervision approaching the Danger Point

Due to the mix of overlap lengths and train types on the AMPRN, there may not be a single fixed RS for each signal that would be acceptable to all train types. ETCS does not permit class-specific fixed release speeds. Therefore the RS shall be calculated onboard each train from the train parameters, the distance to the DP, and gradients transmitted from the trackside, except in special circumstances as required for technical or safety reasons (to be approved by
DPTI on a case by case basis).

Whilst having consistent release speeds from signal to signal would be ideal, this is only achievable by dropping release speeds lower than the maximum safe value. Therefore it is proposed to implement the greatest release speeds possible, given the available overlap distances. The highest RS is achieved by calculating it onboard the train, as shown in Figure



5.
Figure 5: Release Speed when calculated onboard

The distance between the signal and the DP that can be used for emergency braking from the RS is effectively reduced by the location accuracy of the train from the previous balise group. This is for two reasons:

- If the balise group at the signal is missing, then the emergency brake will not be tripped until the train has passed the signal position by a distance equal to the location accuracy.

- The train calculates the emergency braking back from the DP in a safe manner, i.e. assuming that the onboard odometry has made the maximum allowable error.

It is necessary for the distance from the signal to the DP (or ETCS Overlap where used) to be greater than the train location accuracy. Otherwise, the emergency braking curve will come onto the approach to the signal meaning that a train will never be able to actually reach the signal balise group when the signal is approached at danger. The maximum location inaccuracy onboard the train is 5% of the distance from the last read balise group. Danger Points (or ETCS Overlaps where used) must therefore be at least this distance. Infill or odometry update balises can be added to reduce this inaccuracy. These would have particular advantages when a DP is close to a signal, and that signal is regularly approached at danger.

It is a requirement that the DP is within the signalling overlap because the distance from the signal to the DP must be proved clear by the interlocking. Additionally, the DP must be before any clearance point of a converging point. In locations where such distances to the DP cannot be achieved, special arrangements may be required and need to be agreed by DPTI.

9.3.3.2. Driver's Instruction for Fixed Release Speed

Fixed release speeds may be proposed, subject to DPTI approval, where it can be demonstrated that calculating the release speed onboard will result in an unduly low release speed. The RS is a fixed ceiling for the driver, i.e. there is no warning curve or service brake intervention; the system will just enforce an emergency brake application when the RS is exceeded. As such it is impractical for the drivers to target driving at or very near to the RS for risk of an inadvertent emergency brake application.

As part of the driver's training and operational rules, drivers are instructed to always target 5 km/h below the RS shown on the DMI as their maximum speed when in release speed supervision.

For the ETCS designers and testers, the relationship of the train travelling speed and the RS are shown in Table 1: Typical scenarios for Fixed Release Speed consideration.

Table 1: Typical scenarios for Fixed Release Speed Consideration

SCENARIO	DESCRIPTION OF FIXED RELEASE SPEED	ASSUMED TRAIN TRAVELLING
#1	Limiting the speed of a train approaching buffers such that its collision speed can never exceed the design collision impact speed of the buffer stop or 10 km/h (whichever is lower) (Section 10.4)	The same speed as the RS at the time of the collision
#2	Limiting the speed of a train which SPAD over a signal such that it cannot exceed the length of the full signalling overlap	The same speed as the RS at the time of the SPAD
#3	Very low RS of 10 km/h (where used)	Maximum of 8-9 km/h

9.3.4. Section Timers

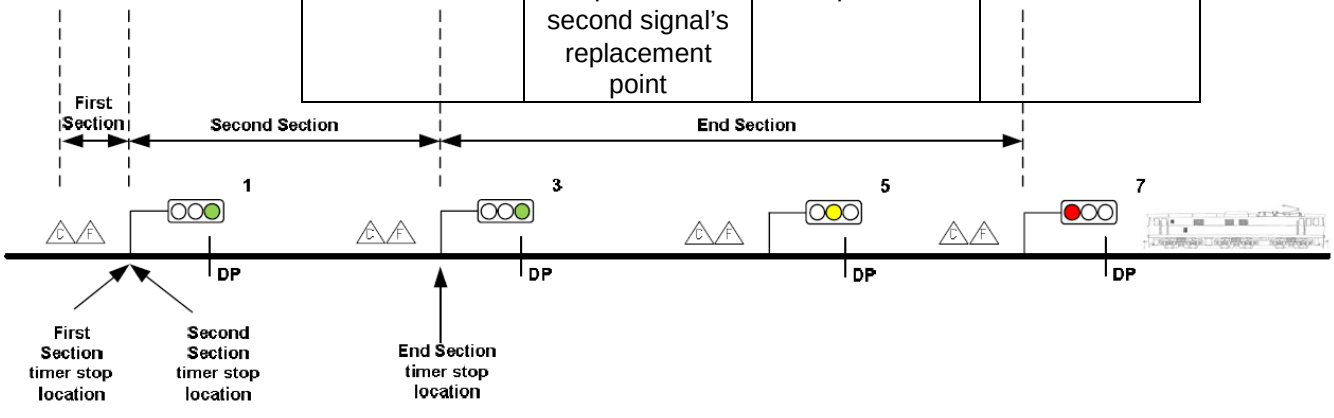
ETCS section timers are used to shorten a MA after it has been received by the train in the case that the train spends an unusually long time in a section. This is because the interlocking will allow the signaller to cancel signals ahead of the train and set conflicting routes after the approach timer has expired.

On AMPRN the preference is for movement Authorities to be split into three sections as implemented between Adelaide Yard and Seaford Interchange station. However for Belair line it is split into two sections between Goodwood station and Belair station. This is to allow the use of timers to reduce the MA if the train has not reached the start of that section within a certain time.

The values of these timers are given in Table 2: Length of Section Timers, and this is illustrated in Figure 6. The start location for all timers is when the train receives the MA from the balise group.

Table 2: Scenarios of Train Travelling Speed under Fixed Release Speed

SECTION	LENGTH	TIMER STOP LOCATION	TIMER VALUE
First	Balise group to first signal's replacement point	First signal's replacement point	30 s
Second	First signal's replacement point to second signal's replacement point	First signal's replacement point	∞



End	Second signal's replacement point to End of Authority	Second signal's replacement point	Note 1

Figure 6: Movement Authority sections

Note 1:

a) Permissive signal, the section timer is infinite;

b) Absolute signal with obstruction in the section (i.e. level crossings, trailing points or facing points), section timer is calculated based on the estimated section running time plus a 30 second delay, rounded up to nearest 10 seconds.

The estimated section running times are based where possible on measured values of a stopping service, taking account of existing line speeds, speed restrictions and station stopping profiles. Otherwise, section running times are estimated based on line speed running times plus 30 seconds platform dwell time (if applicable).

c) Absolute signals with obstruction in the section (i.e. level crossings, trailing points or facing points) and PLOD, section timer is calculated based on the estimated section running time by considering the PLOD application plus a 30 second delay, rounded up to nearest 10 seconds.

d) Absolute signals without obstruction in the section, section timer is calculated based on section running time of 20Km/h speed plus 30 second platform dwell time (if applicable), rounded up to nearest 10 seconds.

Where the calculated ATP Section Timers are not longer than Approach Locking Timers plus 10 seconds, the Approach Locking Timers shall apply. Otherwise, the calculated ATP Section Timers shall be selected.

If ATP Section Timers were to be longer than Approach Locking Timers, it is possible that the ATP system may retain a proceed movement authority after a signal has been replaced and Approach Locking Timer expired. ATP Section Timers shall not exceed the Approach Locking Timers.

9.3.4.1. Multiple Diverging Routes

Where data preparation methods limit only one set of section timer values to be applied for all routes from a signal, the value for the End Section timer shall be configured to be equal to the shortest approach locking timer for the 2nd signal in all possible routes as shown in Figure 7 below. If there is a large difference between possible timer values and it is likely to cause operational issues, this should be raised to DPTI for special consideration.

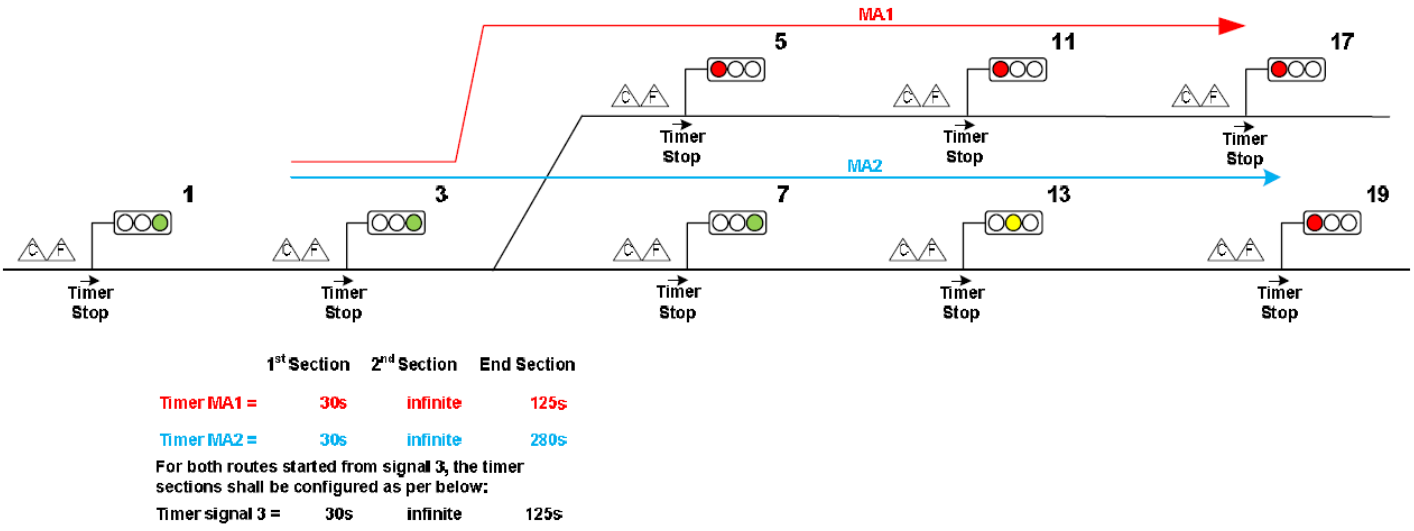


Figure 7: End Section timer for multiple diverging routes

9.3.4.2. Short MAs

If the MA only contains one signal section, then the Second Section would not be present. Thereafter for longer MAs the End Section is changed in length to incorporate the extra sections beyond the first.

9.3.4.3. End Timer

ETCS includes an optional End Timer for the End Section. This is not currently used on AMPRN because if the End Section times off then the train would be left without an MA and therefore not be able to move forward to the next balise without overriding the system.

9.3.4.4. Relationship with Operating Rules

It should be noted that although the section timers are set up to protect against the train being able to beat the approach locking in most situations, it cannot mimic it in all scenarios. Therefore it is important that operational rules inform the driver that after stopping for longer than normal when running on an ETCS movement authority, they should commence at a speed such that they will be below the National Value RS (V_NVREL = 15 km/h, see Appendix A) when they reach the next signal as the MA may be withdrawn to this point as they approach.

9.3.5. Danger Points and ETCS Overlaps

The DP shall be within the signalling overlap of the associated route. For overlaps with no points within them (i.e. plain line), the DP shall be located at the end of the signalling overlap (except if there is a LX within the overlap, in this case the DP shall be placed before the edge of the LX).

The RS associated with the DP in plain line shall be configured to 'Calculated onboard' unless it can be demonstrated that calculating the release speed onboard will result in an unduly low release speed.

Where there are points within the overlap the following principles apply:

9.3.5.1. Swinging Facing Point Overlaps

Where there are swinging facing point overlaps (i.e. multiple possible overlap destinations) the DP shall be set at a distance no longer than shortest possible signalling overlap.

The DP shall be placed on the overlap path with the most restrictive static speed profile (including speed restrictions associated with turnouts).

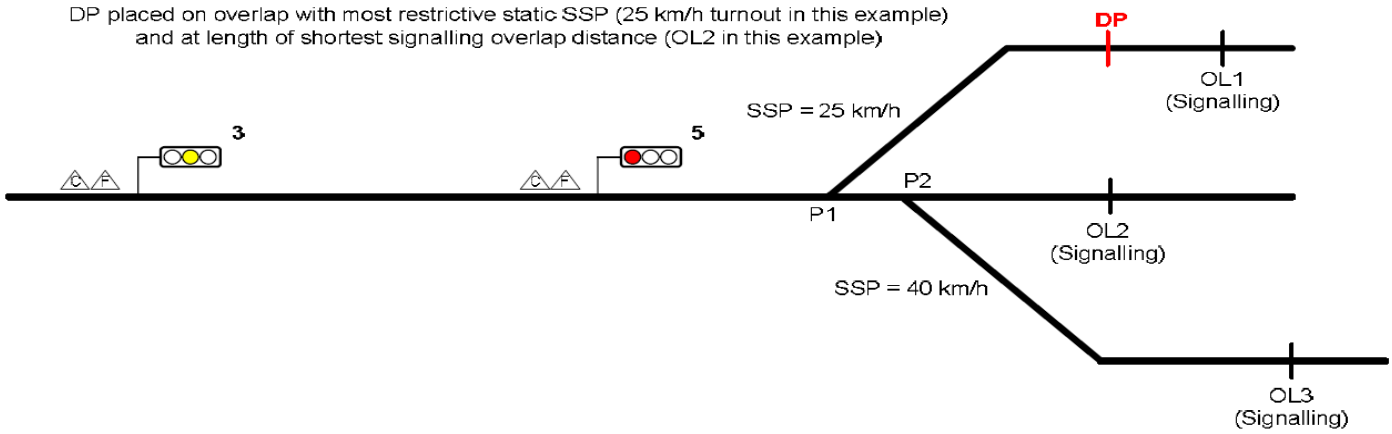


Figure 8: Danger Point placement with multiple possible overlaps

Using these rules, if the overlap path selected for placing the DP does not have the steepest average downhill gradient, a risk assessment shall be conducted to decide if the DP distance needs to be reduced to compensate for less restrictive gradient information being sent to the train.

The RS associated with the ETCS Danger Point in this scenario shall be configured to ‘Calculated onboard’.

9.3.5.2. Trailing Points Overlaps

Where there are trailing points within the overlap the DP shall be placed before the clearance point of the first trailing point within the OL. This is because the full OL locking is allowed to time off in the interlocking after the train has been timed at a stop and then a conflicting route set within the full overlap area.

The ETCS Overlap shall be placed at the end of signalling overlap following the rules set out in Section 9.3.5.1.The ETCS Overlap shall be configured to expire at the same time as the signalling overlap times off in the interlocking logic (as specified in the control tables), when the train occupies the berth track section before the signal for time. The RS associated with the ETCS Overlap shall be configured to ‘Calculated onboard’.

See the scenarios in Section 10.2.1 for further details.

9.3.6. Signals at Danger

A fitted train will be tripped by the balise group immediately before a signal at danger if it is passed, unless the driver has selected 'Override'.

The Balise Groups at such signals shall include 'Stop if in Staff Responsible' messages so that trains can only pass when in 'Override' mode. Trains shall stop before the first point of conflict if it approaches the first signal at danger when coming out of a siding.

The packet 'Danger for Shunting' shall be included within all main signal balise groups for the nominal direction so that trains are driven in 'Shunting' mode will be stopped at such signals.

9.4. Infill Balise Group

Infill balises shall be provided where deemed necessary, this includes at signals which are regularly approached at danger with low release speeds (e.g. at level crossings – see Section 10.1), at shortened overlaps to ensure trains stop before the point of conflict or where there is a specific operational requirement for improved ETCS performance at the signal. Such situations require DPTI approval on a case by case basis.

As not all ETCS-fitted trains are capable of reading 'Euroloops' they are not to be used for providing infill information.

Infill balise groups shall consist of a single controlled balise where the data capacity of a single balise is sufficient. Otherwise infill balise groups shall consist of a pair of balises, in the same manner as for signal balise groups.

9.5. Static Speed Restrictions

ETCS supports six categories of Static Speed Restrictions. They are listed, together with their application for AMPRN, in Table 3: Categories of Static Speed Restrictions.

Table 3: Categories of Static Speed Restrictions

CATEGORY	AMPRN APPLICATION
Static Speed Profile	One basic SSP. This shall be the line speed shown on the Signalling Scheme Plans. Where this is to be simplified from the full list of curves to reduce the number of transitions, then this simplification shall be submitted to DPTI for consideration/approval.
Axle load speed profile	Not used
Maximum train speed	Set onboard the train based on the train class selected.
Signalling related speed restriction	Used to limit the speed of 'On Sight' moves (low speed). For 'Full Supervision' routes, the value of V_NVUNFIT (see Appendix A) shall be included within each MA.
Mode related speed restriction	See Section 8.1for those modes with associated specific speed restrictions.

9.6. Differential Speed Restrictions by Train Class

Where a specific risk is identified by DPTI, a speed restriction applying to only some classes of train may be applied in the trackside data to restrict these types of train. An example of this would be to apply a 0 km/h speed restriction for electric

train categories on the non-electrified roads to prevent electric trains from exiting the electrified area due to an incorrect routing. This must be assessed on a case by case basis.

9.7. Temporary Speed Restrictions

Temporary Speed Restrictions (TSRs) shall be applied by placing an additional temporary balise group on the track before the TSR area. The typical TSR Balise Group arrangement for the unidirectional running track is shown in Figure 9

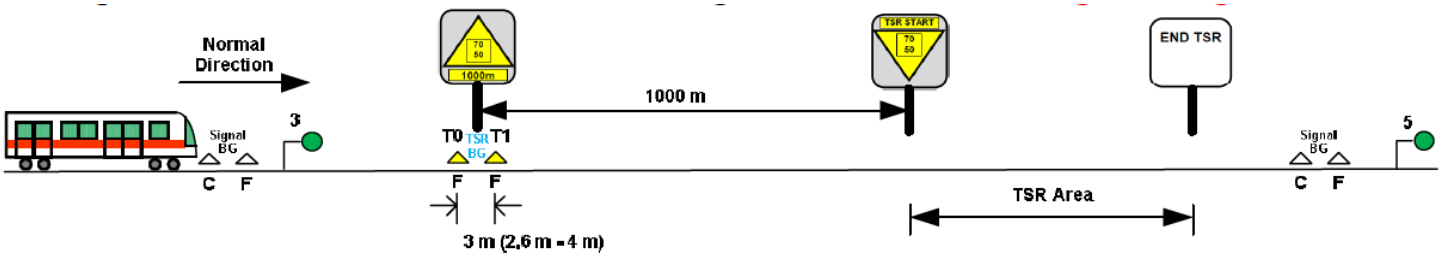


Figure 9: Typical ATP TSR BG Arrangement on Unidirectional Track

For the bidirectional train running sections, the TSR BG arrangement is shown in Figure 10

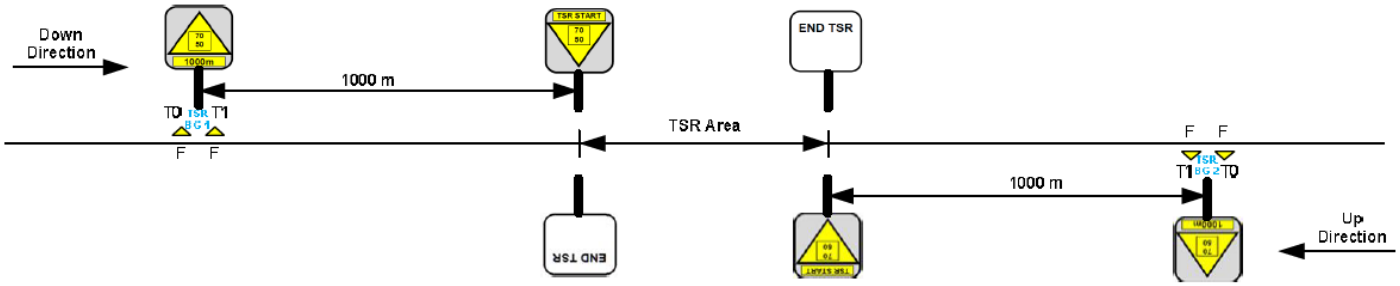


Figure 10: ATP TSR BG Arrangement on Bidirectional Track

Temporary Speed Restriction balise groups (consisting of a pair of fixed balises) may be fitted to the track a fixed distance of 1000 m in advance of the TSR area in both directions for bi-directional running or in normal direction for single train direction running.

The TSR balises will contain pre-programmed data that specifies the text message that will be displayed on DMI, the TSR speed, and TSR area length. The TSR enforcement will be applied until the back of the train has left the TSR area.

These TSR balises will not be linked with the permanent balises, so the system would not detect the accidental removal of both TSR balises. The driver must therefore maintain vigilance in reacting to the trackside physical signs. In all cases the TSR trackside signs take precedence over the information transmitted by the TSR balises.

In case the TSR area including the junctions and crossings with points, or the operator want to reduce the TSR area length, an additional pair of Revocation Balise Group shall be provided at the places to cancel the TSR, see Figure 11.

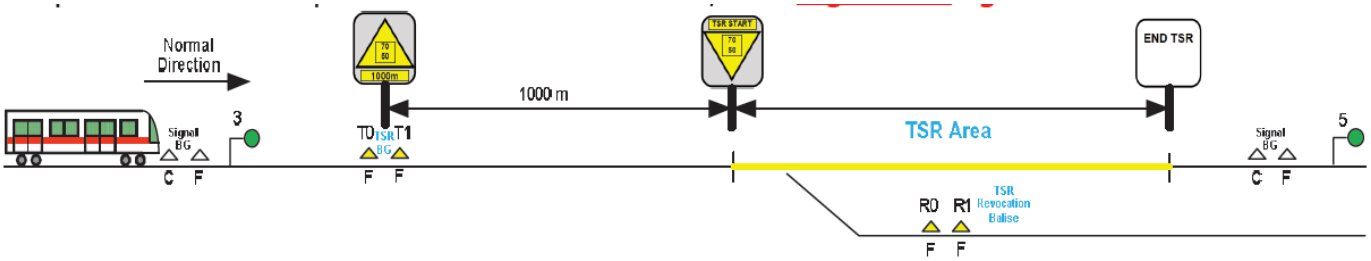


Figure 11: ATP TSR Revocation BG on the non-TSR Track

The TSR Revocation BG can also be used on the normal TSR application area to clear the TSR enforcement earlier, see Figure 12

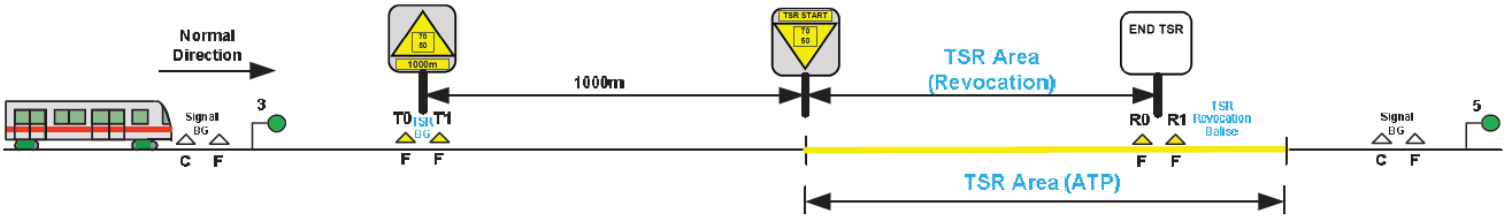


Figure 12: ATP TSR Revocation BG on the TSR Track

9.8. Track Conditions

Indication on the drivers' display of various track conditions is supported by ETCS. No specific 'Track Conditions' are required on the AMPRN.

9.9. Text Transmissions

The transmission of text information to the train driver shall generally not be used. Therefore there is no requirement for fixed text messages to be stored onboard the train. A text transmission shall be used in the case of certain trackside equipment failures to provide details of the failure within the EVC fault log and the train driver (see Section 9.2.2).

Route messages may be transmitted to the train in the form of text that is displayed on the DMI where such information is specifically requested for operational reasons. Generally route information shall be provided to the driver when it is required via lineside signals and not via the ETCS system, so the use of such text transmissions shall be minimal. They shall be considered on a case by case basis.

9.10. Gradient Information

The gradient information shall normally be sent from the fixed balise. Where there are diverging routes with different gradients, the most restrictive one will be applied to all routes that start from the BG to avoid exceeding the balise data capacity limitation.

Where there is a big difference in diverging gradients, this shall be highlighted during the design stage to DPTI for operational impact assessment.

9.11. Version Control

Version numbering shall be implemented as per SRS Section 3.17.2 (refer *ERTMS/ETCS – Class 1, System Requirements Specification, Chapter 3, Principles, Ref: SUBSET-026-3, Version: 2.3.0d, Date: 11-04-08*)

Corresponding with this version of the SRS, M_VERSION shall be set to a value of 16.

10. ETCS Scenarios

This section details typical ETCS application arrangements for scenarios that occur throughout the AMPRN.

10.1. Level Crossings within Overlap

10.1.1. Scenario where level crossing is in the signal overlap

The following diagram shows the typical arrangement on the approach to a LX where the level crossing is within the overlap of the signal.

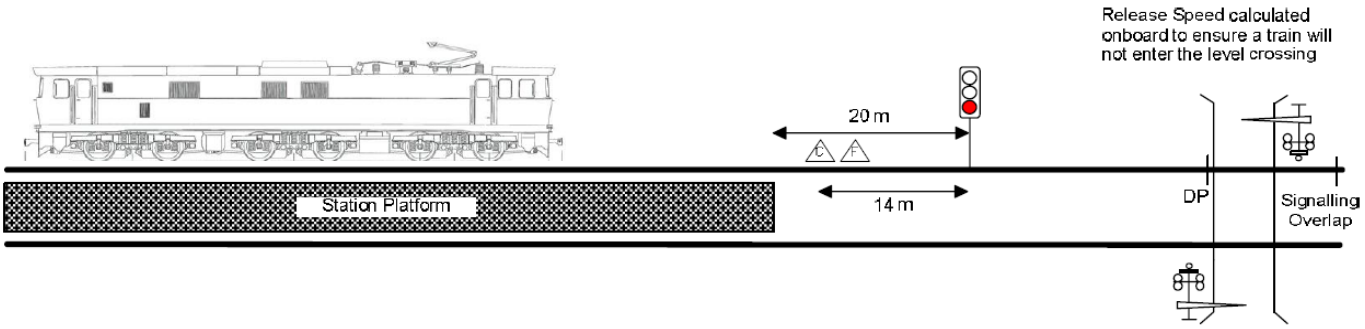


Figure 13: Typical level crossing arrangement where the level crossing is within the signal overlap

The DP shall be placed at the nearest 'Edge of Road' to the signal. The ETCS system therefore shall ensure that any train that SPADs the signal will stop before the crossing.

Note: Typically this scenario is also applicable in the case where there isn't a platform before the LX.

10.2. Points within Overlaps

10.2.1. Trailing Points within Signalling Overlap

The interlocking is designed to release its locking on the overlap beyond a controlled signal when it has timed the train to a stop on the berth track before the signal. This is essential to allow other moves to be set in tight layouts where they conflict with the track previously being used for the overlap.

Figure 14 below shows a trailing point within the signal 23 and 31 overlaps. The DP is configured at the clearance point of the first trailing point that is within the signal overlap. The variable d2 is the distance between the signal and the DP as below.

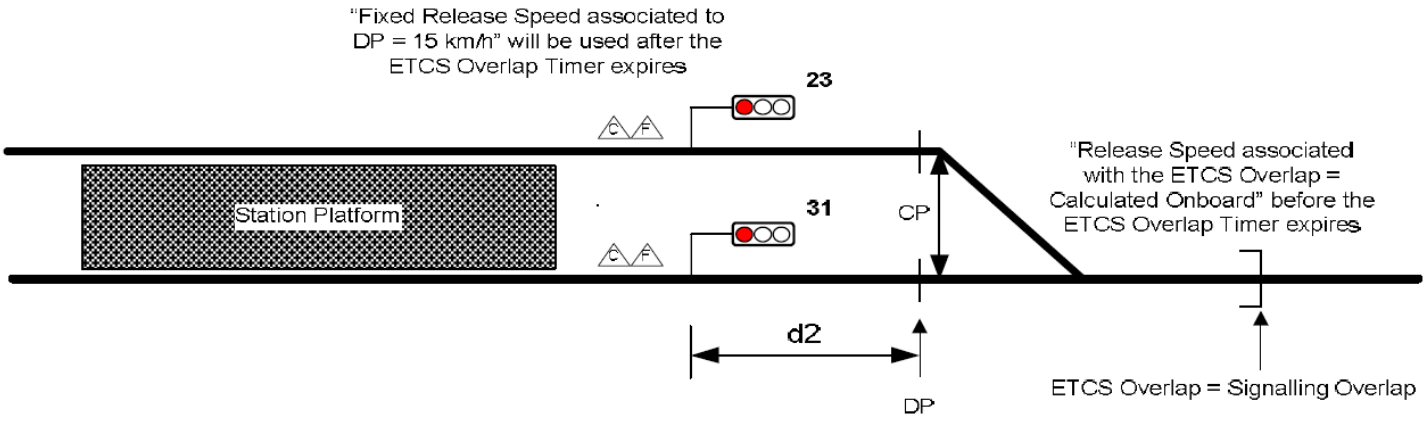


Figure 14: Trailing points within overlap

10.3. Stop Boards

The ETCS system shall target trains to the Stop Board when this is the limit of authority given by the signalling system.

The ETCS system shall enforce a maximum speed of 10 km/h in the vicinity of the Stop Board in order to allow a train to actually reach the board despite any odometry errors. In order to achieve this, it is necessary to introduce a DP beyond the Stop
Board.

If the train is subsequently authorised to pass the Stop Board, it will be necessary for the driver to select 'Shunting'. Otherwise the train would be subjected to a brake application shortly beyond the Stop Board.

If there are obstructions en route towards a Stop Board (for example a fence or a hand point which is not interlocked) the DMI will show a MA up to the first of point of conflict only. The driver will then be forced to stop and select 'Shunting' mode in order to continue further up to the Stop Board.

Figure 15 shows a typical arrangement of the approach to a stop board.

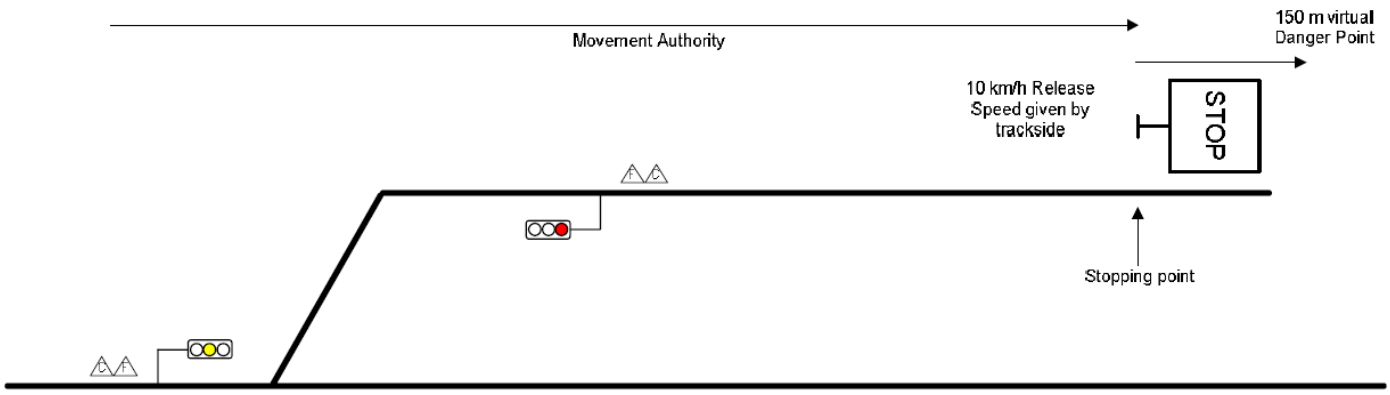


Figure 15: Typical approach to a Stop Board

10.4. Buffer Stops

The ETCS system shall target trains to the usual stopping point on the approach to a buffer stop (to be nominated by DPTI for each buffer stop). This means that the end of the MA will be targeted to this location.

The ETCS system shall ensure that the maximum impact speed (should a train erroneously be driven into a buffer stop) will be limited to a speed less than or equal to that of the designed absorption speed of the buffer stop. It is proposed that the ETCS system enforce a speed limit of 10 km/h on approach to the buffer stop, as well as a fixed RS of 10 km/h at the buffer stop limit. While this is higher than the current 5 km/h speed limit, this is proposed as a practical limit.

As the actual distance from the normal stopping point to the buffer stops is likely to be less than the ETCS odometry error, it is necessary to introduce a DP beyond the buffer stop. This shall be configured at 150 m past the buffer stop to avoid the train entering RS supervision until very close to the buffer stop for optimum performance.

Linking to the last available balise group shall be included so as to reduce odometry errors as much as possible, without installing additional balise groups just for this purpose.

Figure 16 shows a typical arrangement of the approach to a buffer stop.

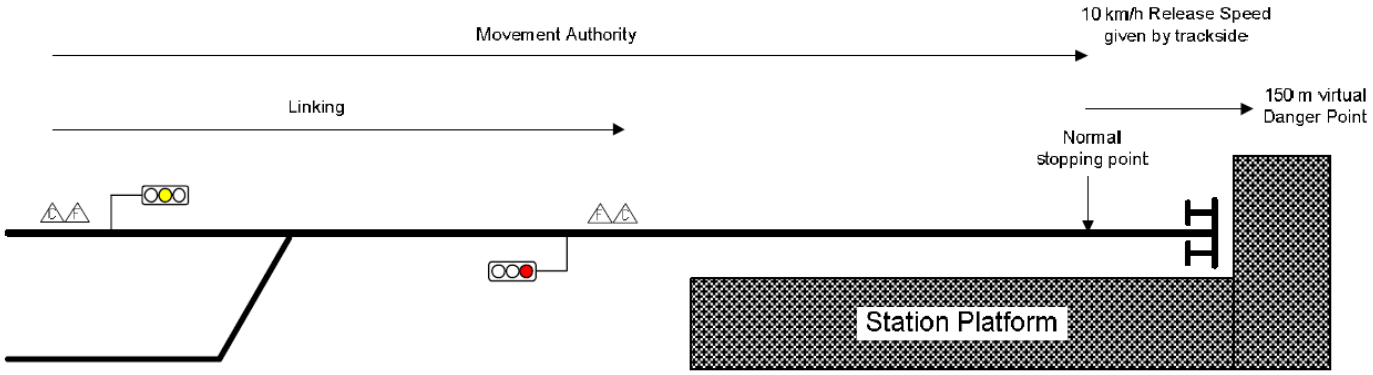


Figure 16: Typical Buffer Stop Arrangement

10.5. Preventing Electric Trains from Entering Non-electrified Lines and Sidings

To prevent electrified trains from exiting the electrified areas, the ETCS trackside shall send special SSP packets which contain different speed information for electric and all other trains within the International Train Category (see Appendix C).

The trackside will send the special SSP packet to the onboard system which will enforce the speed profile according to the International Train Category preventing any electric train from entering non-electrified lines and sidings. The electric trains (i.e. International Train Category = 7) will receive the SSP = 0 km/h for non-electrified areas, while the other International Train Categories will have the actual SSP as per the trackside conditions.

The zero speed SSP shall only apply from the point where the electrification ends and not from the entry signal, so it is only provided as a back-up to prevent a train from exiting the electrified area. It will not prevent a train from taking a non-electrified route at a signal, this is still the responsibility of the train controller and driver. Refer to Figure 17 for more details.

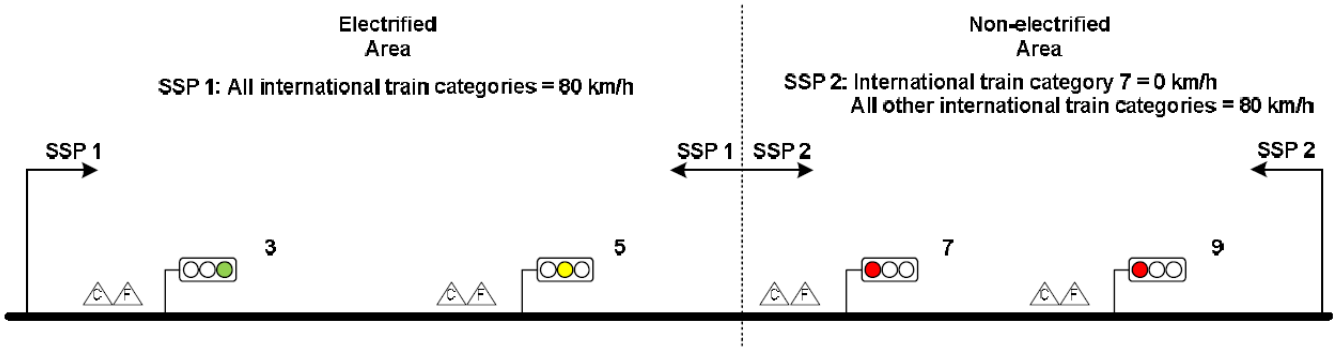


Figure 17: Differential SSPs applied to International Train Categories for non-electrified areas

APPENDIX A: National values

The following set of National Values shall be used:

PARAMETER	ETCS DEFAULT VALUE	AMPRN NATIONAL VALUE	SRS NAME	REMARKS
National Identity number	N/A	546	NID_C	
'Shunting' mode(permitted) speed limit	30 km/h	20 km/h	V_NVSHUNT	Selected so that audible warning is triggered at 25 km/h
'Staff Responsible' mode (permitted) speed limit	40 km/h	25 km/h	V_NVSTFF	
'On Sight' mode (permitted) speed limit	30 km/h	25 km/h	V_NVONSIGHT	
'Unfitted' mode (permitted) speed limit	100 km/h	110 km/h	V_NVUNFI	Represents the maximum possible speed on the whole network.
Release Speed value	40 km/h	15 km/h	V_NVREL	With onboard calculation or sent by trackside, this is only used when MA sections time out.
Distance to be used in roll away protection, reverse movement protection and standstill supervision	2 m	2 m	D_NVROLL	
Use service brake when braking to a target	Yes	Yes	Q_NVSRBKTRG	
Permission to release emergency brake	Only possible at standstill	Only possible at standstill	Q_NVEMRRLS	
Max. speed limit for triggering the 'Override EOA' function	0 km/h	0 km/h	V_NVALLOWOVTRP	Train must be stationary to select 'Override'
Permitted speed limit to be supervised when the 'Override EOA' function is active	30 km/h	25 km/h	V_NVSUPOVTRP	The same value as 'Staff Responsible' speed
Distance for train trip suppression when 'Override EOA' function is triggered	200 m	50 m	D_NVOVTRP	Instructions require driver to be able to read signal number plate when entering 'Override'
Max. time for train trip suppression when 'Override EOA' function is triggered	60 s	180 s	T_NVOVTRP	Based on 1 km/h for 50 m
Distance to be allowed for reversing in 'Post Trip' mode	200 m	2 m	D_NVPOTRP	See Section 5.3.1.4
System reaction if radio channel monitoring time limit expires (T-Contact)	No reaction	No reaction	M_NVCONTACT	Not relevant for a Level 1 installation.
Max. time since creation in the RBC of last	∞ (255 s)	∞ (255 s)	T_NVCONTACT	Not relevant for a Level 1 installation.

PARAMETER	ETCS DEFAULT VALUE	AMPRN NATIONAL VALUE	SRS NAME	REMARKS
received telegram				
Change of driver ID permitted while running	Yes	No	M_NVDERUN	
Max permitted distance to run in 'Staff Responsible' mode	∞(32767)	∞(32767)	D_NVSTFF	
Modification of adhesion factor by driver	Not allowed	Allowed	Q_NVDRIVER_ADHES	The risk of the driver not selecting low adhesion to be considered when selecting braking parameters.

APPENDIX B: Fixed Values

These values are defined by the ETCS SRS as being fixed. Although they can be adjusted for use on non-interoperable railways outside of Europe, it is not proposed to alter them for AMPRN.

Therefore their values remain as per the following table:

FIXED VALUE DATA	SRS [4]	NAME	REMARKS
The number of times to try to establish a safe connection	3 times		Not relevant for Level 1
Repetition of radio messages	3 times	DV_EBI_{min}	Not relevant for Level 1
Speed difference between permitted speed and Emergency Brake Intervention limit, minimum value	5km/hr	DV_EBI_{min}	
Speed difference between permitted speed and Emergency Brake Intervention limit, maximum value	15 km/h	DV_EBI_{max}	
Constant defining the relation between Permitted and Emergency Brake limit.	10%	C_EBI	Required for braking formula
Maximum distance for calculating the geographical distance	10 000 m	D_{GEO}	
MA request repetition cycle, default value	60 s	$T_{CYCRQSTD}$	Not relevant for Level 1
Mode transitions: time to acknowledge a mode transition	5 s	T_{AMT}	
Adhesion value (1), non- slippery rail	1		
Adhesion value (2), slippery rail	0.7		
Distance of metal immunity in Levels 0/STM	300 m	D_Metal	
Default location accuracy of a balise group	12 m		
Time between minimum rear safe end of the train leaving a track condition area and onboard deleting the applicable indication	5 s		

APPENDIX C: International Train Categories

The following International Train Categories shall be used on the AMPRN:

INTERNATIONAL TRAIN CATEGORY	VALUE (NC_DIFF)	TRAIN TYPE
International Train Category 1	0	Not used
International Train Category 2	1	Not used
International Train Category 3	2	Not used
International Train Category 4	3	Not used
International Train Category 5	4	2000 Class (Retired Class)
International Train Category 6	5	3000 Class
International Train Category 7	6	4000 Class
International Train Category 8-15	7-14	Not used