Investigation Body for Railway Accidents and Incidents

Summary
Safety Investigation Report
Derailment of a passenger train
Leuven - 18 February 2017

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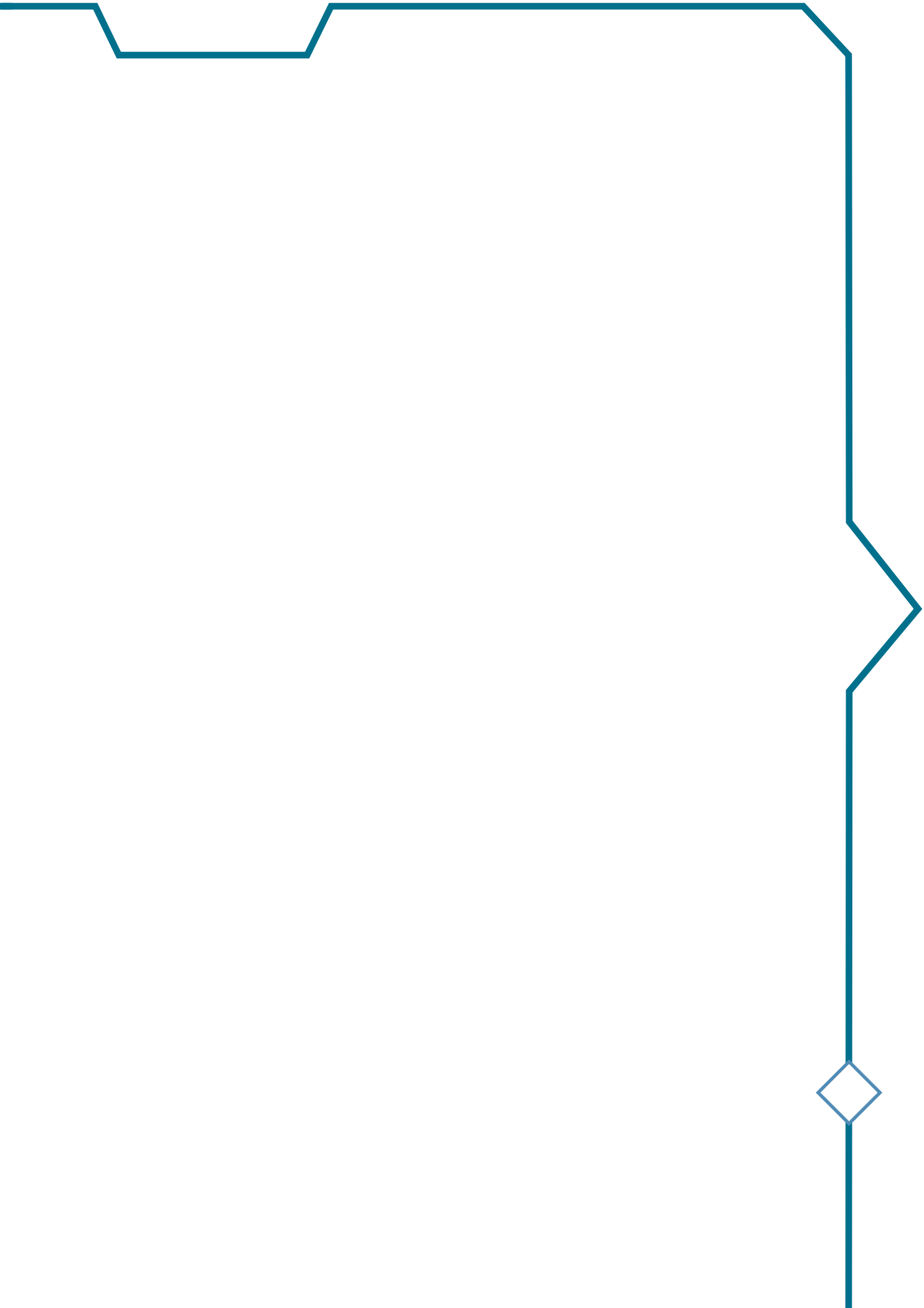
September 2018

REPORT VERSION TABLE

Version number	Subject of revision	Date
1.0	First version	27/09/2018

Any use of this restricted report with a different aim than of accident prevention - for example in order to attribute liability - individual or collective blaim in particular - would be a complete distortion of the aims of this report, the methods used to assemble it, the selection of facts collected, the nature of questions posed and the ideas organising it, to which the notion of liability is unknown. The conclusions which could be deduced from this would therefore be abusive in the literal sense of the term. In case of contradiction between certain words and terms, it is necessary to refer to the French version.



SUMMARY

BRIEF OVERVIEW

On 18 February 2017 around 1:11 p.m., shortly after leaving the Leuven station, a passenger train derails while traversing the switches. The first carriage of the train overturns and ends up on its side next to the track. The second and third carriages derail without turning over.

One passenger dies during the derailment. 26 passengers and one employee of the railway undertaking are transported to nearby hospitals; three passengers are severely injured. There is significant damage to the infrastructure and the rolling stock.

INVESTIGATION

The Investigation Body must conduct an investigation into every serious accident occurring on the railway system. The accident of 18/2/17 meets the definition of a serious accident[1].

CAUSES

Direct cause (driving the train)
According to the retained hypothesis, the direct cause of the derailment is **the inappropriate speed** of the train during the passage over an S-shaped curve formed by two connecting switches.

Indirect factor -1 (person-related problem)
According to the retained hypothesis, the first indirect factor is the incorrect processing of the signalled information (orders) relating to the speed restrictions that must be observed, due to **an incorrect mental perception (cognitive bias)**.

The day of the accident, a combination of various factors caused the train driver to develop and maintain an incorrect mental perception:

- the presentation of a complex environment without clear landmarks;
- the ambiguous character of the end-of-zone sign "9", allowing for increased speeds, while the signal in rear of the end-of-zone sign imposes a speed restriction of 40 km/h at the base of the signal in advance of the end-of-zone sign (HLT (Belgian railways rule book) regulation);
- the ambiguous character of the reference line indicator signs posted for L.36 in advance of platform 7;
- the incomplete definition in the HLT of reference line indicator sign L.36;
- the combination – on the side of the train driver – of passive line knowledge for departure from platform 7 combined with underdeveloped routine driving habits, on the one hand, and the amount of information to process during and shortly after the departure from platform 7, on the other.

These factors cause the driver to develop the mental perception that he is riding on L.36 in normal track regime; in reality, however, he is sent to L.36 while riding in counter-flow track regime.

1 *Article 111. § 1 of the Law of 30 August 2013, Law on the Railway Code.*

Indirect factor – 2 (design)
According to the retained hypothesis, the second indirect factor is the train driver – despite the information provided – not managing to correct the inaccurate mental perception as a result of the limited physical and cognitive salience[2] of the lit memory light in his driving cab and of (the panels of) signal EZ-H.9.

The signals observed by the train driver during and after his departure and the driving cab equipment meet the technical specifications. For the train driver, however, the physical cognitive salience of the TBL1+ memory lamp LGLJM[3] (in the driving cab) and of the panels of the signal EZ-H.9 (in the given temporal and spatial context) is too weak to recall the suppressed information or to correct the inaccurate mental perception.

Indirect factor – 3 (design)
The third indirect factor is the absence of an efficient **recovery system**.

The train has been equipped with driving support system TBL1++ which will occasionally intervene if, upon receiving a double-yellow signal aspect, the imposed maximum speed of 40 km/h is not reached in a timely manner or is no longer observed after having been reached earlier. This function is enabled automatically when a train is leaving from the departure station.

The train driving support system TBL1++ has not been designed to monitor the speed of a train after receiving a Green Yellow Horizontal signal aspect: when passing a signal with signal aspect Green Yellow Horizontal, this function is automatically disabled. The train driving support system can therefore no longer intervene when the imposed speed restriction is not observed.

The train has not been equipped with ETCS technology and the ETCS system on the infrastructure side has yet to become operational.

Systemic factor – 1 (monitoring)
The railway undertaking **neither adequately identifies the danger of failure to observe the imposed speed reduction (in a timely manner)** after receiving a Green Yellow Horizontal signal aspect, nor the recurring character of incidents which may indicate that some train drivers do not systematically acquire the expected driving reflexes.

The untimely observance of a speed reduction may be the result of incorrect driving habits, distraction, etc., and must therefore be considered a precursor of accidents.

Systemic factor – 2 (organisational learning)
The configuration of the tracks and signals in a complex environment, as can be experienced by train drivers when leaving the Leuven station from platform 7, **complicates an intuitive decoding of the information** transmitted by the available signals.

In the past, this has contributed to an incorrect mental perception with several drivers in Leuven and led to various dangerous situations that show analogies with the accident in question. Only a few incidents have been assessed and the analyses of these incidents did not result in a full identification of the problem.

2 *In this case, physical visual salience refers to the cohesion and structure of a scene (the strategically posted signalling panel that demands all the attention because of the monotonous environment it is staged in). The physical visual salience does not refer to technical aspects like luminosity or colour contrasts of objects (lamps, signals, etc.).*
3 *Yellow memory lamp (MEMOR).*

Systemic factor – 3 (organisational learning)
Two specific passages in the internal regulation of the railway undertaking could give rise to drivers developing arbitrary professional actions or making incorrect interpretations:

- the option to 'accelerate or not at the end-of-zone sign following a Green Yellow Horizontal signal aspect' is left to the discretion of the train drivers. Even though train drivers have been duly made aware of the danger of forgetting the imposed speed restriction, no effective measures were established to reduce the risk of forgetting;
- the incomplete definition of the reference line indicator sign in the HLT can give rise to inaccurate interpretations. In Leuven, this leads to the incorrect interpretation of 'riding on L.36' instead of 'riding to L.36'.

Additional observation 1
The potential risk-enhancing character of certain aspects of shift work, in particular the system with so-called backward-rotating early shifts[4], could result in higher than average fatigue levels. The system with backward-rotating early shifts requires a proper FRA (Fatigue Risk Analysis).

Additional observation 2
The communication channels between the Chief of Operations and the Leader Infrabel, on the one hand, and between the Chief of Operations/Leader Infrabel and the various disciplines (SPC (Railway Police)) and other parties (investigators, public prosecutor, etc.), on the other, are too vague and can lead to misconceptions and unsafe situations.

4 *Rotating shift pattern where work starts each day for example one hour earlier.*

RECOMMENDATIONS

Based on its findings, the Investigation Body has developed 2 recommendations, suggesting:

- a review of legislation relating to end-of-zone signs and of the definition of reference line indicator signs;
- the monitoring of situations susceptible of invoking incorrect mental perceptions.

With respect to the remaining observations, the Investigation Body refers to the recommendations mentioned in earlier safety reports.

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