Reference material

Advanced train control Migration System (AMS) Specifications – Balise Arrangement for High Risk Location Design Guideline

This document is published as reference material to support the implementation of Automatic Train Protection as part of the roll out of the Advanced Train Control Migration System project.

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AMS PROJECT SPECIFICATIONS

BALISE ARRANGEMENT FOR HIGH RISK LOCATION DESIGN GUIDELINE

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Guidelines – Applicable to Transport Projects AMS Program

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Authored by: Cyril Chéreau Technical Specialist		**Date:** 12/5/2017
Reviewed by: Paul Hartley Senior Rail Systems Manager	P.Hartley	**Date:** 12/5/2017
Reviewed by: Michael Smith Operations Standards and Procedures Analyst		**Date:** 12/5/2017
Reviewed by: Michael Little Manager Safety Assurance		**Date:** 12-5-2017
Reviewed and Accepted by: Frederic Tricoche Principal Engineering Manager Systems		12/05/17 **Date:**
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2.2	09/05/2017	C. Chéreau	Update after review
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Foreword

This guideline forms a part of the TfNSW suite of railway signalling guidelines which detail the requirements for the implementation of ATP / AMS on the TfNSW heavy rail network. This guideline specifically covers AMS balise placement when Target Speed Monitoring is needed, which includes:

- High risk turnout
- High risk overlap deficiency
- High risk end of lines / buffer stops
- High risk speed sign consideration
- Calibration BG consideration

To gain a complete overview of ATP / AMS signalling design requirements, this document should be read in conjunction with the AMS suite of signalling design principle modules.

Table of contents

1. Introduction 7
1.1. AMS Background 7
1.2. Purpose 8
1.3. Application 9
2. Reference documents 9
3. Terms and definitions 9
4. Concept 12
5. High Risk Location 13
5.1. Flowchart 13
5.2. High-Risk Turnouts 15
5.3. Overlap Deficiency 17
5.4. End of Lines / Buffer Stops 20
5.5. Level Crossing Protection in Wrong Running 22
6. High Risk Speed Sign Consideration 25
6.1. Nominal Case (Sufficient Distance) 25
6.2. Exception Case (Not Sufficient Distance) 26
6.3. High Risk Speed Sign after exiting a Turnout 26
7. Cascaded cases application and examples 27
7.1. High Risk Turnout with supervision of turnout, speed restriction and Level Crossing on the adjacent track 27
7.2. High Risk speed restriction on the adjacent track 28
7.3. High Risk Overlap Deficiency on the adjacent track 28
8. Calibration Balise Group Consideration 29
9. Consideration for train with lower braking capabilities (Optional) 30
9.1. Extra Steps for BG placement 31
9.2. Extra steps for High Risk Speed Sign Consideration 33
Appendix A Clarifications on Target Speed 34
A.1. Target Speed for Overlap Deficiency 34
A.2. Target Speed for High Risk Turnout 34
Appendix B ERA Braking Curve Tool Information 35
Appendix B1: Example Deficient Overlap 35
Appendix B2: Example Buffer Stop 37

1. Introduction

1.1. AMS Background

The ATP program was previously deploying a European Train Control System (ETCS) Level 1 'Full Supervision' system over the Transport network through various approval package rollouts.

In the Level 1 'Full Supervision' (FS) system all signals were to be fitted with an LEU and a balise group.

The ATP Program is now deploying the 'Advanced train control Migration System' (AMS) with the intent of facilitating accelerated trackside deployment, the fitment of additional rolling stock and the realisation of earlier safety benefits. AMS is essentially an ETCS Level 1 'Limited Supervision' (LS) system providing ceiling speed supervision and targeting high risk areas of the network e.g. signals without mechanical train stops, high risk junctions and buffer stops.

Speed supervision under ETCS is achieved through comparing the train speed and position to the various supervision limits. The Onboard equipment provides this relevant information to the Driver, and if the Driver does not react appropriately, the Onboard generates traction cut-off commands and braking commands. The information displayed to the Driver is selected according to the supervision status of the speed and distance monitoring function: Normal status, Indication status, over speed status, Warning status and Intervention status.

Under AMS, the following types of speed and distance monitoring are defined:

- Ceiling speed monitoring (CSM)
- Target speed monitoring (TSM)
- Release speed monitoring (RSM), only for Buffer Stop

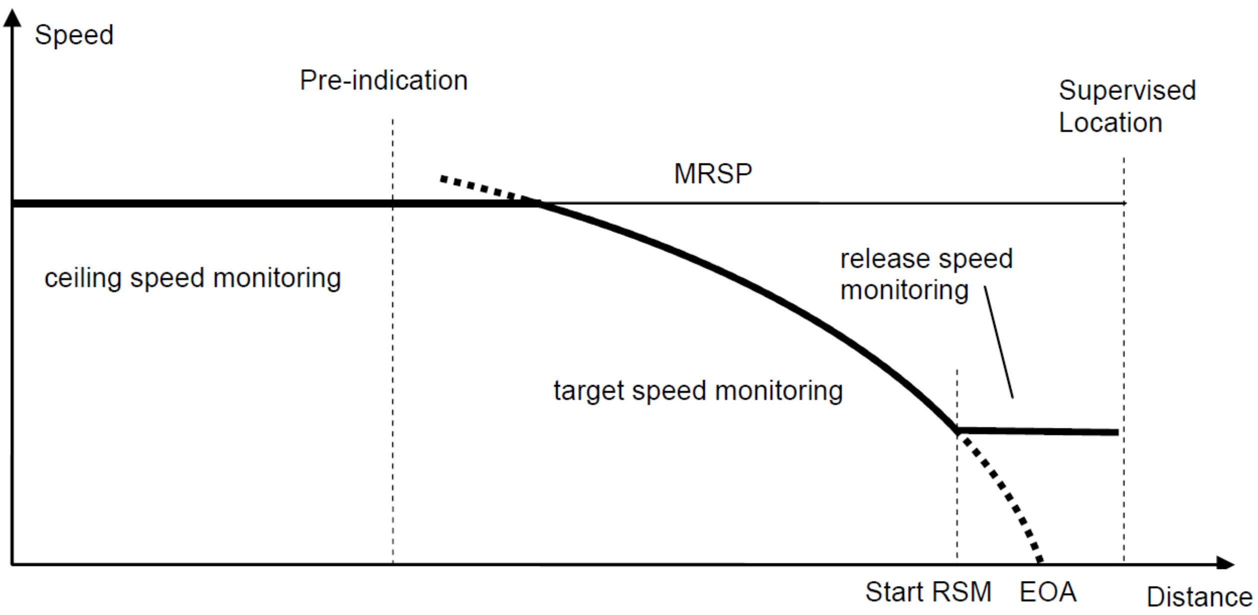

Figure 1 – Different types of speed and distance monitoring

Ceiling speed monitoring is general speed supervision in areas where no target speed monitoring for high risk locations is required.

Target speed monitoring is speed and distance supervision on the approach to a high risk location.

Release speed monitoring is speed supervision on the approach to an End of Authority.

For AMS, release speed monitoring (RSM) only applies to Buffer Stops supervision. For all other ATP fitments under AMS, only ceiling speed monitoring (CSM) and target speed monitoring (TSM) will be applied.

1.2. Purpose

This guideline describes how the AMS Project will apply Target Speed Monitoring (TSM) to designated high risk locations, including the following:

- High risk turnouts;
- Deficient overlaps, or level crossings or catchpoints within an overlap;
- Ends of lines and/or buffer stops
- Level Crossing Protection in Wrong running

Within the AMS context, the term 'TSM' means that Onboard ATP equipment will provide braking curves on the approach to specific high risk locations and will trigger a brake intervention if braking curves are exceeded.

Balise Group (BG) located on the approach to high risk locations will provide speed and gradient information relevant to the high risk location ahead. The location of these BGs needs to be prior to the start of the TSM. The system has built in redundancy for TSM by announcing it from at least 2 BGs (first from a fixed BG, for redundancy, and then announced from a controlled BG, which would confirm the TSM only if required by the signal aspect), which will prevent a single missing balise from causing the TSM to be missed by the train.

This guideline describes the requirements for calculating the (ETCS) TSM curves and to ensure BGs for high risk locations are placed at the optimum position, taking into account safety, operations and cost.

1.3. Application

This document applies to AEOs engaged to carry out signal design for new works.

2. Reference documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

Transport for NSW standards

T HR RS 00830 ST RSU Appendix C – Brake Performance Curves

AMS Technical Issue Paper

AMS-TIP-230 - Arrangements of Balises for Protection of Designated Hazards

Tools

ERA Braking Curve Tool configured for AMS

AMS Project Specifications

AMS Signal Design Principle

Design Guideline for AMS Identification of High Risk Turnouts

AMS Report

Deficient Overlaps, Catch Points and Level Crossings Report

3. Terms and definitions

The following terms and definitions apply in this document:

AEO Authorised Engineering Organisation; means a legal entity (which may include a Transport Agency as applicable) to whom the ASA has issued an ASA Authorisation

AMS Advanced train control Migration System

ASA Asset Standards Authority

ATP Automatic Train Protection; a system which supervises train speed and target speed, alerts the driver of the braking requirement, and enforces braking when necessary. The system may be intermittent, semi-continuous or continuous according to its track-to-train transmission updating characteristics.

BG Balise Group

CI Confidence Interval, referring to the odometer error used by the EVC

DP Danger Point

EBD/EBI Emergency Brake Deceleration/Intervention

EOA End Of Authority

ETCS European Train Control System; a four level, unified, modular automatic train protection specification to enhance interoperability across Europe

ERA European Railway Agency

EVC European Vital Computer; the on-board computer that processes train data and track data to calculate the required braking, speed, distance and intervention functions. The **Onboard** also refers to the EVC in the guideline.

FS Full Supervision

GE52 / GE52A / GE62 / GX2M Braking Curve for different trains, referenced in T HR RS 00830 ST RSU Appendix C – Brake Performance Curves

High Risk Turnout refers to turnout or crossover where there is a risk of derailment due to high speed differential between the line speed and the turnout speed. Other contributing factors include running line geometry, configuration of the turnout and surrounding infrastructure. The high risk definition and criteria is given in the high risk turnout guideline.

LEU Lineside Electronic Unit

LOA Limit of Authority

LS Limited Supervision

MA Movement Authority

MRSP Most Restrictive Speed Profile

Overlap Deficiency refers to high risk deficient overlaps, high risk catch points within an overlap and high risk level crossings within an overlap. The Deficient Overlaps, Catch Points and Level Crossings Report listing all the high risk deficient overlaps that exist in the network shall be provided by TfNSW.

SBD/SBI Service Brake Deceleration/Intervention

SvL Supervised Location

TfNSW Transport for New South Wales

TOC Train Operating Conditions (ASA)

TSM Target Speed Monitoring

TSM Initiating BG refers to the BG closest to the hazard being protected. This guideline refers to the positioning of this BG.

TSM Redundant BG refers to the BG in rear of the TSM initiating BG, which is used to pre-announced the hazard, in case the TSM initiating BG is lost.

4. Concept

There are various functions defined in AMS and others considerations which require TSM calculations, these are listed below:

- High Risk Speed Sign (BG at Speed Sign)
- High Risk Turnout (section 5.2)
- High Risk Overlap Deficiency (section 5.3)
- End of line / Buffer Stop (section 5.4)
- Level Crossing Protection for wrong running movement (section 5.5)
- High Risk Speed Reduction consideration (section 6)
- Cascaded cases application and examples (section 7)
- Calibration BG consideration (section 8)
- Consideration for train with lower Braking Capabilities (section 9 - Optional)

The TSM announcement BG for a High Risk Speed Sign is positioned directly at the speed sign, and so there is no need to calculate its position, but it is required to ensure the speed reduction over two speeds is achievable given the distance between the speed signs (see section 6.2).

For all other AMS functions requiring TSM, the ERA Braking Curve Tool, customised for AMS, is used to calculate the braking curves of an ETCS train, and hence the minimum distance from the hazard for the TSM announcement BG (i.e. TSM initiating BG).

The placing of BGs needs to consider various input requirements, and several iterations of calculation using the ERA Braking Curve Tool may be required to correctly positions those BGs, so that they are placed so as to prevent any unwarranted warning from the on board ATP system occurring. This process is described in this guideline.

For trains with lower braking capabilities (e.g. K-sets), some additional calculations is required, which could have an impact on the BG placement described in other sections.

5. High Risk Location

5.1. Flowchart

The following flowchart applies to the sections related to High Risk Turnout (5.2), Overlap Deficiency (5.3) and End of Lines / Buffer Stops Protections (5.4). Also refer to section 6 (Speed Sign consideration) and section 7 (cascaded cases considerations), where the flowchart could also be used, with minor modification.

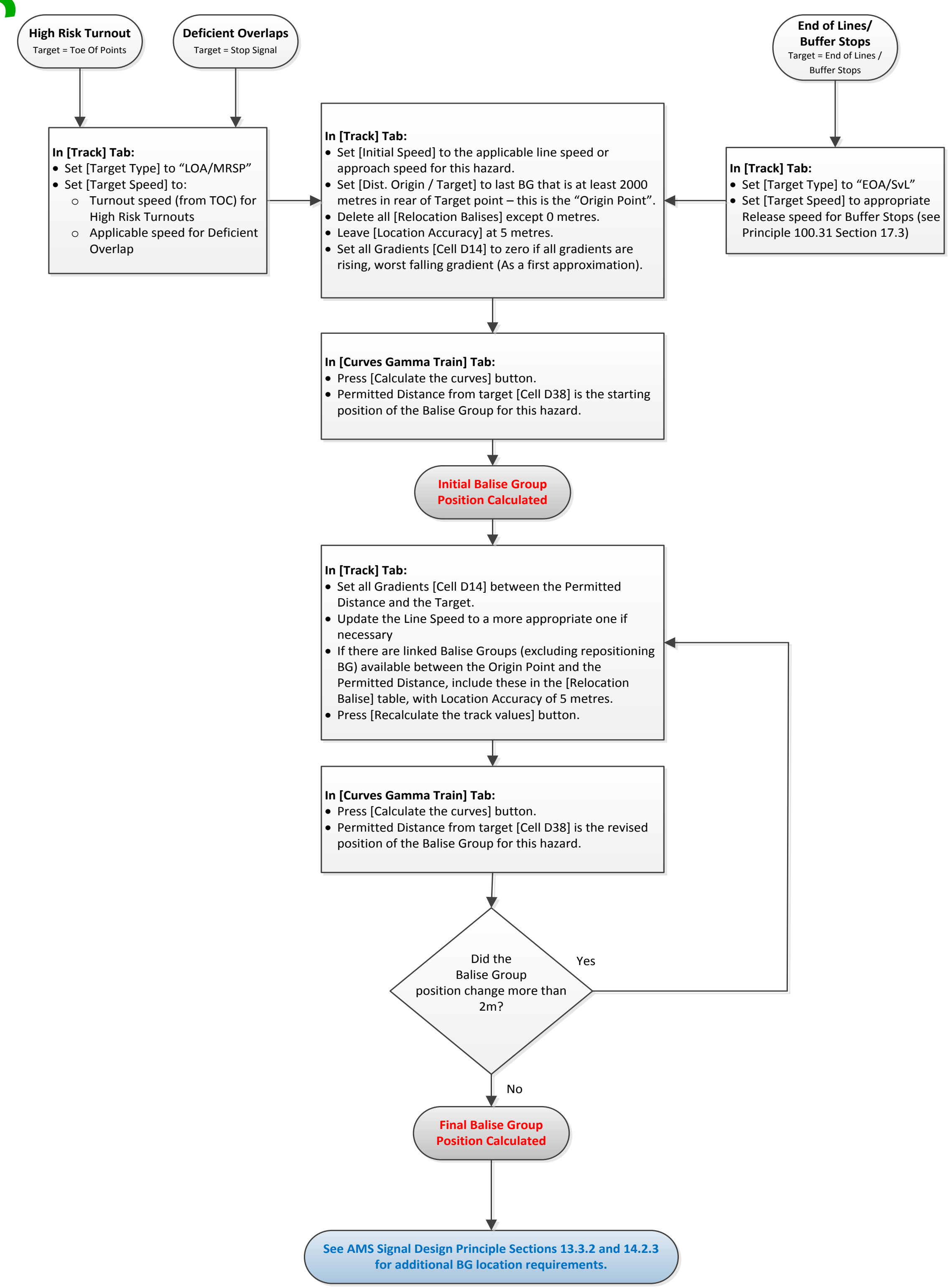

Figure 2 – High Risk Location flowchart

5.2. High-Risk Turnouts

5.2.1. Introduction

Figure 3 shows the BG arrangement for a typical high-risk turnout and the braking curves that have been used to determine the positioning of the BG (i.e. BG1).

This section only refers to the protection of the turnout when the turnout speed is enforced at the toe of point. For protection of any other speed beyond the turnout, refer to section 7.

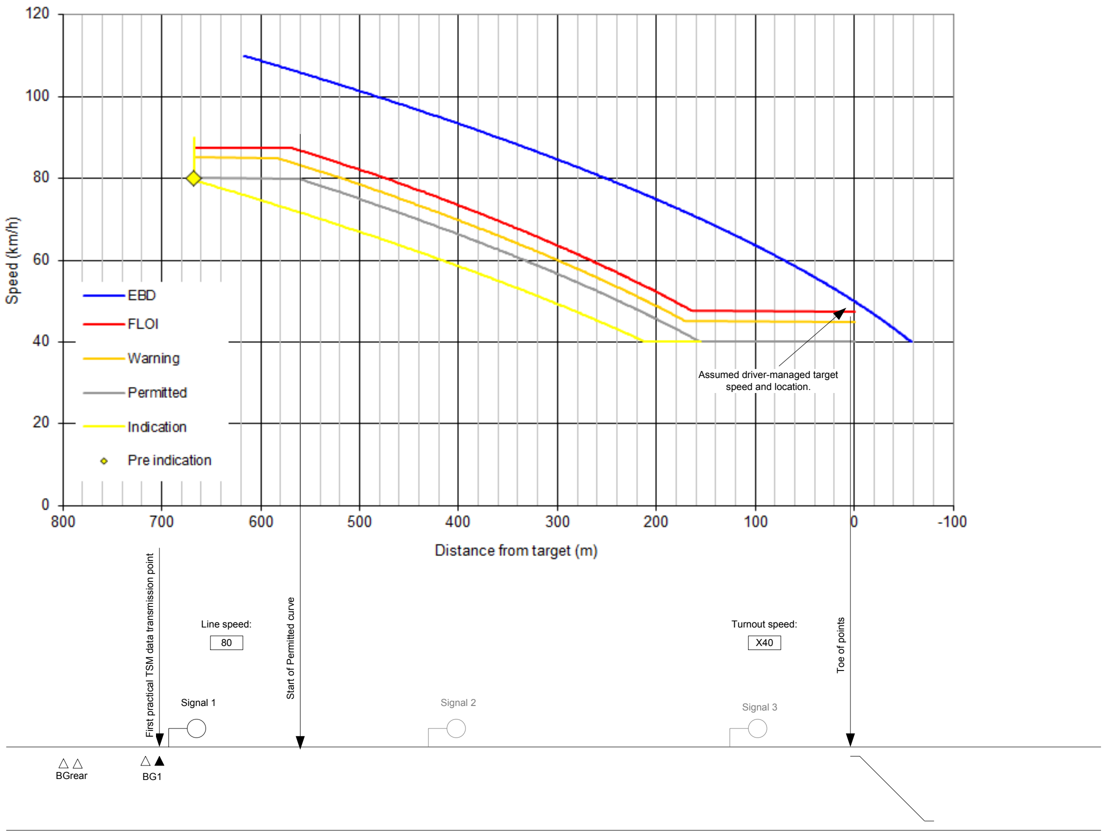

Figure 3 - General BG arrangement for high risk turnouts

The example of Figure 3 consists of the following:

- The speed for the turnout is X40 from a line speed of 80 km/h.

5.2.2. Method to Determinate the Balise Placement Arrangement for High-Risk Turnouts

The BG arrangement for Figure 3 should be determined as follows:

1. The TSM target speed is the turnout speed (e.g. 40 km/h).
2. Using the location of the TSM target determined above, generate the braking curves with the referenced ERA's braking curves tool (see section 2), as follows:
   a. The target type is set to LOA/MRSP (Limit of Authority / Most Restrictive Speed Profile) and the target speed is set to the turnout speed (from step 1, above);
   b. The Initial Speed shall be set to the highest possible line speed (e.g. High speed profile) on the approach to the turnout (i.e. 80 km/h) up to 2000m in rear of the turnout. The choice of the line speed may need an iterative selection depending on the point where the Permitted Speed Curve starts to decrease and the speed sign chosen, i.e. the speed chosen shall allow the train to brake to the target speed when passing over the announcing BG;
   c. The gradient shall initially be set to cover 2000m before the start of the target speed (See section 5.1) and could be refined iteratively depending on the initial braking distance;
   d. The Distance Origin/Target is set to be the distance from the toe of the turnout to the first BG before the forecasted permitted speed curve.
      i. The value will be set to 2000m.
      ii. On the tab [Curves Gamma Train] calculate the curves using the "Calculate the curves" button. The value of the "Permitted Distance from Target" is 561m in this case (no additional calibration balise, so last BG considered at 2000m prior to the turnout).

         In the tab [Track], a linked BG prior to the position of the "Permitted Distance from Target" (called BG_{rear}) shall be included in the relocation balise list. In case that BG_{rear} is not the Redundant TSM BG, it shall be checked that the permitted curve (from TSM sent from the redundant BG) will not start before reading BG_{rear} and in the contrary, another BG (more in rear than BG_{rear}) shall be used. For example, for a BG at 800m from the target, with a Dist. Origin of 2000m, the relocation BG shall be included in the table as 1200m. Dist. Origin shall also be modified to a higher value if the BG doing the calibration is located further than 2000m.
3. The distance calculated in step 2, gives the nearest distance from the TSM target at which a controlled BG must provide the first instance of the TSM information[1]. In this example, the distance is 561 m;

[1] The first instance of TSM information may be provided earlier, but not later. Other/additional instances of the information may be provided later.

4. Identify the first convenient location case for a (controlled) BG (and LEU) in rear of the initial Balise position identified in step 3, above[2]. BG1[3,4] is placed at this location.

5.3. Overlap Deficiency

5.3.1. Introduction

This section proposes a methodology for deficient overlaps, which includes high risk catch points and level crossings within the signalling overlap. The track layout of Figure 4 is used in an example application.

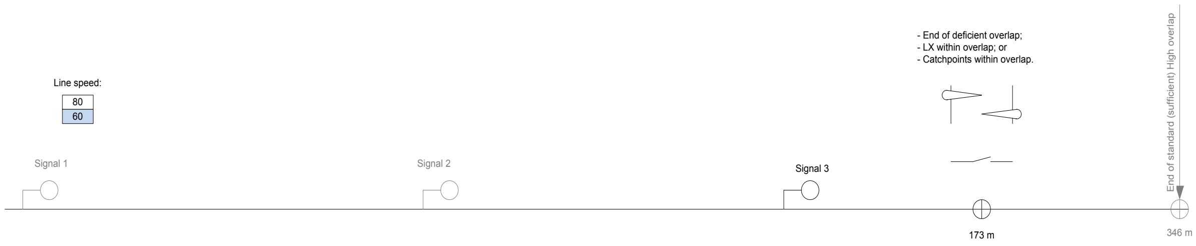

Figure 4 – Example of Track layout for deficient overlaps

This track layout in Figure 4 has the following features:

- The overlap beyond signal 3 is deficient; the length of the overlap is only 173 m.
- Based on High speed profile and using GX2M braking curves, the overlap is only suitable for a trip speed of 55 km/h and not 80 km/h.
- Based on Medium speed profile and using either GE52 or GE52A braking curves (depending on location of deficiency on the network), the overlap is only suitable for a trip speed of 50 km/h and not 60 km/h.

[2] In practice, this would be in the vicinity of a signal or a cabling pit.

[3] BG1 would send information ahead depending on the signal aspect.

[4] Look-ahead may be required to bring the relevant route information to the LEUs.

5.3.2. Method to Determine the Balise Placement Arrangement for Overlap Deficiency

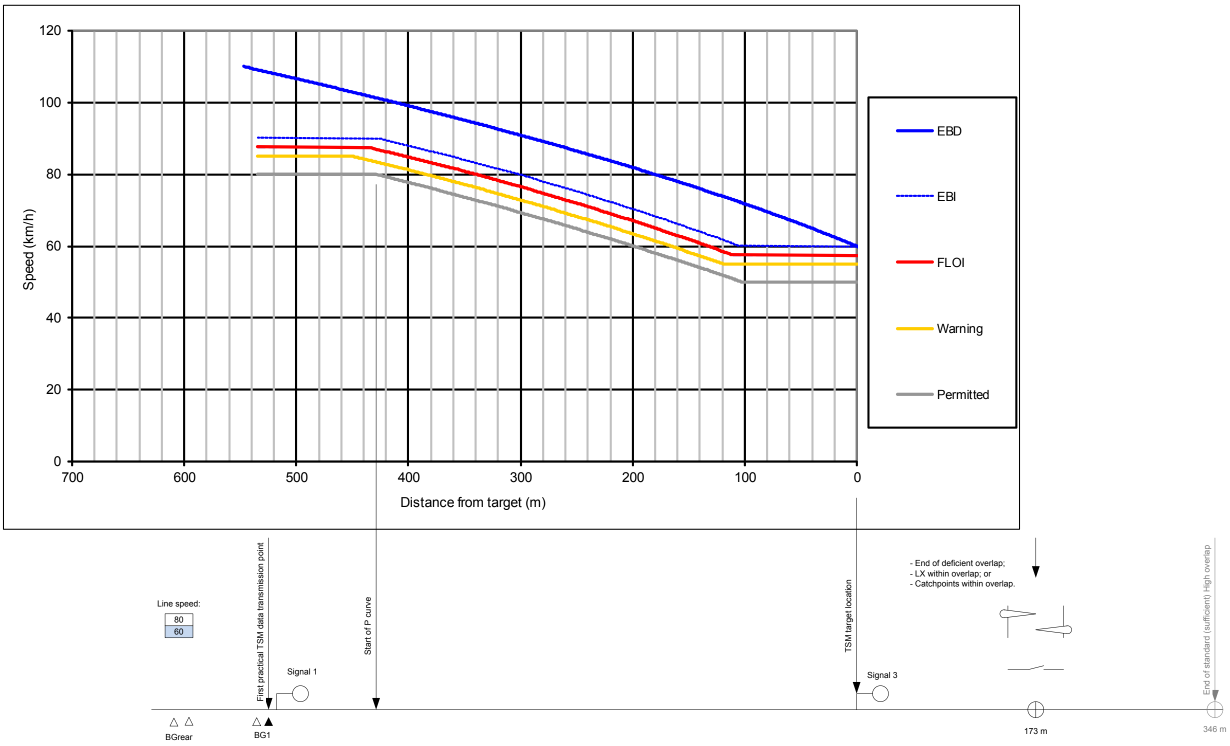

Figure 5 - General BG arrangement for the “Early Announcement” option for deficient overlaps.

The BG arrangement for Figure 5 should be determined as follows:

1. Determine the trip speed for which the overlap is suitable for, for each of the Medium and High speed profiles. The lowest trip speed (for this example, this is 50 km/h) determines the BG arrangement (see Appendix A for details);
2. Using the location of the TSM target determined above, generate the braking curves with the referenced ERA’s braking curves tool (see section 2), as follows:
    a. The target type is set to LOA/MRSP (Limit of Authority / Most Restrictive Speed Profile) and the target speed is set to the lowest trip speed (from step 1, above);
    b. The Initial Speed shall be set to the highest possible line speed on the approach to the signal protecting the deficient overlap (i.e. 80 km/h) up to 2000m in rear of the protecting signal. The choice of the line speed may need an iterative selection depending on the point where the Permitted Speed Curve starts to decrease and the speed sign chosen, i.e. the speed chosen shall allow the train to brake to the target speed when passing over the announcing BG;
    c. The gradient shall be initially set to cover 2000m before the start of the target speed (See section 5.1) and could be refined iteratively depending on the initial braking distance;

d. The Distance Origin/Target is set to the distance from signal 3 to the first BG before the forecasted permitted speed curve.

   i. The value will be set to 2000m;

   ii. On the tab [Curves Gamma Train] calculate the curves using the "Calculate the curves" button. The value of the "Permitted Distance from target" is 495m in this case (no additional calibration balise, so last BG considered at 2000m prior to the turnout).

   In the tab [Track], a linked BG prior to the position of the "Permitted Distance from target" (called BG_{rear}) shall be included in the relocation balise list. In case that BGrear is not the Redundant TSM BG, it shall be checked that the permitted curve (from TSM sent from the redundant BG) will not start before reading BG_{rear} and in the contrary, another BG (more in rear than BG_{rear}) shall be used. For example, for a BG at 600m from the target, with a Dist. Origin of 2000m, the relocation BG shall be included in the table as 1400m. Dist. Origin shall also be modified to a higher value if the BG doing the calibration is located further than 2000m.

   For that additional BG at 600m, the "Permitted Distance from target" is now at 429m from the target speed.

e. The calculated curves are shown in Figure 5 (with a BG at 600m from target providing calibration)

3. The distance calculated in step 2, gives the nearest distance from the TSM target at which a controlled BG must provide the *first instance* of the TSM information[5]. In this example, the distance is 429 m;

4. Identify the first convenient location case for a (controlled) BG (and LEU) in rear of the initial Balise position identified from step 3, above[6]. BG1[7,8] is placed at this location.

5.4. End of Lines / Buffer Stops

5.4.1. Introduction

Figure 6 shows the general BG arrangement for ends of lines.

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[5] The first instance of TSM information may be provided earlier, but not later. Other/additional instances of the information may be provided later.

[6] In practice, this would be in the vicinity of a signal or a cabling pit.

[7] BG1 would send information ahead depending on the signal aspect.

[8] Look-ahead may be required to bring the relevant route information to the LEUs.

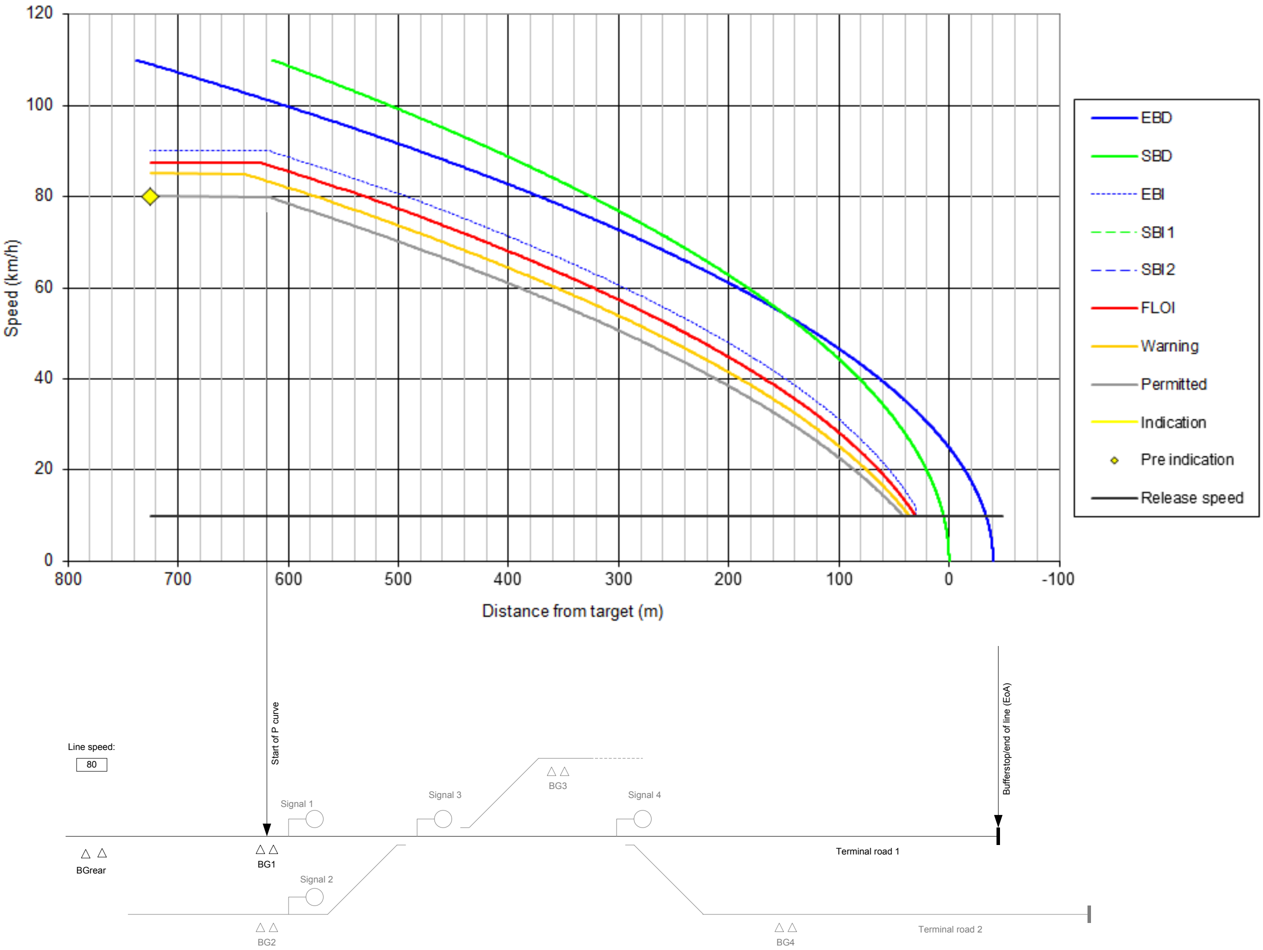


Figure 6 - General BG arrangement for ends of lines

5.4.2. Method to Determinate the Balise Placement Arrangement for End of Lines

The BG arrangement for Figure 6 should be determined as follows:

1. generate the braking curves with the referenced ERA's braking curves tool (see section 2), as follows:
   a. Where there are multiple ends of lines, the end of line nearest to approaching trains should be selected as the target (in case no controlled BG is used to distinguish the different tracks);
   b. The target type is set to EOA/SvL, the "Distance EOA/SvL" is set to 100m (The danger point (DP) should be set to the location 100m beyond the end of line[9]);
   c. The target speed should be configured with a 10 km/h fixed release speed;

[9] This is intended to minimise the distance in which drivers would be required to operate under RSM.

d. The Initial Speed shall be set to the highest possible line speed on the approach to the buffer stops (i.e. 80 km/h) up to 2000m in rear of buffer stops. The choice of the line speed may need an iterative selection depending on the point where the Permitted Speed Curve starts to decrease and decrease and the speed sign chosen, i.e. the speed chosen shall allow the train to brake to the target speed when passing over the announcing BG;

e. The gradient shall be initially set to cover 2000m before the start of the target speed (See section 5.1) and could be refined iteratively depending on the initial braking distance.

f. The Distance Origin/Target is set to the distance from the signal 3 to the first BG before the forecasted permitted speed curve.

   i. In order to set this value, it will first be set to 2000m.

   ii. On the tab [Curves Gamma Train] calculate the curves using the “Calculate the curves” button. The value of the “Permitted Distance from target” is 677m in this case (no additional calibration balise, so last BG considered at 2000m prior to the turnout).

   In the tab [Track], a linked BG prior to the position of the “Permitted Distance from target” (called BG_{rear}) shall be included in the relocation balise list. In case that BG_{rear} is not the Redundant TSM BG, it shall be checked that the permitted curve (from TSM sent from the redundant BG) will not start before reading BG_{rear} and in the contrary, another BG (more in rear than BGrear) shall be used. For example, for a BG at 800m from the target, with a Dist. Origin of 2000m, the relocation BG shall be included in the table as 1200m. Dist. Origin shall also be modified to a higher value if the BG doing the calibration is located further than 2000m.

   For that additional BG at 800m, the “Permitted Distance from target” is now at 621m from the target speed.

g. These curves are shown in Figure 6 (with a BG at 800m from target providing calibration)

2. The distance calculated in step 1, gives the minimum distance from the TSM target at which a fixed BG must be provided[10]. In this example, the distance is 621 m;

3. Identify the first convenient location case for a BG in advance of the location identified from step 2, above. BG1 is placed at this location.

4. Where there are multiple approaches to the end of line, all approaches need to be considered for the BG placement. In this example, BG2 is provided for this purpose;

[10] The first instance of TSM information may be provided earlier, but not later. Other/additional instances of the information may be provided later.

5. Where there are routes starting within the TSM area of the nearest end of line that diverge to a less restrictive route, a BG needs to provide for each diverging path to update or revoke the TSM; In this example, BGs 3 and 4 are provided for this purpose.

5.5. Level Crossing Protection in Wrong Running

5.5.1. Introduction

Figure 7 shows the BG arrangement for a typical level crossing requiring protection in wrong running direction and the braking curves that have been used to determine the positioning of the BG (i.e. BG1).

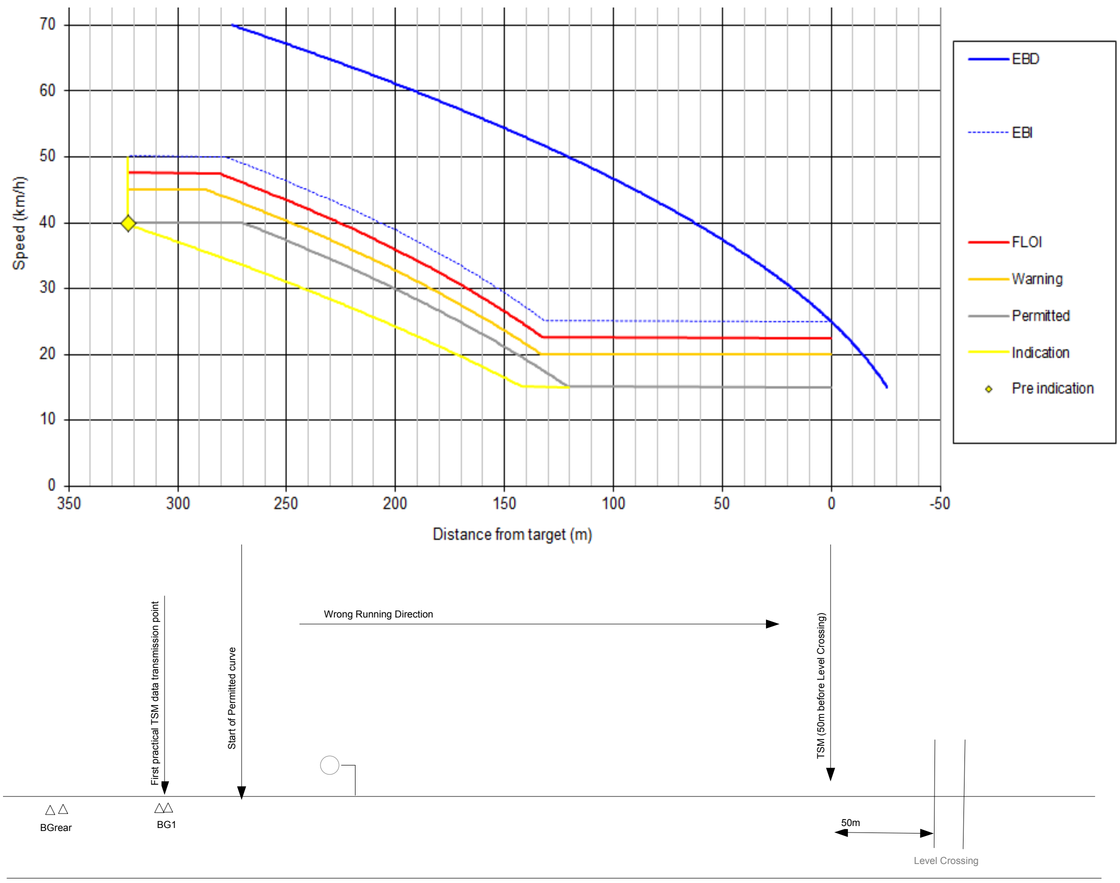


Figure 7 - General BG arrangement for Level Crossing Protection in Wrong running

5.5.2. Method to Determinate the Balise Placement Arrangement for Level Crossing Protection in wrong running direction

The BG arrangement for Figure 7 should be determined as follows:

1. The TSM target speed is 15km/h and starts 50m before the closest edge of the level crossing.

2. Using the location of the TSM target determined above, generate the braking curves with the referenced ERA's braking curves tool (see section 2), as follows:
   a. The target type is set to LOA/MRSP (Limit of Authority / Most Restrictive Speed Profile) and the target speed is set to 15 km/h (from step 1, above);

   b. The Initial Speed shall be set to the wrong running speed (i.e. 40 km/h) up to 2000m in rear of the target location.

   c. The gradient shall initially be set to cover 2000m before the start of the target speed (See section 5.1) and could be refined iteratively depending on the initial braking distance;

   d. The Distance Origin/Target is set to be the distance from the target location to the first BG before the forecasted permitted speed curve.

      i. The value will be set to 2000m.

      ii. On the tab [Curves Gamma Train] calculate the curves using the "Calculate the curves" button. The value of the "Permitted Distance from Target" is 270m in this case (no additional calibration balise, so last BG considered at 2000m prior to the target speed for the level crossing protection).

      In the tab [Track], a linked BG prior to the position of the "Permitted Distance from Target" (called BG_{rear}) shall be included in the relocation balise list. In case that BG_{rear} is not the Redundant TSM BG, it shall be checked that the permitted curve (from TSM sent from the redundant BG) will not start before reading BG_{rear} and in the contrary, another BG (more in rear than BGrear) shall be used. For example, for a BG at 800m from the target, with a Dist. Origin of 2000m, the relocation BG shall be included in the table as 1200m. Dist. Origin shall also be modified to a higher value if the BG doing the calibration is located further than 2000m.

3. The distance calculated in step 2, gives the nearest distance from the TSM target at which a fixed BG must provide the first instance of the TSM information[11]. In this example, the distance is 270 m;

4. Identify the first convenient location case for a BG in rear of the initial balise position identified in step 3, above. BG1 is placed at this location.

[11] The first instance of TSM information may be provided earlier, but not later. Other/additional instances of the information may be provided later.

6. High Risk Speed Sign Consideration

All speed signs will usually have a BG fitted at the speed sign, but there are some considerations that need to be highlighted for which use of the ERA Braking Curve tool would be required:

- Insufficient Braking Distance between 2 speed signs, the latter being high risk (see section 6.2)
- A speed restriction, which is beyond a turnout onto the adjacent track, considered as High Risk, which would need to be announced by a controlled BG (see section 6.3 and AMS Identification of High Risk Turnouts guidelines). In this situation the turnout has been assessed as requiring AMS TSM protection due to the existence of a high risk speed reduction across the turnout.

The use of the ERA Braking Curve tool shall follow the same rules as in section 5.3, but the target speed (i.e. trip speed from section 5.3) is replaced with the speed of the high risk speed sign.

6.1. Nominal Case (Sufficient Distance)

In Figure 8, the speed restriction of 60 km/h is announced by both the 105 km/h speed sign (as the primary announcement) and by the 120 km/h speed sign (for redundancy purpose in case the BG at the 105 km/h speed sign is lost).

Figure 8 shows a scenario where the braking curve starts when a TSM is required after the previous speed sign (i.e. after 105 speed sign) and that there is sufficient distance for the train to brake down to 60 km/h for the upcoming 60 km/h speed sign. Before the start of the braking curve, the Driver is allowed to drive at 105 km/h from the 105 km/h speed sign.

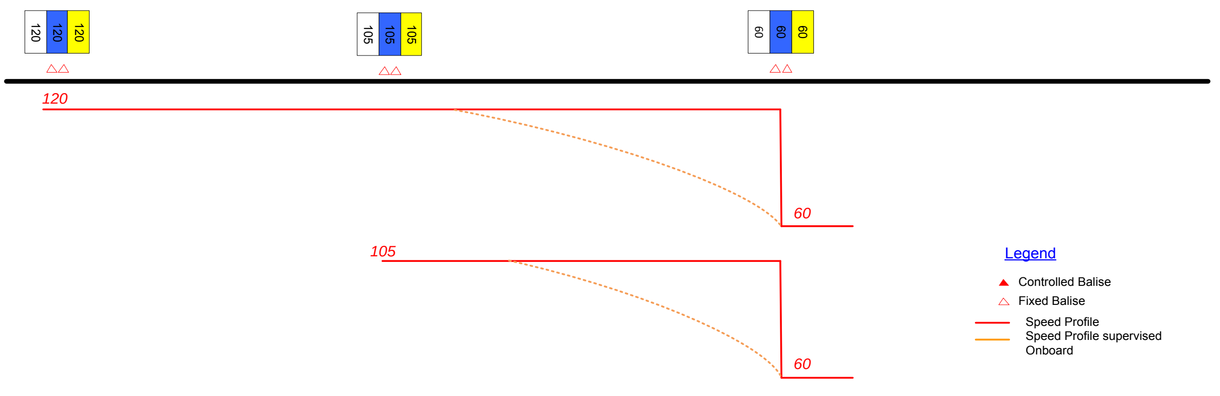


Figure 8 – High Risk Turnout with redundancy

6.2. Exception Case (Not Sufficient Distance)

In Figure 9, the speed restriction of 60 km/h is announced by both the 110 km/h speed sign (as the primary announcement) and by the 120 km/h speed sign (for redundancy purpose in case the BG at the 110 km/h speed sign is lost). The 115 km/h speed sign only sends a speed restriction of 115 km/h, and does not announce any high risk speed reduction ahead.

Figure 9 shows the example of a high risk speed reduction (110 km/h to 60 km/h) that cannot be announced with sufficient distance from the 110 km/h speed sign for the train to brake to 60 km/h. As a result, the train approaching the 110 km/h speed sign will be limited by AMS to a speed of around 90 km/h, to then be able to reduce speed to the 60 km/h speed sign.

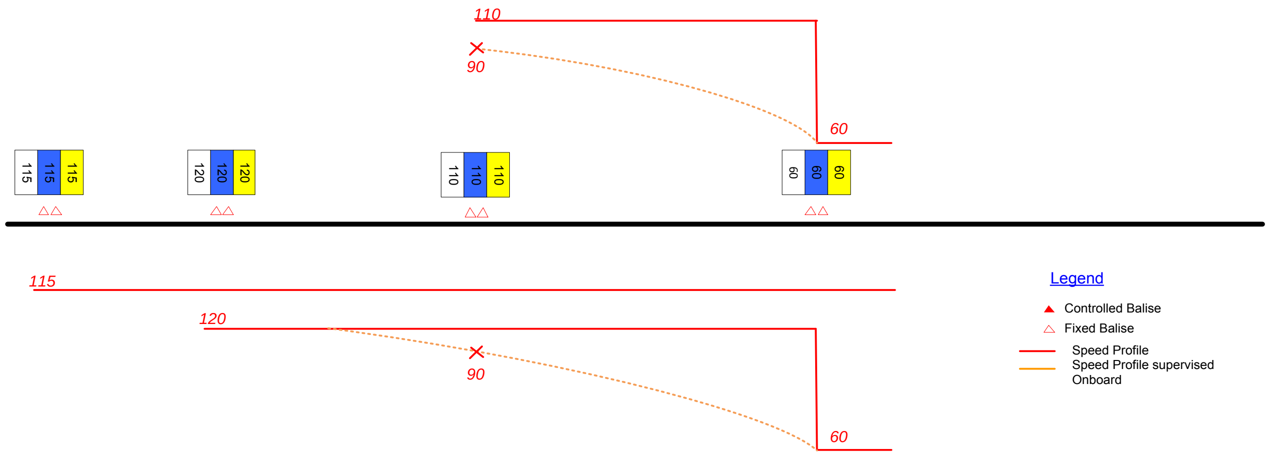


Figure 9 – Limited Announcement for High Risk Speed Reduction

Should this situation arise then it needs to be raised with the AMS Project System Integrator as alternative solutions are available:

- Signalling System: Move Speed Sign
- Signalling System: Reduce Speed of speed sign
- AMS: Accept Operational Constraint

6.3. High Risk Speed Sign after exiting a Turnout

It is necessary to determine the impact of a speed restriction after exiting the turnout, on the adjacent track.

If the turnout has been assessed to require AMS protection due to a high risk speed sign reduction after the turnout, there will be a need for a controlled BG in order to ensure that the adjacent track speed is not exceeded by the train on exiting the turnout.

7. Cascaded cases application and examples

As detailed in the Design Guideline for AMS Identification of High Risk Turnouts, a speed restriction or an overlap deficiency might need to be protected on exiting a turnout, which would mean that more than one protecting TSM might be needed.

7.1. High Risk Turnout with supervision of turnout, speed restriction and Level Crossing on the adjacent track

Figure 10 shows an example where 3 functions have been identified as needing to be protected for an identified High Risk Turnout (Turnout, Speed Sign Reduction and Level Crossing in Overlap), and how the different TSM impact the BG placement.

Each hazard will be assessed separately, with each hazard requiring a separate braking distance, ensuring that the train will be limited to the target speed for that specific hazard. The furthest distance from the first TSM target at which a BG must be placed (based on BG placement calculation done for the 3 hazards) shall announce all three separate TSMs.

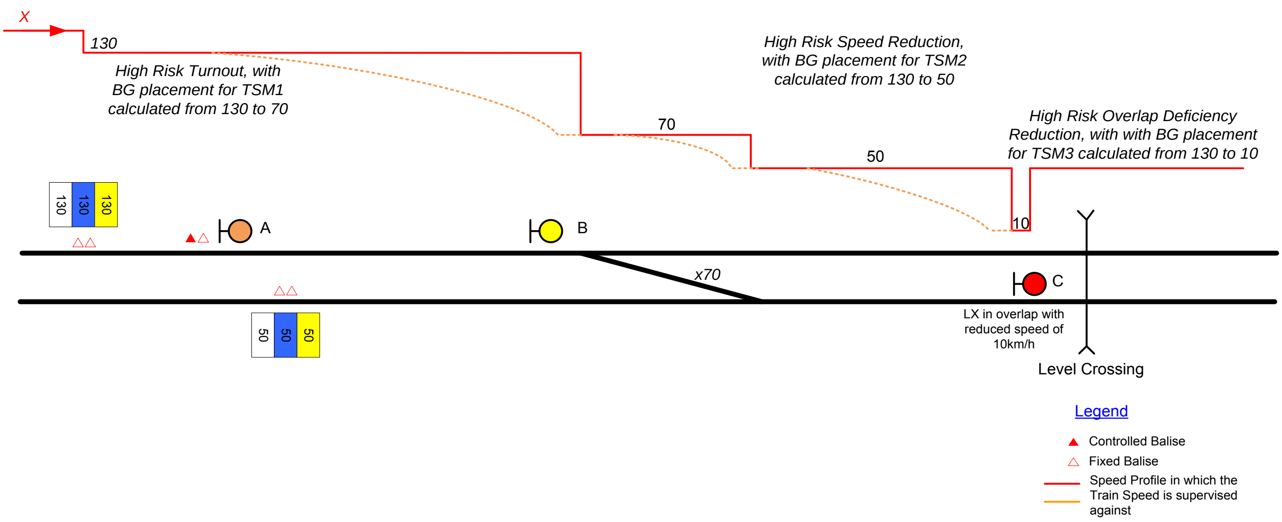


Figure 10 – Multiple TSM due to multiple hazards through a turnout

7.2. High Risk speed restriction on the adjacent track

Figure 11 shows an example where a speed reduction has resulted in a turnout requiring AMS protection. The speed at the exit of the turnout is lower than the turnout speed and ordinarily only the TSM to 50 km/h would need to be supervised. However, for consistency, the turnout speed will also be supervised, as shown in Figure 10. The BG will be placed in order to cover both TSMs, i.e. as per section 5.2, supervising a TSM starting at the entry of the turnout and as per section 6, supervising a TSM starting at the exit of the turnout.

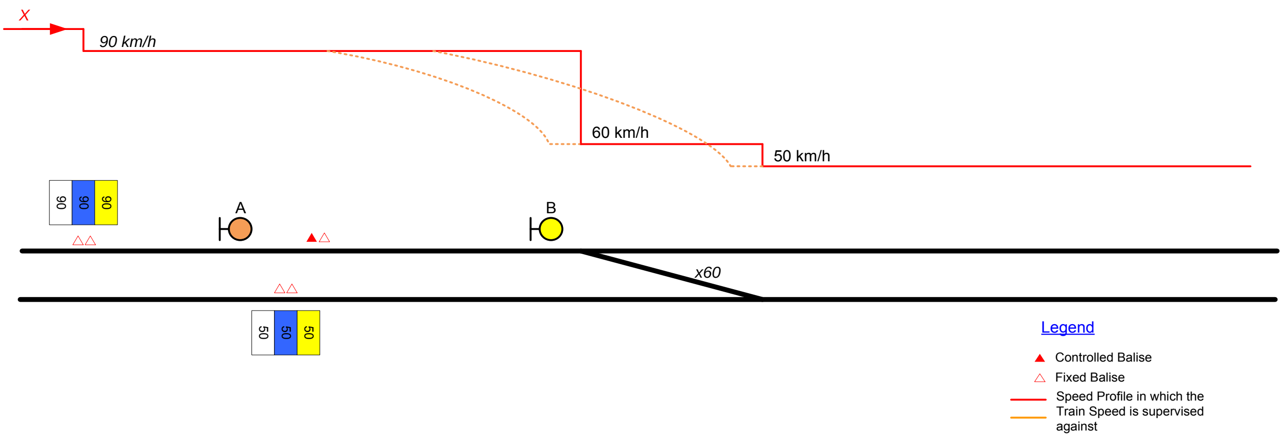


Figure 11 – High Risk Turnout with speed reduction lower than turnout speed on adjacent track

7.3. High Risk Overlap Deficiency on the adjacent track

Figure 12 shows an example where the presence of a deficient overlap on the adjacent line has resulted in a turnout requiring AMS protection. The speed through the turnout would not ordinarily need to be supervised, as the risk identified is the deficient overlap. However, for consistency, the turnout speed will be supervised from the start of the turnout, as shown in Figure 11. The BG will be placed in order to cover both TSMs, i.e. as per section 5.2, supervising a TSM starting at the entry of the turnout and as per section 6, supervising a TSM at the exit of the turnout, ensuring that the train will be at the correct speed before signal C.

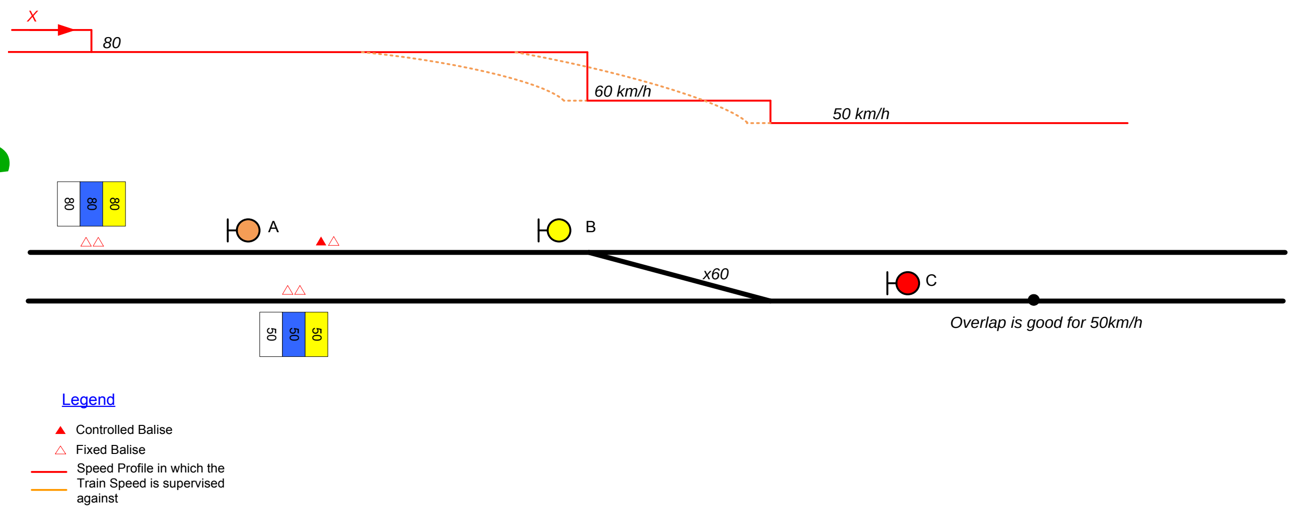


Figure 12 – High Risk Turnout with speed reduction to protect an overlap on adjacent track – Case 1

Figure 13 shows an example where the start of the braking distance is in the adjacent track, which avoids the need of a controlled BG.

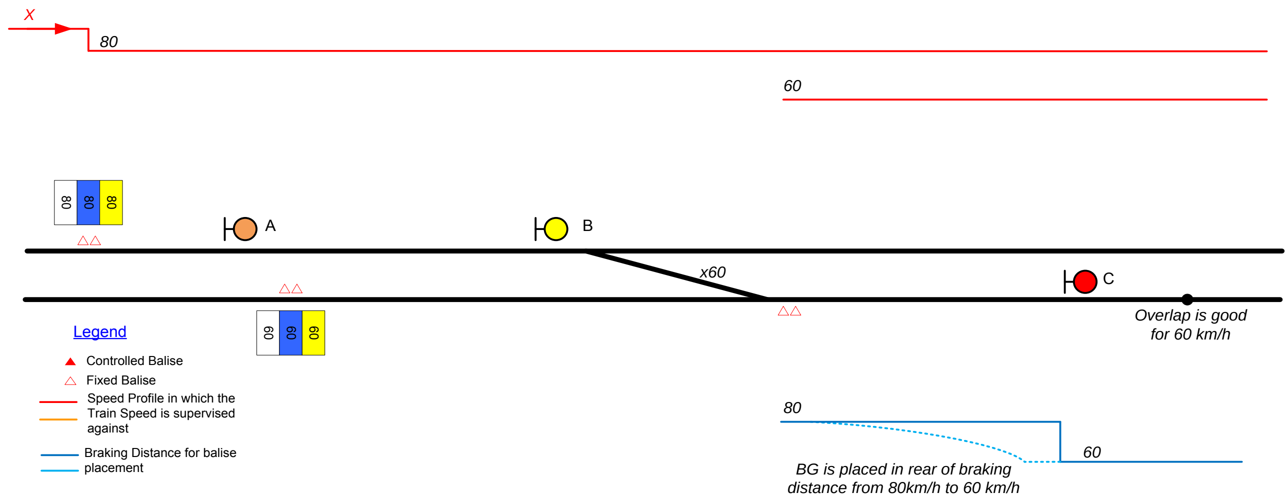


Figure 13 – High Risk Turnout with speed reduction to protect an overlap on adjacent track - Case 2

8. Calibration Balise Group Consideration

Whenever a calibration BG is required, the location of that BG shall be placed before the start of the permitted speed curve (See Figure 14).

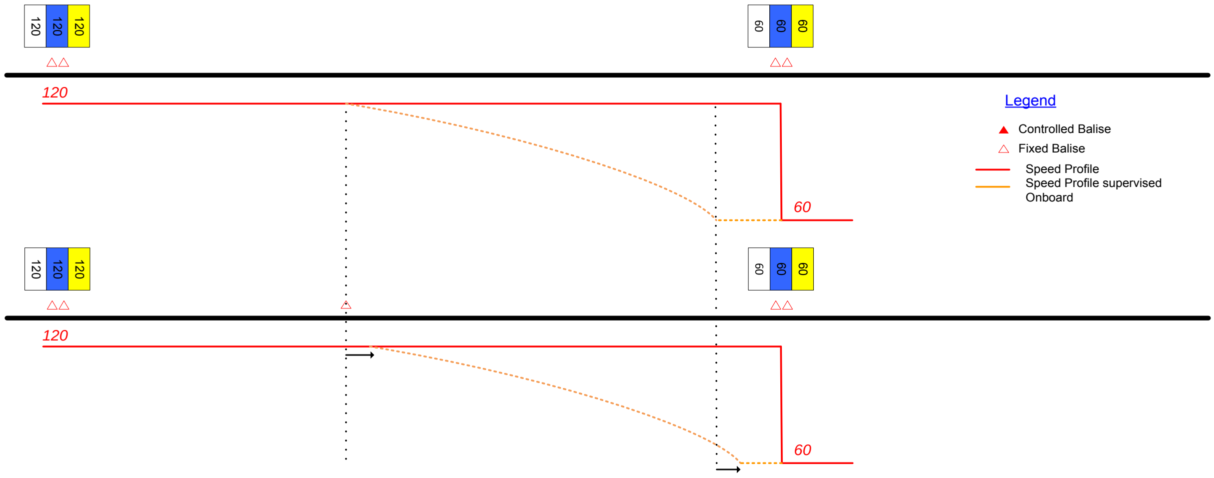


Figure 14 – Limited Announcement for High Risk Speed Reduction

The use of the ERA tool shall follow the same rules as in section 5.3, replacing the target speed with the target speed signs values.

The calibration balise will be placed at the start of the calculated permitted speed curve.

9. Consideration for train with lower braking capabilities (Optional)

Important Note: This section of the guideline is **only** applicable following a formal instruction from the AMS project. If no instruction is given, this section will not be applicable for design purposes.

The calculations made in previous sections (5.2, 5.3, 6 and 7) do not specifically specify a braking model, but it is assumed to be a default one valid for all trains (e.g. $0.6m.s^{-2}$). No extra calculations are required for functions described in sections 5.4 and 8.
In case another passenger train set (e.g. K-sets) with lower braking capabilities (e.g. $0.55m.s^{-2}$) is able to run over the fitted trackside, some additional calculations are required to confirm the placement of a BG or the sufficient braking distance between 2 speed signs.
In the example hereafter, it is considered that the trackside is designed to a deceleration of $0.6m.s^{-2}$ and that the extra calculation for this section is using a deceleration of $0.55m.s^{-2}$.
It shall be noted that a different configuration for the ERA Braking Curve Tool shall be used whenever the deceleration is different, where the following parameters (not excluding others) need to be modified:

- Emergency Brake Deceleration
- Service Brake Deceleration
- T_brake_emergency
- T_brake_service

9.1. Extra Steps for BG placement

As per Figure 15, the start of the permitted curve deceleration is denoted by P(0.6). The TSM initiating balise group will be placed in rear of this curve, known as P(BG).

An extra calculation shall be done with the ERA tool configured with $0.55 m.s^{-2}$, and another start permitted curve decreased using $0.55 m.s^{-2}$, P(0.55).

It shall be highlighted that where P(0.6) has been calculated using the highest available speed (e.g. High Speed Sign), the trains having a lower braking performances might be using some lower value speed sign (e.g. K-set uses Medium Speed Sign), which then shall be used to calculate P(0.55), as shown in Figure 15.

If P(0.55) is further away from the hazard than where P(BG) is located, then
Move previous P(BG) to new location in rear of or at P(0.55)
Else
No action is required.

The following Figures gives examples on the extra calculation and actions required for a high risk Turnout.

The same steps applies for a high risk deficient overlap,

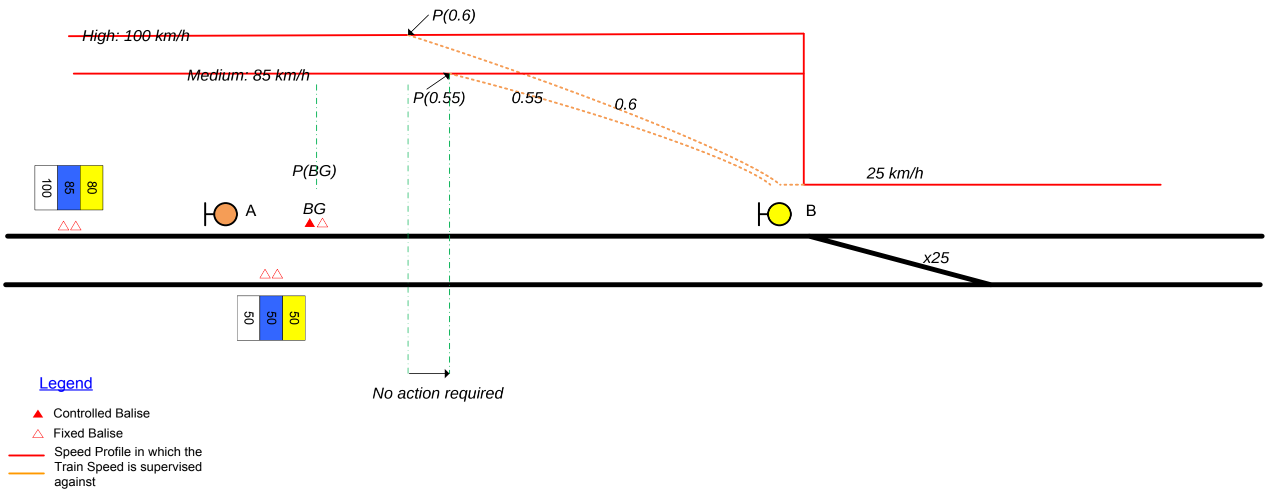


Figure 15 – Extra Calculation of High Risk Turnout – No action required as shorter braking distance

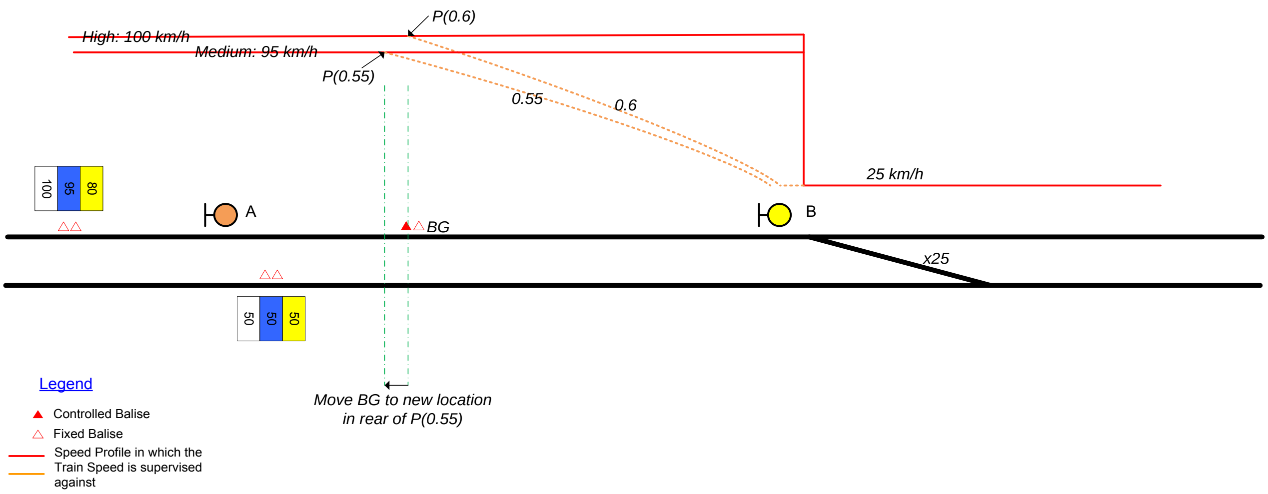


Figure 16 – Extra Calculation of High Risk Turnout – Move BG to new location

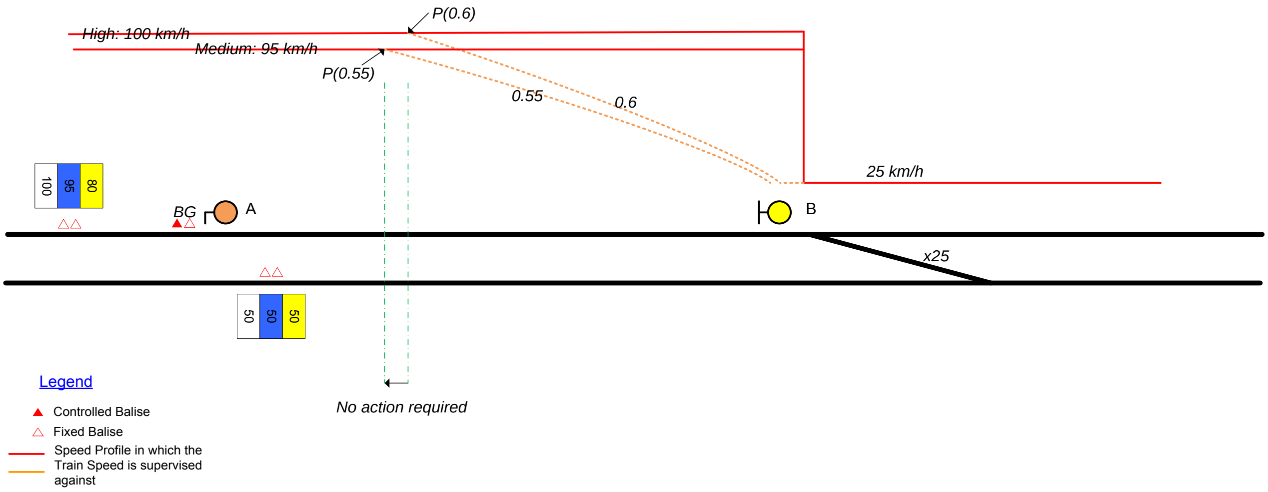


Figure 17 – Extra Calculation of High Risk Turnout – No action required as BG already in rear of both P(0.55)

9.2. Extra steps for High Risk Speed Sign Consideration

As described in section 6, the distance between 2 speed sign might not be sufficient. The confirmation of such distance shall be repeated with the lower braking characteristics (e.g. 0.55m.s^{-2}) and considering that lower performing trains would operate to medium speed sign profile.

Appendix A Clarifications on Target Speed

A.1. Target Speed for Overlap Deficiency

In general, two trip speeds need to be considered:

- one for the high speed profile, which using the GX2M braking curve;
- the other, for the medium speed profile, using either the GE52 or GE52A braking curve (depending on location).

The trip speed(s) will be given in the Deficient Overlaps, Catch Points and Level Crossings Report (see section 2).

A.2. Target Speed for High Risk Turnout

Figure 18 shows the target speed to be used for a high risk turnout. The target speed sent from the trackside BG will start at the toe of the point and is equal to the lowest turnout speed defined in the TOC.

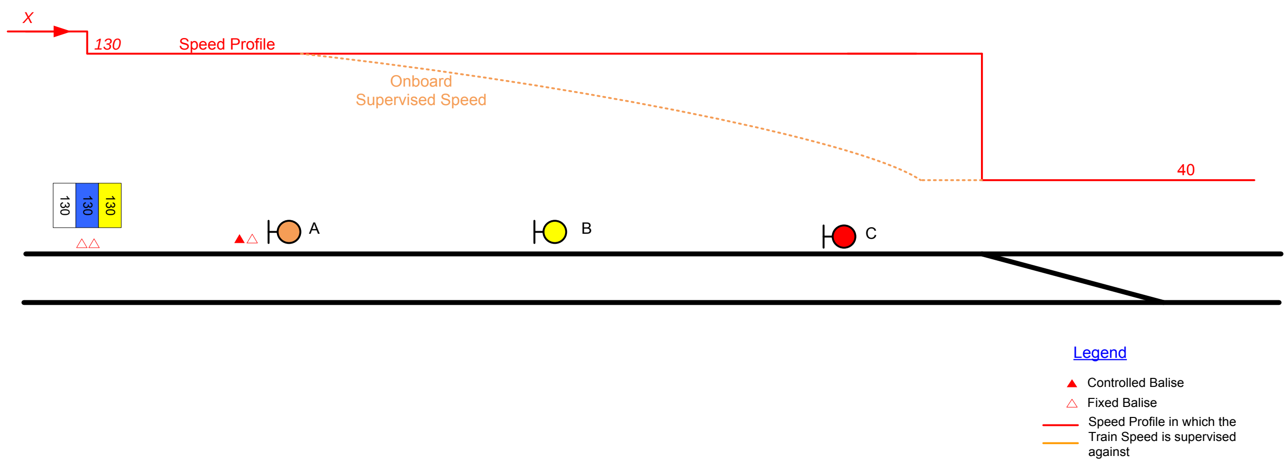


Figure 18 – Target Speed for High Risk Turnout

Appendix B ERA Braking Curve Tool Information

The aim of the ERA Braking Curves Tool is to compute the braking curves EBD and SBD, the associated EBI, SBI, Warning, Permitted, Indication, Pre-indication and release speed supervision limits, according to the track and train characteristics. These characteristics are already embedded into the ERA Braking Curves Tool and are not considered to be 'user editable'

Additional information can be found in the ERA webpage (http://www.era.europa.eu/Core-Activities/ERTMS/Pages/Braking-Curves-Simulation-Tool.aspx).

For AMS, only the "Track" and "Curves gamma train" tabs are required to be used.

Appendix B1: Example Deficient Overlap

Note: The example is also applicable to High Risk Turnout.

Figure 19 below relates the signalling layout to how it is translated into the ERA Braking Curve tool.

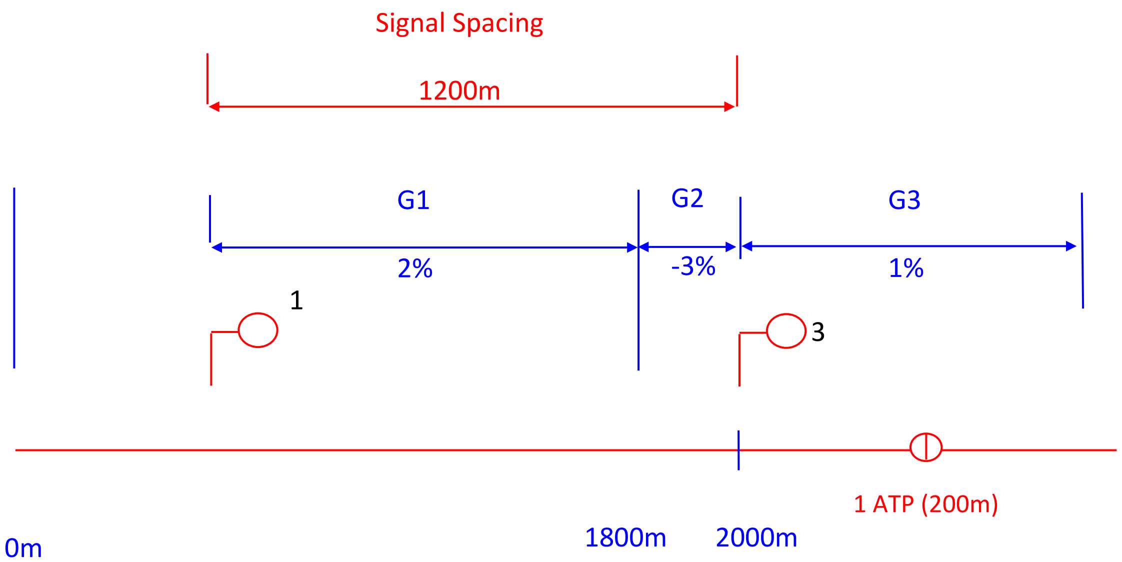


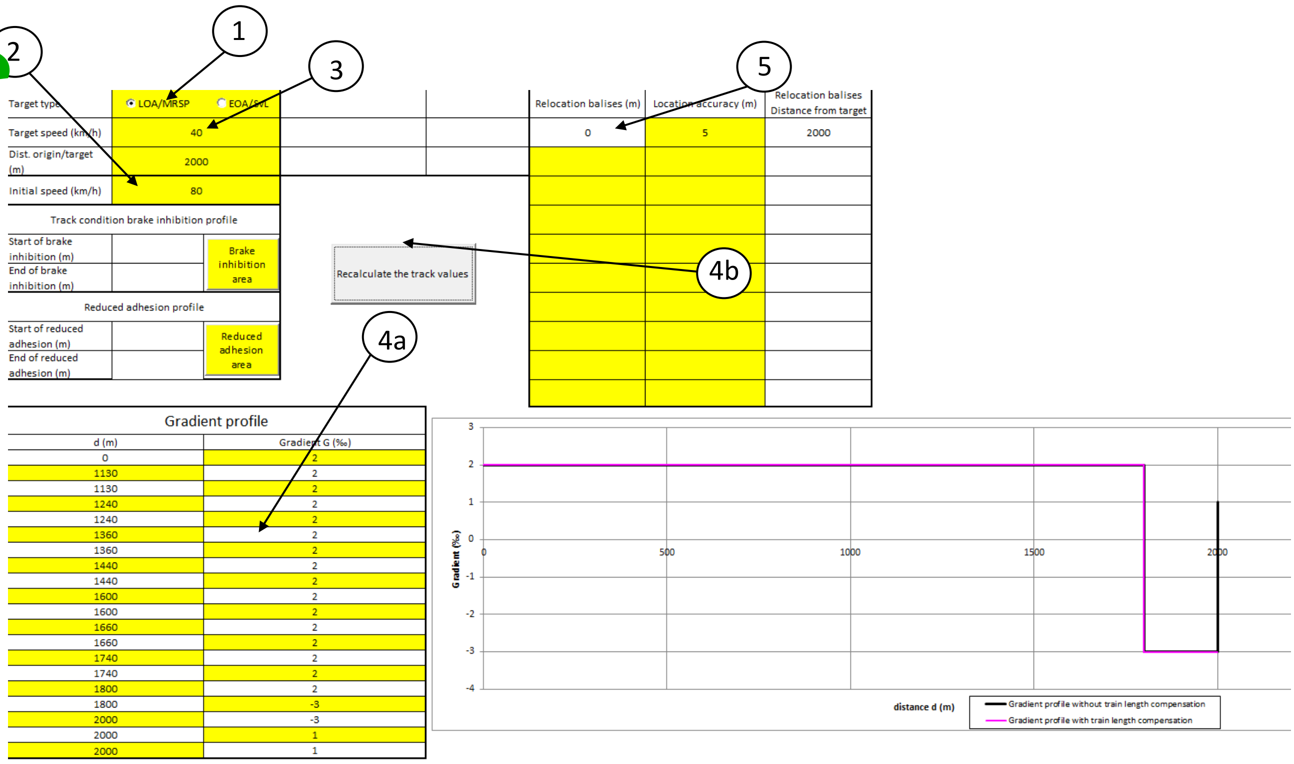
Figure 19 – Example ERA Tool (Deficient Overlap) - Layout

In the 'Track' Tab (refer to Figure 20):

1) Ensure LOA/MRSP is selected
2) Ensure initial speed is the approaching speed to the EOA (in this case 80km/h)
3) Enter the ATP estimated target speed for the overlap
4) The Gradient is considered between 0m and 2000m, 2000m is considered the Signal (Target Speed).
   a. The gradient shall be entered in the table
   b. Recalculate the track values in case the gradient changes.
   c. The gradient within the overlap is not required, as target speed already takes it into account.

d. Only yellow cells shall be filled in.

5) Relocation balises list with placement and accuracy



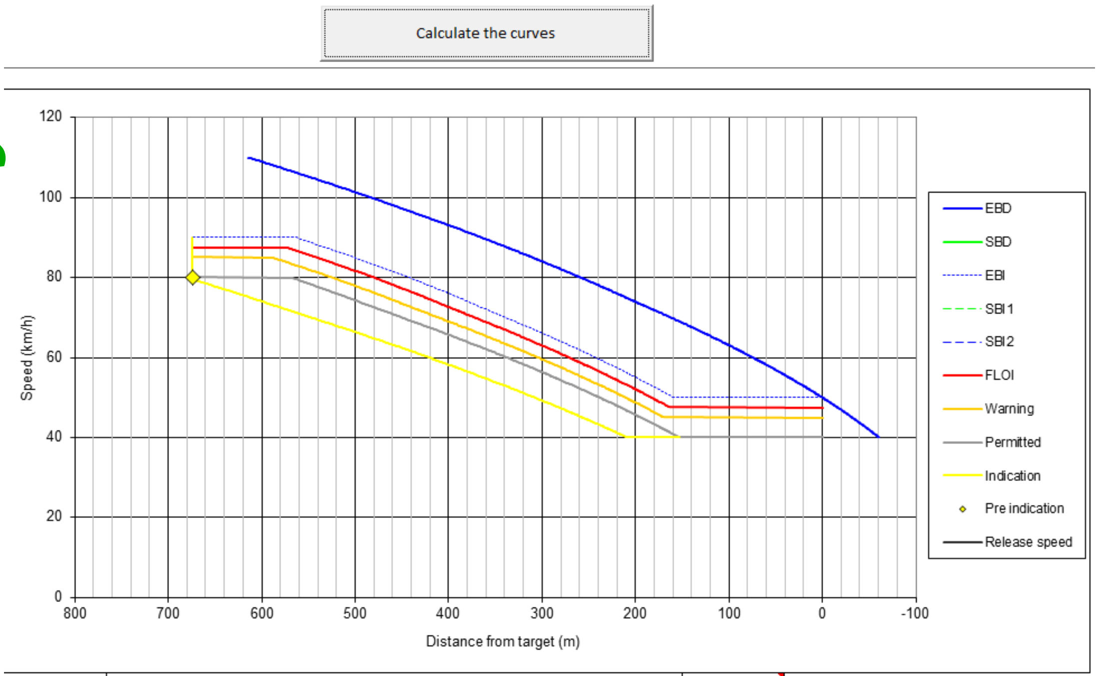
d (m)	Gradient G (‰)
0	2
1130	2
1130	2
1240	2
1240	2
1360	2
1360	2
1440	2
1440	2
1600	2
1600	2
1660	2
1660	2
1740	2
1740	2
1800	2
1800	-3
2000	-3
2000	1
2000	1

Figure 20 – Example ERA Tool (Deficient Overlap) - Track

In the ‘Curves Gamma Train’ Tab:

Press the ‘Calculate the curves’ button

The curves are shown in the Figure 21, showing the permitted speed, with a BG at 2000, at 568m:



Initial speed (km/h)	Distance from target (m)							Release speed (km/h)
	Pre-indication	Indication	Permitted	Warning	FLOI	EBI	StartRSM	
80.00	674.03	674.03	568.20	523.75	479.52	441.74	N/A	N/A

Figure 21 – Example ERA Tool (Deficient Overlap) - Graph

Appendix B2: Example Buffer Stop

Figure 22 below relates the signalling layout to how it is translated into the ERA tool (Figure 24).

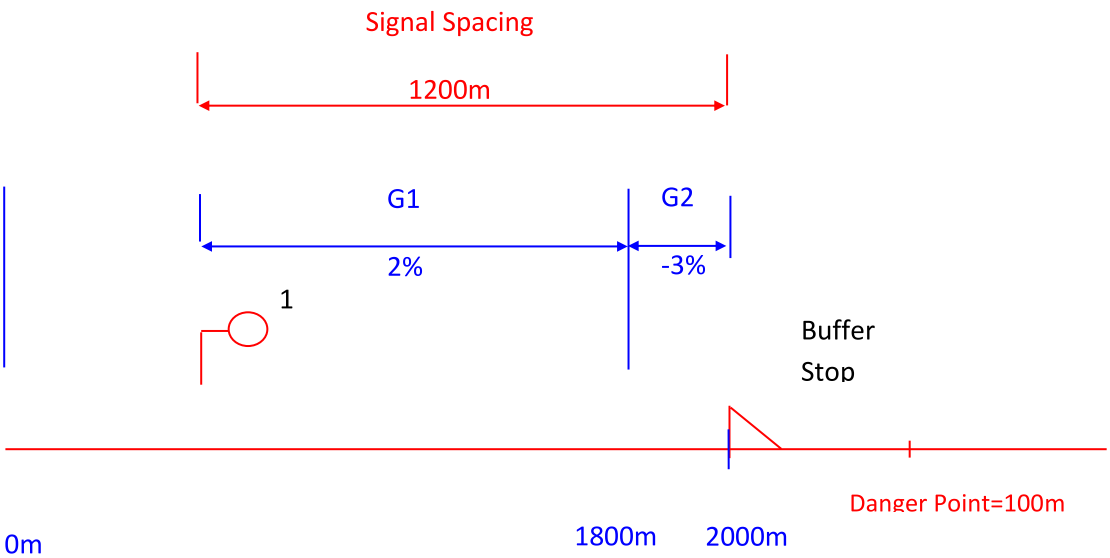


Figure 22 – Example ERA Tool (Buffer Stop) - Layout

In the 'Track' Tab (refer to Figure 23):

1) Ensure EOA/SVL is selected
2) Ensure initial speed is the approaching speed to the EOA (in this case 80km/h)
3) Enter the Distance to EOA/SVL (in this example: 40m)
4) Ensure that the Option “Fixed” is selected
5) Enter the Release Speed (in this case 10km/h for a buffer stop)
6) The Gradient is considered between 0m and 2000m, 2000m is considered at the Buffer Stop.
   a. The gradient shall be safe
   b. Recalculate the track values in case the gradient changes.
   c. The gradient for the ATP overlap will be considered as the same as the one reaching the buffer stop (i.e. -3% in Figure 23)
7) Relocation balises list with placement and accuracy.

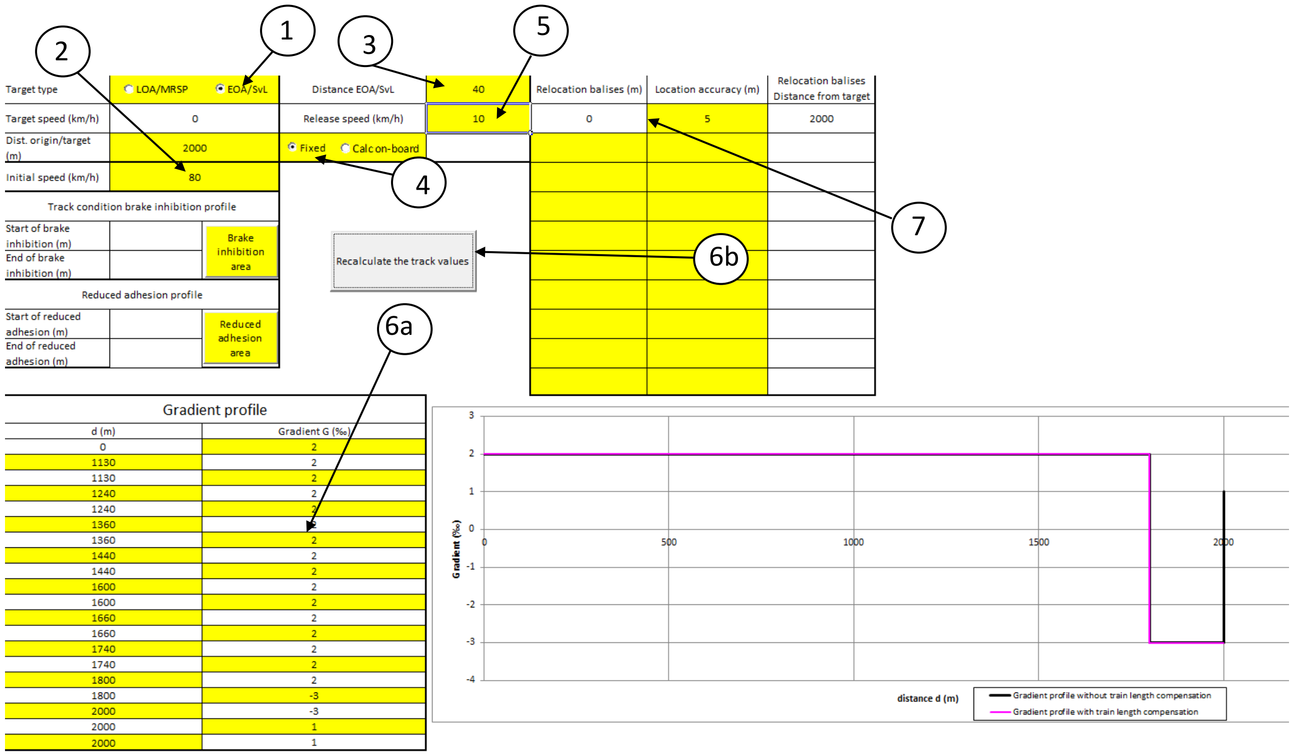
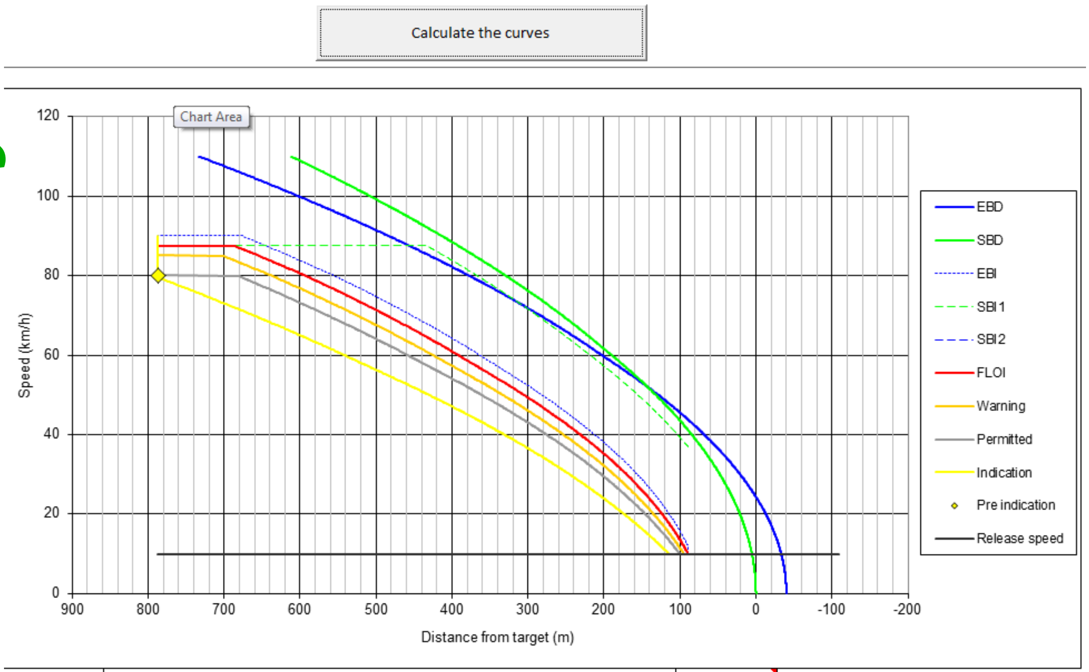


Figure 23 – Example ERA Tool (Buffer Stop) - Track

In the ‘Curves Gamma Train’ Tab:
Press the ‘Calculate the curves’ button
The curves are shown in Figure 24, showing the permitted speed, with a BG at 2000, at 681m:



Initial speed (km/h)	Distance from target (m)							Release speed (km/h)
	Pre-indication	Indication	Permitted	Warning	FLOI	EBI	StartRSM	
80.00	787.37	787.37	681.54	637.09	592.85	555.07	89.41	10

Figure 24 – Example ERA Tool (Buffer Stop) - Graph