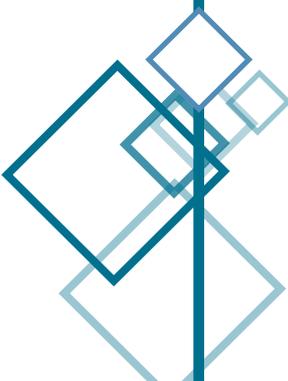


# SUMMARY

## Safety Investigation Report Switch run-through Noorderkempen - 11 February 2019

## **REPORT VERSION TABLE**

<u>Version number</u>	<u>Subject of revision</u>	<u>Date</u>
1.0	First version	22/09/2020



*Any use of this report with a different aim than of accident prevention - for example in order to attribute liability - individual or collective blame 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 Dutch version.*

# 1. SUMMARY

On 11 February 2019, an empty passenger train (E15214) departs early in Antwerpen-Schijnpoot station, arrives at Antwerpen-Luchtbal station on HSL 4<sup>1</sup>, and continues in the direction of Noorderkempen station. The train is running in ETCS Level 1. The route of the empty passenger train (E15214) is actuated and locked until stop marker board C-W.12, the entry signal of Noorderkempen station.

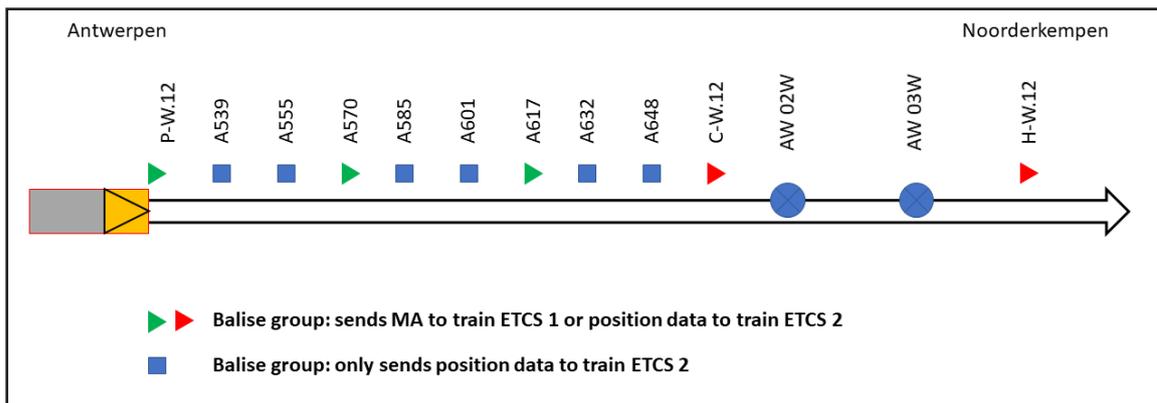


Figure: sequence of the signals between Antwerpen and Noorderkempen.

When the empty passenger train (E15214) is approaching stop marker board A617, the train driver receives a telephone call from the signal box (Block 12 HSL) asking him whether the signal in advance of him (signal C-W.12) may be closed. The train driver replies in the affirmative, and the movement agent of the signal box (Block 12 HSL) confirms that he will close the signal. The route of the empty passenger train (E15214) crosses that of another passenger train E7226 waiting at Noorderkempen station for permission to depart. Because the route of the empty passenger train (E15214) was actuated first, the departure of the other passenger train (E7226) is automatically stopped.

During the telephone call, the empty passenger train (E15214) crosses the balise group of stop marker board A617. Stop marker board A617 is the last location, in rear of signal C-W.12, equipped with an ETCS 1 balise where the MA<sup>2</sup> of the empty passenger train (E15214) can still be adapted. The conversation between the train driver and the signal box (Block 12 HSL) comes to an end, and the movement agent of signal box Block 12 HSL operates the help function SDG<sup>3</sup> to close signal C-W.12.

The train driver keeps an eye on his DMI screen<sup>4</sup>. He is expecting a new MA which will instruct him to adjust his speed to stop his train at stop marker board C-W.12. Because the empty passenger train (E15214) is already running in advance of the balise group at stop marker board A617 after the closing of signal C-W.12, the train does not receive a new MA.

Immediately after the closing of signal C-W.12, the movement agent operates the help function NT<sup>5</sup>. In this way, the movement agent cancels the route of the empty passenger train (E15214), which is a prerequisite for the departure of the other passenger train (E7226).

<sup>1</sup> HSL4: Hogesnelheidslijn Noord, Spoorlijn 4 (High-speed line North, Railway line 4).

<sup>2</sup> MA: Movement Authority = permission to drive over a specified distance in accordance with infrastructure requirements.

<sup>3</sup> SDG: Sein Dringend Gesloten (Signal Closed Urgently), function for the emergency closing of a signal.

<sup>4</sup> DMI: Driver Machine Interface, ETCS control screen.

<sup>5</sup> NT: Nietiging Traject (Cancellation Route), EBP emergency function for the cancellation of a route.

When the route for the empty passenger train (E15214) is cancelled, the route for train E7226 is automatically locked by the EBP<sup>6</sup>, after being operated by the ARS<sup>7</sup>. The departure signal DX-W.12 at Noorderkempen station automatically opens for train E7226. The driver of train E7226 sees the light with which the stop marker board is equipped being illuminated and sets his train in motion.

At 5:58 a.m., the empty passenger train E15214 passes the early closed entry signal C-W.12 of Noorderkempen station at a speed of 129 km/h, and the ETCS safety system intervenes: the train driver receives a TRIP<sup>8</sup>, and the train is stopped by emergency braking. In the specific circumstances of the day of the accident, and because of the intervention of the movement agent, the ETCS system cannot prevent the train from reaching the first dangerous point (switch 02W). The train runs through the switch.

The occupation of switch 02W is detected, and the EBP system automatically closes signal DX-W.12 and turns off light of the stop marker board at Noorderkempen station.

The driver of train E7226 notices in time that the permissive signal is turned off, and he initiates a service braking to bring his train to a standstill a few metres in rear of the stop marker board. Without this intervention, the train would have passed the light, resulting in an emergency braking.

<sup>6</sup> EBP: Elektronische BedieningsPost (Electronic Control Station).

<sup>7</sup> ARS: Automatic Route Setting, tool that can partially automate the management of train traffic.

<sup>8</sup> TRIP = emergency braking.

## 2. OUR INVESTIGATION

### **Influence of the early departure**

The empty passenger train (E15214) departs early in Antwerpen-Schijnpoort, and a 'conflict situation' arises at the entry signal of Noorderkempen station.

Neither the movement agent of the responsible signal box (Block 12 HSL), nor Traffic Control are informed of the advanced departure time. This is contrary to the internal rules of the Infrastructure Manager.

As a result of the advanced departure of the empty passenger train (E15214), the exit signal for the second passenger train (E7226) at Noorderkempen station is kept closed. The passenger train (E7226) cannot leave on time.

Moreover, according to the planning, two trains are supposed to run simultaneously in ETCS 1 on HSL 4. This is contrary to the conclusions of the risk analysis made when applying for the authorisation for placing in service.

The statistics of the train departures from the Antwerpen-Schijnpoort fan of sidings show that more than 50% of the trains start running more than 2 minutes before the scheduled departure time.

→ Non-compliance with the departure conditions is not unique.

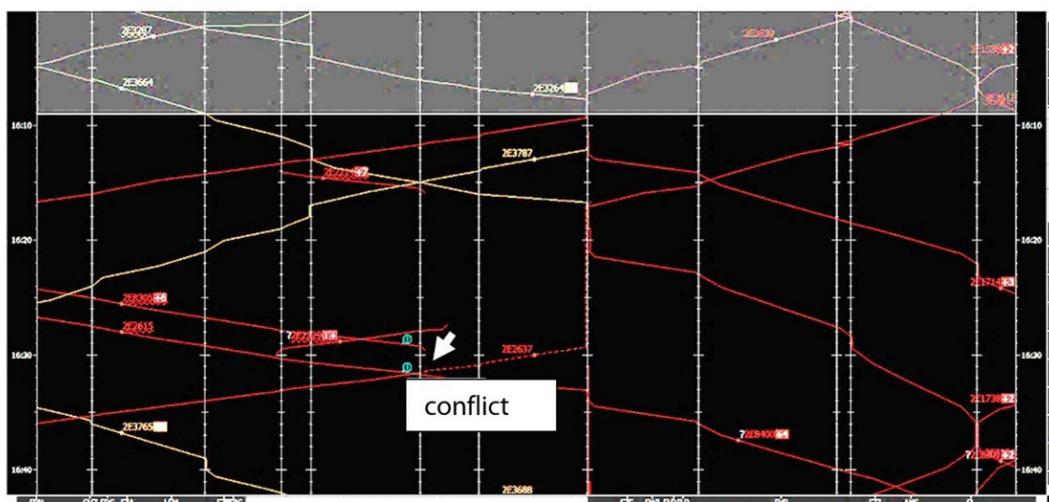
### **Measures taken by the movement agent**

In order to manage this conflict situation, the movement agent must follow specific arrangements in order to guarantee the punctuality and safety of the operation.

At 5:50 a.m., the empty passenger train (E15214) arrives on HSL 4. At that moment, the train also appears on the EBP screen of the movement agent of signal box Block 12 HSL.

The movement agent of the night shift does not notice that the train comes on HSL 4 and leaves. He meets the movement agent of the 'morning shift' in the corridors, and verbally confirms (debriefing) that everything is ok.

When the movement agent of the early shift comes to his worktable, he notices that the second passenger train E7226 cannot depart at the scheduled time (5:55 a.m.).



The movement agent then decides to limit the delay of the second passenger train (E7226).

At 5:56 a.m., the movement agent contacts the train driver and informs him that he will close the signal in advance of him. He does not give any reason and does it for operational reasons. The movement agent assumes that the train driver understood his 'information' and that he will stop his train. The movement agent activates the help functions SDG and NT.

When activating the help function NT, the movement agent must follow a dialogue function on his EBP screen. The dialogue allows the movement agent to check whether all the safety conditions for cancelling the route are met. However, when going through the steps required to activate the help function NT, he enters incorrect data in the EBP dialogue box, bypassing a built-in safety feature. To the question whether the empty passenger train (E15214) has stopped, he answers positively in a rush without checking whether the train actually stopped.

A follow-up of cancellations was set up by the Infrastructure Manager because the cancellation of a route has a major operational and safety impact. For the purpose of this follow-up, the traffic controller must follow a dialogue on his EBP screen. One of the questions asked to the traffic controller in the dialogue box is why<sup>9</sup> the route is cancelled.

The Infrastructure Manager already identified and analysed "SDG" incidents in the past. Recommendations were formulated in 2014 and 2016.

According to Infrabel's figures, 104 NTs were carried out for stop marker board C-W.12 between 01/01/2018 and 11/02/2019:

- 56 NTs with a non-locked route (SAFE): the normal way of managing traffic,
- 48 NTs with a locked route.

The analysis of the 48 NTs with a locked route shows that 33 NTs took place in combination with an SDG function because of a 'safety risk'.

<sup>9</sup> The options menu on the EBP screen suggests the following answers:

1. tests or works,
2. operational reasons,
3. malfunctions,
4. mistake by the agent operating the box.

### **Expectations from the driver and ETCS**

The train driver is informed by the movement agent of his intention to close the signal in advance of the train. The movement agent does not give any reason and there is no mention of a danger and a doubtful situation arises.

The HLT (train driver's manual) gives incomplete instructions for doubtful situations. The HLT determines, among other things, what train drivers are expected to do when they receive information about a signal that is closed, not for situations when a signal will be closed. Despite this doubtful situation, the train driver does not brake or request additional information.

The train driver follows the instructions on his DMI screen, as learnt during the training courses. There are no light signals on HSL 4. There are stop marker boards.

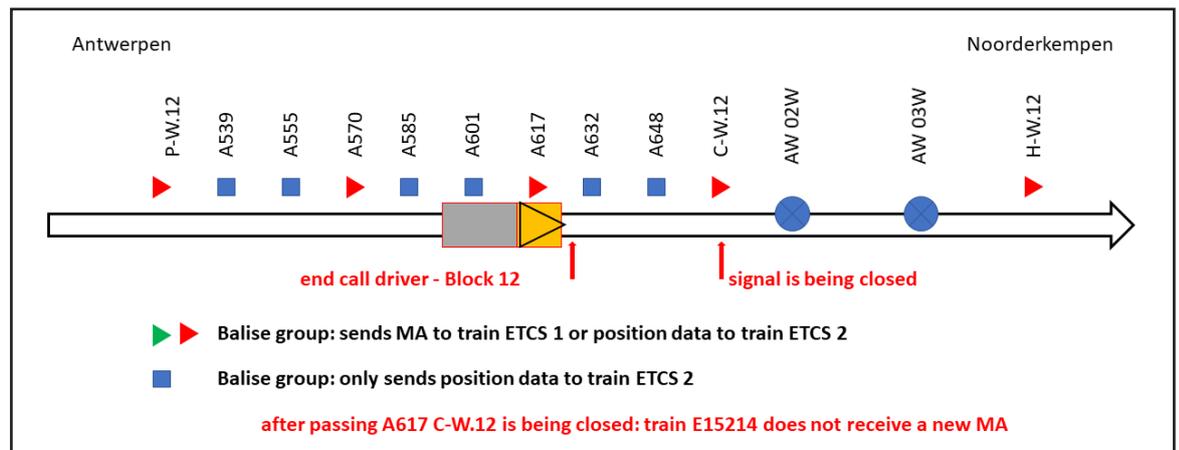


*Picture: exit signal DX-W.12 in Noorderkempen station.*

It is dark. The train driver is therefore unable to determine his exact position in relation to the balises and he is not expected to do so.

The train driver expects the Movement Authority (MA) of his train to be modified by an ETCS balise. It is not possible for him to know that he passed the last stop marker board and that the MA cannot / will not be modified anymore.

During the GSM conversation with the agent, the empty passenger train passes stop marker board A617 without the movement agent and the train driver noticing it. Signal A617 is the signal where the MA (Movement Authority) could be modified, instructing the train driver to stop in rear of the closed signal C-W.12.



In the case of a line equipped with ETCS 2, data is regularly refreshed via GSM-R. Eurobalises in Level 2 transmit their position to the train so that the train equipment can correct the position of the train.

For ETCS 1 equipment, balises are only placed at certain identification points which are approximately 4 to 5 km apart for Line 4. The distance between the balises of stop marker board level 1 A617 and stop marker board level 1 C-W.12 is 4,627 m. As a result, the train E15214 runs to the closed stop marker board C-W.12 without slowing down.

When crossing the closed signal (C-W.12), the train runs at a speed of approx. 129 km/h. The ETCS system intervenes and activates an automatic emergency braking. The actual stopping distance is approx. 480 m and the train comes to a standstill in advance of the closed signal (C-W.12) on switch 02W. In other words, the train reached the dangerous point.

#### **Authorisation for operation in ETCS 1 on high-speed line 4**

*"Line 4 is a high-speed line connecting Antwerp with the Dutch border at the Hoogstraten municipality.*

*It is normally intended for high-speed trains (300 km/h) and for domestic train traffic (200 km/h) that will serve the newly built stopping point 'Noorderkempen'."*

Line 4 is designed for operation in ETCS 2 (with fallback in ETCS 1 in case of problems with the GSM-R network<sup>10</sup>), and the application for the authorisation for placing in service of HSL4 is therefore submitted for operating HSL4 in ETCS 2 with fallback in ETCS 1 in case of problems with the GSM-R network. No application is submitted for an authorisation to place in service for operation in nominal mode ETCS1, including the operation of Noorderkempen station.

Whereas the Ministerial Decree of 20 June 2008 allows the operation in ETCS1 under conditions, the operation in ETCS1 is not regularised with an amended or new application for authorisation to place in service and no authorisation for operating HSL4 in ETCS1 nominal mode is given by the DRSI. All this time, audits, monitoring and supervision, as foreseen by the Infrastructure Manager as well as by the supervisory authorities, have not been able to identify that HSL4 is being operated by Infrabel in ETCS 1 nominal mode and that SNCB/NMBS uses rolling stock equipped with ETCS 1, without the authorisation being regularised.

### **Conditions for operating high-speed line 4 in ETCS 1**

In accordance with Directive 2004/49/EC, the basic elements of the safety management system should include procedures and methods for carrying out risk evaluation and implementing risk control measures whenever a change of the operating conditions or new material imposes new risks on the infrastructure or on operations.

The Ministerial Decree of 20 June 2008 allows operation of HSL4 in ETCS 1 *'under the conditions laid down by the Infrastructure Manager'*.

Allowing operation of HSL4 in ETCS 1 nominal mode generates new risks. The Infrastructure Manager identifies these risks and discusses them with the control bodies. The evaluation reports of control bodies refer to conditions to control the risks when operating HSL4 in nominal mode ETCS 1. These conditions result from the risk analysis of the Infrastructure Manager.

The Investigation Unit notes that no information could be obtained on whether - how - for how long the *'conditions laid down by the Infrastructure Manager'* were applied, or on the reason why these conditions are no longer met.

In accordance with Article 15§1 of the Commission Decision of 11 August 2006, the proposer (i.e. the Infrastructure Manager) shall be responsible for determining if and how to take into account the conclusions of the safety assessment report for the safety acceptance of the assessed change. When applicable, the proposer shall justify and document the part of the safety assessment report that he contests.

At the same time, the reference to *'conditions laid down by the Infrastructure Manager'* in the successive amendments to the Ministerial Decree of 20 June 2008 is no longer repeated. The Investigation Unit could not obtain information about the reasons for not repeating these 'conditions' anymore. From 2010 onwards, it is only stipulated that rolling stock equipped with ETCS 1 may run on that part of the infrastructure equipped with ETCS 2 on HSL4 provided that the speed is limited to 160 km/h and *"in case of proven compatibility"*.

The Ministerial Decree of 20 June 2008 was amended by the Ministerial Decree of 30 July 2010, which was repealed and amended by the Royal Decree of 1 July 2014. This Royal Decree was amended in 2018.

The Belgian State (FPS Mobility and Transport) is responsible for drawing up and publishing Ministerial and Royal Decrees with the technical support of the Safety Authority. Neither the Federal Public Service nor the Safety Authority could explain the amendments to the original Ministerial Decree of 20 June 2008 and with regard to the deletion of the 'conditions'.

# 3. CONCLUSIONS AND RECOMMENDATIONS

**The direct cause** of the train running through switch 02W in Noorderkempen is the inability to stop train E15214 (ETCS 1) in time in rear of stop marker board C-W.12 on HSL 4 (ETCS 2 with fallback in ETCS 1), due to a combination of 3 factors:

- Operating the help function SDG after the passage of the train at a balise. As a result, a new, more restrictive, MA is not imposed, and the braking curve is not modified;
- Operating the help function NT before the conditions laid down for this purpose are met;
- Failure of the train driver to react to an information from the movement agent (he follows the instructions on his DMI screen).

The Investigation Unit does not formulate recommendations when measures have been taken: the Infrastructure Manager and the railway undertaking have discussed the event with the parties concerned and have shared experiences for raising awareness with the employees (see Chapter 5 Measures taken).

**The first indirect factor** is the non-compliance with rules and instructions for operating the help functions SDG and NT by the movement agent:

- Operating the SDG for operational reasons;
- Not checking whether the train has come to a standstill;
- Entering incorrect data when operating the NT.

Because the help function NT is operated, it is possible to run through the switch.

The Investigation Unit does not formulate recommendations when measures have been taken: the Infrastructure Manager has discussed the event with the parties concerned (see Chapter 5 Measures taken), also see System factor 4.

**The second indirect factor** is the train driver's failure to identify a doubtful situation in time. Train drivers cannot be expected to react reflexively to situations that have not been experienced before and for which there are no instructions.

The Investigation Unit does not formulate recommendations when measures have been taken: the railway undertaking has adjusted the HLT, taking into account the findings (see Chapter 5 Measures taken).

**The third indirect factor** are the rash actions of the movement agent of the morning shift without the intervention of a supervisor during the shift change.

The DRSI is recommended to ensure that the Infrastructure Manager manages the dynamic working conditions, which arise during the shift change, in such a way as to avoid hasty decisions that could endanger operations.

**The first system factor** is the lack of clear and non-contradictory guidelines on 'urgently closing a signal' for 'non-urgent reasons'.

The DRSI is recommended to ensure that the Infrastructure Manager takes measures to eliminate or avoid the risks associated with an 'urgent signal closing'.

**The second system factor** is the lack of clear guidelines on standardised conversations between movement agents and train drivers for closing a signal at the verbal request of the movement agent.

The DRSI is recommended to ensure that the Infrastructure Manager and all railway undertakings discuss whether communication can be improved in the case of an 'urgent signal closing' and how to achieve this goal.

**The third system factor** is the fact that the RSEIF/VVESI<sup>11</sup> and the RGE/ARE<sup>12</sup> assume that train drivers and movement agents can determine the position of a train in a long section with sufficient accuracy. In the VVESI and ARE, as regards the HSL4, insufficient attention is drawn to the consequences of an 'early signal closing', taking into account the length of the 'long sections' specific to HSL4.

The DRSI is recommended to ensure that the Infrastructure Manager examines whether their his rules and instructions take sufficient account of the characteristics of running in ETCS 1 on HSL4.

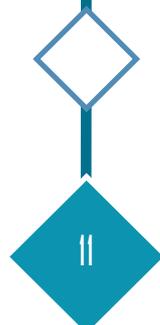
**The fourth system factor** is that for journeys to Noorderkempen station numerous early departures and numerous improper operations of the help functions SDG and NT are identified, without any measures being taken by the Infrastructure Manager.

The DRSI is recommended to ensure that the Infrastructure Manager makes sure that the rules for operating the help function SDG and NT will be better complied with.

The DRSI is recommended to ensure that the Infrastructure Manager makes sure that the early signal closing procedure is made compatible with ETCS Level 1, taking into account the location of the balises (safe integration procedures in the ETCS system).

<sup>11</sup> Safety Regulations for the Operation of Railway Infrastructure

<sup>12</sup> General Operating Regulations

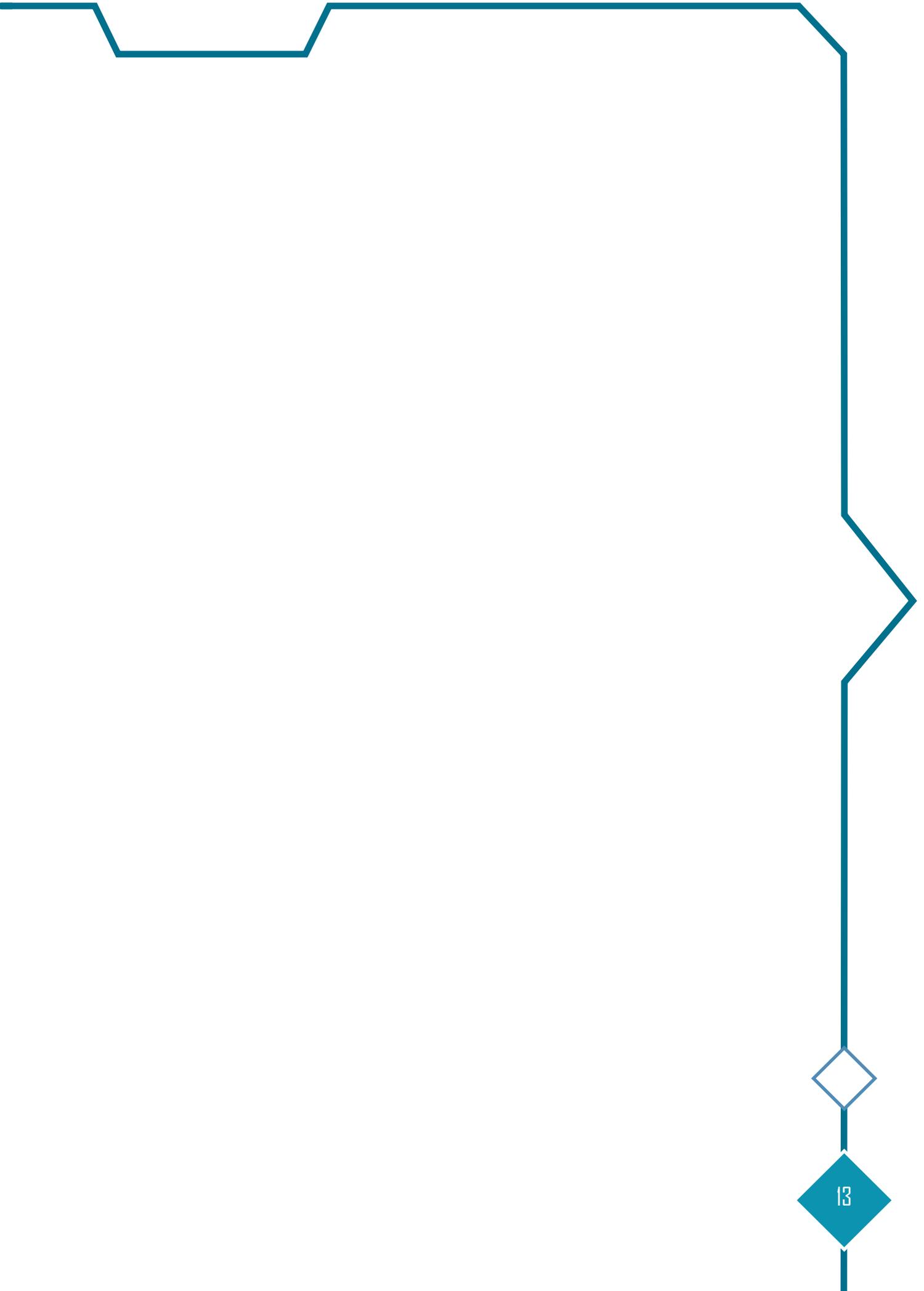


**The fifth system factor** is that the audit, monitoring, and supervision processes provided by the Infrastructure Manager and by the supervisory authorities did not lead to the finding that operation in nominal mode ETCS1 was never regularised.

The DRSI should ensure that the operation of HSL4 in ETCS1 nominal mode is regularised in cooperation with the parties involved.

**The sixth system factor** is a lack of traceability in the decision taken. Due to a lack of traceability, it is no longer possible to verify until when the '*conditions*' were complied with and why they were no longer complied with. Due to a lack of traceability, it is also no longer possible to verify why the reference to '*conditions laid down by the Infrastructure Manager*' as stated in the Ministerial Decree of 2008 was no longer mentioned.

The Investigation Unit recommends all parties involved (FPS Mobility and Transport, DRSI, Infrabel, ...) to ensure that decisions and risk analyses leading to the drafting of operating conditions are traceable and made by mutual agreement. This is regardless of whether these decisions are taken on the basis of legal, technical, or political motives.



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