

# The BR ATP System

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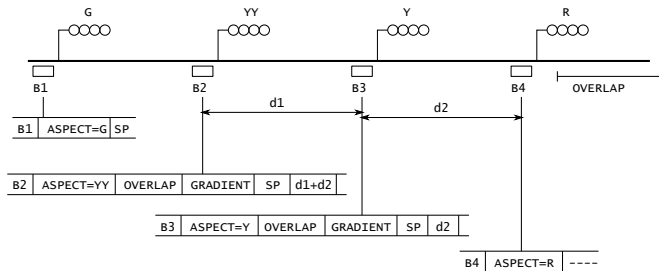
# Outline

- ▶ Aims
- ▶ Architecture
- ▶ Speed supervision
- ▶ Breaking supervision
- ▶ Operation
- ▶ Summary

# Aims

- ▶ To provide safety by preventing trains from:
  - ▶ exceeding speed restrictions,
  - ▶ passing signal at danger.
- ▶ Initially, supplement the existing automatic warning systems (AWS) and replace them eventually.

# Architecture

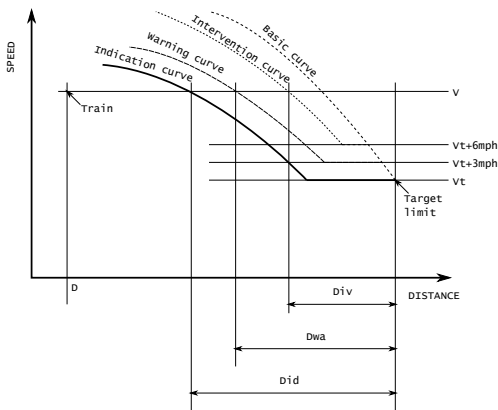


# Speed supervision

- ▶ Speed supervision involves comparing between the train speed and the most restrictive *current limit*.
- ▶ Current limits are derived from track and train data.
- ▶ A speed limit can be permanent (PSR) or temporary (TSR) and presented in track data in two form
  - ▶ Immediate and,
  - ▶ Target.

# Braking Supervision

- ▶ Braking Supervision involves comparing between the position of the train speed and distance with various speed/distance curves:



## Braking Supervision: basic curve

$$D_b = \frac{V^2 - V_t^2}{2(B + I)}$$

where:

- ▶  $D_b$  is the basic braking distance,
- ▶  $V$  is the train speed,
- ▶  $V_t$  is the target speed,
- ▶  $B$  is the braking deceleration (assumed to be constant),
- ▶  $I$  is the inclination deceleration (assumed to be constant).

# Braking Supervision: intervention curve

$$D_{iv} = D_b + VT_b$$

where:

- ▶  $D_{iv}$  is the intervention distance,
- ▶  $D_b$  is the basic braking distance,
- ▶  $V$  is the train speed,
- ▶  $T_b$  is time to build up brake force.



## Braking Supervision: warning curve

$$D_{wa} = D_b + V(2T_b + T_{wa})$$

where:

- ▶  $D_{wa}$  is the warning distance,
- ▶  $D_b$  is the basic braking distance,
- ▶  $V$  is the train speed,
- ▶  $T_b$  is time to build up brake force,
- ▶  $T_{wa}$  is the warning time.

## Braking Supervision: indication curve

$$D_{id} = D_b + V(2T_{bs} + T_{wa} + T_{id})$$

where:

- ▶  $D_{id}$  is the indication distance,
- ▶  $D_b$  is the basic braking distance,
- ▶  $V$  is the train speed,
- ▶  $T_{bs}$  is the maximal time to build up brake force,
- ▶  $T_{wa}$  is the warning time,
- ▶  $T_{id}$  is the indication time.

# Operation

- ▶ Train data entry,
- ▶ Driver's interface,
- ▶ Warning and intervention.

## Operation: train data entry

Before the start of a journey, the following data need entering into the train ATP equipment:

- ▶ Maximal train permitted speed,
- ▶ Train category,
- ▶ Train length,
- ▶ Braking rate,
- ▶ Braking delay.

## Operation: driver's interface



# Operation: warning and intervention

- ▶ If a train passes the warning curve:
  - ▶ ATP gives audible warning and flash the main display.
- ▶ If the train passes the intervention curve:
  - ▶ ATP applies full service braking,
  - ▶ Brake light is lit,
  - ▶ When the train is below the intervention curve, brake light flashes and the driver may regain control.

# Summary

- ▶ The aims and architecture of BR ATP,
- ▶ The supervision principles of speed and braking,
- ▶ The operation of ATP.