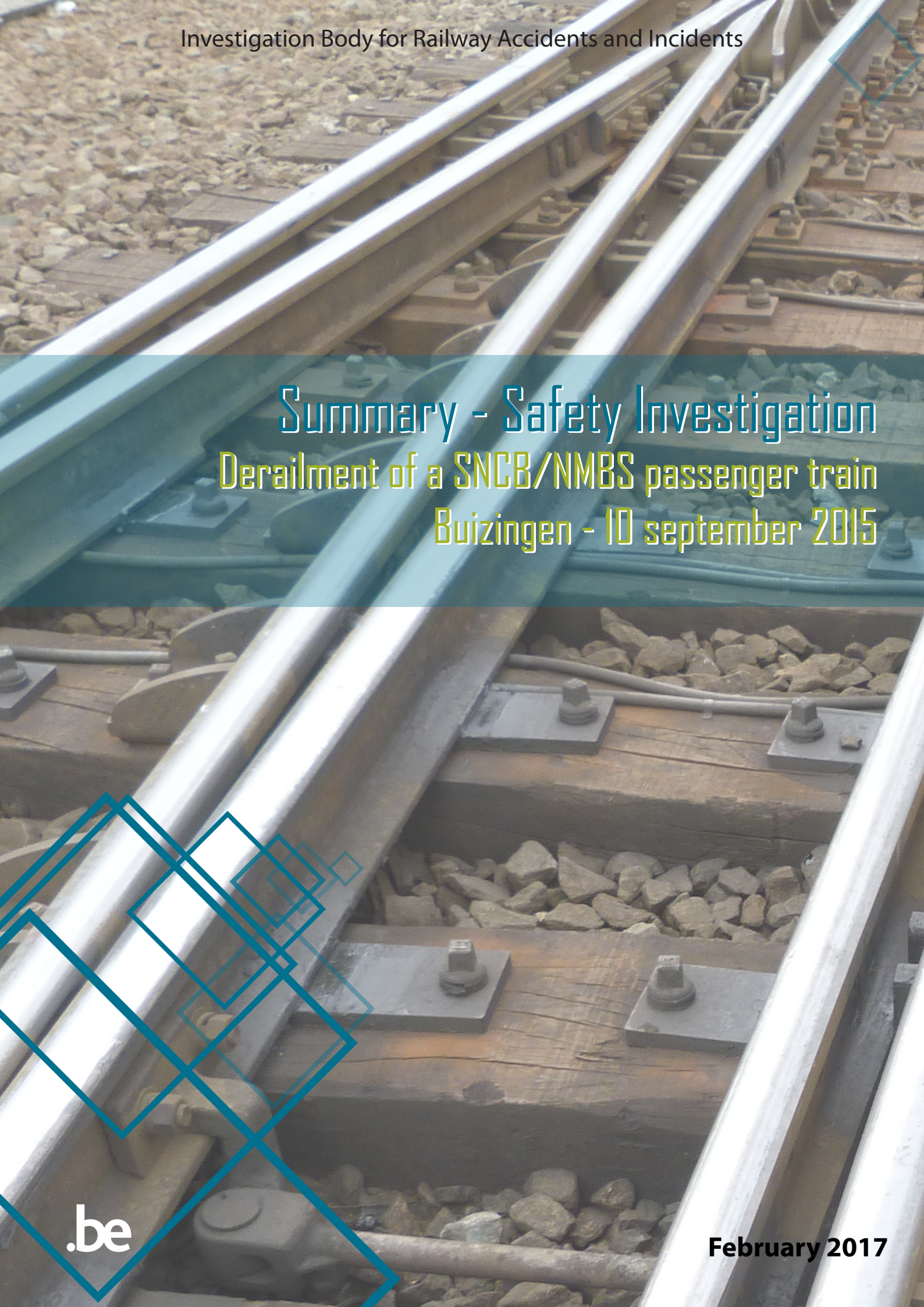
Investigation Body for Railway Accidents and Incidents



Summary - Safety Investigation

Derailment of a SNCB/NMBS passenger train

Buizingen - 10 september 2015

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February 2017

SUMMARY

On Thursday 10 September 2015, the SNCB/NMBS passenger train E8574 making the journey between Schaerbeek and Geraardsbergen, was operating on line 96. The train was composed of an electric locomotive of type 21 followed by 8 M4 carriages.

The study of the recording strip, testing at the accident site and analysis of the documents provided have allowed the chain of events to be retraced.

On the day in question, the sky was clear and the sun was clearly visible. The temperature was around 20°C. At 16:56, the train passed a first signal (K-D.1) at a speed of around 139km/h.
This signal was showing Green-Yellow Horizontal (GYH). Its mast is equipped with a warning signal in the form of a speed sign; a white triangular sign with rounded corners showing a black "5" figure. This sign indicates that the lowest speed that the following stop signal may require is 50km/h and this, if the signal (K-D.1) shows a "Green-Yellow Horizontal" aspect.
The driver accepted the restrictive aspect of the signal using the on-board equipment. We notice a slight drop in speed but the driver does not decelerate sufficiently and as expected.

One minute later (16:57), the train approached a second signal (C-D.1) which also showed Green-Yellow Horizontal (GYH) but with an overhead illuminated sign with a chevron and an illuminated sign underneath showing the figure 5. In this configuration:

- the figure 5 means that the speed of the train au droit du signal at the signal should be 50km/h or less,
- the illuminated chevron indicated that the train is changing regime, moving from normal track to counter-track via the points (11BD-11AD).

The speed of the train is around 120km/h when passing the signal instead of 50km/h. The driver engaged the emergency brake. The train entered the points at an excessively high speed. The locomotive, which has a higher mass, did not derail, only the first bogie of the first carriage derailed. The train came to a standstill at the platform of the unmanned stopping point in Buizingen: the locomotive and the first two carriages were at the platform.

The driver launched an alarm via GSM-R and train circulation was suspended. 39 passengers suffered bruising, of whom 10 were taken to hospitals in the region and were discharged within 24h.
Damage was noted to the infrastructure: concrete sleepers were splintered, deformations to the track and the track equipment. The first carriage of the train was also damaged.

The accident did not meet the definition of serious accident; however, in slightly different circumstances, this could have had more serious consequences. The IB decided to open an investigation.

Various checks to signal operation, as well as measurements on the track and points were carried out: nothing abnormal was noted in these various checks, any damages to the infrastructure were resulting from the accident.

Various measurements were also carried out on the rolling stock (measurement of the wheel profile of the locomotive and the first carriage, brake testing (pressure resistance)) in the SNCB/NMBS workshops: nothing abnormal was noticed in these various checks and the damage inventoried was resulting from the accident.
This is why the IB called upon external experts to carry out an investigation into "human and organisational factors". The investigation closely followed the failures in the safety principles or application of these principles which allowed the accident to occur. An in-depth study of the behaviour of actors and organisations could then be carried out: comparison of common practices, comparison of reference frames, search for psychological and psycho-sociological explanations. The results are summarised below.

The most probable scenario retained to explain the occurrence of the train accident is a bad apprehension of the appearance of a warning signal by the driver who was little experienced, due to the heavy work schedule, not adapted to the situation at that location the day of the accident, without a doubt reinforced by a momentary lack of attention.

In a normal operational context, the perception and interpretation of signals are highly influenced by the habits and line knowledge acquired by drivers. Visual circuits are simplified and only pertinent information is looked for. Due to this, the appearance of unexpected information is more likely to be missed. The study by Baysari et al. (2009) shows that 2 factors encouraging driver error are :

- the drop in concentration and
- the incorrect expectations on the information to come.

In the operational situation usually encountered by the driver, the itinerary of the train continued in a straight line meeting in the order the signals K-D.1 green, C-D.1 and H-E.1. In this configuration, the speed restriction on signal H-E.1 is 120km/h.
On the day of the accident, the driver's sequence of actions demonstrated behaviour coherent with this situation: passage of signal K-D.1 at 139km/h in progressive deceleration and passage of C-D.1 at 123km/h.

The mast of signal K-D.1 was equipped with a warning signal in the form of a speed sign; a white triangular sign with rounded corners showing a black "5" figure. This board/sign is not to be taken into consideration when the signal K-D.1 is showing Green Yellow Horizontal.

Safety is guaranteed by a good perception of the signal by the driver, then by his good interpretation and finally by installing a suitable attitude. The drivers are trained so as to meet these requirements in particular by their training on line knowledge.
The combination of the aspect of the signal and the triangular, point down sign showing the number "5" is not simply and intuitively decodable. It requires an effort at interpretation and assumes that the driver will have allocated sufficient resources to take on this effort or that he will have developed sufficient experience to accrue the necessary automatic reflexes to be able to decode this type of unusual situation.

This effort assumes an allocation of mental resources - attention - which was not available, probably due to the fact the driver was operating in a way that was routine.

The driver concerned had little experience. To interpret the signal, he was using his experience in the area i.e. the fifty or so times he had passed through there (as the investigation was able to establish).
Numerous studies in psychology have long shown that concentration is a limited process in resources and in time (James, W. 1890). The literature shows that, for a simple action, it needs to be repeated at least twenty times to turn it into a habit.
The objective of a substitution test is to distinguish the factors of individual behaviour from the generic factors. The test carried out by the experts in the context of this accident has shown different results depending on the driving experience of the drivers: in conclusion, some inexperienced drivers could have made the same mistake.

There is a risk for drivers little experienced to incorrectly read a signal in a similar operational situation due to their expectations.

Recommendation N° 1

The IB recommends that the NSA makes sure that the railway undertaking, in cooperation with training centres, reinforce the trained drivers on possible routine errors and the traps linked to routine in operational situations rarely encountered.

The day of the accident, the driver carried out his third service after a long work interruption of almost 8 weeks (a 4 week holiday period, followed by 5 services, followed by a 4 week holiday period) and he started work at noon (not requiring getting up early and therefore not generating a lack of sleep) : the deficit of attention cannot be attributed to a high level of fatigue.

The attention deficit could easily be explained by the fact that the driver was returning from a long holiday: accidentology data from SNCB/NMBS shows more events during these periods of return from holiday. This phenomenon can be explained by the weakening of automatic reflexes, the cognitive solicitations in relation to the activity and which maintain them being suspended during the holiday period. This effect is all the more marked when the reflexes have not yet fully taken root, which is the case for inexperienced drivers.

The length of the driver's holiday periods did not exceed 6 months for which regulations impose that a professional aptitude test is carried out.
In theory, for shorter periods, the driver is able to report if he is not feeling at ease. However, even if they recognise without difficulty that it is not easy to return to driving after a long absence, drivers never ask to be accompanied, as culturally, this type of request is not appreciated by colleagues.
On the other hand, if they have not driven a certain type of traction unit for a long time, drivers more easily ask to be accompanied for their first journey. Culturally, this second situation seems more legitimate and therefore is more easily accepted.

Recommendation N° 2

The IB recommends that railway undertakings identify rules of good practice be installed with regard to management of leave and return from leave.

The occurrences of overspeed noted by the analysis centre of SNCB/NMBS are recorded in a database SIROCCO since April 2015.
They are listed according to the severity of the overspeed :

- significant overspeeds, exceeding 30 km/h : a quarterly report is drawn.
- overspeeds not exceeding 30 km/h are filed under section "others".
- overspeeds exceeding 8 km/h are communicated to the concerned driving personnel.

Due to the difficult detection of this type of events it is very likely that , the number of cases of overspeed is under-estimated. In the mapping of risks, an overspeed incident over 30km/h is considered by the SNCB/NMBS as being as serious as a SPAD.

The SNCB/NMBS has little information on the robustness of this principle of "overspeed" linked to a GYH: it does not have information on the level of exposure to this problem or the risk of failure. What is more, non-compliance with GYH signals is not differentiated from other overspeed incidents (for example non-compliance with a speed restriction due to the presence of works).

SNCB/NMBS does not hold statistics permitting the cross-checking of data in terms of potential explanatory factors such as age, seniority, the driver's profile, the time of occurrence (for example return from leave), place, or any other contextual element.

SNCB/NMBS is developing a procedural project in which corrective and/or precautionary measures are being developed with regard to the severity of the overspeed.

Recommendation N° 3

The IB recommends that railway undertakings carry out:

- **sufficient sampling of speed tapes in order to assure efficient management of overspeed risks;**
- **statistics permitting the cross-checking of data in terms of potential explanatory factors.**

The Buizingen "grill" is known to be a complicated section:
what makes it so special and its major difficulty is the high speeds allowed and the large gap between the minimum speed (40km/h) and the maximum speed allowed (160km/h).

Itineraries are traced by EBP-operators in terms of the EBP-system's programming : programming is carried out in order to assure a safe passage through the switches.

On the day of the accident, the unusual action sequence requires a deceleration from 160km/h to 50km/h

The large drop in speed from 140km/h to 50km/h is not signalled by an illuminated number but by a speed sign as warning signal.
The combination of the aspect of the signal and the triangular, point down sign showing the number "5" is not simply and intuitively decodable. It requires an effort at interpretation.

On this subject, a letter from the SNCB/NMBS dated 08/12/2015 (prior to the accident) requested that Infrabel equip certain signals with an additional overhead screen showing the maximum speed required. The drivers questioned were unanimous about the fact that this type of sign would avoid interpretation errors and would be particularly useful for signs giving a large number of possible speeds or for those suggesting 2 speeds very far apart.
The letter mentioned that this type of sign would help maintain regularity as it would avoid drivers slowing down more than necessary.

Effectively, literature on the subject (Wickens, 2000) shows that to reduce the number of errors, the design of working posts should be different according to the nature of the activity concerned, whether routine or more rare.

According to verbal information received from the Infrastructure Manager, the switch permitting this itinerary will soon be phased out. .

Recommendation N° 4

The IB recommends that the infrastructure manager review its current risk management to determine if new elements related with the analyzed accident do not require an adaptation of this risk management.

The infrastructure and the rolling material was equipped with TBL1+. As the TBL1+-system does not assure continuous speed monitoring, it has not triggered an emergency brake. As ETCS was not present either on board the rolling material or on the ground, the mistake could not be corrected which would have prevented the event from happening.

ETCS is currently being installed according to a deployment plan from 2012 to 2022.

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