Belgian Railway Accident & Incident Investigation Unit

Summary of Security Investigation Report

DERAILMENT OF A FREIGHT TRAIN
WETTEREN - 4 MAY 2013

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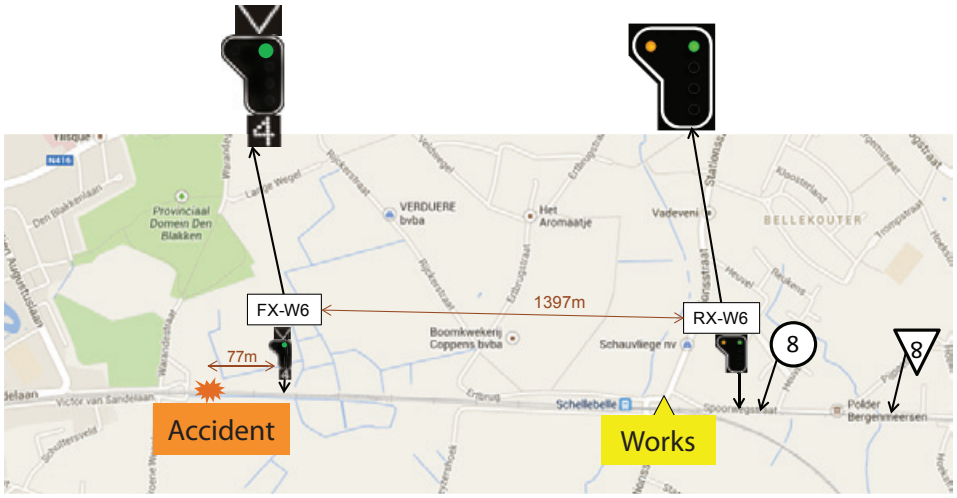
SUMMARY

On Saturday 4 May 2013 around 01:58 AM, freight train Z44601 derails between Schellebelle and Wetteren. The freight train was carrying out a cross-border night service from Kijfhoek (Netherlands) via Gent-Zeehaven (Belgium) with final destination Terneuzen (Netherlands).
The convoy is composed of two locomotives pulling 18 wagons. Several wagons are loaded with goods subject to RID regulations.

At the entrance to Dendermonde station, the driver encounters a horizontal green-yellow warning signal and carries out the expected professional movements: the convoy moved to the opposite line as there were works on the normal track further along the line. The driver has received no information from his employer at the start of his workday about the presence of works in Schellebelle and has no knowledge about the reason why he has to move onto the opposite track. The fixed signals along the tracks guide the drivers during their journey. The signals are placed on the left side for movements on the normal track and on the right side for movements on the opposite track. The "wrong-line signals" flash so as to distinguish them from the normal line signals; this is not an unsafe or unusual situation.



The driver encounters 9 consecutive green flashing signals. Then he encounters a green-yellow horizontal flashing warning signal (RX-W.6) that informs him of the aspect of the following signal (FX-W.6). In the absence of a speed indication (on the signal RX-W6) the train is permitted to travel at a restricted speed of 40km/h from the next dangerous point.
At that moment, the driver has no elements that indicate the reasons for the lowered speed restriction. He has to spontaneously alter the indications according to their instructions.
The expected behaviour of the driver is:

- acknowledge the warning signal by activating the button of the Memor system;
- in accordance with procedures by the railway undertaking, slow down to a speed of 40km/h from the next signal;
- pay attention to his surroundings.

The driver continues along the works on the left side of the track and encounters the next signal (FX-W6) showing a flashing green light with 2 fixed illuminated indications: a white chevron "V" and a white digit "4". This indicates to the driver the change of regime, from the opposite track to the normal track, and recalls the instruction to limit the speed to 40km/h for changing regime.

Approximately one km from the zone of the maintenance works the driver encounters the signal FX-W.6. The speed of movement at the signal FX-W.6 is around 84 km/h.

At 01:58 AM, 77 metres from the signal FX-W.6, the freight train 44601 changes over the switches to the normal track. In the switches area the first 7 wagons derail from the tracks. At least three tank wagons are perforated in the derailment and their toxic and flammable liquids pours into the ditch alongside the track. After the derailment the driver sends a GSM-R alarm.

The analysis of the events revealed three successive failures, i.e. three deviations from the expected behaviour.
An initial failure is the absence of braking while passing the signal RX-W.6, which indicates a horizontal green-yellow flashing signal aspect.
The two subsequent failures are to do with the lack of means of recovery by the Memor system and on approaching the signal FX-W.6 with a green signal aspect and illuminated indications "V" and "4": the train goes straight over the switches at a speed of 84km/h.
These failures have resulted in the failure of a safety principle of the railway system, that wants that drivers take the logical action after seeing a signal aspect.

According to the technical analysis carried out with the help of several external experts, no evidence could be found to attribute the accident to the track, the signalling system or the rolling stock.

According to our scenario, the direct cause of derailment is the toppling of the first three wagons when they passed over the switches. The toppling of the wagons was made possible by the combination of the following factors:

- a non-adapted speed;
- two successive small curves of switches, radius ±215m, in a S-shape and designed for a maximum speed of 40km/h when placed in deviating position;
- the high centre of gravity of the fully (correctly) loaded wagons;
- the initiated emergency brake.

The railway system expects drivers operating on its network to take account of signals, interpret them correctly and adopt appropriate behaviour. To support this safety principle, the available equipment and installations must support as well as possible the driver to fulfil these expectations.

The driver has acknowledged the flashing green-yellow horizontal warning signal aspect. The accident has shown that it is possible for a driver to "automatically" acknowledge a signal aspect without taking the particular action, which creates a break in the safety function of the Memor system, as this inhibits the emergency brake.

An analysis of the human and organisational factors was carried out to understand these mechanisms.

Train drivers are expected to interpret signal aspects in real time so as to create a mental picture of the signal aspects and act as a result of this. An external distraction causes attentional resources to be divided, or more monopolising attention on an external target.
The simultaneous presence of works and the signal RX-W.6 could have disturbed the perception of the signal and created confusion in the driver's mind. As well as cognitive perturbation, there could even be some questions as to a visual perturbation: the works were carried out with light from two projectors directed towards the ground. Lights can create a halo effect which could potentially be a perturbation from seeing signals. This effect however did not appear in the interviews.

The evaluation of the driver's timetable, carried out using two different models, gave matching results and indicated a high level of fatigue on the two days prior to the accident, reaching a maximum at the time of the accident.
These evaluations suggest that the driver was very probably showing a high level of fatigue.
The evaluation of the driver's timetable over the previous weeks shows that it was in accordance with the various European Directives and legal provisions. The European regulations do not oblige railway undertakings to implement a fatigue risk management system, as used in the aviation sector.
There were various studies carried out, in laboratory and real conditions, on the impact of fatigue on performance. In a disturbed situation, i.e. a situation where all the necessary mental resources are not available (situation of lowered vigilance), the reflexes acquired during trainings become the automatic response. This could explain the acknowledgement of the horizontal green-yellow warning signal without fully perceiving or appreciating its significance.

In addition to the effect of lack of sleep and the time of the day, the nature of the activity (monotony of the task) contributes to a lowered level of awareness. The phenomena "Driving without Awareness" leads to the appearance of cerebral activity close to somnolence, and to attentional "gaps". The driver encounters a series of 9 consecutive green signals: we can consider that for around 7 minutes his driving activity has been monotonous.

Another observation from the study is that there were no real recovery loops possible for the driver. The switching on of the Memor lamp allows at best a re-evaluation of the situation by the driver, but does not allow a mental representation of the situation. While the signal is not longer visible, the driver is able to correct his mental image of the situation but the Memor system will give no information on the aspect of the missed warning signal.

In conclusion, the undertakings have adopted various protection methods to help prevent accidents: signalling systems, Memor, etc.; however these mechanisms are insufficient in the situation where the train driver wrongly interprets or does not properly perceive the warning signal, in the same way as when he wrongly applies an operational rule. The most recent tools such as TBL1+ offer no solution in the circumstances of this accident, only the ETCS control system or similar system would have brought the train to a standstill in time. In absence of intrinsic physical defence mechanisms for the control of trains, the current means of defence were revealed to be insufficient to prevent the derailment.
A safety system must reach a high level of performance and must incorporate a realistic tolerance of failures so that a simple failure does not lead to a catastrophic event.

On the day of the accident the train path was allocated to the railway undertaking SNCB/NMBS Logistics, the convoy was composed of 2 locomotives belonging to the undertaking DB Schenker Rail Nederland. The train driver was under a DB Schenker Rail Nederland contract.
In our investigation, we have concentrated on aspects linked to railway safety. The two railway undertakings were in possession of a Belgian Part B safety certificate confirming that the two undertakings satisfy the necessary requirements for safe operation on the Belgian railway network.

Since 2010 SNCB/NMBS Logistics and DB Schenker Rail have a collaboration via COBRA.
The two railway operators join their forces in order to enforce quality and efficiency on route in Belgium, Germany and The Netherlands. COBRA functions as a production company, and as result all commercial activities remain in hands of the two principal operators. The role of COBRA is limited only to a logistical task to create a pool of train drivers and locomotives available to these railway undertakings.

A partnership contract[1], established between both parties, recorded the following minimum requirements:

- comply with the general European regulations
- allow inspections to be carried out
- reserve the right to carry out audits

According to the DSRI, the National Safety Authority, the partnership agreements exist in the context of technical inspection of wagons, train exchanges; however in the context of the accident, the undertaking DB Schenker Rail Nederland is considered as an auxiliary undertaking of the railway undertaking SNCB/NMBS Logistics. an overview of auxiliary undertakings used by the railway undertaking must be sent to the DRSI. SNCB/NMBS Logistics was administratively in order. The DRSI does not check all the contracts drawn up by railway undertakings in the context of the approval of their safety management system but carries out supervision inspections where they verify that amongst others: who is the holder of the train path, or if the railway undertaking is indicated as auxiliary undertaking , etc. An additional study of contracts is possible in case of demonstrated dysfunction during the supervising inspection.
Belgian legislation was not very clear at the time of the accident: there were no definitions/vague interpretations of the terms partners and/or subcontractors. The Royal Decree of 9 July 2013 gives more details on the definition of auxiliary undertaking and the requirements to be met by the undertakings using auxiliaries.
Through the various interviews carried out, it was revealed that the situation between DB Schenker Rail Nederland and SNCB/NMBS Logistics is not unique in Belgium and is not limited to the Belgian railway network.

A discussion with the railway sector about the use of the word 'auxiliary ' and 'subcontractor' is planned on future ERA exchanges with NSA's, in order to clarify the situation, and in order to comply, with ERA guidance's and to evaluate actions to be taken.

The DRSI will adapt its procedures and will modify Belgian legislation to follow the common position defined by the ERA.

We have carried out a study and an analysis of safety management systems according to the Belgian procedures in force whether it is for the training of train drivers, the use of wagons, the information exchanged, etc. Our analysis has shown that the various procedures between DB Schenker Rail Nederland and NMBS/SNCB Logistics to meet requirements from their safety management system were clearly in place. The aforementioned fatigue management system is not imposed by the law.

The report formulates 4 recommendations directly linked to the causes of the accident:

- a first preventive recommendation aims to re-evaluate events that could disturb the behaviour of train drivers
- a second preventive recommendation is related to the introduction of a efficient fatigue risk management system
- two recommendations discuss recovering measures in case of attention failure of train drivers.

1 *"Overeenskomst besturing in partnerschap EW20120302 uitgave 12/2012"*

The damage following the derailment was significant. The first 5 wagons were carrying acrylonitrile, a toxic and flammable substance. The simultaneous perforation of the 3 tanks on 3 wagons released suddenly large quantities of the toxic and flammable product and it immediately burst into flames.
The functioning of the rolling stock is investigated where possible during inspections, through simulations and by measurements. The wagons 1 to 7 meet the technical requirements for example with regard to the construction of the tank and its safety labelling.
Priority should be given to measures for accident prevention, but at the same time the analysis of the damage on the rolling stock can be used to initiate a discussion about the advantages and disadvantages of the measures to improve the crashworthiness of RID freight wagons or to improve the resistance against perforation by foreign objects..

From the telephone conversations on the GSM-R network, it appears that several telephone calls take place between the driver and Traffic Control, but no conversation is established. After several unsuccessful attempts with the GSM-R set, the driver uses a fixed line on the signal to inform block 6 in Gent.
Analysis show that the GSM-R set operates correctly. The emergency call is well registered and received. Simulations of the journey confirm the proper normal functioning of the GSM-R set on the locomotive.
The investigation points the risks related to an incorrect use of the GSM-R sets in emergency situations and the lack of vital information, for example the nature of dangereous goods and on the events.

The intervention of the emergency services starts before complete and accurate information about the RID products is available. Ideally, emergency services should obtain this information before arrival at the scene.
The fire services arrives quickly at the scene, the inhabitants of the surrounding houses are evacuated and a safety perimeter is created in accordance with the information available to the fire service at that moment.
They decided to let the substances burn themselves out in a controlled way and to spray the tank wagons with water to cool them down in order to avoid explosions. The generous use of extinguishing and cooling water fills the ditch with a mixture of water and toxic products. Very quickly the ditch threatens to flood, and the decision is taken to pump the content of the ditch into the pumping station. According to our information, the submersible pump from the pumping station switches automatically on when the liquid level reaches a certain level and pumps the contaminated liquid via the separated rainwater drainage system into the river Schelde. The sewers are filled with toxic gases, that come up through the manholes It became clear that the initial safety perimeter did not take in account the release of toxic gases via the sewers. It was then decided to enlarge the safety perimeter.
One person was found deceased in his home: the judicial enquiry is still ongoing to determine the exact cause of decease.

After the accident, the collaboration between the emergency services, municipalities, provinces is openly discussed and evaluated in detail as well as the emergency plans. The discussion reveals that the risk linked to the sewage system and to the resulting toxic release of gases in the houses had been under-estimated. Since to date, as we know, the railway undertakings and the infrastructure manager have only partially interchanged their experiences.
One recommendation aims to share the lessons learned in response to serious accidents by the railway undertakings and the infrastructure manager with all parties.

Four recommendations aim to improve the safety of members of emergency services, representatives of railway undertakings and infrastructure manager on site by improved communication and improved awareness of risks linked to RID-goods.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