Transport for NSW

Reference material

Advanced train control Migration System (AMS) Specifications – Approach Balise Group Selection and Position 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.

The content described might be of assistance to individuals and organisations performing work on Transport for NSW Rail Assets.

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AMS PROJECT SPECIFICATIONS

APPROACH BALISE GROUP SELECTION AND POSITION DESIGN GUIDELINE

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Guidelines – Applicable to Transport Projects AMS Program

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0.5	16/03/2016	C. Chéreau	New Update after further review
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1.0	13/04/2016	C. Chéreau	Release version
1.1	02/05/2016	C. Chéreau	Updated Release version

Foreword

This guideline forms a part of the TfNSW suite of railway signalling principles which detail the requirements for the implementation of ATP / AMS on the TfNSW heavy rail network. This guideline specifically covers Approach Balise Groups (BG).

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

Table of contents

1. Introduction

A Driver should ideally be able to accelerate without impediment when they see a signal clear to a less restrictive aspect. Under AMS, there are situations where the implementation of Target Speed Monitoring would prevent a Driver from being able to do so. The addition of an Approach Balise Group (BG) can be used to minimise the impact of a signal clearing after the Driver has passed the TSM announcement balise.

The purpose of an Approach BG is to provide the Onboard ATP equipment with aspect information for the signal that the train is approaching, after it has already passed the AMS balise announcing (initiating) the start of the Target Speed Monitoring (TSM). This enables the train to take early advantage of a clearing signal by being relieved of restrictions associated with the more restrictive aspect which was previously displayed.

An Approach BG is generally required where the target speed is low compared to the line speed (e.g. reduced overlap or high risk turnout). Where a sufficiently high target speed can be provided for all rolling stock, an Approach BG is less likely to be required.

Approach information shall be transmitted to the train via an Approach BG made of one controlled balise and one fixed balise. An Approach BG shall be made up of two balises in order to allow for a train in SR to return to LS.

Note: Only one balise could be enough as the Approach BG would be linked from a previous balise, but the availability of the system if one balise fails, the requirements for permitting a train to return to LS, and the capacity limitations of balise telegrams have been considered in the design and it has been determined that two balises would be more appropriate.

2. Purpose

The purpose of this design guideline is to identify the process for determining when an Approach BG is to be provided and where it should be placed.

2.1. Scope

This document provides requirements to determine the need for an Approach BG, as well as the location and effectiveness of an Approach BG, for the following:

- Approach BG between the Intermediate Signal and the Protecting Signal
- Approach BG at an Intermediate Signal

2.2. Application

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

3. 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.

AMS Project Specifications

AMS Signal Design Principle

Balise Arrangement for High Risk Location Design Guideline

AMS Technical Issue Paper

AMS-TIP-204 - Turnout Protection

AMS-TIP-221 - Reduced Overlap

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

AMS Report

Deficient Overlaps, Catch Points and Level Crossings Report

4. 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

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

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.

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.

LS Limited Supervision

Overlap Deficiency synonym of **Reduced Overlap** in the context of this guideline

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.

TfNSW Transport for New South Wales

5. Concept

There are several locations for ATP fitment defined under the AMS project, with the main ones listed below:

- Speed Sign
- ETCS Train Stop
- End of line / Buffer Stop
- High Risk Reduced Overlap
- High Risk Turnout

The consideration for an Approach BG is only required where Target Speed Monitoring (TSM) is applied by a controlled balise, such that the conditions for TSM can change after a train has passed the TSM announcement BG. This limits the Candidate Signals for Approach BGs to those signals protecting High Risk Turnouts and High Risk Reduced Overlaps. An Approach BG will only be used wherever there is a valuable operational benefit in terms of a significantly reduce journey time..

Figure 1 shows the example of a reduced overlap ahead of a signal C which is announced by a balise group two signals in the rear (signal A). The balise at the speed sign in rear of Signal A also sends the speed announcement for redundancy reasons, but it will be updated by the balise group at Signal A before it impacts the approaching train.

Similarly, Figure 2 shows the example of a high risk turnout.

There are two types of Approach BG to be considered:

- Approach BG between the Intermediate Signal and the Protecting Signal: The BG is within the last signal section before the hazard, and is connected to an LEU that is getting information from the Protecting signal (Signal C in Figure 1 and Figure 2).
- Approach BG at an Intermediate Signal: The Approach BG is located at a signal (Signal B in Figure 1) between the initiating BG (at Signal A in Figure 1 and Figure 2) and the Protecting signal (Signal C in Figure 1 and Figure 2). There could be more than one intermediate signal to consider.

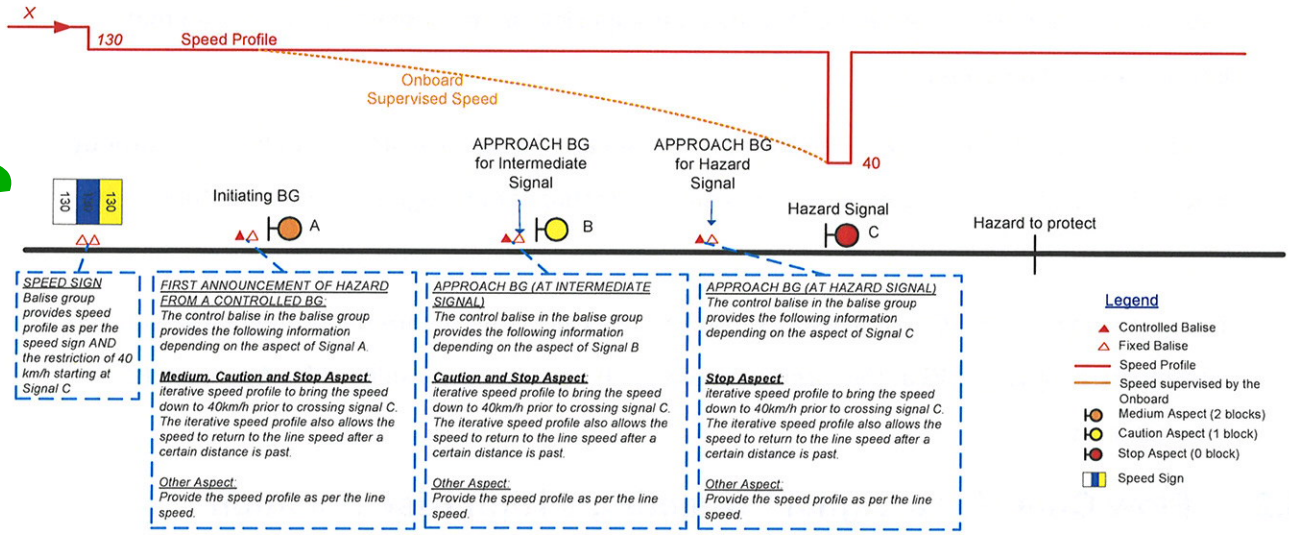


Figure 1 – Approach Balise Group (BG) for Reduced Overlap

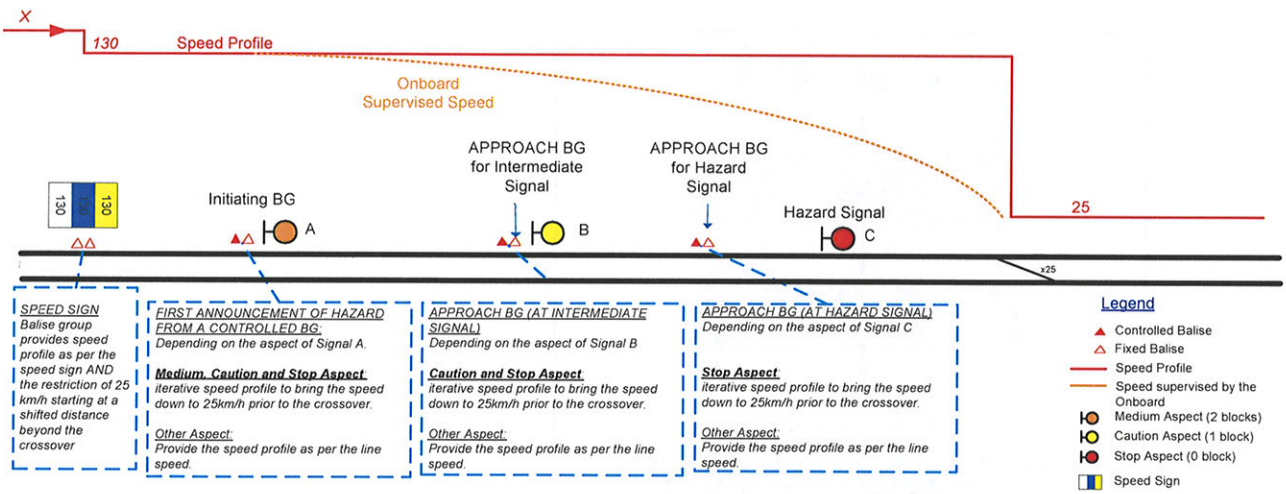


Figure 2 – Approach Balise Group (BG) for high Risk Turnout

6. Assessment of signals for the provision of an Approach BG

6.1. Introduction

Once a train has read a BG with a TSM ahead, if the approaching signal has cleared since the last speed restriction was issued, the Approach BG will remove the Target Speed and allow the train to accelerate back to line speed before it gets its next update from a balise or passes the hazard itself.

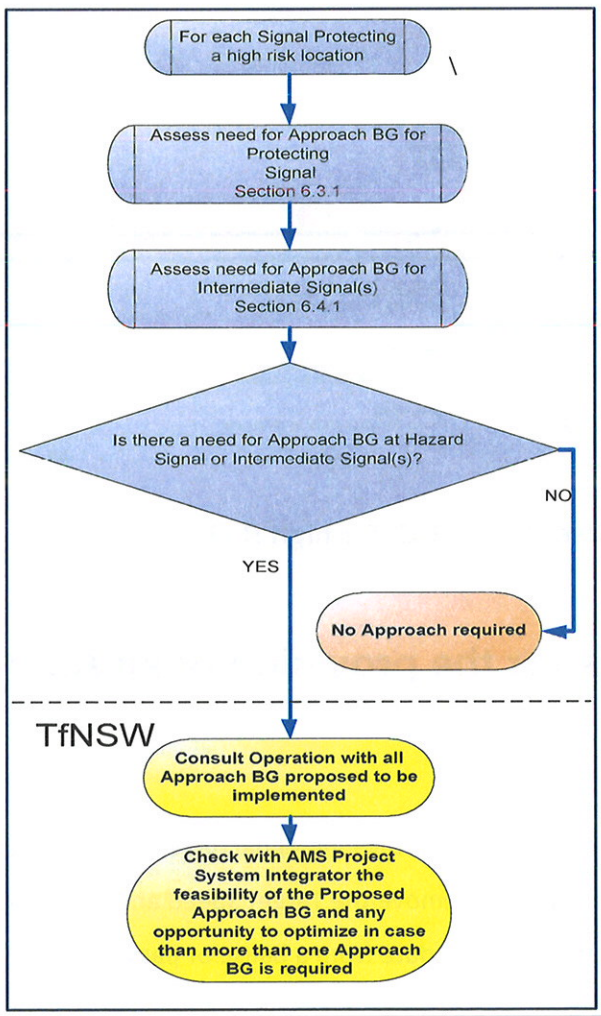
This may considerably improve the journey time, especially in the case of a target speed that is much lower than the line speed.

This situation applies to either a reduced overlap ahead of a signal at stop, or to high risk turnout where the Target Speed is sent when the signal protecting (or any signal prior to) the turnout is showing Stop.

The protecting signal (BG installed at a distance to be calculated before the protecting signal) and all intermediate signal(s) (BG at the intermediate signal) need to be considered for Approach BG requirements.

6.2. Flow Chart for a Signal Protecting a High Risk Location

For each signal protecting a high risk location, the requirements for an Approach BG shall be established using the flowchart below:



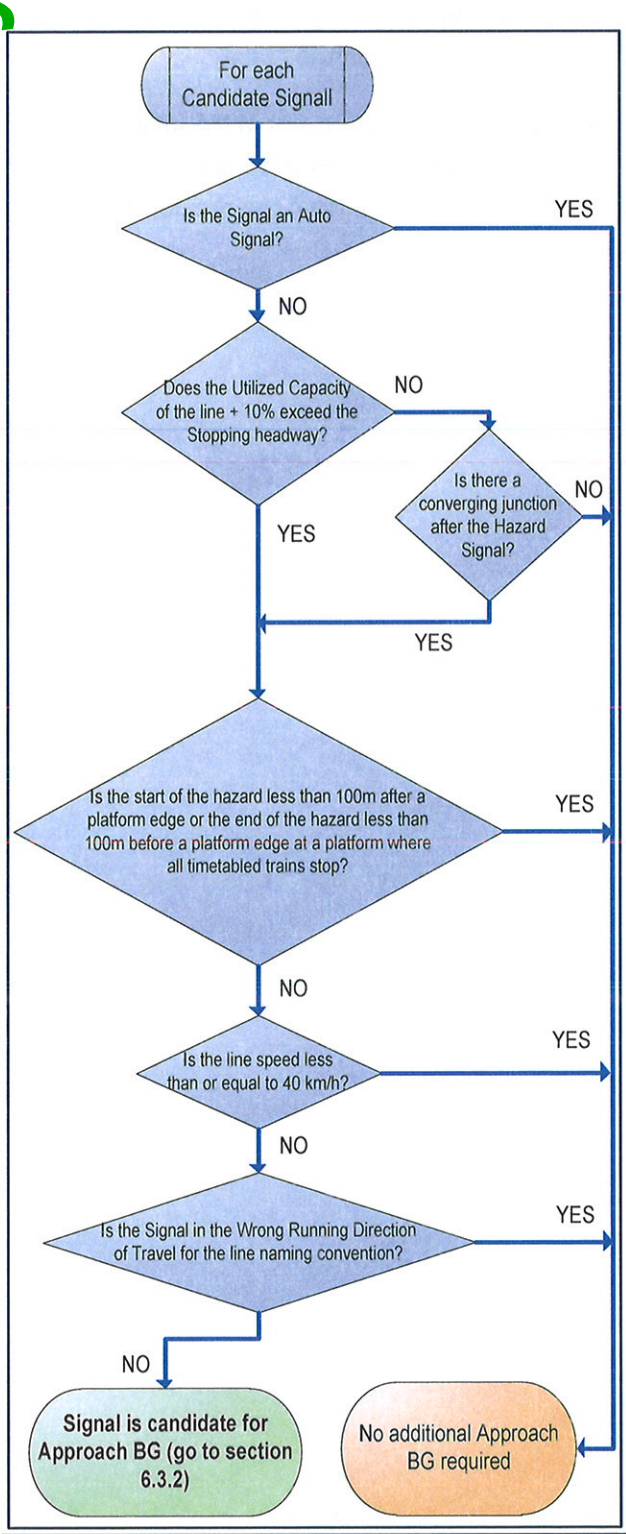
For each Candidate Signal for Approach BG fitment (as defined in section 5), a consultation with Operations shall be undertaken to confirm the need for an Approach BG, and then the AMS Project System Integrator shall be consulted for approval, with a cost estimate for the fitment.

Cable Route unavailability could mean the cost of the Approach BG is too expensive for the Client and the cost / benefits of doing trenching shall be further discussed within the Client.

In case of having a suitable cable route available but with cable access points not in the ideal position, the location of the Approach BG could be revised in order to align with an access point (e.g. for underground cable route, the Approach BG could be moved +/– 100m from the previously calculated location, to align with the available cable access points).

6.3. Approach BG for Protecting signal

6.3.1. Flow Chart to Determine the Need for an Approach BG Between the intermediate Signal and the Protecting Signal



Notes:

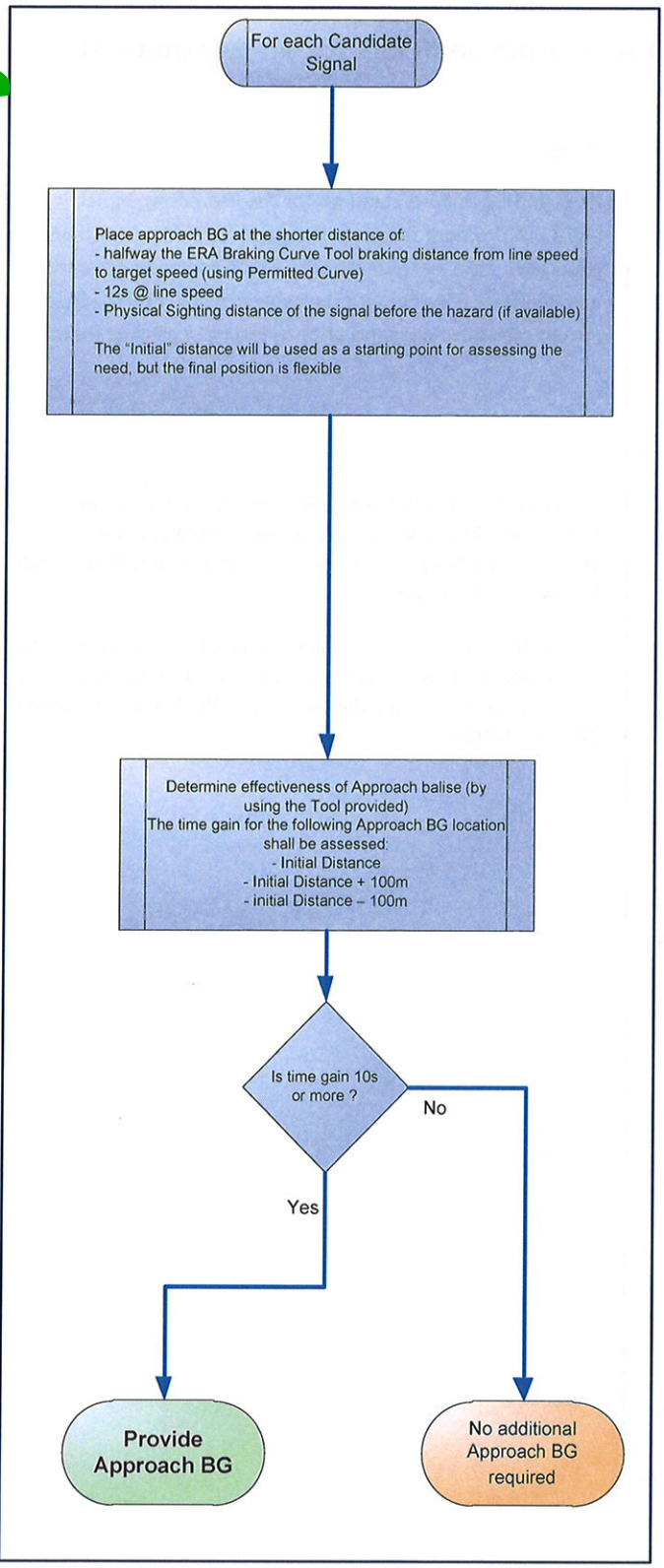
The latest Signal and Control Systems Annual Asset integrity Report should be used to assess the Utilised Capacity and Stopping Headway for the line. The worst case scenario shall be taken into account.

Where the Protecting signal is placed immediately in rear of the convergence of two electrified main lines, the stated Utilised Capacity is irrelevant as the capacity of the line ahead would be much higher.

Whenever all trains stop at a platform, the benefits of the Approach BG is limited.

It is unlikely that timetabled moves would be in the reverse direction of travel, and so the operational benefit of an Approach BG is less likely.

6.3.2. Flow chart to Determine Location and Effectiveness of an Approach BG between the Intermediate Signal and the Protecting Signal



Notes:

Approach BG Candidates Signals are coming from section 6.2.1.

The physical sighting distance refers to possible obstructions in the line of sight and should be considered. As it is not always available information, this criterion for the positioning of the Approach BG can be assessed later.

The Approach BG location shall be referenced from the hazard itself, not the signal protecting the hazard, and should always be located before the protecting signal.

It shall be noted that the Approach BG could be located in rear of the signal prior to the protecting signal (intermediate signal). In that case, the Approach BG shall get the information from the signal just ahead of it (i.e. not the Protecting signal)

The effectiveness of the Approach BG is determined by its "time gain" which is defined as the difference between the time penalty of the Target Speed without any Approach BG and the time penalty of the Target Speed with the Approach. The larger the time gain, the most effective the Approach BG is. The tool below allows to calculate the time gain:

Approach Tool v1.0.xls

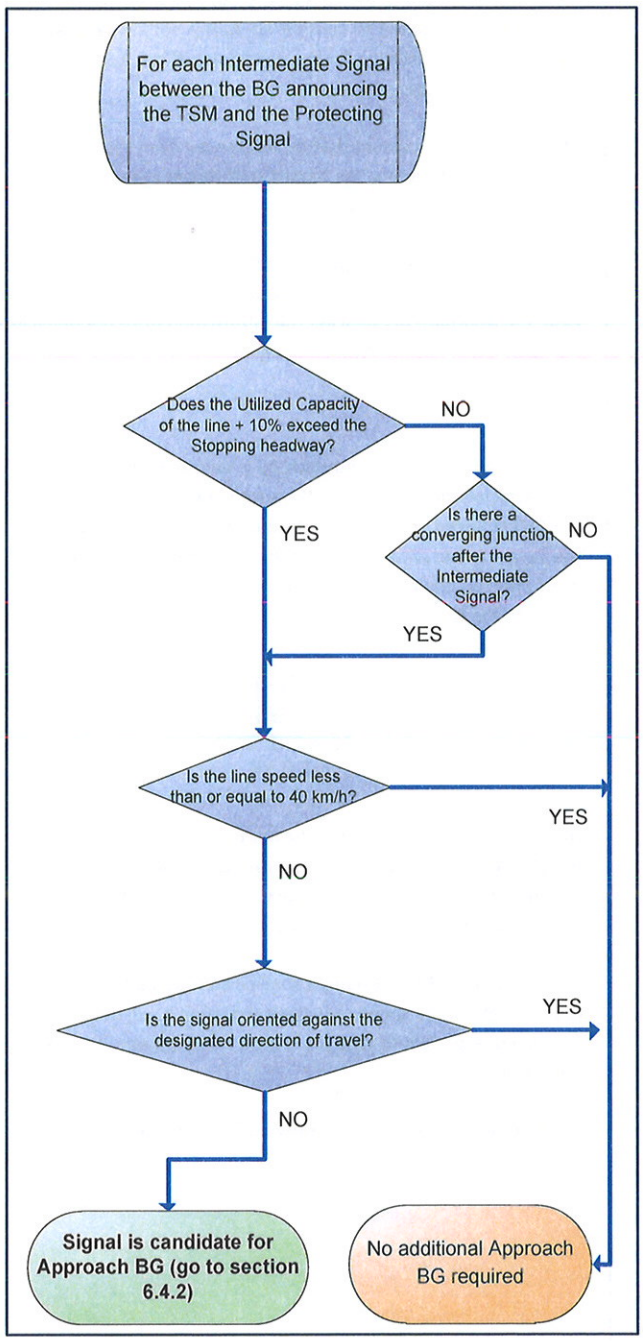
Note 1: The further away from the hazard, the more time gain will be achieved, but it also means less train would benefits from it depending on when the signal clears. If any, the shorter distance that fit the 10s criteria shall be used.

Note 2: For High Risk Turnout, it shall be considered the delay due to the length of the speed reduction and when it will be sent back to line speed, especially in case there is no BG at the signal protecting the turnout.

Clarification on target speed is provided in Appendix A.

6.4. Approach BG for an Intermediate Signal

6.4.1. Flow Chart to Determine the Need for an Approach BG for an Intermediate Signal



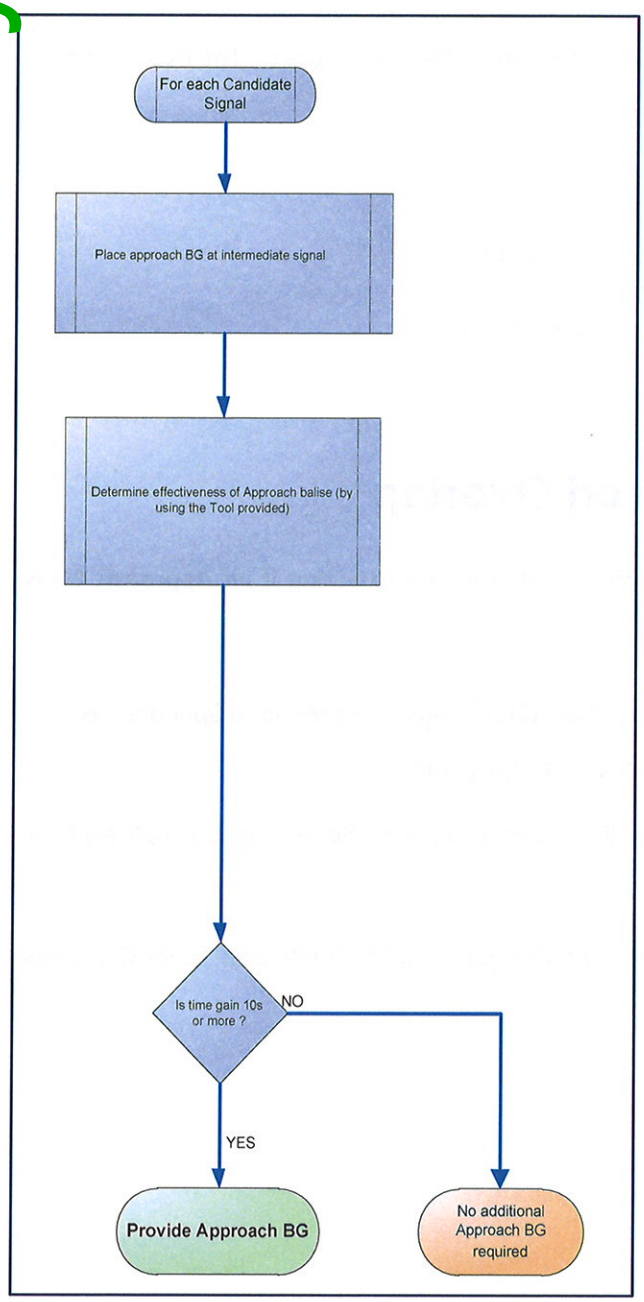
Notes:

If no Approach BG is required for the Protecting signal, it is still a requirement to assess the need for an Approach BG, especially if the announcement of TSM has been done from a long distance in rear and the aspect of any intermediate signals may have changed prior to the train passing them.

The latest Signal and Control Systems Annual Asset integrity Report should be used to assess the Utilised Capacity and Stopping Headway for the line. The worst case scenario shall be taken into account.

Where the Protecting signal is placed on the approach to the convergence of two electrified main lines, the stated Utilised Capacity is irrelevant as the capacity of the line ahead would be much higher.

6.4.2. Flow Chart to Determine the Effectiveness of an Approach BG for at an Intermediate Signal



Notes:

The effectiveness of an Approach BG is determined by its "time gain" which is defined as the difference between the time penalty of the Target Speed without any Approach BG and the time penalty of the Target Speed with the Approach BG. The larger the time gain, the most effective the Approach BG is. The Approach BG tool allows calculating this (see 6.3.2).

Appendix A Clarifications on Target Speed

A.1. Applicable Speed

The ETCS overspeed margins should be ignored when calculating the target speed. The overspeed margins are defined as:

- Warning = Allowable Speed + 5km/h
- Service Brake Intervention = Allowable Speed + 7.5km/h
- Emergency Brake Intervention = Allowable Speed +10km/h

A.2. Target Speed for Reduced Overlap

The figure below shows the target speed to be considered when determining if an Approach BG is required in a reduced overlap scenario.

GE52 / GE52A will be used when determining the trip speed for trains using Medium Speed Signs (Applicable for C, K, V, S and T sets), i.e. Medium Speed Category trains.

GX2M will be used when determining trip speed for the trains using High Speed Signs (Applicable for H, M and A sets), i.e. High Speed Category trains.

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

A.3. Target Speed for High Risk Turnout (with Shifting of Target)

The figure below shows the shifted target speed to be considered when determining if an Approach BG is required in a high risk turnout scenario. The target speed sent from the trackside balise would start at shifted distance after the toe of the points. The target speed is the speed of the turnout.

The shifted distance can be obtain from the Balise Arrangement for High Risk Location Design Guideline (see section 2)

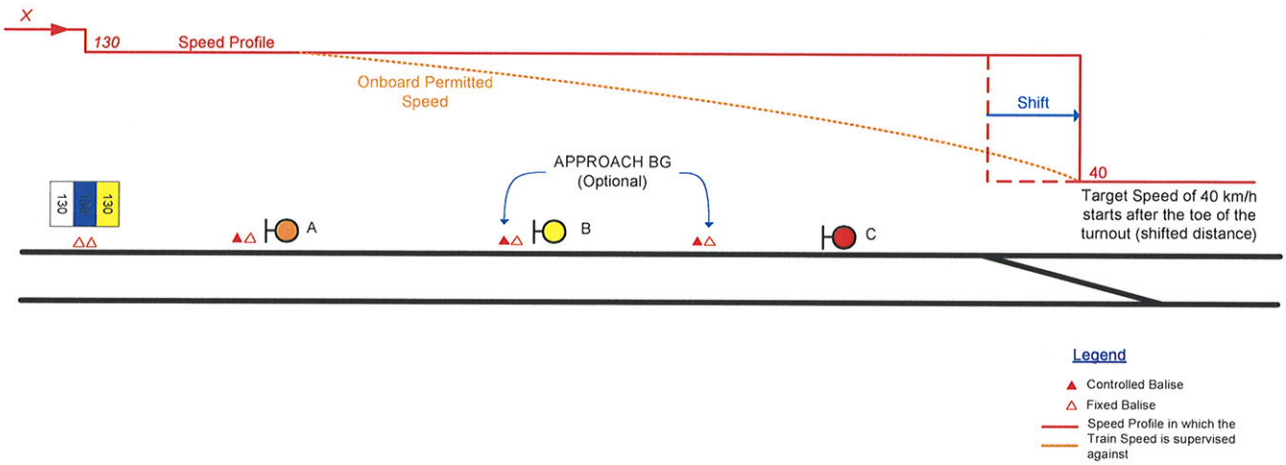


Figure 3 – Target Speed for High Risk Turnout (Shifting of Target)